file

M-9/D23

Tim Eichenberg - Chair
Danny Hernandez - Vice Chair
Daniel F. Lyon - Secretary - Treasurer
Ronald D. Brown - Assistant Secretary - Treasurer
Janet Saiers - Director

John P. Kelly, P.E.
Executive Engineer

Albuquerque
Metropolitan
Arroyo
Flood
Control
Authority
2600 Prospect N.E., Albuquerque, NM 87107
Phone: (505) 884-2215 Fax: (505) 884-0214

March 27, 2006

Mr. Brad Bingham, P.E., C.F.M.
City of Albuquerque
Development & Building Services Division
600 2nd Street NW
Albuquerque, NM 87102

Re: Agreements for Amole Arroyo Improvements between Curb Inc. and AMAFCA

Dear Mr. Bingham:

As you are aware, AMAFCA has entered into several agreements with Curb Inc., developer of the property around Gibson Boulevard and 98th Street. I have enclosed the agreements for your use. The agreements are for channel improvements to the Amole Arroyo from Westgate Park to the Snow Vista Channel and from the Snow Vista confluence to the Amole Detention Basin. AMAFCA agreed to maintain the drainage facilities. Since all of the facilities have been constructed or are currently under construction, AMAFCA approves release of Financial Guarantees as related to the developer's subdivisions adjacent to the facilities.

If you have any questions, please call me at 884-2215.

Sincerely,
AMAFCA

Lynn M. Mazur

Lynn M. Mazur, P.E., C.F.M.
Development Review Engineer

City of Albuquerque
P.O. BOX 1293 ALBUQUERQUE, NEW MEXICO 87103

November 3, 2003

Fred Arfman, PE
Isaacson & Arfman
128 Monroe NE
Albuquerque, NM 87108

Re: Amole Arroyo Drainage Report
Engineer's Stamp dated 9-10-03, (M9/D23)

Dear Mr. Arfman,

Based upon the information provided in your submittal dated 9-16-03, the above referenced report is for Work Order requirements.

If you have any questions, you can contact me at 924-3986.

Sincerely,

Bradley L. Bingham, PE
Sr. Engineer, Planning Dept
Development and Building Services

C: Loren Meinz, AMAFCA
file

THE CITY OF ALBUQUERQUE IS AN EQUAL OPPORTUNITY/REASONABLE ACCOMMODATION EMPLOYER

DRAINAGE AND TRANSPORTATION INFORMATION SHEET
(REV. 1/28/2003rd)

M-9 / D23

PROJECT TITLE: Amole Arroyo
DRB #: _____ EPC#: _____
ZONE MAP/DRG. FILE #: ~~M9/M9~~
WORK ORDER#: 712991

LEGAL DESCRIPTION: _____
CITY ADDRESS: _____

ENGINEERING FIRM: Isaacson & Arfman, P.A.
ADDRESS: 128 Monroe Street NE
CITY, STATE: Albuquerque, NM
CONTACT: Åsa Nilsson-Weber
PHONE: (505) 268-8828
ZIP CODE: 87108

OWNER: AMAFCA/City of Albuq./Curb Inc.
ADDRESS: _____
CITY, STATE: _____
CONTACT: Loren Meinz/Dan Hogan/Bo Johnson
PHONE: _____
ZIP CODE: _____

ARCHITECT: _____
ADDRESS: _____
CITY, STATE: _____
CONTACT: _____
PHONE: _____
ZIP CODE: _____

SURVEYOR: _____
ADDRESS _____
CITY, STATE: _____
CONTACT: _____
PHONE: _____
ZIP CODE: _____

CONTRACTOR: _____
ADDRESS: _____
CITY, STATE: _____
CONTACT: _____
PHONE: _____
ZIP CODE: _____

CHECK TYPE OF SUBMITTAL:

- X DRAINAGE REPORT
- ____ DRAINAGE PLAN 1st SUBMITTAL, *REQUIRES TCL or equal*
- ____ DRAINAGE PLAN RESUBMITTAL
- ____ CONCEPTUAL GRADING & DRAINAGE PLAN
- ____ GRADING PLAN
- ____ EROSION CONTROL PLAN
- ____ ENGINEER'S CERTIFICATION (HYDROLOGY)
- ____ CLOMR/LOMR
- ____ TRAFFIC CIRCULATION LAYOUT (TCL)
- ____ ENGINEERS CERTIFICATION (TCL)
- ____ ENGINEERS CERTIFICATION (DRB APPR. SITE PLAN)
- ____ OTHER

CHECK TYPE OF APPROVAL SOUGHT:

- ____ SIA / FINANCIAL GUARANTEE RELEASE
- ____ PRELIMINARY PLAT APPROVAL
- ____ S. DEV. PLAN FOR SUB'D. APPROVAL
- ____ S. DEV. PLAN FOR BLDG. PERMIT APPROVAL
- ____ SECTOR PLAN APPROVAL
- ____ FINAL PLAT APPROVAL
- ____ FOUNDATION PERMIT APPROVAL
- ____ BUILDING PERMIT APPROVAL
- ____ CERTIFICATE OF OCCUPANCY (PERM.)
- ____ CERTIFICATE OF OCCUPANCY (TEMP.)
- ____ GRADING PERMIT APPROVAL
- ____ PAVING PERMIT APPROVAL
- X WORK ORDER APPROVAL
- ____ OTHER (SPECIFY)

WAS A PRE-DESIGN CONFERENCE ATTENDED:

- ____ YES
- X NO
- ____ COPY PROVIDED

RECEIVED
SEP 16 2003
HYDROLOGY SECTION

DATE SUBMITTED: 9/16/03 BY: Åsa Nilsson-Weber

Requests for approvals of Site Development Plans and/or Subdivision Plats shall be accompanied by a drainage submittal. The particular nature , location and scope ot the proposed development defines the degree of drainage detail. One or more of the following levels of submittal may be required based on the following:

1. **Conceptual Grading and Drainage Plan**: Required for approval of Site Development Plans greater than five (5) acres and Sector Plans.
2. **Drainage Plans**: Required for building permits, grading permits, paving permits and site plans less than five (5) acres.
3. **Drainage Report**: Required for subdivisions containing more than ten (10) lots or constituting five (5) acres or more.

FINAL DESIGN REPORT

FOR

AMOLE ARROYO

INCLUDING REVISIONS TO
THE AMOLE-HUBBELL
DRAINAGE MANAGEMENT PLAN

ALBUQUERQUE, NEW MEXICO

AUGUST 2003

RECEIVED
SEP 1 6 2003
HYDROLOGY SECTION

Prepared by:

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

FRED C. ARFMAN
STATE OF NEW MEXICO
7322
REGISTERED PROFESSIONAL ENGINEER

09-10-03

Fred C. Arfman, PE **Date**

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Confluence 13
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APPENDICES

Appendix A: **AHYMO Files for 100-Year Storm**
- Amole Basin
- Snow Vista Basin

Appendix B: **Basin Map--Portion of DMP Basin 60104**

Appendix C: **HEC-RAS Profiles and Summary Tables**
- Amole Arroyo
- Snow Vista

Appendix D: **Summary of Channel Depth Including Superelevation**

Appendix E: **Centerline Radius and Easement Curve Length Calculations**

Appendix F: **Slug Flow Calculations and References**

Appendix G: **Upstream Transition Exhibit, Riprap Sizing Calculations and References**

Appendix H: **Confluence Exhibit and Momentum Balance Check**

Appendix I: **Excerpts from Amole-Hubbell Drainage Management Plan, Volume I**

POCKETS

AHYMO Files and HEC-RAS Files
Amole Arroyo Plan & Profile Exhibits

I. INTRODUCTION

The Amole Arroyo will be improved between west of Delgado Drive and the Snow Vista Channel (see Location Map on page 2). The easterly portion of the Amole Arroyo will be realigned through the existing 100-foot City of Albuquerque right-of-way through the El Rancho Grande Subdivision.

These improvements are in accordance with the *Amole-Hubbell Drainage Management Plan, Volume I* (DMP), by Leedshill-Herkenhoff, Inc., Alternative 2, with the following exceptions:

- The proposed El Rancho Grande, Units 6 and 7[1)] and an offsite portion of Westgate Heights are included in the Amole Basin instead of the Snow Vista Basin.
- A 70-acre portion of DMP Basin 60104 is included in the Amole Arroyo Basin instead of the Sacate Blanco Basin. This change reflects a revision to the proposed Gibson Blvd alignment.

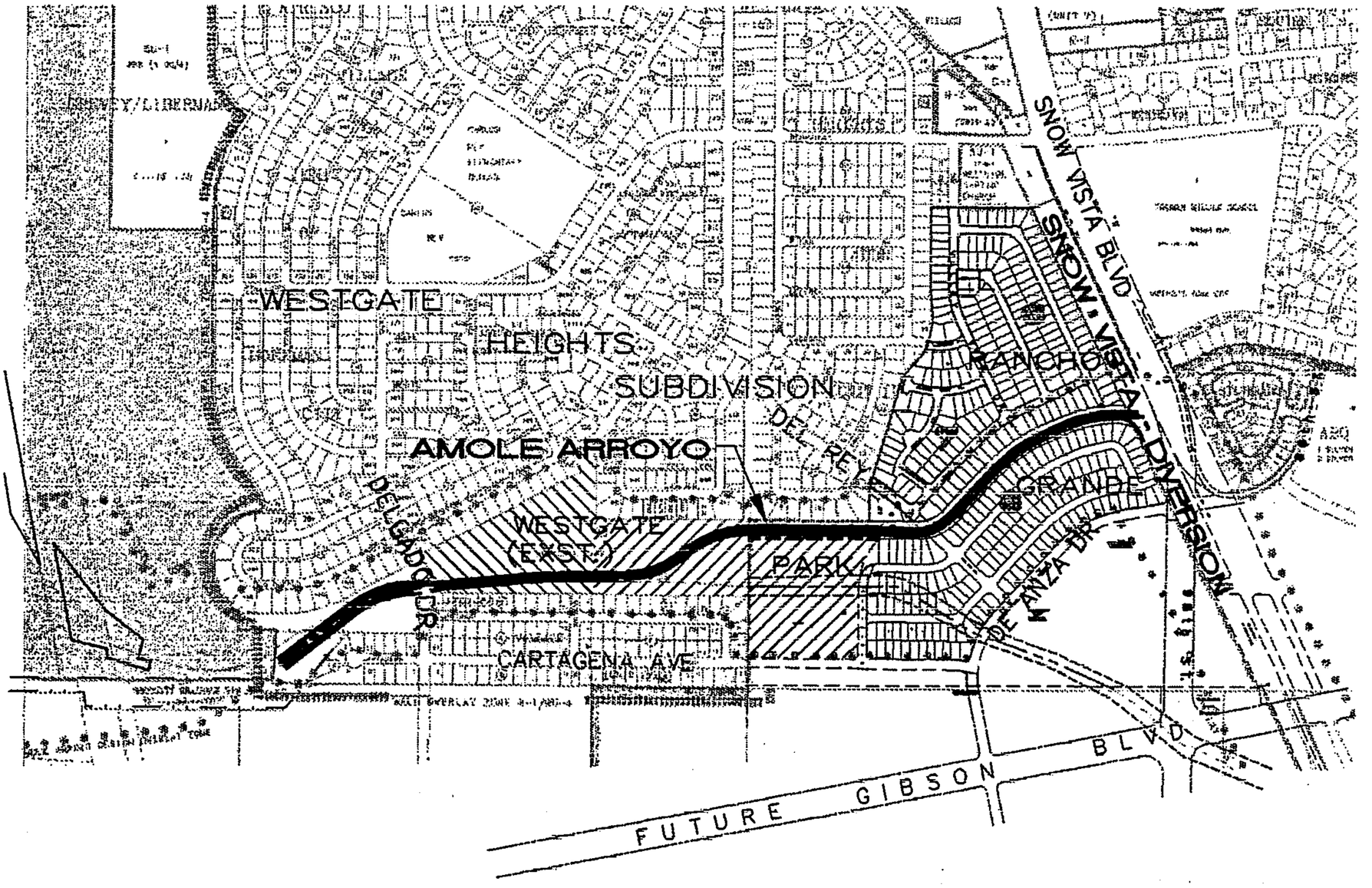
The addition of DMP Basin 60104 was analyzed in detail in the preliminary Design Report for Amole Arroyo, dated February 2003. This addition was approved by the City of Albuquerque and AMAFCA. The AHYMO was rerun in the 1997 version (which is the required version for LOMR submittal), and some minor routing errors for the Amole Basin were corrected resulting in flow reductions of less than one percent.

In addition to the channel improvements, a bridge crossing structure at the Del Rey Road extension will be constructed as part of this project. Also, a storm drain system in Del Rey Road will convey the offsite flows from Westgate Heights to the Amole Arroyo channel.

1) El Rancho Grande, Unit 7, as referred to in this report is now known as Elegante at El Rancho Grande.

LOCATION MAP

SCALE:
1"=1000'

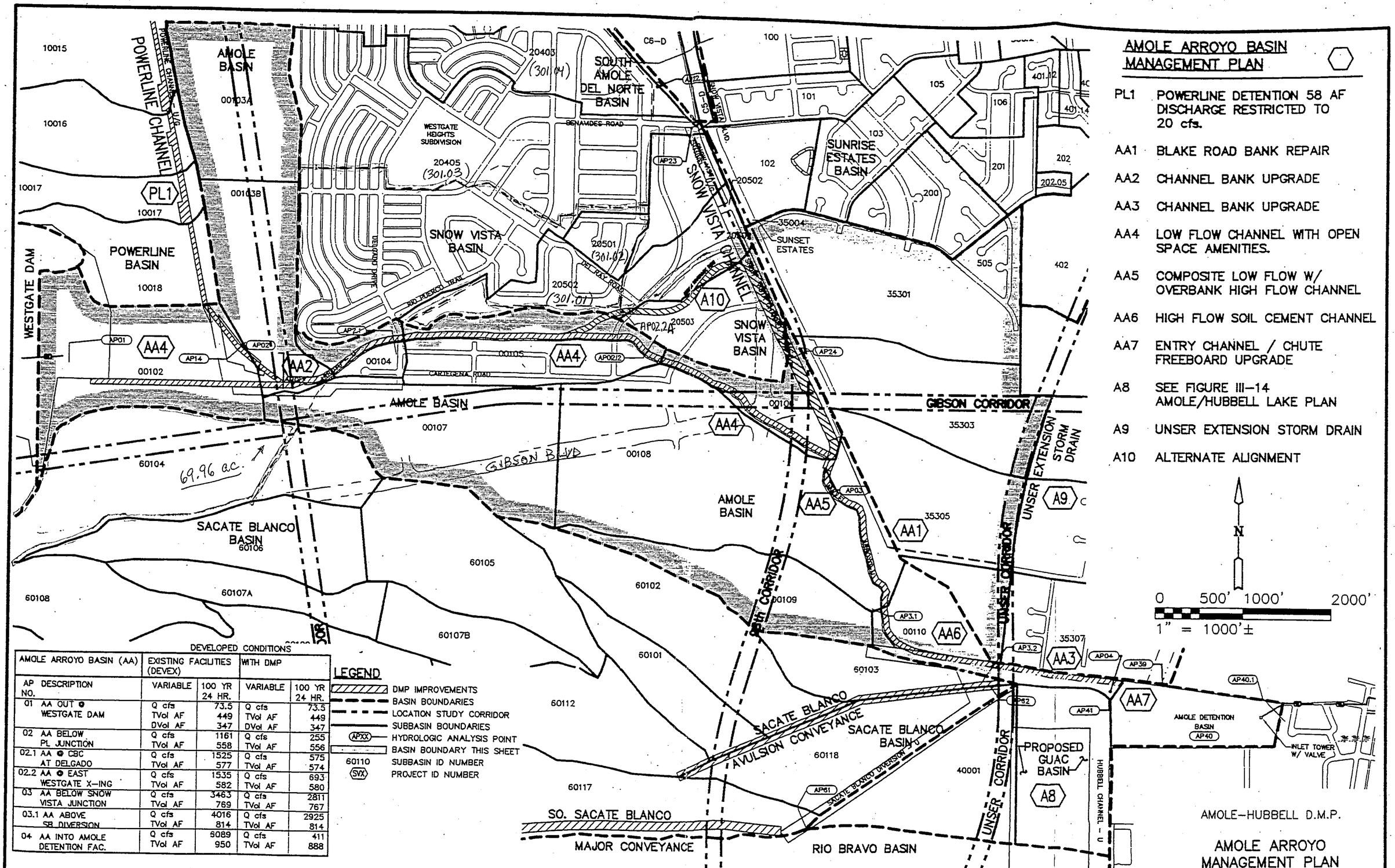


II. BASIN REVISIONS

The proposed El Rancho Grande subdivision development--El Rancho Grande, Units 6 and 7--and a portion of Westgate Heights will drain to the realigned Amole Arroyo instead of the Snow Vista Channel. Therefore, the AHYMO runs from the DMP were modified to include these areas in the Amole Arroyo basin and exclude them from the Snow Vista basin. Also, a 70-acre portion of DMP Basin 60104 is proposed to drain to the Amole Arroyo because of revisions to the proposed location of Gibson Boulevard. See Appendix B for an enlarged basin map.

The DMP basin map on page 4 shows the revised limits of the basins. The El Rancho Grande subdivisions on-site and off-site basins are shown on pages 5-6. The table below lists the changes.

Area Changes to the Amole Arroyo Basins		
El Rancho Grande Units 6 & 7	Basins 210-280 & 600	+ 32.1 ac
El Rancho Grande Offsite	Basins A-L	+120.9 ac.
DMP	Portion of Basin 20405 added to Basin 00105	+ 5.8 ac.
	Total Excluding Portion of Basin 60104	+158.8 ac.
DMP	Portion of Basin 60104	+70.0 ac.
	Total Including Portion of Basin 60104	+228.8 ac.
Area Changes to the Snow Vista Basins		
DMP	Basin 20501 (=301.02)	- 25.0 ac.
DMP	Basin 20502 (=301.01)	- 44.2 ac.
DMP	Basin 20405 (=301.03)	- 91.1 ac.
El Rancho Grande Unit 6	Basin 500	+ 1.4 ac.
	Total	-158.8 ac.



DEVELOPED CONDITIONS

AMOLE ARROYO BASIN (AA)	EXISTING FACILITIES (DEVEX)		WITH DMP	
AP NO. DESCRIPTION	VARIABLE	100 YR 24 HR.	VARIABLE	100 YR 24 HR.
01 AA OUT @ WESTGATE DAM	Q cfs TVol AF DVol AF	73.5 449 347	Q cfs TVol AF DVol AF	73.5 449 347
02 AA BELOW PL JUNCTION	Q cfs TVol AF	1161 558	Q cfs TVol AF	255 556
02.1 AA @ CBC AT DELGADO	Q cfs TVol AF	1525 577	Q cfs TVol AF	575 574
02.2 AA @ EAST WESTGATE X-ING	Q cfs TVol AF	1535 582	Q cfs TVol AF	693 580
03 AA BELOW SNOW VISTA JUNCTION	Q cfs TVol AF	3463 769	Q cfs TVol AF	2811 767
03.1 AA ABOVE SB DIVERSION	Q cfs TVol AF	4016 814	Q cfs TVol AF	2925 814
04 AA INTO AMOLE DETENTION FAC.	Q cfs TVol AF	5089 950	Q cfs TVol AF	411 888

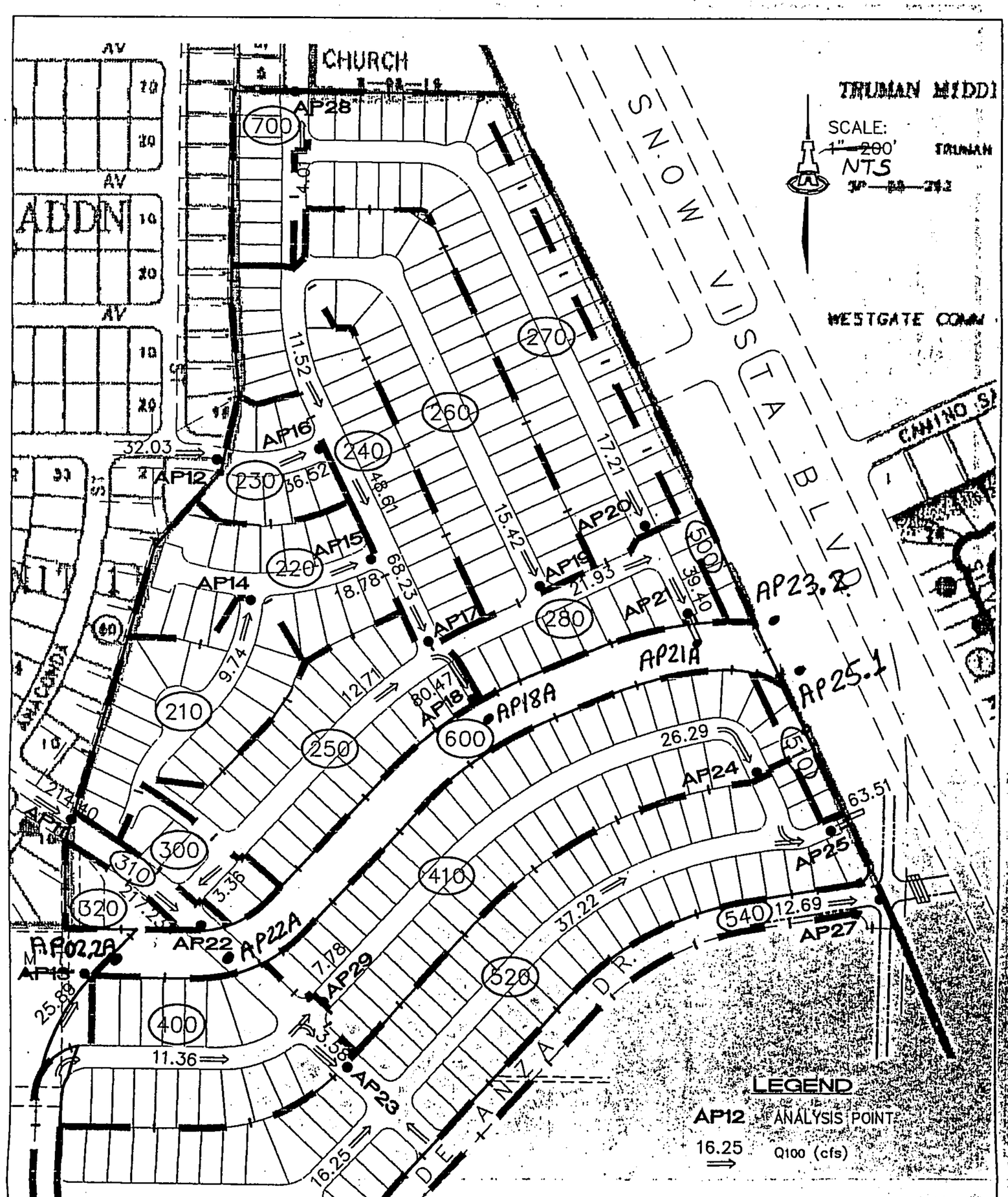
LEGEND

- DMP IMPROVEMENTS
- BASIN BOUNDARIES
- LOCATION STUDY CORRIDOR
- SUBBASIN BOUNDARIES
- (APXX) HYDROLOGIC ANALYSIS POINT
- BASIN BOUNDARY THIS SHEET
- 60110 SUBBASIN ID NUMBER
- (SVX) PROJECT ID NUMBER

LEEDSHILL-HERKENHOFF, INC.

P:\95043\95043_32\DWG\C\AM-BASIN.dwg 6-9-99 KHK

FIGURE NO. III-1

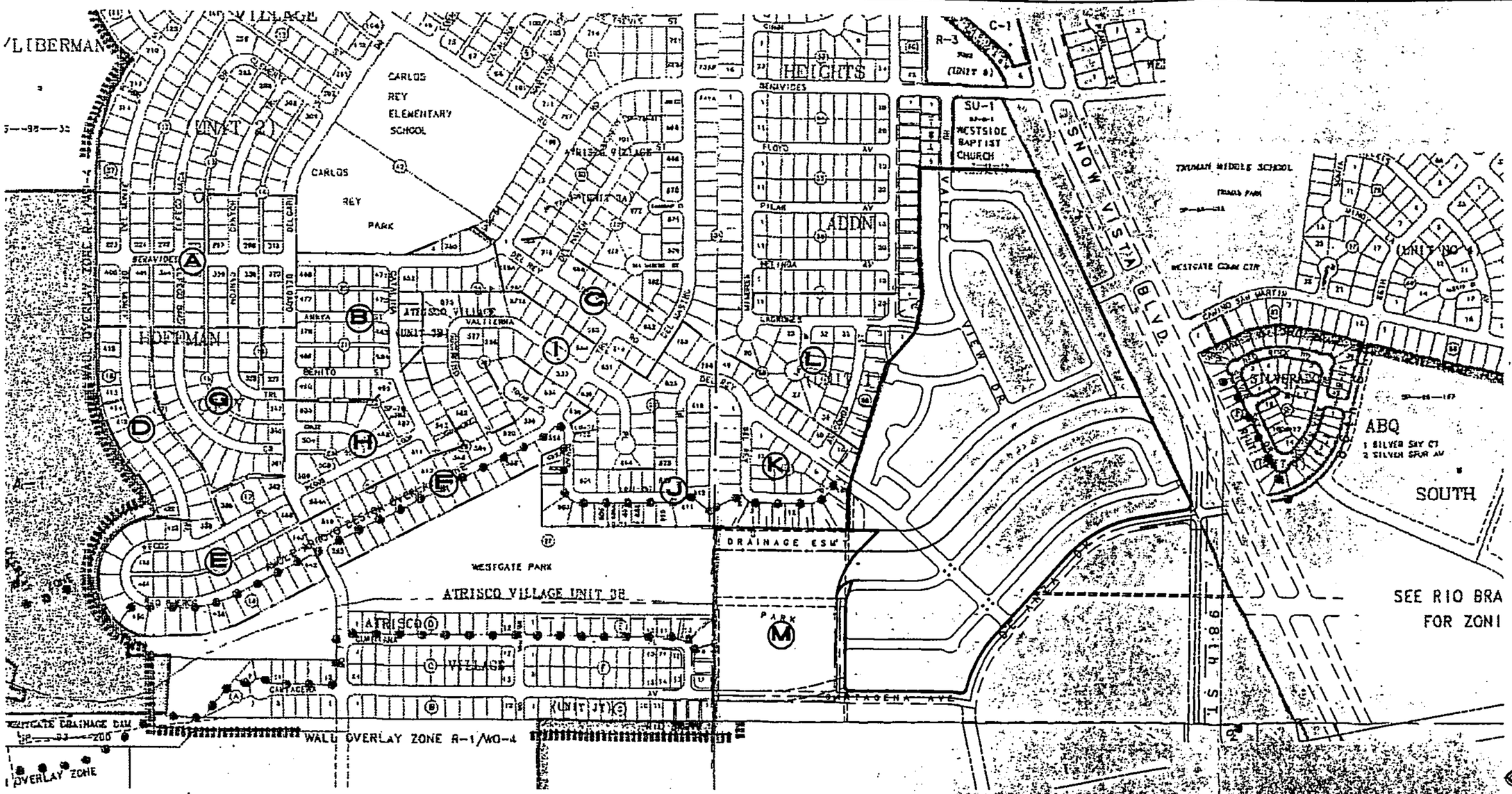


BASIN	AC.	BASIN	AC.
210	2.79	320	0.56
220	2.60	400	3.85
230	1.27	410	6.54
240	3.30	500	1.39
250	3.64	510	0.37
260	5.08	520	11.07
270	5.92	530	2.63
280	2.04	540	1.96
300	0.96	600	3.45
310	0.51	700	1.14

BASIN AREA TABLE

ISAACSON & ARFMAN, P.A.
Consulting Engineering Associates
128 Monroe Street N.E.
Albuquerque New Mexico
167EXH4.DWGnov 08/21/01

PROPOSED ONSITE BASIN MAP



BASIN AREA TABLE			
BASIN	AC.	BASIN	AC.
A	14.14	H	8.44
B	12.32	I	11.89
C	5.95	J	10.63
D	6.33	K	9.80
E	12.65	L	10.30
F	9.66	M	11.00
G	8.80		

OFFSITE BASIN MAP

ISAACSON & ARFMAN, P.A.
Consulting Engineering Associates
1285 Monroe Street N.E.
Albuquerque New Mexico
167EXH3.DWG 08/23/01

III. FLOW RATE REVISIONS

The AHYMO runs from the DMP were modified to include these additional areas in the Amole Basins and exclude them from the Snow Vista Basins, and to include the proposed addition of the 70-acre portion of Basin 60104. See Appendix A for AHYMO Summary Tables. The table below summarizes the revised flows versus the DMP flow rates at the analysis points shown on pages 4-6. The DMP flow rate summary tables for the Amole Basin and the Snow Vista Basin are included in Appendix I.

Flow Rate Summary Table

Analysis Point	Flow Rate (cfs)	
	DMP	Revised Incl. Basin 60401
AP02.1 (Delgado)	652	784
AP02.2A (West of Del Rey)	693	907
AP22A (Sta 25+00)	N/A	1124
AP18A (Sta 17+00)	N/A	1185
AP21A (Sta 12+50)	N/A	1223
AP25 (Amole outfall to Snow Vista)	N/A	1230
AP 23 (Snow Vista north of subdivision)	2050	1723
AP23.2 (Snow Vista north of confluence)	2143	1692
AP25.1 (Snow Vista south of confluence)	N/A	2879

IV. CHANNEL DESIGN

Centerline Radii and Easement Curves

The horizontal alignment was laid out with a minimum centerline radius of 265 feet. The horizontal curves have easement curves upstream

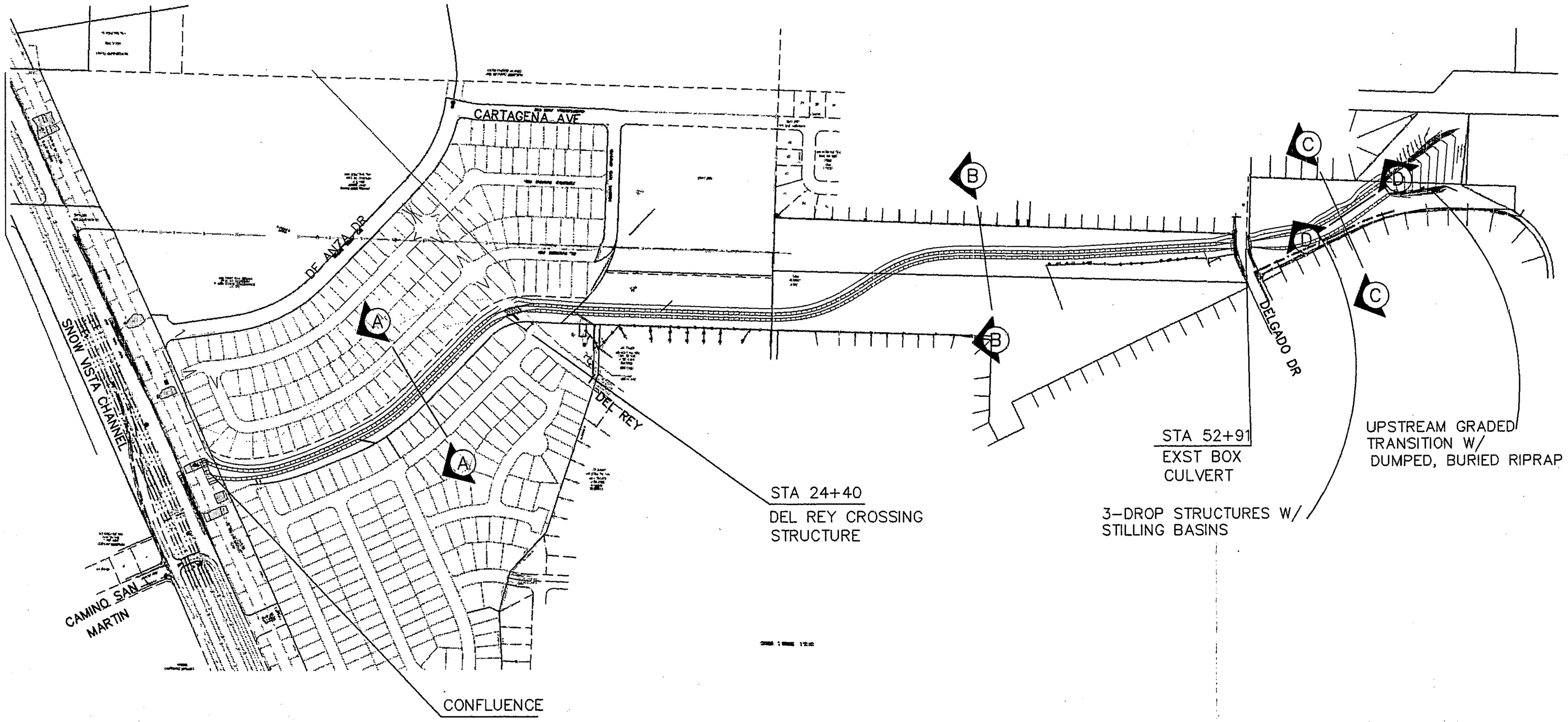
and downstream per the City of Albuquerque Development Process Manual (DPM). See Appendix E for calculations.

Hydraulic Analysis

HEC-RAS was used to model the Amole Arroyo and the Snow Vista Channel. The stations in HEC-RAS correspond to those shown on the plan & profile exhibits in the back pocket. Summary tables and water surface profiles are shown in Appendix C. The superelevation depths on the curves were calculated and added to the water depths, and a tabulation of the total water depths in the Amole Arroyo are included in Appendix D. Freeboard is 2 feet minimum throughout the project. The channel depth will vary between 6 feet east of the Del Rey crossing structure, 5.5 feet west of the crossing structure and 7 feet at the stilling pools as shown on the plan and sections on pages 9-12. From the west end of the project to the Delgado crossing, the channel will have shotcrete-lined sides, an earthen bottom and three shotcrete drop structures with stilling pools. The remaining portion of the channel will be completely lined with shotcrete. The flows are mixed west of the Delgado crossing and supercritical in the remaining reach.

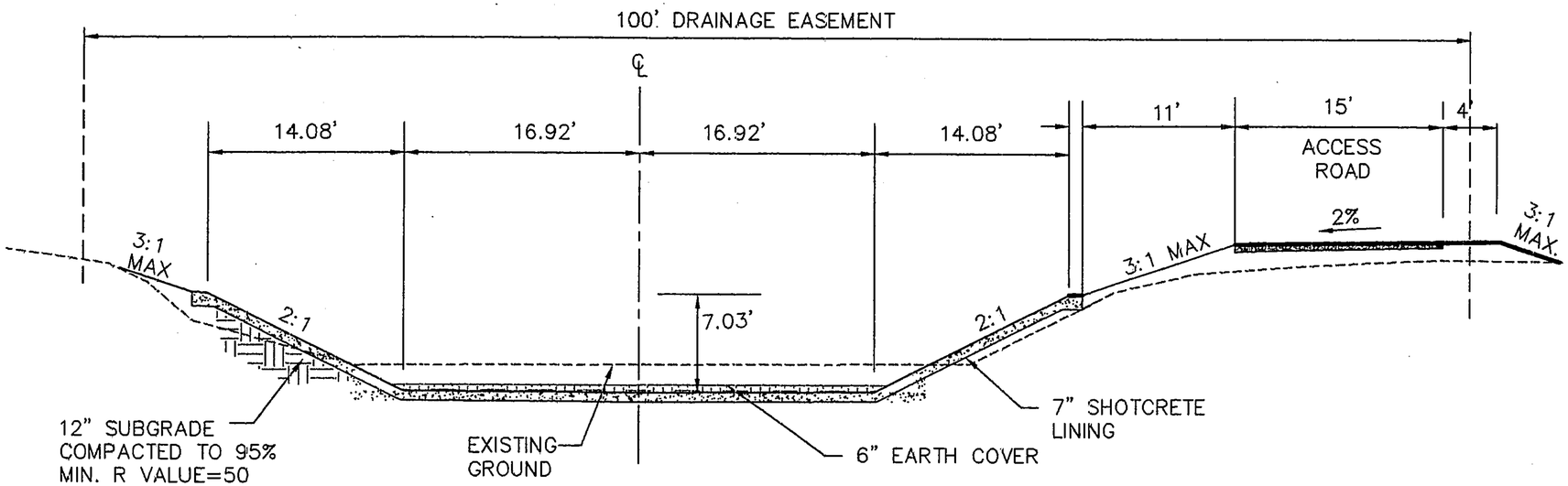
Slug Flows

Waves generated by slug flows "are the result of transition from supercritical laminar to subcritical turbulent state of flow," (*Open Channel Hydraulics*, Chow). Theoretically, slug flow can occur when the Froude number is greater than 2 and the slope of the channel is greater than 12 divided by the Reynolds number. An experiment by Mayer showed that, in actuality, slug waves were formed only on slopes greater than two percent and for Reynolds number between 1000 and 4000 (Chow).



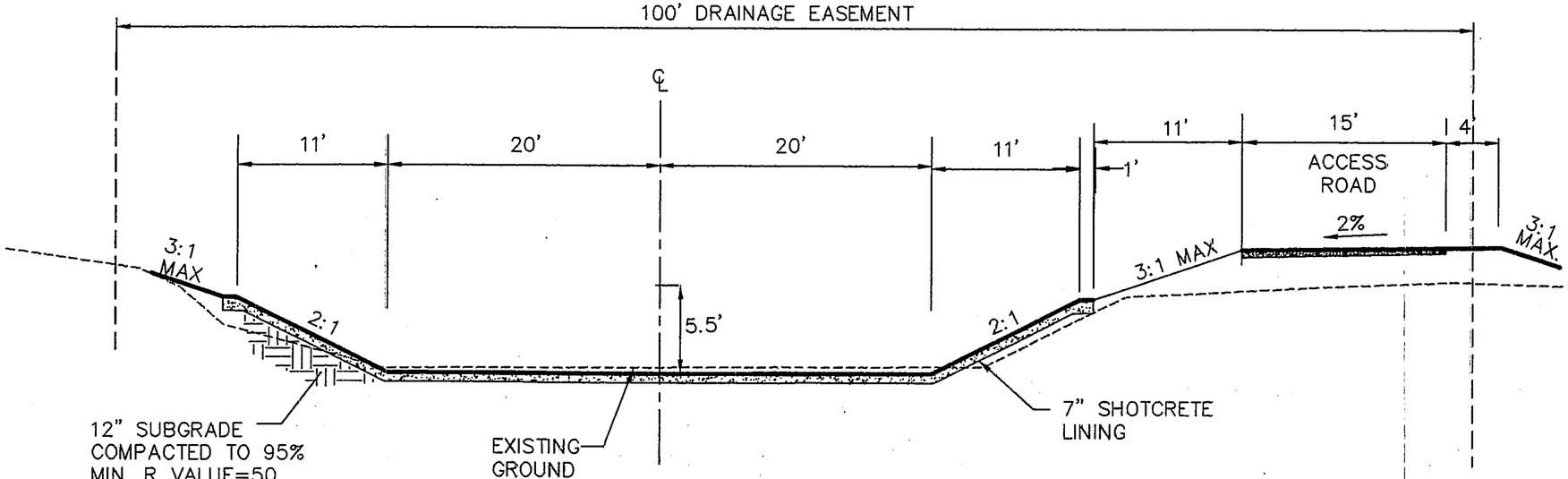
AMOLE ARROYO

1"=400'



SECTION E-E

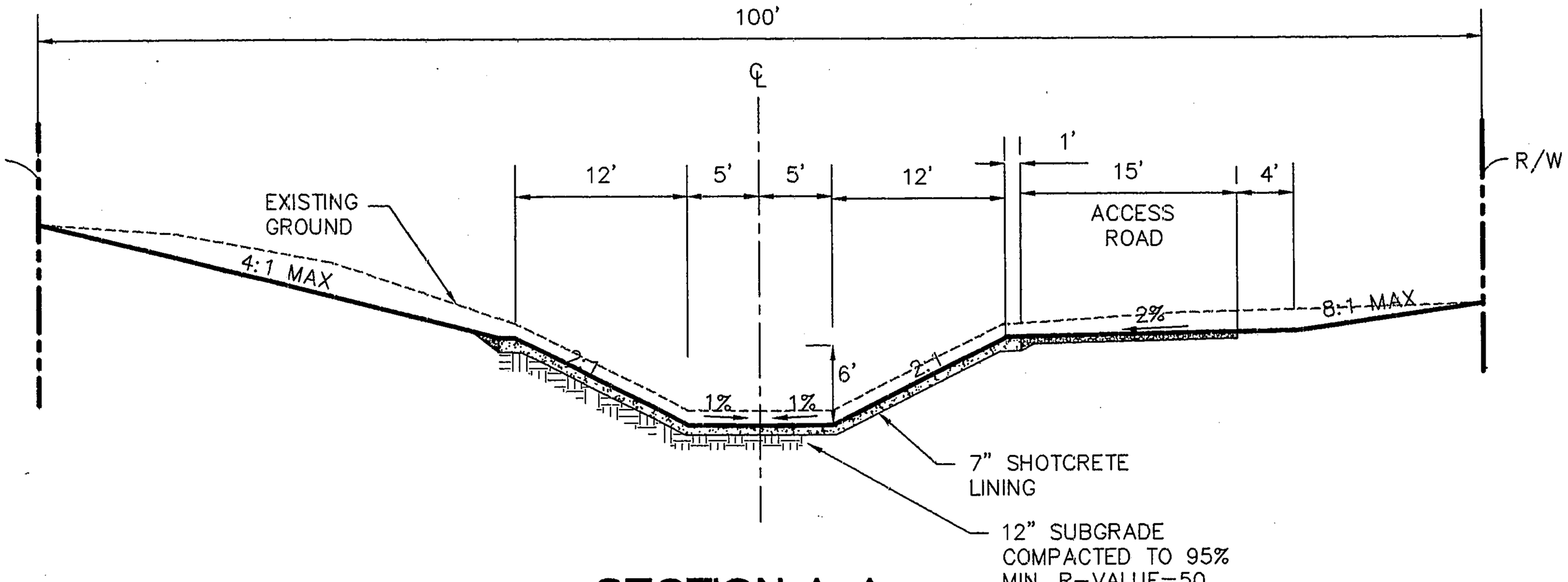
1"=10'



SECTION F-F

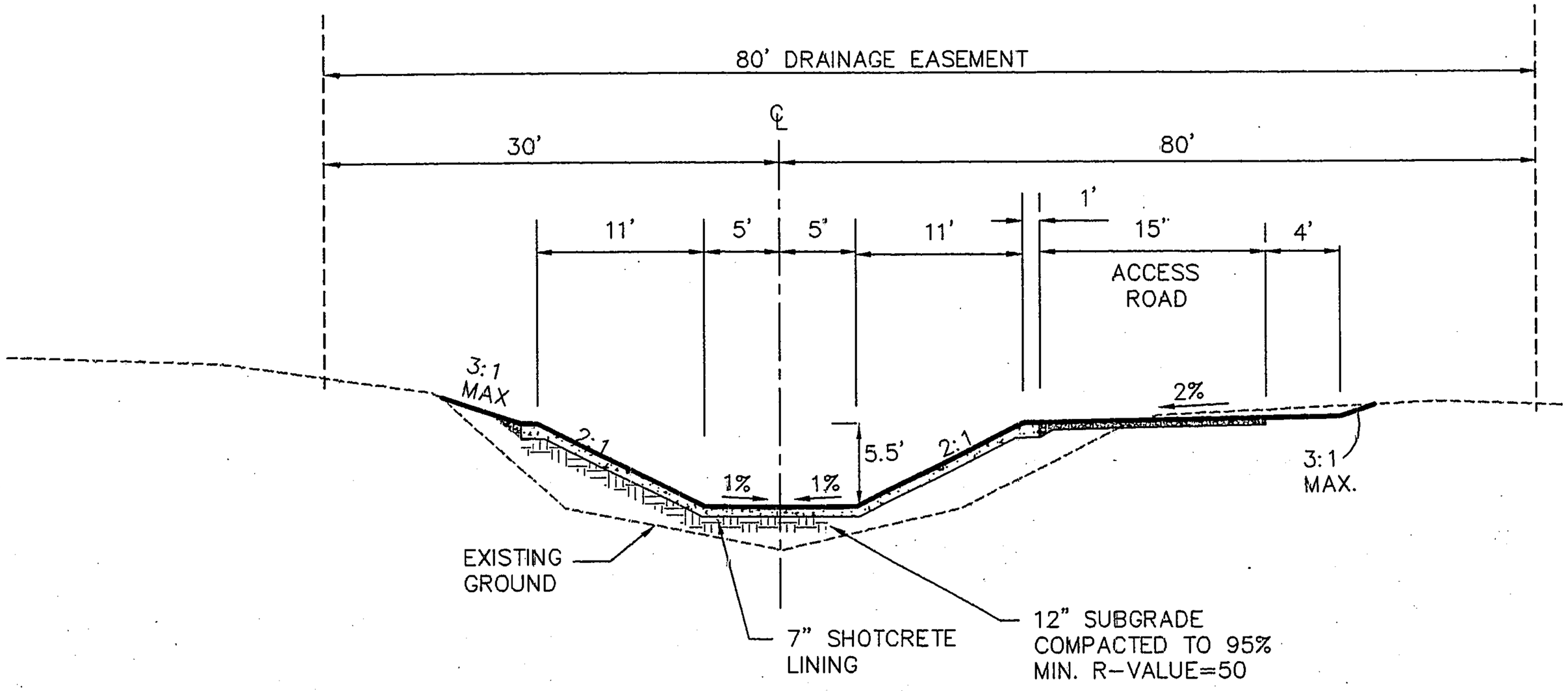
1"=10'

EL RANCHO GRANDE
UNITS 6 & 7



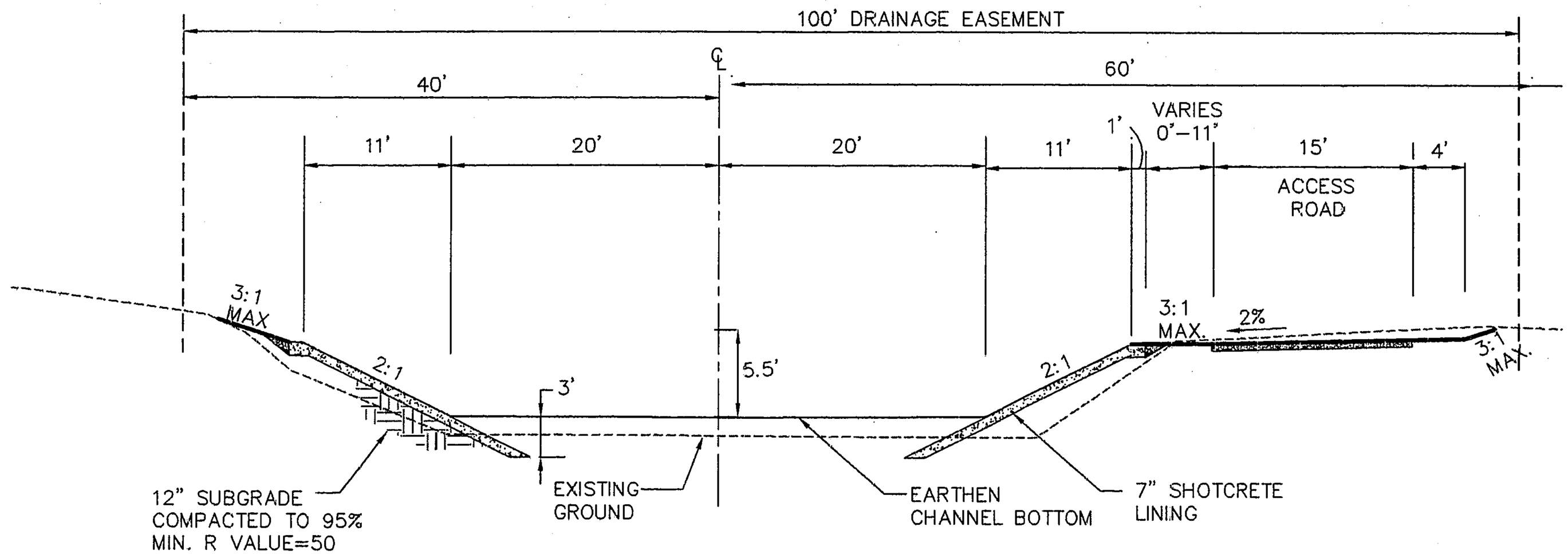
SECTION A-A

1"=10'



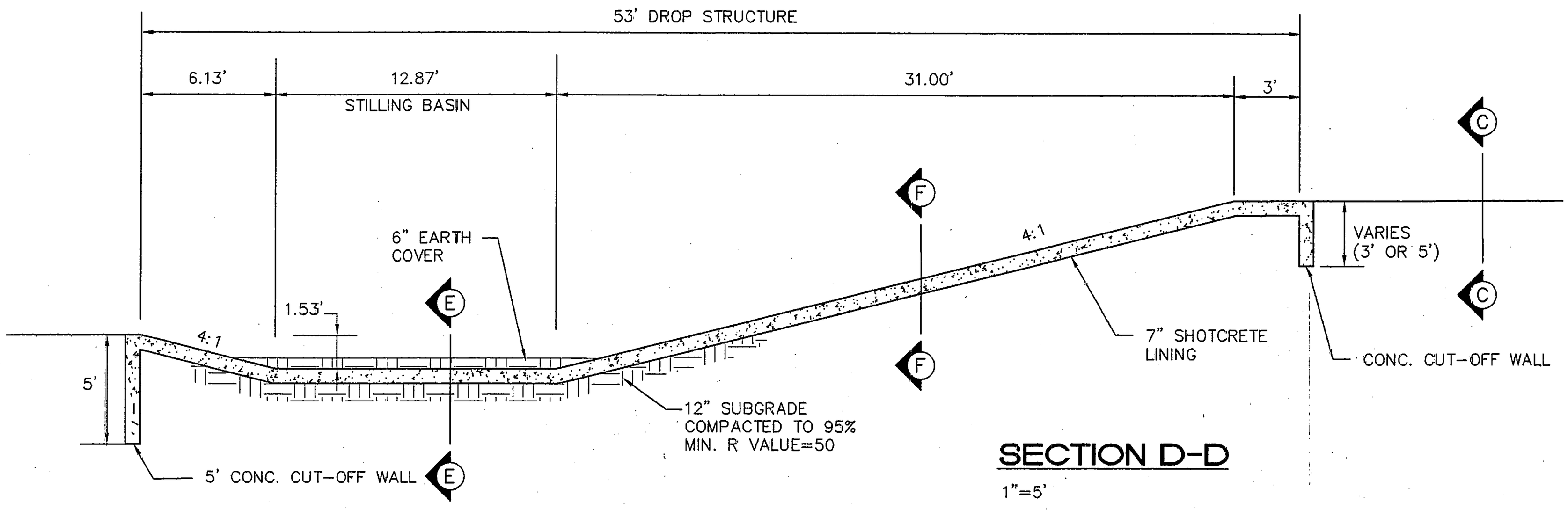
SECTION B-B

1"=10'



SECTION C-C

1"=10'



SECTION D-D

1"=5'

The areas where slug waves possibly could occur in the Amole Arroyo channel are at the drop structures (4:1 slope) west of the Delgado crossing. Calculations for a typical drop structure indicate that slug flow will not form (See Appendix F).

Upstream Transition

The Amole Arroyo upstream transition will have buried riprap as shown on the plan in the back pocket. See Appendix G for an exhibit of the upstream transition area and riprap sizing calculations.

Confluence

The Amole Arroyo and Snow Vista Channel confluence was analyzed using the momentum method in HEC-RAS. The hydraulic jump will occur where the supercritical flows in the Amole Arroyo enter the subcritical flows in Snow Vista at the junction. A momentum balance check was calculated (see Appendix H) and shows a five percent deviation. This deviation may be a result of 1) an average friction slope equal to the energy grade line slope was used in the calculations, while HEC-RAS uses a flow-weighted friction slope and 2) the flow rate out does not equal the flow rate in, since the peak flow rates from AHYMO were used as input for the three sections at the confluence.

There is an existing riprap check structure at the confluence that is proposed to be removed. The rundown from the Amole Arroyo is proposed to be shotcreted to the invert of the Snow Vista Channel with riprap gabion baskets tied to the 5-foot deep cutoff wall along the rundown. The bottom and sides of the Snow Vista Channel through the confluence will have wire-tied riprap. See Appendix H for an exhibit of the confluence.

Snow Vista Channel Freeboard

The hydraulic analysis shows that the Snow Vista Channel does not have adequate freeboard on the east side downstream of the confluence. An earthen berm along portions of the east bank will be constructed with the El Rancho Grande, Unit 8 construction by the developer.

V. SUMMARY

The Amole Arroyo will be improved from the Snow Vista Channel to approximately one mile west per the plan and sections shown on pages 9-10. The required improvements include:

- 5.5-foot deep channel with earthen bottom and shotcrete check structures and side slope shotcrete lining west of the existing Delgado box culvert
- 5.5-foot deep shotcrete lining between Delgado Drive and the proposed Del Rey Road crossing.
- 6-foot deep shotcrete lining from Sta 25+00 to Snow Vista Channel
- wire-tied riprap confluence structure per the plan in back pocket
- graded upstream transition with buried, dumped riprap
- crossing structure at the proposed Del Rey Road extension.
- storm drain system in Del Rey Road

Appendix A

AMOLE BASIN

```
(s16.66H
 AHYMO PROGRAM SUMMARY TABLE (AHYMO_97) -                    - VERSION:  1997.02d     RUN DATE (MON/DAY/YR) =08/19/2003
 INPUT FILE = 1241DEVR.DAT                                                          USER NO.= AHYMO-I-9702dIsa-Arfman1

                                 FROM  TO                    PEAK        RUNOFF                TIME TO    CFS      PAGE =   1
                     HYDROGRAPH   ID   ID        AREA     DISCHARGE     VOLUME      RUNOFF      PEAK     PER
 COMMAND        IDENTIFICATION   NO.  NO.      (SQ MI)      (CFS)       (AC-FT)    (INCHES)   (HOURS)   ACRE     NOTATION
 START                                                                                                   TIME=        .00
 *S
 *S      AMOLE ARROYO AND HUBBLE LAKE SYSTEM
 *S
 *S
 *S
 *S THE DRAINAGE MANAGEMENT PLAN AHYMO FILE AA_DMP2.DAT WAS MODIFIED TO
 *S INCLUDE UNITS 6 & 7 OF EL RANCHO GRANDE SUBDIVISION ALONG WITH
 *S A 120.9-ACRE PORTION OF OFFSITE FLOWS FROM WESTGATE HEIGHTS. A 5.8-
 *S ACRE OF BASIN 20502 (=301.01) WAS INCLUDED IN BASIN 00105.
 *S IT ALSO INCLUDES A 69.4-ACRE PORTION OF THE DMP SACATE BLANCO BASIN
 *S 60104.
 *S
 *S REVISED FILE DATA:
 *S FILE NAME: 1241DEVR.DAT
 *S BY: ASA NILSSON-WEBER
 *S LAST REVISION: 8/18/03
 *S
 *S ORIGINAL FILE DATA:
 *S 100-YR, 24-HR STORM WITH SEDIMENT
 *S FILE NAME: AA_DMP2.DAT LOW FLOW ALT
 *S BY: RICHARD STOCKTON / KAREN JACOBSEN
 *S LAST REVISION: 3-10-99
 *S
 *S*************************************************************************
 *S THE PURPOSE OF THIS MODEL IS TO CALCULATE THE RUNOFF FROM THE AMOLE ARROYO,
 *S FROM WESTGATE DAM THROUGH TO THE HUBBLE LAKE DETENTION FACILITY.  THIS RUN
 *S USES THE RECALL HYD COMMAND TO INPUT HYDOGRAPHS FROM POWERLINE CHANNEL (PL),
 *S SNOW VISTA CHANNEL (SV), SACATE BLANCO CHANNEL (SB), AMOLE DEL NORTE CHANNEL
 *S (AN), RIO BRAVO (RB), AND THE BORREGA CHANNEL (BR).  THIS RUN ALSO CALCULATES
 *S RUNOFF FROM SUB-BASINS ADJACENT TO THE CHANNEL THAT ARE NOT INCLUDED IN THE
 *S ABOVE MENTIONED HYDROGRAPHS.
 *S*********************************************************************
 *S
 *S IMPORTANT NOTE1: ROUTE RESERVOIR DOES NOT INCLUDE ALL OF THE VOLUME FROM
 *S                  WESTGATE DAM. THEREFORE, ADD ** 278 AC.FT ** OF VOLUME
 *S                  TO ALL OF THE HYDROGRAPHS PUBLISHED IN THIS RUN.
 *S                  THIS WILL ACCOUNT FOR THE VOLUME OF RUNOFF
 *S                  TRUNCATED FROM WESTGATE DAM.
 *S*********************************************************************
 *S
 *S IMPORTANT NOTE2: ROUTE RESERVOIR DOES NOT INCLUDE ALL OF THE VOLUME FROM
 *S                  POWERLINE CHANNEL. THEREFORE, ADD ** 55.4 AC.FT ** OF VOLUME
 *S                  TO THE AFFECTED HYDROGRAPHS PUBLISHED IN THIS RUN.
 *S                  THIS WILL ACCOUNT FOR THE VOLUME OF RUNOFF
 *S                  TRUNCATED FROM THE POWERLINE ALTERNATIVE.
```

```
                                 FROM  TO                    PEAK        RUNOFF                TIME TO    CFS      PAGE 2
                   HYDROGRAPH     ID   ID        AREA     DISCHARGE     VOLUME      RUNOFF      PEAK     PER
COMMAND          IDENTIFICATION  NO.  NO.      (SQ MI)     (CFS)       (AC-FT)    (INCHES)   (HOURS)   ACRE     NOTATION

*S
*S*********************************************************************
*S
*S IMPORTANT NOTE3: N/A
*S
*S*********************************************************************
*S
*S IMPORTANT NOTE4: ROUTE RESERVOIR DOES NOT INCLUDE ALL OF THE VOLUME FROM
*S                  AMOLE DEL NORTE. THEREFORE, ADD ** 3.2 AC.FT ** OF VOLUME
*S                  TO THE AFFECTED HYDROGRAPHS PUBLISHED IN THIS RUN.
*S                  THIS WILL ACCOUNT FOR THE VOLUME OF RUNOFF
*S                  TRUNCATED FROM THE AMOLE DEL NORTE ALTERNATIVE.
*S*********************************************************************
*S ANALYSIS ASSUMPTIONS:
*S*********************************************************************
*S 1. ALL LAND IN THIS BASIN IS MODELED AS DEVELOPED CONDITION.
*S
*S 2. A BULKING FACTOR OF 15% HAS BEEN ADDED TO EACH UNDEVELOPED SUB-BASIN AND
*S    A BULKING FACTOR OF 6% HAS BEEN ADDED TO EACH DEVELOPED SUB-BASIN LIKELY
*S    TO PRODUCE SEDIMENT.  A BULKING FACTOR OF 3% HAS BEEN ADDED TO EACH
*S    DEVELOPED SUB-BASIN THAT COULD PROBIBLY PRODUCE SOME SEDIMENT, SUCH AS PAR
*S    AND SCHOOL PLAY GROUNDS.   AND, NO BULKING FACTOR FOR WELL
*S    DEFINED RESIDENTIAL DEVELOPMENTS.
*S
*S 3. BOTH THE AMOLE DETENTION FACILITY AND HUBBELL LAKE DETENTION FACILITY
*S    PRINCIPAL SPILLWAYS ARE MODELED CLOSED.  THESE TWO FACILITIES ARE
*S    REPRESENTATED AS AP40.1 AND AP 50.1, RESPECTIVELY ON THE SUPPLEMENTAL
*S    MAPPING AND REPORT.
*S
*S 4. THE AMOLE BASIN HAS FREE DISCHARGE TO THE AMOLE ARROYO.  POWERLINE
*S    HAS A RESTRICTED DISCHARGE OF 20 AND SNOW VISTA IS FREE DISCHARGE.
*S    THE RUNOFF IS CONVEYED IN A HIGH FLOW CHANNEL TO THE AMOLE DETENTION FACIL
*S
*S 5. THIS ALTERNATIVE INCLUDES THE GUAC DETENTION BASIN.
*S
*S 6. THIS ALTERNATIVE INCLUDES BASINS 35301, 35303, AND 35305 FROM THE
*S    AN_DMP.DAT FILE AS A RESULT OF THE UNSER EXTENSION.
*S*********************************************************************
*S100 YEAR 24HR STORM DEVELOPED CONDITION
RAINFALL  TYPE= 2                                                                          RAIN24=   2.660
*S RECALL OUTFLOW HYDROGRAPH FROM THE WESTGATE DAM
*S  HYD NO. WG100D1B.HYD IS ***** AP 01 *****
RECALL HYD        WG_DMP.HYD   -     5       5.15730        73.47     170.999       .62169    7.050     .022
*S ROUTE FLOW TO AP02
ROUTE                WG101.5    5   11       5.15730        73.47     170.672       .62050    6.950     .022
*S CALCULATE FLOW FROM SUB-BASIN 00102
*S GENERATION OF SEDIMENT LIKELY, BULK FLOWS 6%
SEDIMENT BULK                                                                              PK BF =    1.06
COMPUTE NM HYD        102.00   -     2        .11190       218.60       9.283      1.55544    1.500    3.052 PER IMP=  47.00
*S ADD THE ROUTED FLOW FROM SUB-BASIN WG101.5 TO THE FLOW FROM SUB-BASIN 00102.
ADD HYD               102.10 11& 2   3       5.26920       254.43     179.955       .64035    1.500     .075
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                                                                                                                  ***
                                                                                                                  ***
                                FROM  TO                    PEAK        RUNOFF                TIME TO    CFS      PAGE ***  3
                   HYDROGRAPH   ID   ID        AREA      DISCHARGE      VOLUME      RUNOFF      PEAK     PER
COMMAND          IDENTIFICATION NO.  NO.     (SQ MI)      (CFS)        (AC-FT)    (INCHES)   (HOURS)   ACRE      NOTATION

*S RECALL OUTFLOW HYDROGRAPH FROM POWERLINE CHANNEL
*S
*S IMPORTANT NOTE2: ROUTE RESERVOIR DOES NOT INCLUDE ALL OF THE VOLUME FROM
*S                  POWERLINE CHANNEL. THEREFORE, ADD ** 20.6 AC.FT ** OF VOLUME
*S                  TO THE AFFECTED HYDROGRAPHS PUBLISHED IN THIS RUN.
*S                  THIS WILL ACCOUNT FOR THE VOLUME OF RUNOFF
*S                  TRUNCATED FROM THE POWERLINE ALTERNATIVE. THE TOTAL
*S                  TRUNCATED VOLUME TO THIS POINT IS 289.6 AC FT
*S
RECALL HYD       PL_DMP1.HYD   -    11       1.20470       19.34      42.699       .66457   29.900     .025
ADD HYD              102.10 11& 3   3       6.47390      256.59     222.654       .64486    1.500     .062
*S HYD=102.1 IS *** AP02 *****
*S ROUTE FLOW IN THE AMOLE ARROYO TO 900 FEET EAST OF POWERLINE CHANNEL.
ROUTE                102.50    3   12       6.47390      256.93     222.486       .64437    1.550     .062
*S
*S GENERATION OF SEDIMENT LIKELY, BULK FLOWS 6%
SEDIMENT BULK                                                                                          PK BF =    1.06
COMPUTE NM HYD       00103A    -    2        .07170      162.04       6.475      1.69326    1.500    3.531 PER IMP=  49.00
*S ROUTE FLOW THROUGH SUB-BASIN 00103B TO THE AMOLE ARROYO.
ROUTE              00103A.5    2   11        .07170      100.85       6.475      1.69325    1.600    2.198
*S CALCULATE FLOW FROM SUB-BASIN 00103B
*S GENERATION OF SEDIMENT LIKELY, BULK FLOWS 6%
SEDIMENT BULK                                                                                          PK BF =    1.06
COMPUTE NM HYD       00103B    -    2        .12070      202.77      10.858      1.68669    1.600    2.625 PER IMP=  49.00
*S ADD THE ROUTE FLOW FROM SUB-BASIN 00103A.5 TO THE FLOW
*S FROM SUB-BASIN 00103B.
ADD HYD            00103B.1 11& 2   3        .19240      303.62      17.333      1.68913    1.600    2.466
*S ADD THE COMBINED FLOW FROM SUB-BASIN 00103B.1 TO THE ROUTED FLOW
*S IN THE AMOLE ARROYO.
ADD HYD            00103B.2 12& 3   4       6.66630      543.70     239.819       .67453    1.550     .127
*S CALCULATE THE FLOW FROM SUB-BASIN 60104.
*S BULK FLOWS 6%
SEDIMENT BULK                                                                                          PK BF =    1.06
COMPUTE NM HYD       D60104    -    2        .10900      228.92       8.785      1.51117    1.500    3.282 PER IMP=  40.00
*S ADD THE FLOWS FROM SUB-BASIN 60104 TO SUB-BASIN 00103B.2.
ADD HYD            00103B.3  2& 4   5       6.77530      749.16     248.604       .68799    1.550     .173
*S ROUTE FLOW FROM SUB-BASIN 00103B.3 IN THE AMOLE ARROYO TO
*S DELGADO STREET.
ROUTE              00103B.5    5   11       6.77530      748.42     248.088       .68656    1.550     .173
*S
*S CALCULATE FLOW FROM SUB-BASIN 00104
*S GENERATION OF SEDIMENT LIKELY, BULK FLOWS 6%
SEDIMENT BULK                                                                                          PK BF =    1.06
COMPUTE NM HYD       104.00    -    2        .01830       40.11       1.617      1.65724    1.500    3.424 PER IMP=  49.00
*S ADD THE FLOW FROM SUB-BASIN 00104 TO THE ROUTED FLOW IN THE AMOLE ARROYO.
*S HYD NO. 00104.1 IS ***** AP 02.1 *****
ADD HYD              104.10 11& 2   3       6.79360      784.22     249.706       .68917    1.550     .180
*S ROUTE FLOW FROM SUB-BASIN 00104 IN THE AMOLE ARROYO TO 2990 FEET EAST
*S FOR SNOW VISTA CHANNEL
ROUTE                104.50    3   11       6.79360      774.81     249.103       .68751    1.600     .178
*S
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                                FROM  TO                    PEAK        RUNOFF                 TIME TO    CFS
                  HYDROGRAPH    ID    ID        AREA     DISCHARGE     VOLUME      RUNOFF      PEAK      PER
COMMAND         IDENTIFICATION  NO.   NO.     (SQ MI)     (CFS)       (AC-FT)    (INCHES)   (HOURS)    ACRE      NOTATION

*S CALCULATE FLOW FROM SUB-BASIN 00105
*S GENERATION OF SEDIMENT LIKELY, BULK FLOWS 6%
SEDIMENT BULK                                                                                                  PK BF =    1.06
COMPUTE NM HYD          105.00   -     2       .08581      181.91       7.484     1.63539    1.500    3.312 PER IMP=  49.00
*S ADD THE FLOW FROM SUB-BASIN 00105 TO THE ROUTED FLOW IN THE AMOLE ARROYO.
*S HYD NO. 00105.1 IS ***** AP 02.2A *****
ADD HYD                 105.10 11& 2  41      6.87941      906.98     256.588      .69934    1.600     .206
*S*************************************************************
*S***              EL RANCHO GRANDE SUBDIVISION                ****
*S***               UNITS SIX, SEVEN, & EIGHT                  ****
*S***                  DEVELOPED CONDITIONS                    ****
*S*************************************************************
*S*************** OFFSITE BASINS *******************
*S
*S  BASIN A (102)
COMPUTE NM HYD          102.00   -     2       .02210       45.19       1.774     1.50473    1.500    3.195 PER IMP=  42.00
*S  ~~~~~~~~~  AP1  ~~~~~~~~~
ROUTE                   102.20    3    2       .02210       43.14       1.774     1.50475    1.550    3.050
*S  BASIN B (103)
COMPUTE NM HYD          103.00   -     3       .01926       39.39       1.546     1.50472    1.500    3.195 PER IMP=  42.00
ADD HYD                 103.10  2& 3   1       .04136       78.57       3.319     1.50472    1.550    2.968
*S  ~~~~~~~~~  AP2  ~~~~~~~~~
ROUTE                   103.20    1    3       .04136       79.71       3.319     1.50473    1.550    3.011
*S  BASIN C (104)
COMPUTE NM HYD          104.00   -     4       .00929       19.01        .746     1.50473    1.500    3.197 PER IMP=  42.00
ADD HYD                 104.10  3& 4   1       .05065       96.81       4.065     1.50471    1.550    2.986
*S  ~~~~~~~~~  AP3  ~~~~~~~~~
ROUTE                   104.20    1    4       .05065       94.44       4.065     1.50473    1.600    2.913
*S  BASIN D (110)
*S  ~~~~~~~~~  AP4  ~~~~~~~~~
COMPUTE NM HYD          110.00   -     5       .00989       20.23        .794     1.50473    1.500    3.196 PER IMP=  42.00
*S  BASIN E (111)
COMPUTE NM HYD          111.00   -     6       .01977       40.43       1.587     1.50473    1.500    3.195 PER IMP=  42.00
ADD HYD                 111.10  5& 6   1       .02966       60.66       2.380     1.50470    1.500    3.196
*S  ~~~~~~~~~  AP5  ~~~~~~~~~
ROUTE                   111.20    1    6       .02966       54.53       2.380     1.50473    1.550    2.873
*S  BASIN F (112)
COMPUTE NM HYD          112.00   -     7       .01510       30.88       1.212     1.50472    1.500    3.196 PER IMP=  42.00
ADD HYD                 112.10  6& 7   1       .04476       82.31       3.592     1.50471    1.550    2.873
*S  ~~~~~~~~~  AP6  ~~~~~~~~~
ROUTE                   112.20    1    7       .04476       78.22       3.592     1.50472    1.600    2.731
*S  BASIN G (120)
*S  ~~~~~~~~~  AP8  ~~~~~~~~~
COMPUTE NM HYD          120.00   -     8       .01375       28.12       1.103     1.50473    1.500    3.196 PER IMP=  42.00
*S  BASIN H (121)
COMPUTE NM HYD          121.00   -     9       .01319       26.98       1.059     1.50472    1.500    3.196 PER IMP=  42.00
ADD HYD                 121.10  8& 9   1       .02694       55.10       2.162     1.50470    1.500    3.196
*S  ~~~~~~~~~  AP9  ~~~~~~~~~
ROUTE                   121.20    1    9       .02694       53.66       2.162     1.50476    1.550    3.112
*S  BASIN I (122)
COMPUTE NM HYD          122.00   -    10       .01858       38.00       1.491     1.50472    1.500    3.195 PER IMP=  42.00
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COMMAND	HYDROGRAPH IDENTIFICATION	FROM ID NO.	TO ID NO.	AREA (SQ MI)	PEAK DISCHARGE (CFS)	RUNOFF VOLUME (AC-FT)	RUNOFF (INCHES)	TIME TO PEAK (HOURS)	CFS PER ACRE	NOTATION
ADD HYD	122.10	9&10	1	.04552	89.31	3.653	1.50472	1.500	3.066	
*S ~~~~~~~~~ AP7 ~~~~~~~~~										
ROUTE	122.20	1	10	.04552	85.57	3.653	1.50474	1.550	2.937	
ADD HYD	104.30	4&10	10	.09617	179.19	7.718	1.50472	1.550	2.911	
*S BASIN J (130)										
COMPUTE NM HYD	130.00	-	11	.01661	33.97	1.333	1.50473	1.500	3.196	PER IMP= 42.00
ADD HYD	130.10	10&11	1	.11278	209.75	9.051	1.50472	1.550	2.906	
*S ~~~~~~~~~ AP10 ~~~~~~~~~										
ROUTE	130.20	1	11	.11278	206.48	9.051	1.50472	1.600	2.861	
*S BASIN K (131)										
COMPUTE NM HYD	131.00	-	12	.01532	31.33	1.229	1.50472	1.500	3.196	PER IMP= 42.00
ADD HYD	131.10	11&12	1	.12810	229.34	10.280	1.50472	1.550	2.797	
*S ~~~~~~~~~ AP11 ~~~~~~~~~										
ROUTE	131.20	1	12	.12810	219.98	10.280	1.50472	1.600	2.683	
*S BASIN L (140)										
*S ~~~~~~~~~ AP12 ~~~~~~~~~										
COMPUTE NM HYD	140.00	-	13	.01609	32.91	1.291	1.50472	1.500	3.196	PER IMP= 42.00
*S										
*S********** ONSITE BASINS **********										
*S										
COMPUTE NM HYD	300.00	-	38	.00150	3.45	.144	1.80120	1.500	3.594	PER IMP= 57.88
COMPUTE NM HYD	310.00	-	39	.00080	1.85	.077	1.80120	1.500	3.610	PER IMP= 57.88
COMPUTE NM HYD	320.00	-	40	.00087	2.01	.084	1.80120	1.500	3.606	PER IMP= 57.88
ADD HYD	310.10	12&39	15	.12890	221.26	10.357	1.50655	1.600	2.682	
ADD HYD	310.20	38&15	16	.13040	223.67	10.501	1.50994	1.600	2.680	
ADD HYD	310.30	41&16	1	7.00981	1130.65	267.089	.71442	1.600	.252	
*S ~~~~~~~~~ AP22 ~~~~~~~~~										
ROUTE	310.40	1	39	7.00981	1122.07	266.981	.71413	1.600	.250	
*S ~~~~~~~~~ AP22A ~~~~~~~~~										
ADD HYD	310.A	39&40	1	7.01068	1123.47	267.064	.71426	1.600	.250	
*S ROUTE FLOW IN THE AMOLE ARROYO TO AP18										
ROUTE	310.B	1	11	7.01068	1121.35	266.904	.71383	1.600	.250	
*S ~~~~~~~~~ AP14 ~~~~~~~~~										
COMPUTE NM HYD	210.00	-	30	.00436	10.00	.419	1.80120	1.500	3.584	PER IMP= 57.88
COMPUTE NM HYD	220.00	-	31	.00408	9.36	.392	1.80120	1.500	3.584	PER IMP= 57.88
ADD HYD	220.10	30&31	1	.00844	19.36	.811	1.80112	1.500	3.584	
*S ~~~~~~~~~ AP15 ~~~~~~~~~										
ROUTE	220.20	1	31	.00844	19.00	.811	1.80131	1.500	3.518	
COMPUTE NM HYD	230.00	-	32	.00208	4.78	.200	1.80120	1.500	3.590	PER IMP= 57.88
ADD HYD	230.10	13&32	1	.01817	37.68	1.491	1.53863	1.500	3.241	
*S ~~~~~~~~~ AP16 ~~~~~~~~~										
ROUTE	230.20	1	32	.01817	37.87	1.491	1.53867	1.500	3.257	
COMPUTE NM HYD	240.00	-	33	.00516	11.83	.496	1.80120	1.500	3.583	PER IMP= 57.88
ADD HYD	240.10	32&33	1	.02333	49.70	1.987	1.59669	1.500	3.329	
ROUTE	240.20	1	33	.02333	49.54	1.987	1.59672	1.500	3.318	
ADD HYD	240.30	31&33	1	.03177	68.54	2.798	1.65103	1.500	3.371	
*S ~~~~~~~~~ AP17 ~~~~~~~~~										
ROUTE	240.40	1	33	.03177	67.88	2.798	1.65105	1.550	3.338	
COMPUTE NM HYD	250.00	-	34	.00569	13.05	.547	1.80120	1.500	3.583	PER IMP= 57.88
*S ~~~~~~~~~ AP 18 ~~~~~~~~~										
ADD HYD	250.10	33&34	34	.03746	80.87	3.344	1.67383	1.500	3.373	

COMMAND	HYDROGRAPH IDENTIFICATION	FROM ID NO.	TO ID NO.	AREA (SQ MI)	PEAK DISCHARGE (CFS)	RUNOFF VOLUME (AC-FT)	RUNOFF (INCHES)	TIME TO PEAK (HOURS)	CFS PER ACRE	NOTATION
*S ~~~~~~~~~ AP18A ~~~~~~~~~										
ADD HYD	250.A	34&11	1	7.04814	1184.83	270.248	.71893	1.600	.263	
*S ROUTE FLOW IN THE AMOLE ARROYO TO AP21										
ROUTE	250.B	1	34	7.04814	1182.50	270.134	.71863	1.600	.262	
COMPUTE NM HYD	260.00	-	35	.00793	18.18	.762	1.80120	1.500	3.582	PER IMP= 57.88
*S ~~~~~~~~~ AP19 ~~~~~~~~~										
ROUTE	260.10	36	35	.00793	16.19	.762	1.80126	1.550	3.190	
COMPUTE NM HYD	270.00	-	36	.00926	21.22	.890	1.80120	1.500	3.581	PER IMP= 57.88
*S ~~~~~~~~~ AP20 ~~~~~~~~~										
ROUTE	270.10	37	36	.00926	17.89	.890	1.80124	1.550	3.019	
COMPUTE NM HYD	280.00	-	37	.00319	7.32	.306	1.80120	1.500	3.587	PER IMP= 57.88
ADD HYD	280.10	35&37	1	.01112	22.70	1.068	1.80116	1.550	3.190	
ROUTE	280.20	1	37	.01112	23.15	1.068	1.80123	1.550	3.253	
ADD HYD	280.30	36&37	1	.02038	41.04	1.958	1.80117	1.550	3.147	
*S ~~~~~~~~~ AP21 ~~~~~~~~~										
ROUTE	280.40	1	37	.02038	40.79	1.958	1.80121	1.550	3.127	
*S ~~~~~~~~~ AP21A ~~~~~~~~~										
ADD HYD	280.A	37&34	1	7.06852	1222.63	272.092	.72175	1.600	.270	
*S ROUTE FLOW IN THE AMOLE ARROYO TO SNOW VISTA CHANNEL										
ROUTE	250.B	1	34	7.06852	1222.16	272.060	.72167	1.600	.270	
COMPUTE NM HYD	600.00	-	49	.00539	11.55	.471	1.63961	1.500	3.349	PER IMP= 50.00
*S ~~~~~~~~~ AP25 ~~~~~~~~~										
ADD HYD	AP25	34&49	1	7.07391	1230.30	272.532	.72237	1.600	.272	
FINISH										

(s10H

SNOW VISTA BASIN

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(s16.66H
 AHYMO PROGRAM SUMMARY TABLE (AHYMO_97) -                    - VERSION:  1997.02d      RUN DATE (MON/DAY/YR) =08/19/2003
 INPUT FILE = 1241SV.DAT                                                              USER NO.= AHYMO-I-9702dIsa-Arfman1

                                FROM  TO                    PEAK        RUNOFF                TIME TO    CFS      PAGE =   1
                     HYDROGRAPH  ID   ID        AREA     DISCHARGE     VOLUME      RUNOFF      PEAK     PER
 COMMAND           IDENTIFICATION  NO.  NO.    (SQ MI)     (CFS)       (AC-FT)    (INCHES)   (HOURS)   ACRE     NOTATION
 START                                                                                                     TIME=       .00
 *S
 *S THE DRAINAGE MANAGEMENT PLAN AHYMO FILE SV_DMP1.DAT WAS MODIFIED TO
 *S EXCLUDE UNITS 6 & 7 OF EL RANCHO GRANDE SUBDIVISION ALONG WITH
 *S A 120.9-ACRE PORTION OF OFFSITE FLOWS FROM WESTGATE HEIGHTS.
 *S BASINS 20501(=301.02) AND 20502 (=301.01) WERE ELIMINATED AND
 *S BASIN 20502 (=301.03) WAS REDUCED FROM 220 ACRES TO 128.9 ACRES.
 *S EL RANCHO GRANDE BASIN 500 WAS ADDED.
 *S
 *S NEW FILE DATA:
 *S FILE NAME : 1241SV.DAT
 *S BY: ASA NILSSON-WEBER
 *S LAST REVISION: 8/18/03
 *S
 *S              SNOW VISTA
 *S             WITH MANAGEMENT PLAN IN PLACE
 *S
 *S ORIGINAL FILE DATA:
 *S 100-YR, 24-HR STORM WITH NO SEDIMENT**
 *S FILE NAME : SV_DMP1.DAT
 *S BY: TOM BLAINE AND RICHARD STOCKTON/K. JACOBSEN
 *S LAST REVISION: 06-08-99 (PIPE FOR POND.71 CHANGED AND HYD=400)
 *S100 YEAR 24HR STORM DEVELOPED CONDITION
 RAINFALL  TYPE= 2                                                                                      RAIN24=   2.660
 COMPUTE NM HYD        100.00   -     2      .13520     340.82     15.597     2.16311    1.500    3.939 PER IMP=  85.00
 ROUTE RESERVOIR       100.10   2     5      .13520     111.60     15.611     2.16501    1.850    1.290 AC-FT=    4.075
 ROUTE                 100.20   5     3      .13520     112.75     15.611     2.16502    1.400    1.303
 ROUTE                 100.30   3    10      .13520     114.14     15.611     2.16502    1.450    1.319
 COMPUTE NM HYD        110.00   -     2      .07170     181.36      8.272     2.16311    1.500    3.952 PER IMP=  85.00
 ROUTE RESERVOIR       110.10   2     5      .07170      59.19      8.377     2.19060    2.600    1.290 AC-FT=     .001
 ROUTE                 110.20   5    11      .07170      61.29      8.377     2.19061    1.400    1.336
 COMPUTE NM HYD        120.00   -     2      .04030     101.99      4.649     2.16311    1.500    3.954 PER IMP=  85.00
 ROUTE RESERVOIR       120.10   2     5      .04030      33.30      4.654     2.16525    1.850    1.291 AC-FT=    1.219
 ADD HYD               120.20 11& 5  12      .11200      94.58     13.031     2.18148    1.400    1.319
 ROUTE                 120.30  12    11      .11200      95.88     13.031     2.18148    1.400    1.338
 COMPUTE NM HYD        130.00   -     2      .03770      95.41      4.349     2.16311    1.500    3.954 PER IMP=  85.00
 ROUTE RESERVOIR       130.10   2     5      .03770      31.10      4.349     2.16310    1.850    1.289 AC-FT=    1.142
 ADD HYD               130.20 11& 5  12      .14970     126.97     17.380     2.17685    1.400    1.325
 ADD HYD               130.30 10&12  12      .28490     238.38     32.991     2.17123    1.450    1.307
 ROUTE                 130.40  12    90      .28490     241.75     32.991     2.17124    1.450    1.326
 COMPUTE NM HYD        140.00   -     2      .04300     105.07      4.718     2.05746    1.500    3.818 PER IMP=  79.00
 ROUTE RESERVOIR       140.10   2     5      .04300      35.50      4.739     2.06628    1.800    1.290 AC-FT=    1.198
 ROUTE                 140.20   5    11      .04300      36.97      4.739     2.06630    1.400    1.343
 COMPUTE NM HYD        150.00   -     2      .02420      55.95      2.451     1.89898    1.500    3.612 PER IMP=  70.00
 ROUTE RESERVOIR       150.10   2     5      .02420      19.99      2.456     1.90318    1.800    1.291 AC-FT=     .589
 ADD HYD               150.20 11& 5  12      .06720      56.96      7.195     2.00755    1.400    1.324
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COMMAND	HYDROGRAPH IDENTIFICATION	FROM ID NO.	TO ID NO.	AREA (SQ MI)	PEAK DISCHARGE (CFS)	RUNOFF VOLUME (AC-FT)	RUNOFF (INCHES)	TIME TO PEAK (HOURS)	CFS PER ACRE	NOTATION
COMPUTE NM HYD	170.00	-	70	.02853	65.96	2.889	1.89898	1.500	3.612	PER IMP= 70.00
ROUTE RESERVOIR	150.10	70	5	.02853	23.61	2.893	1.90140	1.800	1.293	AC-FT= .693
ADD HYD	170.20	12& 5	12	.09573	80.56	10.088	1.97591	1.400	1.315	
ROUTE	150.30	12	11	.09573	83.24	10.088	1.97592	1.400	1.359	
COMPUTE NM HYD	160.00	-	2	.02170	50.17	2.198	1.89898	1.500	3.612	PER IMP= 70.00
ROUTE RESERVOIR	160.10	2	5	.02170	15.89	2.198	1.89896	1.850	1.144	AC-FT= .888
ADD HYD	160.20	11& 5	12	.11743	94.99	12.286	1.96168	1.850	1.264	
ROUTE	170.40	12	11	.11743	94.99	12.286	1.96169	1.850	1.264	
COMPUTE NM HYD	180.00	-	2	.02810	64.96	2.846	1.89898	1.500	3.612	PER IMP= 70.00
ROUTE RESERVOIR	180.10	2	5	.02810	23.20	2.854	1.90432	1.800	1.290	AC-FT= .684
ADD HYD	180.20	11& 5	10	.14553	118.19	15.140	1.95061	1.850	1.269	
ROUTE	180.30	10	11	.14553	118.20	15.140	1.95061	1.850	1.269	
COMPUTE NM HYD	190.00	-	2	.03130	79.22	3.611	2.16311	1.500	3.955	PER IMP= 85.00
ROUTE RESERVOIR	190.10	2	5	.03130	25.80	3.611	2.16310	1.850	1.288	AC-FT= .950
ADD HYD	190.00	90& 5	1	.31620	267.54	36.602	2.17043	1.450	1.322	
ROUTE	190.20	1	10	.31620	271.17	36.602	2.17043	1.450	1.340	
ADD HYD	190.30	11&10	12	.46173	380.80	51.742	2.10114	1.450	1.289	
COMPUTE NM HYD	200.00	-	2	.02520	49.60	2.074	1.54349	1.500	3.075	PER IMP= 52.00
*S THE VOLUME FROM 200.1 IS THE SNOW VISTA POND VOLUME UNDER DEV. COND.										
*S HYD=200.1 IS *****AP 21.1*****										
ADD HYD	200.10	2&12	10	.48693	423.42	53.816	2.07228	1.450	1.359	
ROUTE RESERVOIR	200.20	10	3	.48693	387.71	53.814	2.07218	2.000	1.244	AC-FT= 6.455
*S HYD=200.2 IS *****AP 21*****										
MODIFY TIME	200.20	3	3	.48693	387.71	53.667	2.06654	2.000	1.244	DT= .050000
*s BEGIN ONSITE WATERSHED										
COMPUTE NM HYD	210.00	-	2	.00920	20.66	.871	1.77514	1.500	3.509	PER IMP= 61.00
ADD HYD	210.10	3& 2	10	.49613	392.49	54.538	2.06113	1.900	1.236	
ROUTE	210.20	10	11	.49613	392.68	54.538	2.06113	1.950	1.237	
COMPUTE NM HYD	220.00	-	2	.00800	17.97	.757	1.77514	1.500	3.510	PER IMP= 61.00
ADD HYD	220.10	11& 2	10	.50413	396.83	55.295	2.05659	1.950	1.230	
ROUTE	220.20	10	11	.50413	396.72	55.295	2.05658	1.900	1.230	
COMPUTE NM HYD	230.00	-	2	.00940	21.11	.890	1.77514	1.500	3.509	PER IMP= 61.00
ADD HYD	230.10	11& 2	10	.51353	402.40	56.185	2.05143	1.850	1.224	
ROUTE	230.20	10	11	.51353	402.94	56.185	2.05141	1.900	1.226	
COMPUTE NM HYD	240.00	-	2	.01450	32.56	1.373	1.77514	1.500	3.509	PER IMP= 61.00
*s END ONSITE WATERSHED										
ADD HYD	240.10	11& 2	10	.52803	411.52	57.557	2.04382	1.800	1.218	
COMPUTE NM HYD	250.00	-	2	.00220	5.04	.201	1.71016	1.500	3.582	PER IMP= 50.00
ADD HYD	250.10	10& 2	11	.53023	413.17	57.758	2.04244	1.800	1.218	
COMPUTE NM HYD	260.00	-	2	.01570	34.01	1.443	1.72289	1.500	3.385	PER IMP= 60.00
ROUTE	260.10	2	15	.01570	32.36	1.443	1.72292	1.550	3.221	
COMPUTE NM HYD	270.00	-	2	.01020	20.61	.841	1.54680	1.500	3.157	PER IMP= 50.00
ADD HYD	270.10	15& 2	16	.02590	52.62	2.284	1.65352	1.500	3.175	
DIVIDE HYD	270.20	16	15	.02035	25.79	1.795	1.65352	1.500	1.980	
	270.30	and	3	.00555	26.84	.489	1.65352	1.500	7.556	
ROUTE	270.40	3	16	.00555	24.11	.489	1.65360	1.550	6.788	
COMPUTE NM HYD	280.00	-	2	.00220	5.42	.243	2.07506	1.500	3.850	PER IMP= 80.00
ADD HYD	280.10	16& 2	17	.00775	28.88	.733	1.77310	1.550	5.821	
ADD HYD	280.20	17&11	10	.53798	418.16	58.491	2.03856	1.750	1.214	
ROUTE	280.30	10	11	.53798	418.00	58.487	2.03843	1.750	1.214	
COMPUTE NM HYD	290.00	-	2	.00670	12.00	.421	1.17900	1.500	2.799	PER IMP= 25.00
ADD HYD	290.10	11& 2	10	.54468	423.10	58.909	2.02786	1.700	1.214	

COMMAND	HYDROGRAPH IDENTIFICATION	FROM ID NO.	TO ID NO.	AREA (SQ MI)	PEAK DISCHARGE (CFS)	RUNOFF VOLUME (AC-FT)	RUNOFF (INCHES)	TIME TO PEAK (HOURS)	CFS PER ACRE	NOTATION
COMPUTE NM HYD	300.00	-	2	.07090	179.34	8.179	2.16311	1.500	3.952	PER IMP= 85.00
ROUTE	330.50	15	17	.02035	25.49	1.795	1.65356	1.550	1.958	
ROUTE RESERVOIR	300.10	2	5	.07090	58.60	8.192	2.16634	1.850	1.291	AC-FT= 2.142
ROUTE	300.20	5	11	.07090	58.59	8.192	2.16636	2.350	1.291	
COMPUTE NM HYD	310.00	-	2	.08640	214.61	9.724	2.11028	1.500	3.881	PER IMP= 82.00
ROUTE RESERVOIR	310.10	2	5	.08640	71.30	9.826	2.13237	1.800	1.289	AC-FT= 2.505
ADD HYD	310.20	11& 5	12	.15730	129.89	18.018	2.14769	2.300	1.290	
ROUTE	310.30	12	11	.15730	129.89	18.018	2.14769	2.300	1.290	
ROUTE	310.40	11	13	.15730	129.89	18.018	2.14769	2.350	1.290	
COMPUTE NM HYD	320.00	-	2	.05470	122.45	5.283	1.81093	1.500	3.498	PER IMP= 65.00
ROUTE RESERVOIR	320.10	2	5	.05470	16.32	5.206	1.78457	2.100	.466	AC-FT= 3.035
ROUTE	320.20	5	11	.05470	16.32	5.205	1.78432	2.150	.466	
COMPUTE NM HYD	330.00	-	2	.02380	53.29	2.299	1.81093	1.500	3.498	PER IMP= 65.00
ADD HYD	330.10	11& 2	12	.07850	63.27	7.504	1.79239	1.500	1.259	
ADD HYD	330.20	12&13	14	.23580	190.99	25.522	2.02940	1.500	1.266	
ROUTE	330.30	14	12	.23580	189.79	25.521	2.02938	1.550	1.258	
ROUTE	330.40	12	11	.23580	190.04	25.521	2.02933	1.550	1.259	
ROUTE	330.60	17	16	.02035	25.11	1.795	1.65356	1.550	1.928	
COMPUTE NM HYD	340.00	-	2	.01550	31.31	1.279	1.54680	1.500	3.156	PER IMP= 50.00
ADD HYD	340.10	16& 2	15	.03585	54.98	3.073	1.60737	1.500	2.396	
ROUTE	340.20	15	16	.03585	54.73	3.073	1.60739	1.500	2.385	
ROUTE	340.30	16	15	.03585	54.39	3.073	1.60739	1.550	2.371	
COMPUTE NM HYD	350.00	-	2	.04830	97.54	3.985	1.54680	1.500	3.155	PER IMP= 50.00
ADD HYD	350.10	15& 2	16	.08415	151.92	7.058	1.57260	1.500	2.821	
ROUTE	350.20	16	15	.08415	151.81	7.058	1.57261	1.500	2.819	
ROUTE	350.30	15	16	.08415	150.34	7.058	1.57261	1.500	2.792	
COMPUTE NM HYD	360.00	-	2	.02080	42.01	1.716	1.54680	1.500	3.156	PER IMP= 50.00
ADD HYD	360.10	16& 2	15	.10495	192.36	8.774	1.56748	1.500	2.864	
ADD HYD	360.20	15&11	17	.34075	379.23	34.295	1.88709	1.500	1.739	
ROUTE	360.30	17	16	.34075	377.79	34.295	1.88708	1.500	1.732	
ADD HYD	360.40	16&10	15	.88543	740.21	93.203	1.97368	1.600	1.306	
COMPUTE NM HYD	370.00	-	2	.01830	36.97	1.510	1.54680	1.500	3.156	PER IMP= 50.00
ROUTE RESERVOIR	370.10	2	5	.01830	6.64	1.510	1.54678	2.050	.567	AC-FT= .768
*S HYD=AP22 IS *****AP 22*****										
ADD HYD	AP22	5&15	22	.90373	746.31	94.713	1.96504	1.600	1.290	
ROUTE	100.00	22	88	.90373	752.02	94.711	1.96501	1.600	1.300	
*S COMPUTE HYD FOR BASIN 301.61										
COMPUTE NM HYD	301.61	-	61	.03590	84.71	3.399	1.77514	1.500	3.687	PER IMP= 61.00
*S ROUTE ID=61 THROUGH POND.61										
ROUTE RESERVOIR	.61	61	1	.03590	26.35	3.411	1.78163	1.750	1.147	AC-FT= 1.154
*S ROUTE THIS FLOW DOWN THE 24" STORM DRAIN PIPE TO POND.62										
ROUTE	.61	1	11	.03590	26.36	3.411	1.78166	1.800	1.147	
*S HYDROGRAPH ID = 11 IS THE ROUTED FLOW OUT OF POND.61										
*S COMPUTE HYD FOR BASIN 301.62										
COMPUTE NM HYD	301.62	-	62	.03440	81.18	3.257	1.77514	1.500	3.687	PER IMP= 61.00
*S ROUTE ID=62 THROUGH POND.62										
ROUTE RESERVOIR	.62	62	1	.03440	25.02	3.267	1.78046	1.800	1.136	AC-FT= 1.098
*S ROUTED FLOW OUT OF POND.62										
*S ADD HYD ID=11 TO ID=1 AND ROUTE THIS FLOW THROUGH THE 30" STORM DRAIN										
*S TO POND.63										
ADD HYD	POND.62	1&11	1	.07030	51.38	6.678	1.78106	1.800	1.142	

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                          FROM  TO                  PEAK        RUNOFF                TIME TO    CFS
              HYDROGRAPH   ID   ID        AREA    DISCHARGE     VOLUME     RUNOFF     PEAK     PER
COMMAND     IDENTIFICATION NO.  NO.     (SQ MI)    (CFS)       (AC-FT)   (INCHES)   (HOURS)   ACRE      NOTATION
ROUTE                .62    1   12      .07030      51.40       6.678     1.78107    1.800    1.142
*S  HYDROGRAPH ID = 12 IS THE ROUTED FLOW DOWN THE 30" STORM DRAIN PIPE
*S COMPUTE HYD FOR BASIN 301.63
COMPUTE NM HYD      301.63   -   63      .03440      81.18       3.257     1.77514    1.500    3.687 PER IMP=  61.00
*S ROUTE ID=63 THROUGH POND.63
ROUTE RESERVOIR      .63    63    1      .03440      25.02       3.267     1.78046    1.800    1.136 AC-FT=    1.098
*S  ROUTED FLOW OUT OF POND.63
*S  ADD HYD ID=12 TO ID=1 AND ROUTE THIS FLOW THROUGH THE 36" STORM DRAIN
*S  TO POND.64
ADD HYD            POND.63  1&12   1      .10470      76.42       9.944     1.78086    1.800    1.140
ROUTE                .63    1   13      .10470      76.44       9.944     1.78087    1.800    1.141
*S  HYDROGRAPH ID = 13 IS THE ROUTED FLOW DOWN THE 36" STORM DRAIN PIPE
*S  TO THE INLET OF POND.64 TO THIS STORM DRAIN PIPE
*S COMPUTE HYD FOR BASIN 301.64
COMPUTE NM HYD      301.64   -   64      .03440      81.18       3.257     1.77514    1.500    3.687 PER IMP=  61.00
*S ROUTE ID=64 THROUGH POND.64
ROUTE RESERVOIR      .64    64    1      .03440      25.02       3.267     1.78046    1.800    1.136 AC-FT=    1.098
*S  ROUTED FLOW OUT OF POND.64
*S  ADD HYD ID=13 TO ID=1 AND ROUTE THIS FLOW THROUGH THE 36" STORM DRAIN
*S  TO POND.65
ADD HYD            POND.64  1&13   1      .13910     101.46      13.211     1.78076    1.800    1.140
ROUTE                .64    1   14      .13910     101.46      13.211     1.78077    1.800    1.140
*S  HYDROGRAPH ID = 14 IS THE ROUTED FLOW DOWN THE 36" STORM DRAIN PIPE
*S  TO THE INLET OF POND.64 TO THIS STORM DRAIN PIPE
*S COMPUTE HYD FOR BASIN 301.65
COMPUTE NM HYD      301.65   -   65      .03440      81.18       3.257     1.77514    1.500    3.687 PER IMP=  61.00
*S ROUTE ID=65 THROUGH POND.65
ROUTE RESERVOIR      .65    65    1      .03440      25.02       3.267     1.78046    1.800    1.136 AC-FT=    1.098
*S  ROUTED FLOW OUT OF POND.65
*S  ADD HYD ID=14 TO ID=1 AND ROUTE THIS FLOW THROUGH THE 36" STORM DRAIN
*S  TO SNOW VISTA CHANNEL
ADD HYD            POND.65  1&14   1      .17350     126.48      16.477     1.78070    1.800    1.139
*S COMPUTE HYD FOR BASIN 301.05
COMPUTE NM HYD      301.05   -    5      .03280      77.40       3.105     1.77514    1.500    3.687 PER IMP=  61.00
*S TOTAL FLOW AT AP-22.1 IN SNOW VISTA CHANNEL
ADD HYD             301.00 88& 1   3     1.07723     870.06     111.189     1.93533    1.600    1.262
*S HYD=AP22.1 IS *****AP 22.1*****
ADD HYD             AP22.1  3& 5   2     1.11003     915.49     114.294     1.93059    1.600    1.289
ROUTE               301.60    2    1     1.11003     924.58     114.291     1.93054    1.600    1.301
*S COMPUTE HYD FOR BASIN 301.04
COMPUTE NM HYD      301.04   -    4      .07660     180.72       7.252     1.77515    1.500    3.686 PER IMP=  61.00
*S HYD=AP22.2 IS *****AP 22.2*****
ADD HYD             AP22.2  1& 4   1     1.18663    1030.69     121.543     1.92051    1.600    1.357
ROUTE               300.00    1    9     1.18663    1036.41     121.542     1.92049    1.600    1.365
*S COMPUTE HYD FOR BASIN 301.71
COMPUTE NM HYD      301.71   -   71      .06940     163.75       6.570     1.77514    1.500    3.687 PER IMP=  61.00
*S  ROUTE THIS FLOW DOWN THE 60" STORM DRAIN PIPE LINE TO 301.72
ROUTE                .71   71   11      .06940     167.38       6.570     1.77515    1.500    3.769
*S COMPUTE HYD FOR BASIN 301.72
COMPUTE NM HYD      301.72   -   72      .04220      99.58       3.995     1.77514    1.500    3.687 PER IMP=  61.00
*S  ADD BASIN 301.71 AND ROUTE THIS FLOW DOWN THE 60" STORM DRAIN PIPE LINE TO 3
ADD HYD             301.72 72&11   2     .11160     266.96      10.566     1.77514    1.500    3.738
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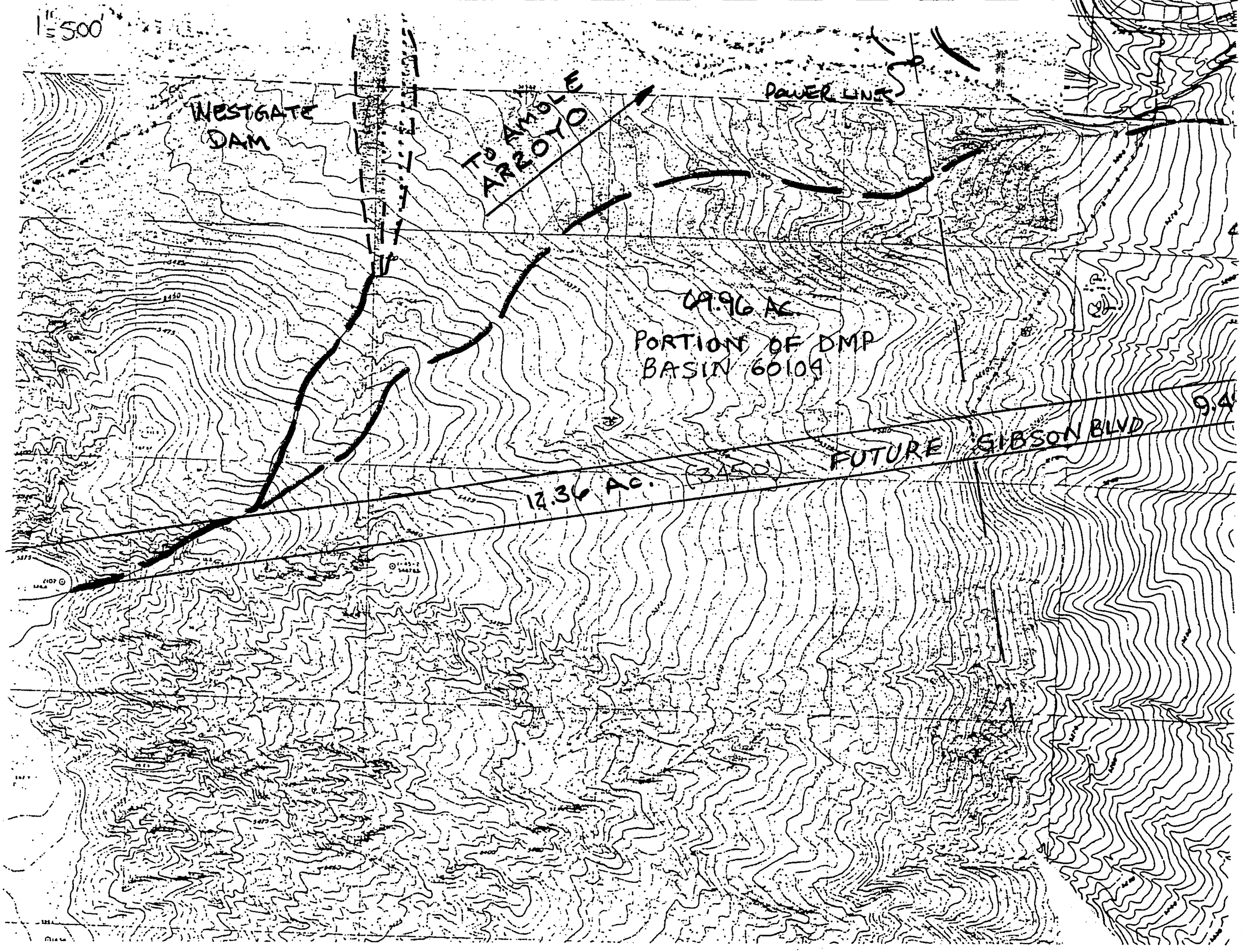
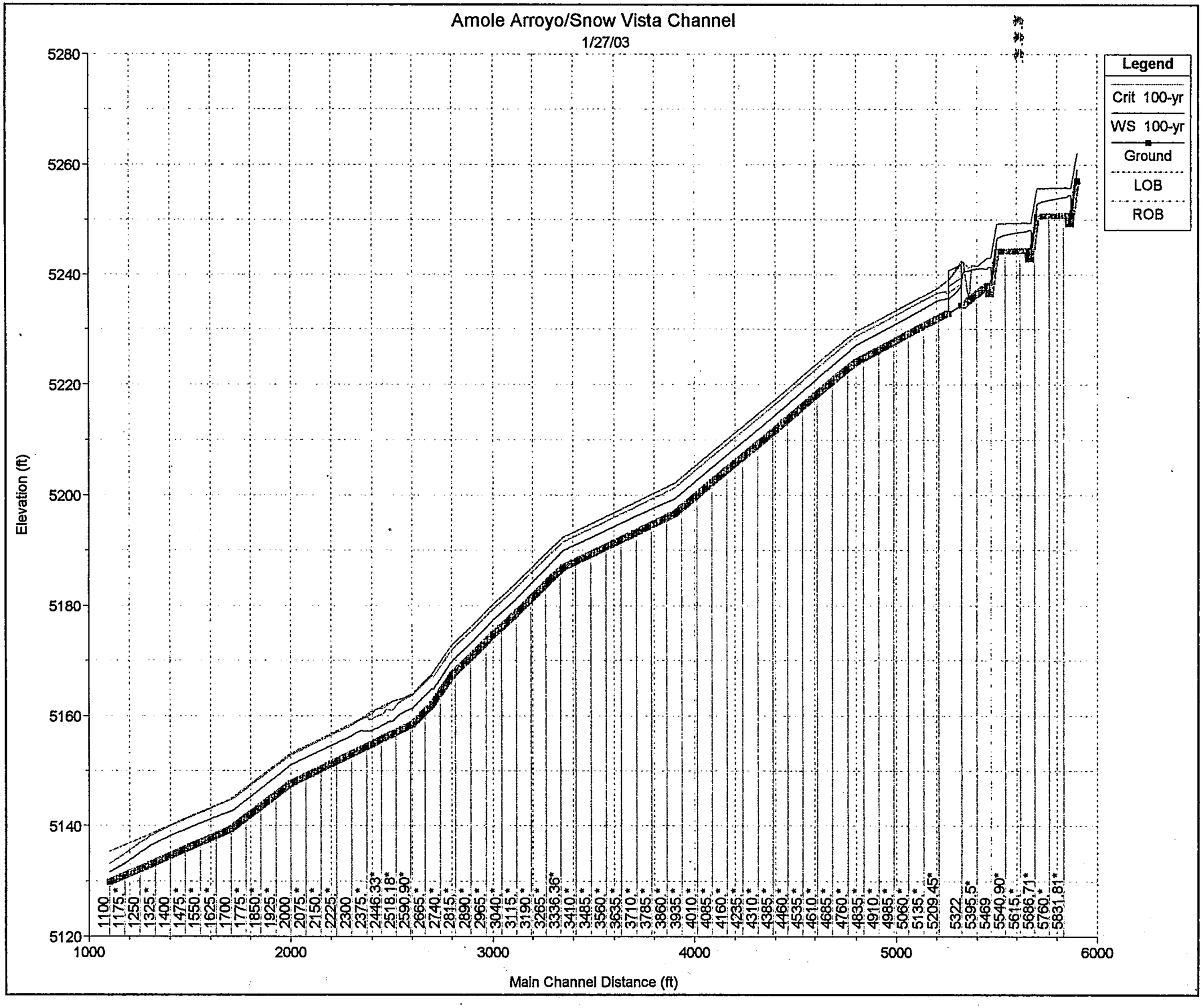
COMMAND	HYDROGRAPH IDENTIFICATION	FROM ID NO.	TO ID NO.	AREA (SQ MI)	PEAK DISCHARGE (CFS)	RUNOFF VOLUME (AC-FT)	RUNOFF (INCHES)	TIME TO PEAK (HOURS)	CFS PER ACRE	NOTATION
ROUTE	.71	2	11	.11160	269.93	10.566	1.77515	1.500	3.779	
*S COMPUTE HYD FOR BASIN 301.74										
COMPUTE NM HYD	301.74	-	74	.00910	21.88	.830	1.71015	1.500	3.757	PER IMP= 50.00
*S ADD BASIN 301.72 AND BASIN 301.74										
ADD HYD	301.74	74&11	11	.12070	291.81	11.396	1.77024	1.500	3.778	
COMPUTE NM HYD	301.73	-	73	.01940	45.78	1.837	1.77514	1.500	3.688	PER IMP= 61.00
*S ADD HYDGRAPHS FROM										
ADD HYD	301.73	73&11	4	.14010	337.60	13.232	1.77092	1.500	3.765	
*S COMPUTE HYD FOR BASIN 301.03										
COMPUTE NM HYD	301.03	-	3	.20140	474.78	19.067	1.77514	1.500	3.683	PER IMP= 61.00
*S HYDROGRAPH ID 73 IS THE INFLOW TO THE SNOW VISTA CHANNEL AT AP-23										
ADD HYD	301.03	3& 4	73	.34150	812.38	32.300	1.77341	1.500	3.717	
*S HYD=AP23 IS *****AP 23*****										
ADD HYD	AP23	9&73	1	1.52813	1722.55	153.842	1.88762	1.500	1.761	
ROUTE	400.00	1	2	1.52813	1726.15	153.842	1.88762	1.500	1.765	
ROUTE	500.00	2	3	1.52813	1708.66	153.838	1.88757	1.550	1.747	
ROUTE	600.00	3	4	1.52813	1716.72	153.836	1.88755	1.550	1.755	
ROUTE	700.00	4	2	1.52813	1687.84	153.827	1.88745	1.550	1.726	
*S BASIN 500 EL RANCHO GRANDE										
COMPUTE NM HYD	500.00	-	44	.00217	4.70	.197	1.69924	1.500	3.386	PER IMP= 57.88
*S *****AP23.2*****										
ADD HYD	AP23.2	2&44	3	1.53030	1692.02	154.024	1.88718	1.550	1.728	
*S RECALL AMOLE ARROYO OUTFLOW HYDROGRAPH										
RECALL HYD	AP25	-	1	7.07391	1244.87	273.006	.72363	1.600	.275	
*S ADD FLOWS AT AP23.2 AND AP25										
*S *****AP25.1*****										
ADD HYD	AP25.1	1& 3	5	8.60421	2878.10	427.030	.93057	1.600	.523	
ROUTE	800.00	5	4	8.60421	2800.55	426.010	.92835	1.600	.509	
*S COMPUTE HYD FOR BASIN 301.00										
COMPUTE NM HYD	300.00	-	1	.05156	121.66	4.881	1.77514	1.500	3.687	PER IMP= 61.00
ROUTE RESERVOIR	.01	1	5	.05156	42.85	4.881	1.77514	1.750	1.298	AC-FT= 1.790
*S HYD=AP24 IS *****AP 24*****										
ADD HYD	AP24	5& 4	2	8.65577	2843.28	430.891	.93339	1.600	.513	
ROUTE	SV_DMP2.HYD	2	66	8.65577	2839.54	430.144	.93177	1.650	.513	
FINISH										

(s10H

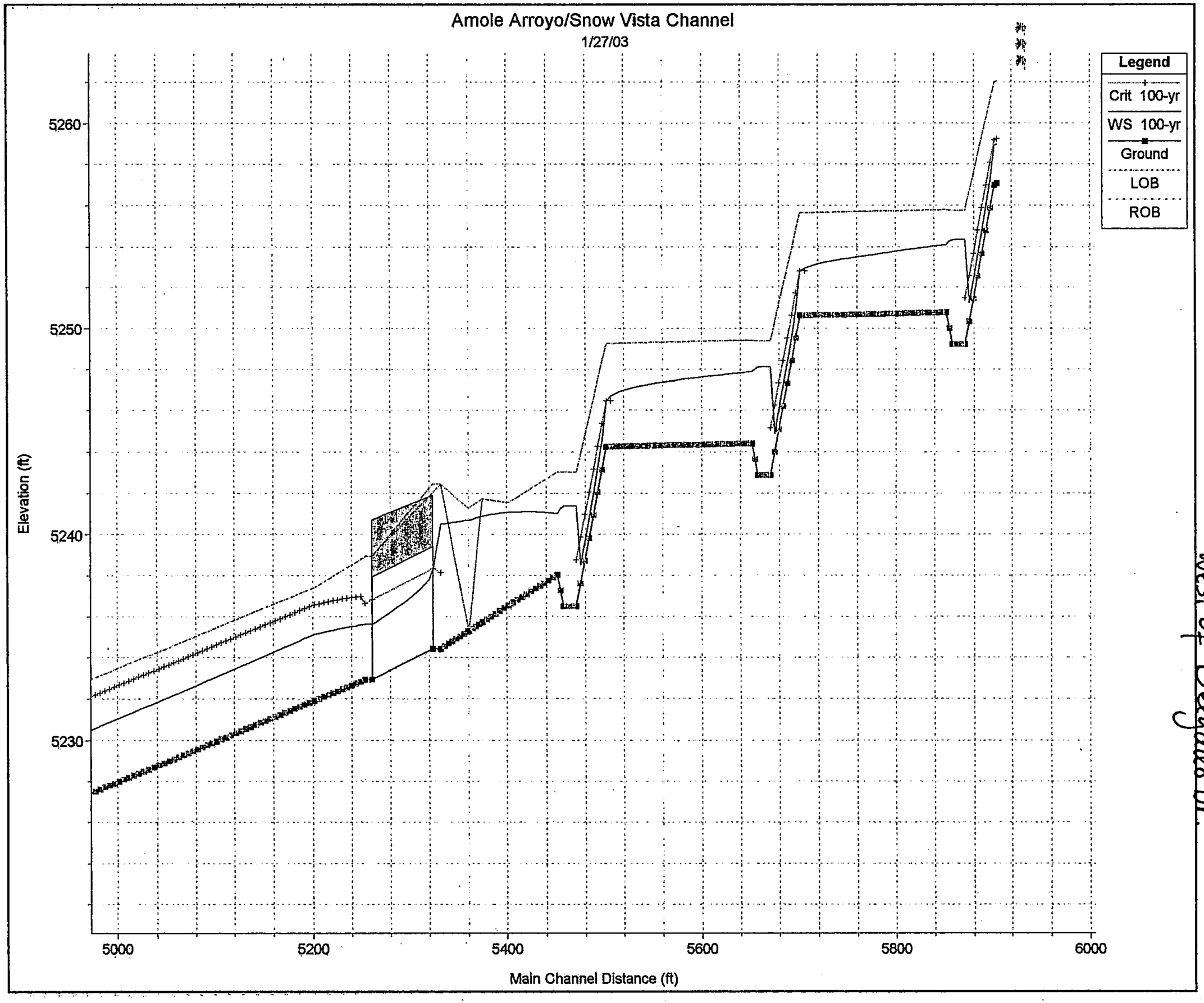
Appendix B


1" = 500'
WESTGATE DAM
TO AMOLE ARROYO
POWER LINE
49.96 AC.
PORTION OF DMP BASIN 60104
FUTURE GIBSON BLVD
(3450)
14.36 AC.

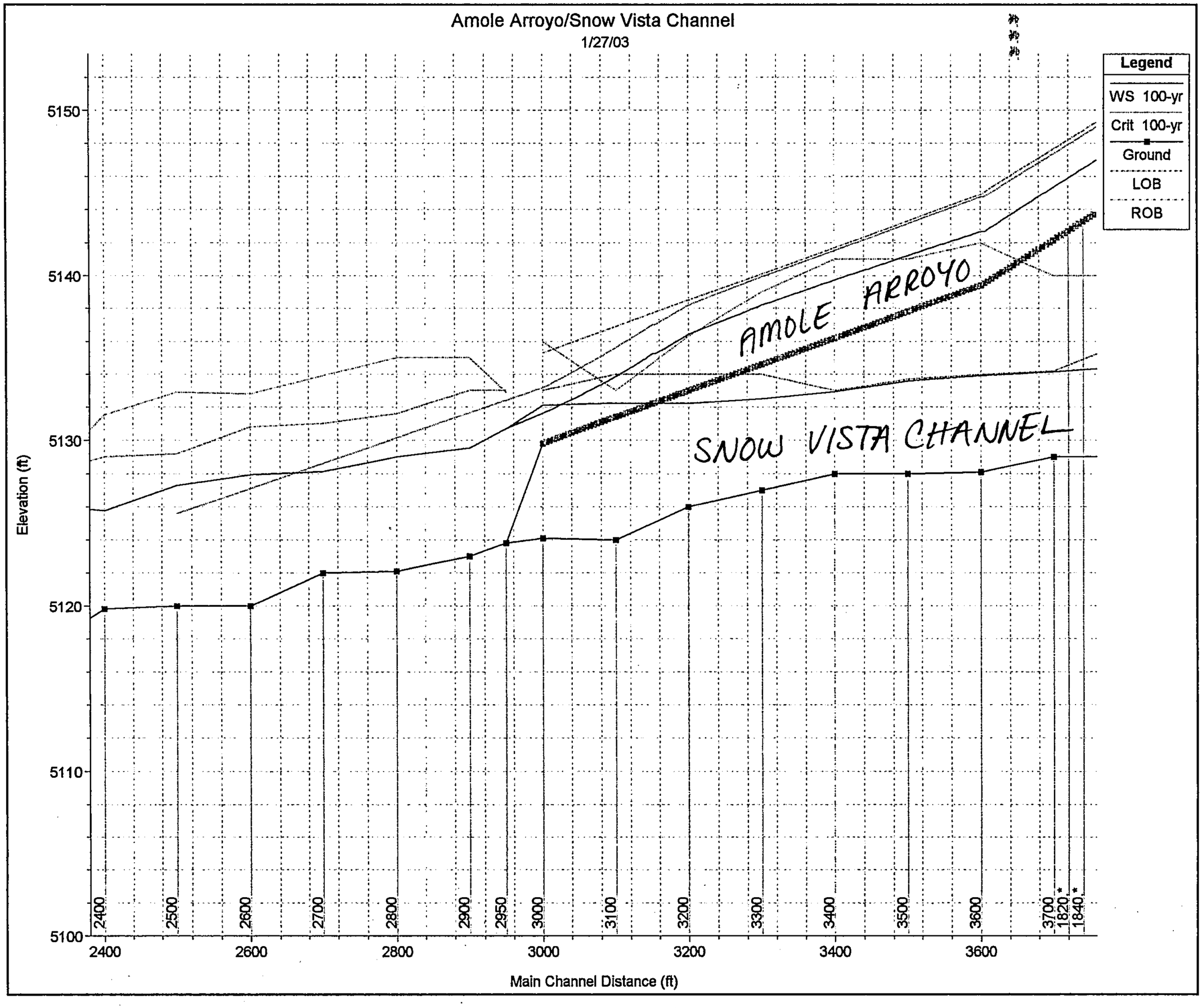
Appendix C



AMOLE ARROYO



AMOLE ARROYO - Drop Structures
West of Delgado Dr.


Amole Arroyo/Snow Vista Channel
1/27/03
Legend
WS 100-yr
Crit 100-yr
Ground
LOB
ROB
AMOLE ARROYO
SNOW VISTA CHANNEL
Elevation (ft)
5150
5140
5130
5120
5110
5100
2400
2500
2600
2700
2800
2900
2950
3000
3100
3200
3300
3400
3500
3600
3700
1820 *
1840 *
Main Channel Distance (ft)

HEC-RAS Plan: 1/27/03 River: Amole Arroyo Reach: Rancho Gr-lined Profile: 100-yr

Reach	River Sta	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
		(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Rancho Gr-lined	5903	784.00	5257.06	5259.00	5259.25	5260.32	0.022432	9.22	85.01	47.75	1.22
Rancho Gr-lined	5900	784.00	5256.99	5258.90	5259.18	5260.26	0.018563	9.38	83.56	47.63	1.25
Rancho Gr-lined	5869	784.00	5249.24	5254.35	5251.48	5254.51	0.000234	3.25	241.36	55.50	0.27
Rancho Gr-lined	5856	784.00	5249.24	5254.34		5254.51	0.000239	3.27	239.48	55.38	0.28
Rancho Gr-lined	5850	784.00	5250.78	5254.11		5254.50	0.002777	5.05	155.20	53.31	0.52
Rancho Gr-lined	5800	784.00	5250.73	5253.79		5254.27	0.003690	5.55	141.28	52.25	0.59
Rancho Gr-lined	5700	784.00	5250.63	5252.82	5252.82	5253.83	0.003918	8.07	97.17	48.76	1.01
Rancho Gr-lined	5669	784.00	5242.88	5248.09	5245.14	5248.25	0.000222	3.19	245.56	55.74	0.27
Rancho Gr-lined	5656	784.00	5242.88	5248.09		5248.25	0.000222	3.20	245.34	55.72	0.27
Rancho Gr-lined	5650	784.00	5244.41	5247.88		5248.24	0.002398	4.81	162.95	53.88	0.49
Rancho Gr-lined	5550	784.00	5244.31	5247.30		5247.81	0.004001	5.70	137.57	51.97	0.62
Rancho Gr-lined	5500	784.00	5244.26	5246.45	5246.45	5247.46	0.011620	8.07	97.17	48.76	1.01
Rancho Gr-lined	5469	784.00	5236.51	5241.38	5238.77	5241.56	0.000281	3.46	226.57	54.60	0.30
Rancho Gr-lined	5456	784.00	5236.51	5241.37		5241.56	0.000282	3.46	226.35	54.59	0.30
Rancho Gr-lined	5450	784.00	5238.04	5241.02		5241.55	0.004240	5.86	133.76	50.47	0.63
Rancho Gr-lined	5405	784.00	5236.69	5241.08		5241.37	0.001453	4.35	180.16	44.66	0.38
Rancho Gr-lined	5400	784.00	5236.54	5241.07		5241.35	0.000458	4.29	182.65	42.47	0.36
Rancho Gr-lined	5373	784.00	5235.73	5240.88		5241.31	0.000663	5.25	149.28	29.18	0.41
Rancho Gr-lined	5359	784.00	5235.31	5240.68		5241.27	0.000772	6.15	127.47	23.79	0.47
Rancho Gr-lined	5358	784.00	5235.28	5240.68		5241.26	0.000761	6.12	128.23	23.83	0.46
Rancho Gr-lined	5330	784.00	5234.44	5240.49	5238.15	5241.19	0.000596	6.71	116.90	19.37	0.48
Rancho Gr-lined	5322	Culvert									
Rancho Gr-lined	5252	907.00	5232.93	5235.64	5236.63	5239.08	0.008197	14.90	52.63	19.90	0.48
Rancho Gr-lined	5200	907.00	5231.91	5235.14	5236.57	5239.67	0.015192	17.07	53.12	22.91	1.98
Rancho Gr-lined	5100	907.00	5229.96	5233.07	5234.62	5238.10	0.017565	17.99	50.41	22.43	2.12
Rancho Gr-lined	5000	907.00	5228.01	5231.07	5232.67	5236.32	0.018675	18.40	49.31	22.24	2.18
Rancho Gr-lined	4900	907.00	5226.06	5229.09	5230.72	5234.47	0.019281	18.61	48.74	22.13	2.21
Rancho Gr-lined	4800	907.00	5224.11	5227.13	5228.77	5232.57	0.019580	18.71	48.47	22.09	2.23
Rancho Gr-lined	4700	907.00	5221.06	5223.89	5225.72	5230.38	0.025039	20.44	44.37	21.33	2.50
Rancho Gr-lined	4600	907.00	5218.01	5220.76	5222.67	5227.79	0.028006	21.28	42.63	21.00	2.63
Rancho Gr-lined	4500	907.00	5214.96	5217.67	5219.62	5224.98	0.029561	21.69	41.81	20.84	2.70
Rancho Gr-lined	4400	907.00	5211.92	5214.61	5216.58	5222.07	0.030400	21.91	41.39	20.76	2.74
Rancho Gr-lined	4300	907.00	5208.87	5211.55	5213.53	5219.08	0.030840	22.03	41.18	20.72	2.75
Rancho Gr-lined	4200	907.00	5205.82	5208.50	5210.48	5216.07	0.031074	22.09	41.07	20.70	2.76
Rancho Gr-lined	4100	907.00	5202.77	5205.44	5207.43	5213.04	0.031203	22.12	41.01	20.69	2.77
Rancho Gr-lined	4000	907.00	5199.72	5202.39	5204.38	5209.99	0.031182	22.11	41.02	20.69	2.77
Rancho Gr-lined	3900	907.00	5196.67	5199.34	5201.33	5206.94	0.031225	22.12	41.00	20.69	2.77
Rancho Gr-lined	3800	907.00	5194.89	5197.73	5199.55	5204.16	0.024698	20.34	44.59	21.37	2.48
Rancho Gr-lined	3700	907.00	5193.12	5196.07	5197.78	5201.88	0.021489	19.35	46.88	21.79	2.32
Rancho Gr-lined	3600	907.00	5191.35	5194.36	5196.01	5199.86	0.019910	18.82	48.18	22.03	2.24
Rancho Gr-lined	3500	907.00	5189.57	5192.61	5194.23	5197.97	0.019186	18.57	48.83	22.15	2.20
Rancho Gr-lined	3400	907.00	5187.80	5190.86	5192.46	5196.12	0.018733	18.42	49.25	22.23	2.18
Rancho Gr-lined	3350	907.00	5186.91	5189.98	5191.57	5195.20	0.018517	18.34	49.46	22.26	2.17
Rancho Gr-lined	3300	907.00	5185.13	5188.02	5189.79	5194.19	0.023345	19.93	45.50	21.54	2.42

AMOLE ARR640

HEC-RAS Plan: 1/27/03 River: Amole Arroyo Reach: Rancho Gr-lined Profile: 100-yr (Continued)

Reach	River Sta	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
		(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Rancho Gr-lined	3200	907.00	5181.58	5184.29	5186.24	5191.59	0.029481	21.67	41.85	20.85	2.70
Rancho Gr-lined	3100	907.00	5178.03	5180.67	5182.69	5188.53	0.032753	22.51	40.30	20.55	2.83
Rancho Gr-lined	3000	907.00	5174.74	5177.37	5179.40	5185.31	0.033213	22.62	40.10	20.51	2.85
Rancho Gr-lined	2900	907.00	5170.92	5173.49	5175.58	5181.90	0.035943	23.27	38.99	20.29	2.96
Rancho Gr-lined	2800	907.00	5167.37	5169.94	5172.03	5178.39	0.036252	23.34	38.87	20.27	2.97
Rancho Gr-lined	2700	1124.00	5162.06	5164.95	5167.26	5174.41	0.035783	24.69	45.53	21.55	2.99
Rancho Gr-lined	2600	1124.00	5158.51	5161.39	5163.72	5170.90	0.036014	24.74	45.43	21.53	3.00
Rancho Gr-lined	2550	1124.00	5157.61	5160.59	5162.82	5169.24	0.031563	23.60	47.64	21.93	2.82
Rancho Gr-lined	2500	1124.00	5156.71	5158.93	5160.99	5167.60	0.037322	23.63	47.57	24.29	2.98
Rancho Gr-lined	2460	1124.00	5155.99	5158.45	5160.59	5166.55	0.016128	22.85	49.20	20.01	2.57
Rancho Gr-lined	2419	1124.00	5155.27	5157.72	5159.87	5165.91	0.016407	22.97	48.93	20.01	2.59
Rancho Gr-lined	2400	1124.00	5154.90	5157.27	5159.39	5165.46	0.031310	22.97	48.93	21.04	2.66
Rancho Gr-lined	2300	1124.00	5153.10	5156.39	5158.31	5162.98	0.021654	20.60	54.57	23.16	2.36
Rancho Gr-lined	2200	1124.00	5151.30	5154.65	5156.51	5160.91	0.020146	20.07	56.02	23.41	2.29
Rancho Gr-lined	2100	1124.00	5149.49	5152.89	5154.70	5158.92	0.019155	19.70	57.05	23.59	2.23
Rancho Gr-lined	2000	1124.00	5147.69	5151.12	5152.90	5156.99	0.018456	19.44	57.82	23.72	2.19
Rancho Gr-lined	1900	1124.00	5144.93	5148.19	5150.14	5154.97	0.022558	20.90	53.77	23.03	2.41
Rancho Gr-lined	1800	1124.00	5142.16	5145.33	5147.37	5152.66	0.025124	21.73	51.72	22.67	2.54
Rancho Gr-lined	1700	1185.00	5139.40	5142.67	5144.73	5150.15	0.024828	21.96	53.96	23.06	2.53
Rancho Gr-lined	1600	1185.00	5137.80	5141.22	5143.13	5147.81	0.020811	20.60	57.52	23.67	2.33
Rancho Gr-lined	1500	1185.00	5136.20	5139.73	5141.53	5145.75	0.018391	19.70	60.16	24.11	2.20
Rancho Gr-lined	1400	1185.00	5134.60	5138.19	5139.93	5143.91	0.017092	19.18	61.78	24.38	2.12
Rancho Gr-lined	1300	1185.00	5133.00	5136.43	5138.19	5142.17	0.017547	19.22	61.64	24.83	2.15
Rancho Gr-lined	1250	1223.00	5132.20	5135.24	5137.01	5141.23	0.019482	19.64	62.29	26.56	2.26
Rancho Gr-lined	1200	1223.00	5131.40	5133.86	5135.62	5140.17	0.024133	20.16	60.67	29.62	2.48
Rancho Gr-lined	1100	1223.00	5129.80	5131.61	5133.16	5137.46	0.029368	19.41	63.01	38.36	2.67

AMOLE ARROYO

HEC-RAS Plan: 1/27/03 Profile: 100-yr

Reach	River Sta	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
		(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Units 6&7-unline	4300	1692.00	5133.00	5137.33	5136.50	5138.08	0.007720	6.95	243.47	77.49	0.69
Units 6&7-unline	4200	1692.00	5133.00	5136.04		5137.04	0.013810	8.04	210.50	83.57	0.89
Units 6&7-unline	4100	1692.00	5131.00	5135.62		5136.16	0.004599	5.88	287.78	79.48	0.54
Units 6&7-unline	4000	1692.00	5131.00	5135.10		5135.67	0.005476	6.01	281.68	86.25	0.59
Units 6&7-unline	3900	1692.00	5129.00	5134.81		5135.23	0.002979	5.18	326.44	78.38	0.45
Units 6&7-unline	3800	1692.00	5129.00	5134.48		5134.91	0.003294	5.27	320.87	81.17	0.47
Units 6&7-unline	3700	1692.00	5129.00	5134.15		5134.58	0.003223	5.32	317.85	77.57	0.46
Units 6&7-unline	3600	1692.00	5128.10	5133.91		5134.27	0.002598	4.81	351.59	85.42	0.42
Units 6&7-unline	3500	1692.00	5128.00	5133.58		5133.99	0.002987	5.13	329.97	80.81	0.45
Units 6&7-unline	3400	1692.00	5128.00	5132.92		5133.56	0.005748	6.44	262.90	74.96	0.61
Units 6&7-unline	3300	1692.00	5127.00	5132.49		5133.02	0.004461	5.87	288.46	78.14	0.54
Units 6&7-unline	3200	1692.00	5126.00	5132.21		5132.62	0.002973	5.18	326.95	78.64	0.45
Units 6&7-unline	3100	1692.00	5124.00	5132.23		5132.41	0.000840	3.40	497.64	86.27	0.25
Units 6&7-unline	3000	1692.00	5124.10	5132.10		5132.31	0.001143	3.68	459.65	89.68	0.29
Unit 8-unlined	2950	2879.00	5123.80	5130.68		5131.34	0.003620	6.52	441.48	86.59	0.51
Unit 8-unlined	2900	2879.00	5123.00	5129.55		5130.97	0.010676	9.58	300.51	74.74	0.84
Unit 8-unlined	2800	2879.00	5122.10	5128.99		5130.02	0.006659	8.12	354.41	79.23	0.68
Unit 8-unlined	2700	2879.00	5122.00	5128.13		5129.28	0.007942	8.61	334.23	78.14	0.73
Unit 8-unlined	2600	2879.00	5120.00	5127.94		5128.62	0.003538	6.63	434.09	81.19	0.51
Unit 8-unlined	2500	2879.00	5120.00	5127.29	5125.59	5128.18	0.005189	7.56	380.59	78.19	0.60
Unit 8-unlined	2400	2879.00	5119.80	5125.76		5127.36	0.011776	10.16	283.46	69.36	0.89
Unit 8-unlined	2300	2879.00	5117.00	5126.12		5126.59	0.002224	5.48	525.56	92.75	0.41
Unit 8-unlined	2200	2879.00	5116.90	5125.71		5126.31	0.003089	6.23	462.14	85.89	0.47
Unit 8-unlined	2100	2879.00	5116.60	5125.26		5125.96	0.003831	6.69	430.19	84.58	0.52
Unit 8-unlined	2000	2879.00	5116.30	5124.99	5122.25	5125.59	0.003004	6.21	463.44	84.42	0.47

SNOW VISTA CHANNEL

Appendix D

Amole Arroyo--Depth of Channel Including Superelevation
Portion of Basin 60104 Included

Superelevation: $S = 1.3V^2(b+2zD)/2gr$ (*COA DPM*) Supercritical Flow

$S = 1.15V^2(b+2zD)/2gr$ (*COA DPM*) Subcritical Flow

S = superelevation
V = velocity
b = channel bottom width
D = depth of flow for equiv. straight reach
R = channel radius
z = cotangent of channel side slope = 2
g = gravity = 32.2 ft/s^2

Station	R (ft)	V (ft/s)	b (ft)	D (ft)	S (ft)	Total Depth (ft)
11+00	400	19.4	31.1	1.8	0.7	2.5
12+00	400	20.2	20.1	2.5	0.6	3.1
12+50	700	19.6	14.6	3.0	0.3	3.3
13+00	700	19.2	11.1	3.4	0.3	3.7
14+00	700	19.2	10.0	3.6	0.3	3.9
15+00	1400	19.7	10.0	3.5	0.1	3.6
16+00				3.4		3.4
17+00	700	21.7	10.0	3.3	0.3	3.6
18+00	700	21.6	10.0	3.2	0.3	3.5
19+00	1400	20.8	10.0	3.3	0.1	3.4
20+00				3.4		3.4
21+00				3.4		3.4
22+00				3.4		3.4
23+00	500	20.6	10.0	3.3	0.4	3.7
23+30	500	20.6	10.0	3.4	0.4	3.8
24+00	265	23.0	10.0	2.4	0.8	3.2
24+19	265	23.0	10.0	2.5	0.8	3.3
24+60	265	22.9	10.0	2.5	0.8	3.3
25+00	500	23.6	10.0	2.2	0.4	2.6
26+00				2.9		2.9
27+00				2.9		2.9
28+00				2.6		2.6
29+00				2.6		2.6
30+00				2.6		2.6
31+00				2.6		2.6
32+00				2.7		2.7
33+00				2.9		2.9
34+00				3.1		3.1
35+00				3.0		3.0
36+00	500	18.8	10.0	3.0	0.3	3.3
37+00	500	19.4	10.0	3.0	0.3	3.3
38+00	1000	20.3	10.0	2.8	0.2	3.0
39+00	1000	22.1	10.0	2.7	0.2	2.9
40+00	500	22.1	10.0	2.7	0.4	3.1
41+00	500	22.1	10.0	2.7	0.4	3.1
42+00	1000	22.1	10.0	2.7	0.2	2.9

DEL REY CROSSING
6' channel depth

5.5' channel depth

	Station	R (ft)	V (ft/s)	b (ft)	D (ft)	S (ft)	Total Depth (ft)	
	43+00				2.7		2.7	
	44+00				2.7		2.7	
	45+00				2.7		2.7	
	46+00	3000	21.2	10.0	2.8	0.1	2.9	
	47+00				2.8		2.8	
	48+00				3.0		3.0	
	49+00				3.0		3.0	
	50+00				3.1		3.1	
	51+00				3.1		3.1	
	51+20				3.1		3.1	
	52+00				3.2		3.2	
	52+52				2.7		2.7	DELGADO CROSSING
	53+30				6.1		6.1	
	53+73				5.1		5.1	
	54+00	1000	4.3	40.0	4.5	0.0	4.5	
	54+20	1000	4.7	40.0	3.9	0.0	3.9	
	54+50	1000	5.9	40.0	3.0	0.0	3.0	5.5' channel depth
SP	54+56	1000	3.5	40.0	4.9	0.0	4.9	
	55+00	1000	8.1	40.0	2.20	0.06	2.3	
	55+50	500	5.7	40.0	3.0	0.1	3.0	
	56+00	500	5.2	40.0	3.3	0.1	3.4	
SP	56+56	500	3.2	40.0	5.2	0.0	5.2	
	57+00	1000	8.1	40.0	2.2	0.06	2.3	
	58+00				3.1		3.1	
	58+50				3.3		3.3	
SP	58+56				5.1		5.1	
	59+00				1.9		1.9	

SP=Stilling Pool

Appendix E

Amole Arroyo--Easement Curve Length & Min. Centerline Radius

V =	velocity	24 fps
b =	bottom width	10 ft
z =	cotangent of channel side slope	2
D =	depth of flow for equiv. straight reach	4 ft

L_E = length of easement curve = $0.32*(b+2*z*D)*(V/D^{0.5})$

L_E = 100 ft

$R_{min.}$ = minimum centerline radius = Q*V/100

Station	Q (cfs)	V (fps)	$R_{min.}$ (ft)
10+68-17+00	1223	21.7	265
17+00-25+00	1124	23.6	265
25+00-53+23	907	22.1	200
53+23-62+00	784	22.3	175

→ Use 265 ft

Appendix F

Amole Arroyo--Slug Flow Analysis

Reference: *Design of Small Canal Structures*, U.S. Department of the Interior

Slug flow may occur at 4:1 slope at drop structure where flows transition from supercritical to subcritical.

Check at drop structure Sta 58+73 - 59+00

Q =	flow	784 cfs			
d =	avg. water depth =		Area of water prism	60.3	1.34 ft
			Top width of water prism	44.9	
V =	velocity	15 fps			
b =	bottom width	40 ft			
L =	length of section	27 ft			
s =	avg. slope of energy gradient	0.059 ft/ft			
ϕ =	angle of inclination of the energy gradient	3.38 °			
wp =	wetted perimeter	45.6 ft			
g =	acceleration of gravity	32.2 ft/s^2			
d/wp =		0.03			

V = Vedernikov number $= 2/3(b/wp)(v/(g*d*\cos\phi)^{1/2}) =$ = 1.34

M^2 = Montuori number $= V^2/(g*s*L*\cos\phi)$ = 4.39

From Figure 2-45 ⟶ Zone of no slug flow
From Figure 2-46 ⟶ Zone of slug flow

"Waves are not likely to be generated in the structure, unless the plotted data falls within the slugging zone on both figures." (page 112) ⟶ No Slug Flows

Check at drop structure Sta 58+56-58+73

Q =	flow	784 cfs
d =	avg. water depth =	5.00 ft
V =	velocity	3.3 fps
b =	bottom width	40 ft
L =	length of section	17 ft
s =	avg. slope of energy gradient	0.00024 ft/ft
ϕ =	angle of inclination of the energy gradient	0.014 °
wp =	wetted perimeter	50.4 ft
g =	acceleration of gravity	32.2 ft/s^2
d/wp =		0.10

V = Vedernikov number $= 2/3(b/wp)(v/(g*d*\cos\phi)^{1/2}) =$ = 0.14

M^2 = Montuori number $= V^2/(g*s*L*\cos\phi)$ = 82.89

From Figure 2-45 → Zone of no slug flow
From Figure 2-46 → Zone of no slug flow

"Waves are not likely to be generated in the structure, unless the plotted data falls within the slugging zone on both figures." (page 112) → No Slug Flows

Check at drop structure Sta 58+50-58+56

Q =	flow	784 cfs
d =	avg. water depth =	4.20 ft
V =	velocity	5.5 fps
b =	bottom width	40 ft
L =	length of section	6 ft
s =	avg. slope of energy gradient	0.00151 ft/ft
ϕ =	angle of inclination of the energy gradient	0.087 °
wp =	wetted perimeter	56.6 ft
g =	acceleration of gravity	32.2 ft/s^2
d/wp =		0.07

V = Vedernikov number $= 2/3(b/wp)(v/(g*d*\cos\phi)^{1/2}) =$ = 0.22

M^2 = Montuori number $= V^2/(g*s*L*\cos\phi)$ = 103.69

From Figure 2-45 → Zone of no slug flow
From Figure 2-46 → Zone of no slug flow

"Waves are not likely to be generated in the structure, unless the plotted data falls within the slugging zone on both figures." (page 112)

→ No Slug Flows

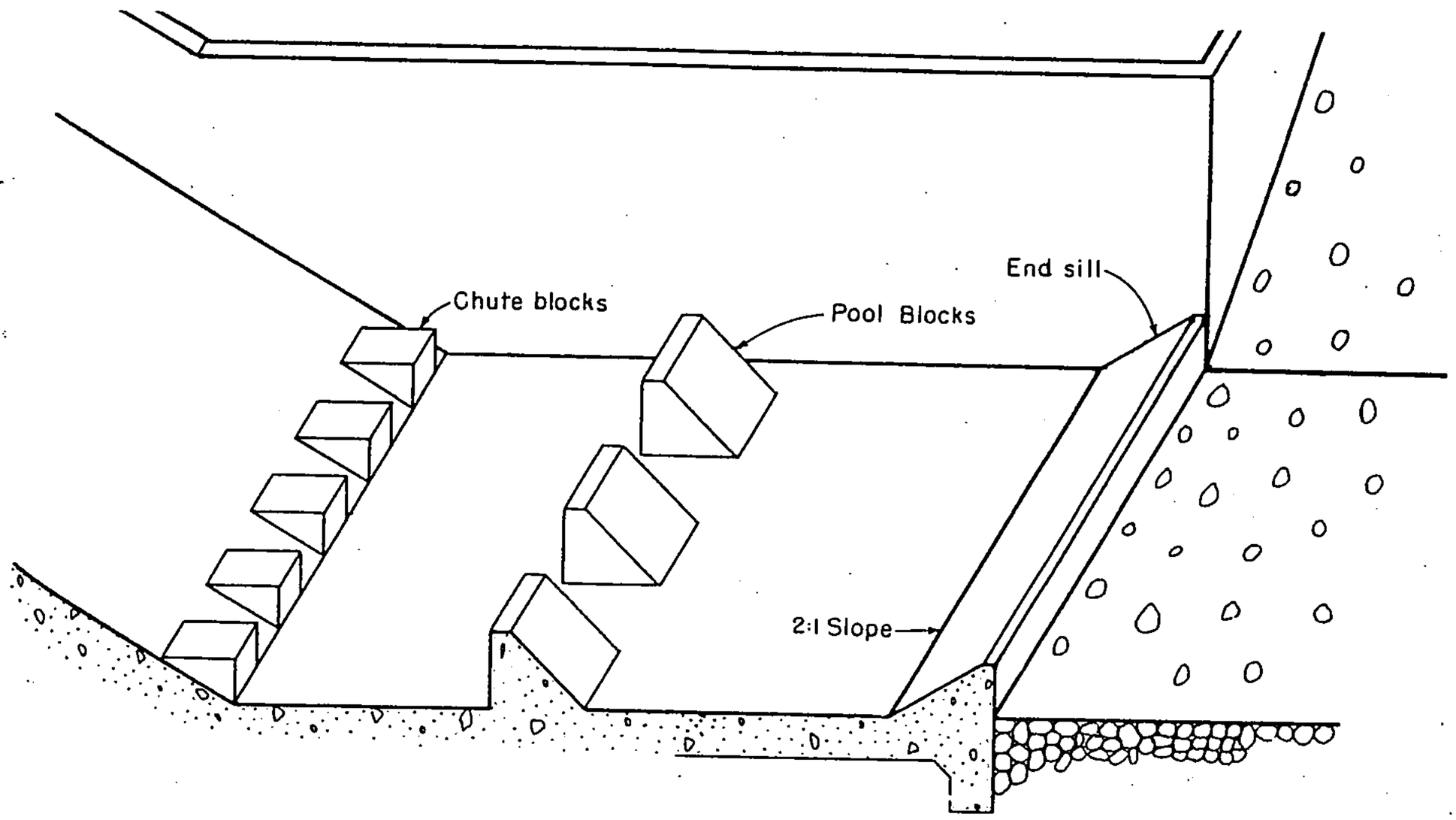


Figure 2-40. **Stilling pool with end sill. 103-D-1277**

Figures 2-45 and 2-46 have been developed to predict the possibility of slug flow occurring in a chute. The use of the figures requires the following operations:

(1) Divide the chute into a number of reaches as shown on figure 2-47. Point 1 should be at the beginning of the chute section.

(2) Using equation (6) or (7), with Q equal to 0.2, 0.5, and 1.0 times design Q, compute the water depth and energy levels at the points along the chute section that are to be checked for slugging. Use Manning's n = 0.010.

(3) Determine sL for the point to be checked (fig. 2-47).

(4) At the points to be considered:

a. Compute the Vedernikov number ($\underline{V}$) [10].

$$\underline{V} = \frac{2}{3} \times \frac{b}{wp} \times \frac{V}{\sqrt{gd \cos\theta}} \qquad (10)$$

b. Compute the square of the Montuori number ($\underline{M}$) [11].

$$\underline{M}^2 = \frac{V^2}{g\, sL \cos\theta} \qquad (11)$$

In equations (10) and (11)

b = bottom width of the chute section

d = average water depth in the chute section:

$$d = \frac{\text{Area of the water prism}}{\text{Top width of the water prism,}}$$

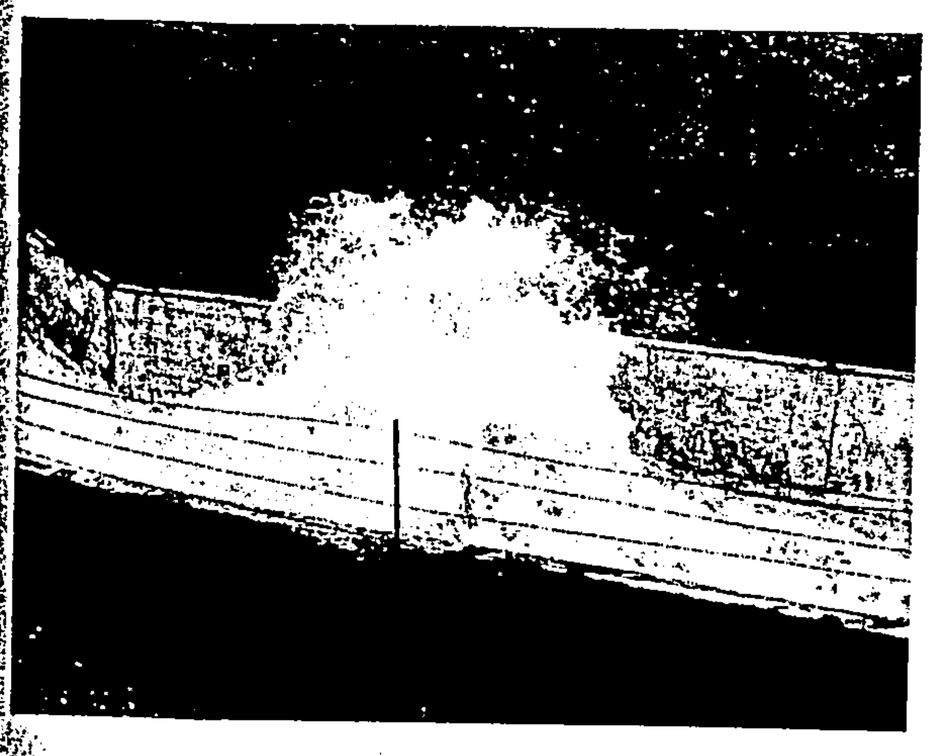


Figure 2-41. **Surging in a stilling pool caused by unstable flow in a chute structure. P222-117-36223**

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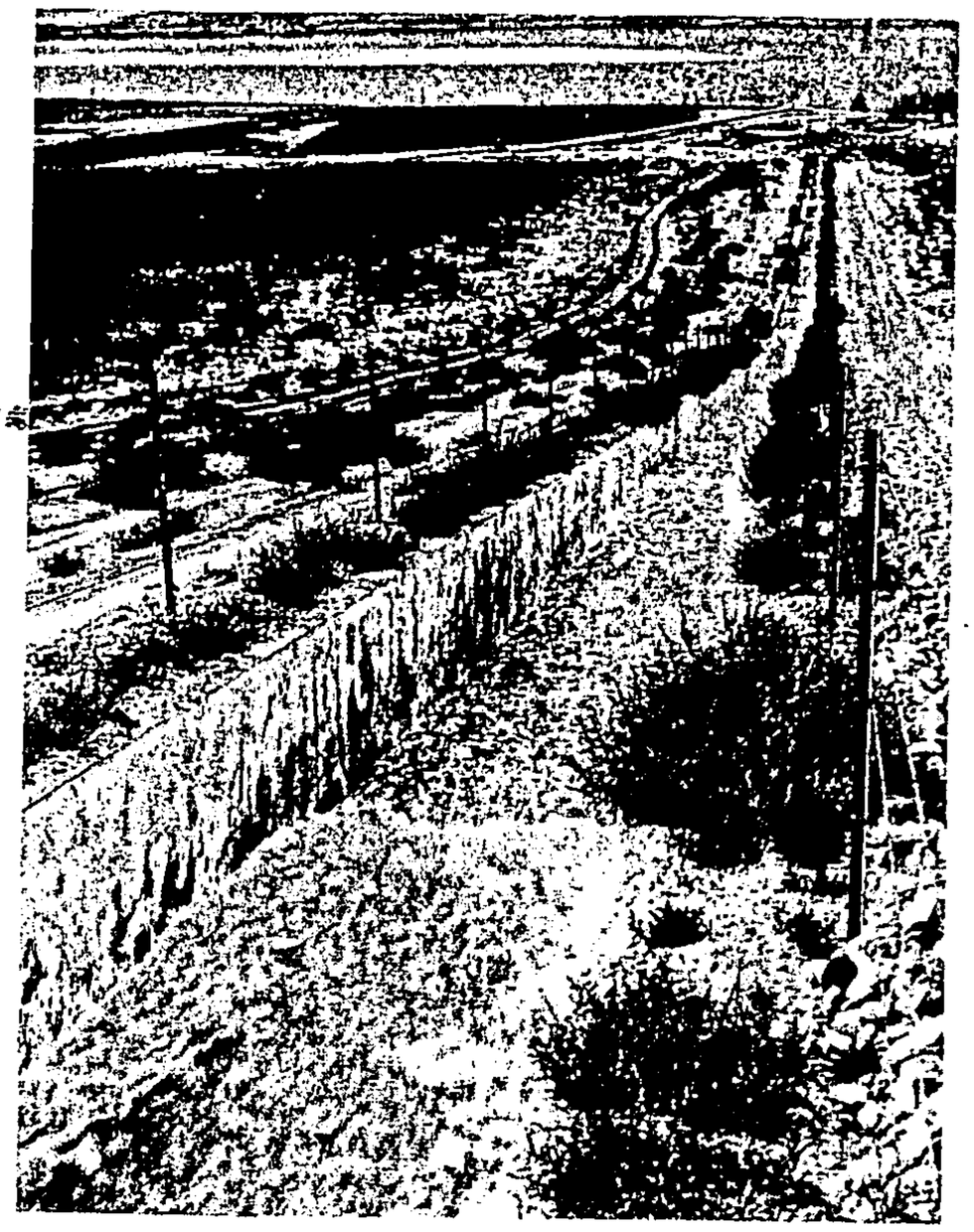

Figure 2-42. **Pulsating flow in steep chute. Flow is 57 cfs. P222-117-36208D**

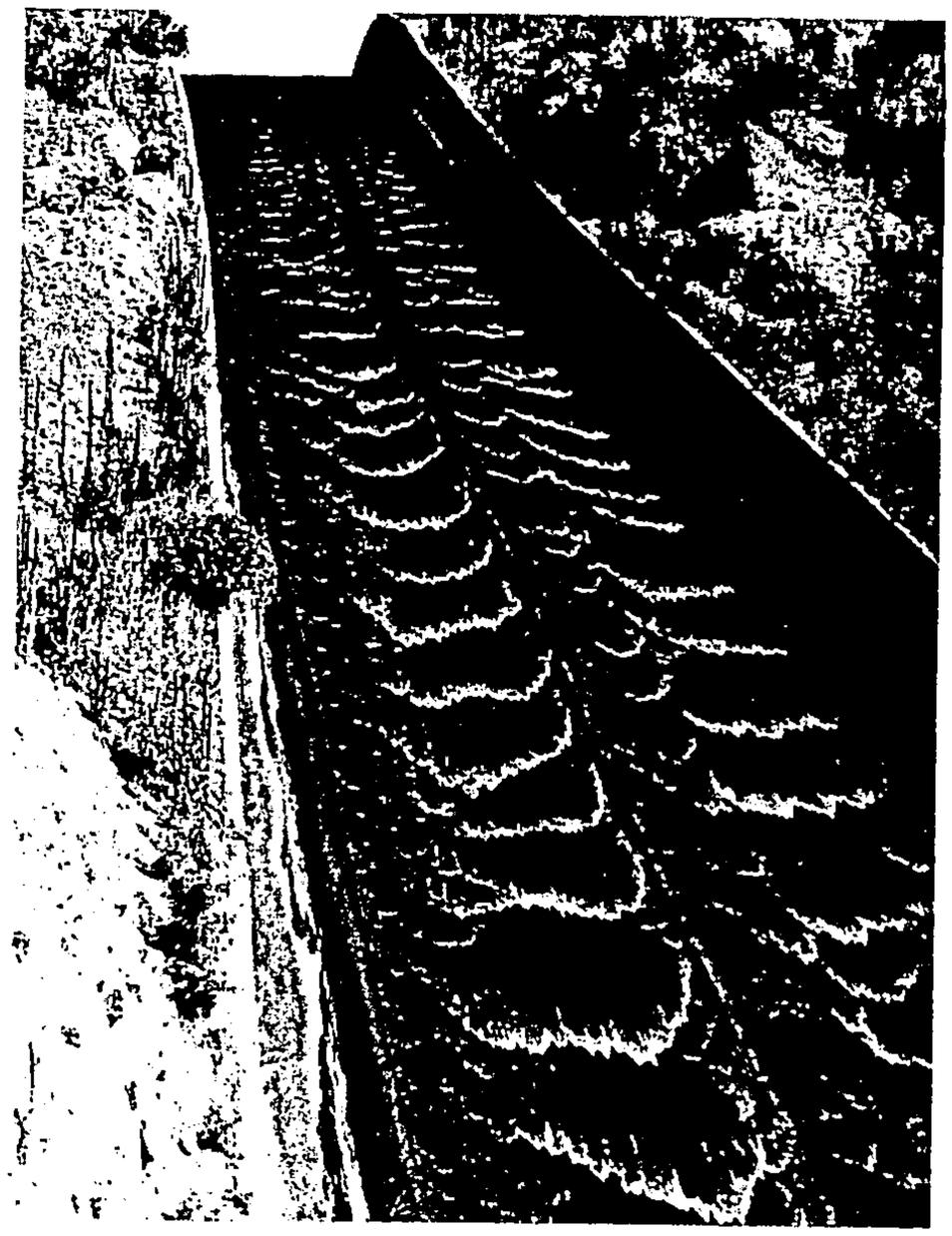

Figure 2-43. **Unstable flow at shallow depth. H-686-55D**

g = acceleration of gravity,
L = length of reach under consideration,
s = average slope of the energy gradient.

$$s = \tan \theta,$$

V = velocity,
wp = wetted perimeter of the section, and
θ = angle of inclination of the energy gradient.

(5) Plot the computed values on figure 2-45. If the plotted points fall within the slug flow zone, intermediate points may be checked to determine the point at which the waves begin to form.

(6) Compute the shape factor for the chute section.

$$\frac{d}{wp}$$

(7) Plot the computed value of $\frac{d}{wp}$ against the slope of the energy gradient, s, on figure 2-46.

Waves are not likely to be generated in the structure, unless the plotted data falls within the slugging zone on both figures 2-45 and 2-46.

If the charts indicate that slug flow will occur, the design may be modified to reduce the probability of waves being generated or the structure may be adapted to accommodate the

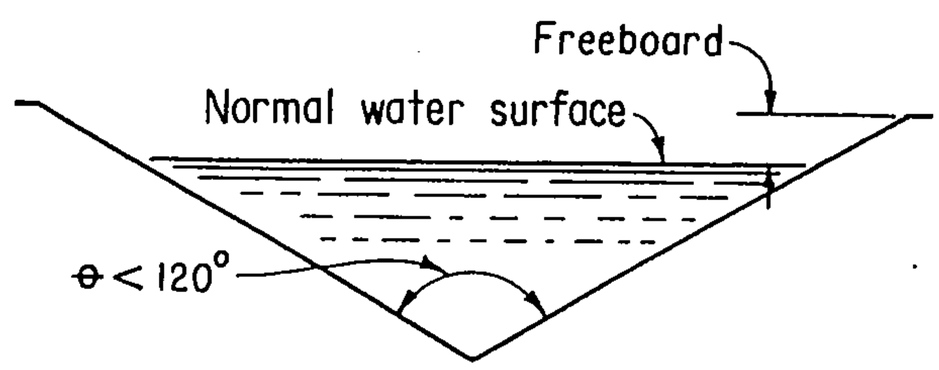

Figure 2-44. **Theoretical waveless chute section. Triangular shape prevents both cross waves and slug flow. 103-D-1278**

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surging flow that does occur. Possible design changes include:

(1) Divide the flow in the chute section with a wall down the center of the chute.

(2) Change the shape of the section. The theoretical waveless shapes could be considered.

(3) Reduce the length of the chute. A series of shorter chutes or drops could be considered.

(4) Steepen the chute.

(5) Replace the open channel chute section with pipe.

If these design changes are impractical, the chute section might be adapted to accommodate surging flow by:

(1) Increasing the freeboard of the chute walls.

(2) Providing a cover for the chute section to contain the waves, or

(3) Protecting the backfill around the chute section with riprap or paving.

Adaptations to the stilling pool could include:

(1) Designing the pool to provide for the momentary surge discharge. This would

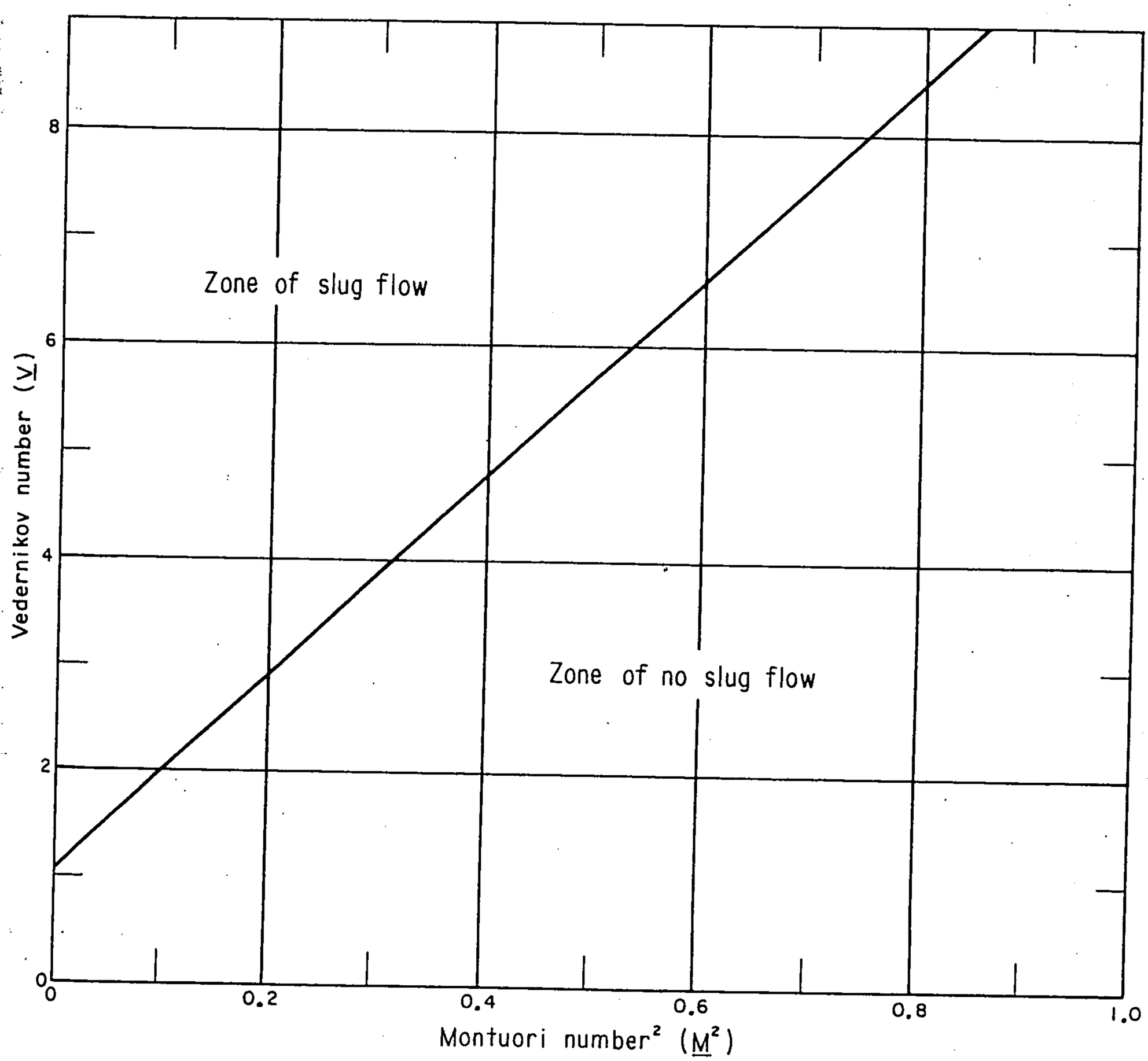

Figure 2-45. Criteria for slug flow. 103-D-1279

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provide a longer pool and higher pool walls to contain the surge.

(2) Provide additional riprap to protect the channel downstream and the backfill around the pool.

(3) Provide a surge suppressing device in the stilling pool. A baffle or weir wall in the pool could prevent flow from sweeping through the pool and outlet transition (fig. 2-48). Weir walls could also provide tailwater to submerge the surges. Rafts or other floating wave dampeners could be used.

(4) An energy dissipator less sensitive to surging could be used.

The study of wave action in chute structures is based largely on empirical data. If a serious wave problem in a structure is indicated, further studies should be undertaken to verify the extent of the problem and the effectiveness of the proposed solutions.

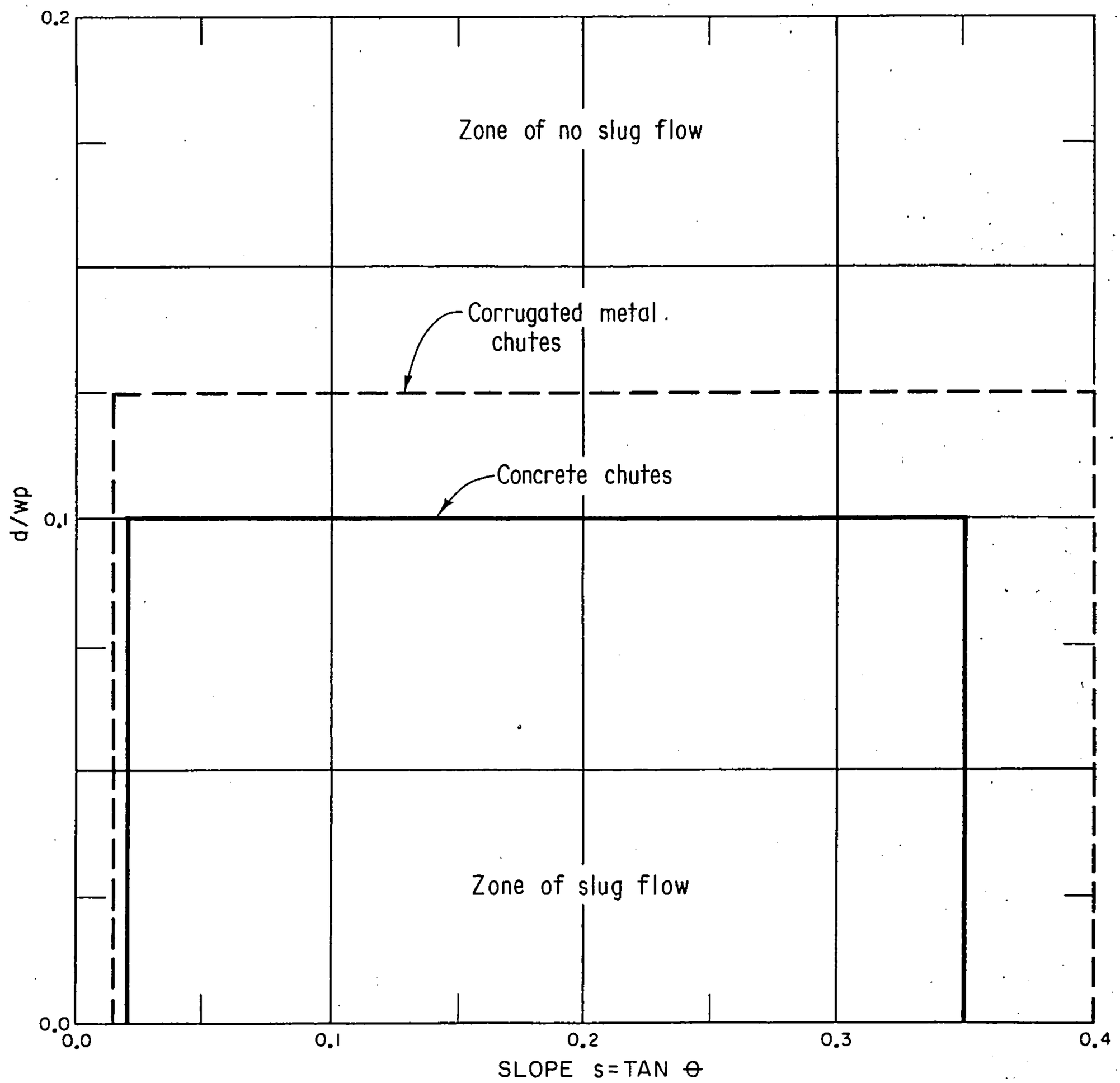

Figure 2-46. **Shape and slope criteria for slug flow. 103-D-1280**

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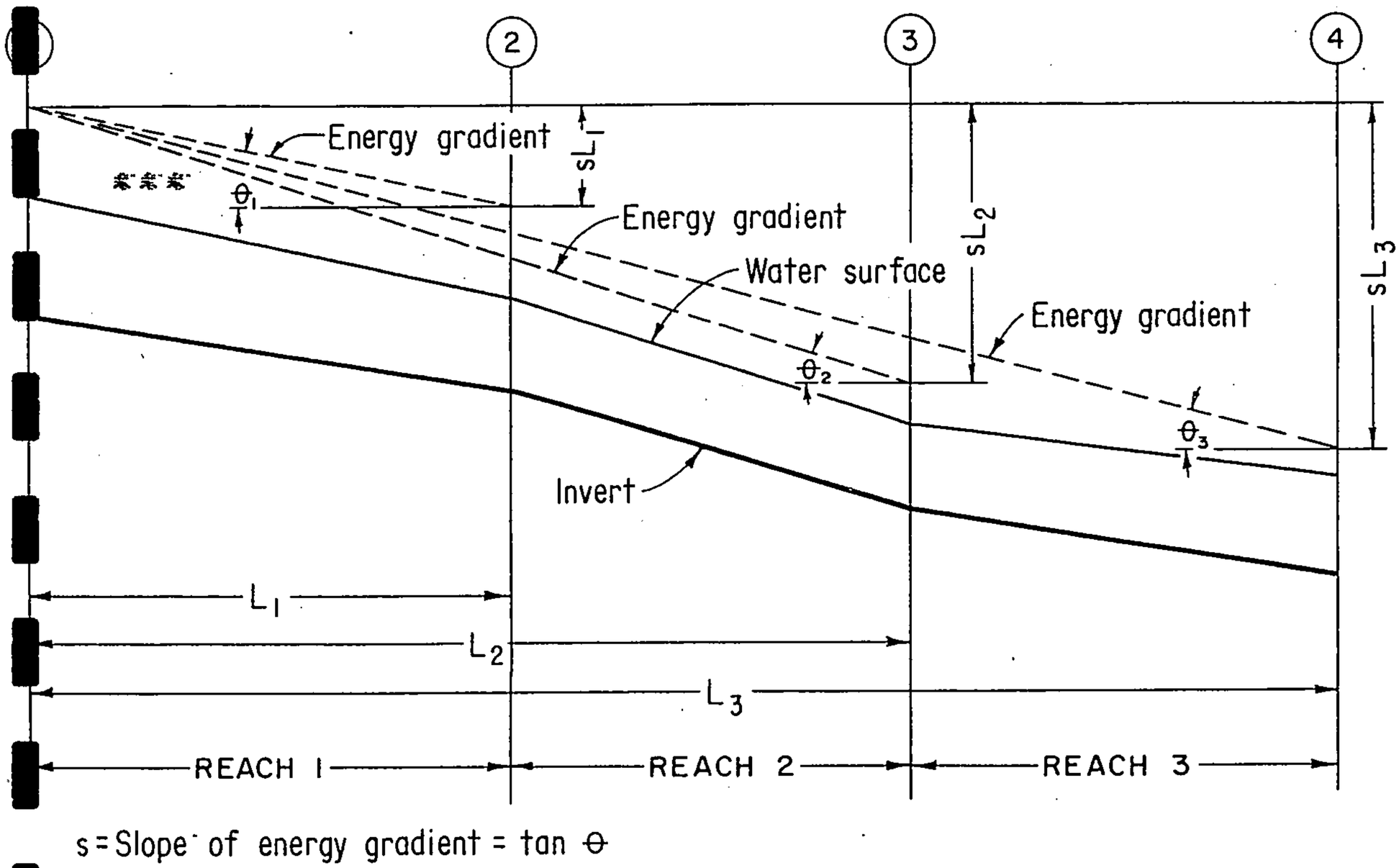

Figure 2-47. **Invert, water surface, and energy profiles of a chute structure. 103-D-1281**

35. *Design Procedure.*—

(1) Select and design the type of inlet to be used.

(2) Determine the energy gradient at the beginning of the chute section.

Figure 2-48. **Wave sweeping through the outlet transition of a stilling pool. Flow is 140 cfs. P222-117-36227**

(3) Compute the variables of flow down the chute section.

(4) Design the trajectory and the steep portion of the chute section.

(5) Assume an elevation for the floor of the stilling pool and compute the characteristics of flow upstream of the hydraulic jump.

Determine d_2 and the energy gradient after the hydraulic jump.

(6) Determine the energy gradient in the channel downstream and compare to the energy gradient after the jump.

(7) It may be necessary to assume a new pool invert elevation and to recompute the above values several times before a check in energy gradients is obtained.

(8) Review for proper operation at partial capacity.

(9) Determine the length of the pool and the height of the pool walls.

(10) Design the chute and floor blocks and the end sill or outlet transition as required.

(11) Check the possibility of waves developing on the structure.

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If an incoming surge of height h_2 approaches the junction from channel II, then it can be shown that

$$h = \frac{2h_2A_2}{Ic_2} \tag{19-84}$$

Similarly, if an incoming surge of height h_3 approaches the junction from channel III, then

$$h = \frac{2h_3A_3}{Ic_3} \tag{19-85}$$

By the above principle, it is possible to analyze surges in a complicated channel network. Such a method has been developed by Swain [32,33] for an approximate determination of surge flows in an interconnected system of estuarine channels in response to tidal variations. In this method, the friction barrier is assumed to be located at the middle of a channel reach. The surges are assumed to have small heights compared with the depth of flow, so that simplified equations can be applied. To further expedite the computation, it is desirable to have coincidental arrival of surges at a barrier or junction at some given instant. This is made possible by the use of a procedure that involves a modification of the true length of the channel reaches. The analytic method developed by Swain was actually applied to a problem for the determination of flows in interconnected estuarine channels in the Delta area of California east of Suisun Bay. The same problem was studied by the U.S. Bureau of Reclamation using an elaborate hydraulic model [34–36] and an electronic analog model [37]. The results of the Swain method were checked satisfactorily.

19-9. Pulsating Flow. When the slope of a channel becomes very steep, supercritical flow of uniform depth in the channel will break into a train of traveling waves or pulses, known as *pulsating flow*. Such an unsteady flow occurs in various situations and in each situation it has specific significance. When it occurs in inclined flumes and spillways, the increased height of the flow requires additional freeboard to prevent spillage, and the concentrated mass of the wavefronts calls for additional structural safety factors against transient pressures and stresses. In hydraulic models, presence of the flow often interferes with similarity conditions. On farm lands and unstabilized roads, the high scouring capacity of the flow causes surface erosions. In chemical processes, the effect of the flow will increase the mass-transfer rate between gas and liquid diffusion reactions.

There have been numerous studies on the phenomenon of pulsating flow. Most of them, however, were made primarily in connection with the investigation of the mechanism of instability of flow (Art. 8-8). An analytical and experimental study of pulsating flow which has long

interested hydraulic engineers was made by Thomas [38]. In this study pulsating flow was described as a flow consisting of two parts, a roughly tumbling head and a smooth tail section. The results of the study indicate that, for pulsating flow to occur in a wide rectangular channel, the channel slope must be more than 4 times the critical slope or the velocity more than twice the critical velocity. Another investigation was made by Mayer [39], who found that pulsating flow can be classified into two distinct types, namely, roll waves and slug flow.

According to Mayer, *roll waves* are characterized by transverse ridges of high vorticity. The regions between the crests are quiescent. The waves are initiated by finite as well as infinitesimal disturbances in the laminar boundary layer. The process can be enhanced by external causes, such as addition of water by rain, release of air bubbles in the upstream pool, roughening the channel entrance, or contact of the flow surface with disturbing air currents. For roll waves to form, however, the surface velocity of the undisturbed flow must be less than the wave velocity, and the channel slope must be supercritical. This requirement will ensure the breaking of waves at their downstream ends and thus allow a frontward steepening of wave configuration and subsequent increase of capillary effects. This process is primarily responsible for the formation of roll waves. In Mayer's experiment, no roll waves were observed on slopes of less than 3% and in no case was the Reynolds number in excess of 420.

Slug flows are characterized by surges of turbulent ridges with wave crests separated by highly agitated regions. In model channels, they are originated randomly at the side walls and in the channel as spotty bursts of turbulence, exhibiting characteristics similar to moving oblique hydraulic jumps. They are the result of transition from supercritical laminar to subcritical turbulent state of flow. For slug flows to form, the surface velocity must be greater than the wave velocity. This will ensure the steepening and breaking of waves at their upstream ends and thereby result in the development of moving hydraulic jumps. In Mayer's experiment, no slug waves were formed on slopes less than about 2%. The range of Reynolds number for slug flows was approximately 1,000 to 4,000. For Reynolds number greater than 4,000, the flow was thoroughly turbulent.

Considering a parabolic distribution of the velocity of a uniform flow in an inclined channel, the surface velocity given by Eq. (6-42) for $y = y_m$ is $gSy_m^2/2\nu$. The average velocity of the flow is given by Eq. (6-43) or $V = gSy_m^2/3\nu$. The surface velocity is, therefore, equal to 1.5 times the average velocity, or $1.5V$.

According to the previous description, a roll wave can be formed when the surface velocity is equal to or less than the absolute wave

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velocity, that is, when

$$1.5V \leqq V + c \tag{19-86}$$

or

$$V/c \leqq 2 \tag{19-87}$$

Since V/c is equal to the Froude number and since roll waves can be formed only on supercritical slopes, the range of Froude number for the formation of roll waves is $1 \leqq F \leqq 2$. Solving Eq. (6-43) for S, it can be shown that $S = 3F^2/R$. Thus, the range of slope for the formation of roll waves is $3/R \leqq S \leqq 12/R$.

Slug flow can be formed when the surface velocity is greater than the wave velocity. Theoretically, therefore, the formation of slug flow will occur when $F > 2$ and $S > 12/R$.

PROBLEMS

19-1. Prove Eq. (19-11).

19-2. Prove Eq. (19-15).

19-3. Assuming the energy loss in the moving hydraulic jump to be negligible, Koch and Carstanjen [27] have derived the following equation for the wave velocity of a surge:

$$V_w = \sqrt{\left(\frac{V_1 - V_2}{4}\right)^2 + gy_1} \pm \frac{V_1 + 3V_2}{4} \tag{19-88}$$

where the positive sign is for type A and C surges and the negative sign is for type B and D surges (Fig. 19-2). Verify this equation.

19-4. Assuming an initial depth of 20 ft, an initial velocity of 15 fps, and a rectangular channel cross section, compute the velocity and overrun of the bore shown in Fig. 19-3 and estimate the distance traveled by the bore in 7 min.

19-5. Compute the heights, depths, and wave velocities of the two component surges produced in Example 19-3.

19-6. A positive surge 0.63 ft high and 51.72 ft deep is moving in still water 51.09 ft deep with a wave velocity of 41.70 fps toward the dead end of a channel. Determine the height and wave velocity of the reflected surge after the original surge hits the dead end.

19-7. Solve Example 19-1 if the original steady flow has a velocity of 10 fps and a depth of 50 ft.

19-8. Solve Example 19-3, if the step has a height of $F = 3$ ft.

19-9. Two positive surges 3 and 2 ft in height, respectively, move in opposite directions toward each other in a frictionless horizontal channel where the water is initially stationary at a depth of 30 ft. The high surge has a wave velocity of 30 fps and the low surge a wave velocity of 20 fps. Determine the flow condition after the surges meet.

19-10. Solve Example 19-1 if the channel has a slope of 0.01. The initial steady flow is assumed uniform.

19-11. Show that the celerity formula in the form of Eq. (18-45) applies only to positive surges and that the corresponding celerity formula for negative surges is

$$c = \sqrt{gy\left(1 - \frac{3h}{2y}\right)} \tag{19-89}$$

19-12. Referring to Example 19-5, show that the crest velocity $V_{w2} = \sqrt{gy_2}$, that the trough velocity $V_{w1} = 2\sqrt{gy_2}$, that the velocity of flow through the dam site is $\frac{2}{3}\sqrt{gy_2}$, and that the discharge through the dam site is $\frac{8}{27}\sqrt{g}\, y_2^{3/2}$.

19-13. Continue the computation of the example illustrated in Fig. 19-12, and determine the flow conditions at 420, 504, 552, 743, and 767 sec, respectively, after the load was suddenly thrown off.

19-14. Solve Example 19-6 if the equalization time is (*a*) 8 min and (*b*) 12 min. The discharge from the lock increases linearly from 0 to 10,000 cfs for the first 20% of the time and then decreases linearly to 0 for the remaining part of the time. Study the effect due to change in equalization time.

19-15. Solve Example 19-7 if the discharge is 1,000 cfs.

19-16. Three horizontal frictionless channels 4, 6, and 8 ft wide meet at a junction. The water in the channels has an initial stationary depth of 10 ft. When an incoming surge 0.4 ft high approaches the junction from the narrowest channel, determine the flow condition after the surge enters the junction. Compute the reflection coefficient of the junction.

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Appendix G

Urban Storm Drainage Criteria Manual, Wright-McLaughlin Engineers

Table 5-5

RIPRAP REQUIREMENTS FOR CHANNEL LININGS **

$VS^{0.17}/(S_s-1)^{0.66}$* (feet per second)	Rock Type ***	d_{50}
1.5 to 4.0	VL	6"
4.0 to 5.0	L	9"
5.0 to 5.8	M	12"
5.8 to 7.1	H	18"
7.1 to 8.2	VH	24"

Use these velocities since riprap is buried

* Use S_s = 2.5 unless the source of rock and its densities are known at the time of design.

** Table valid only for Froude number of 0.8 or less and side slopes no steeper than 2h:1v.

*** Type VL and L riprap shall be buried after placement to reduce vandalism.

SM9 slope mattress with toe protection may be substituted for Type VL or L riprap.

G12 gabion with toe protection may be substituted for Type M and Type H riprap.

5.4.3 Toe Protection

Where only the channel sides are to be lined, additional riprap is needed to provide for long term stability of the lining. In this case, the riprap blanket should extend at least 3 feet below the existing channel bed and the thickness of the blanket below the existing channel bed increased to at least 3 times d_{50} to accommodate possible channel scour during floods (see Figure 5-4a). For sandy soils, consult specific criteria for channels on sandy soils. If wire enclosed rock lining is used, the toe must be protected by placing riprap at the toe. This is needed to protect against frequently occurring abrasion, (see Figure 5-4b and 5-4c).

be estimated for ordinary riprap using:

$$n = .0395\ d_{50}^{\ 1/6}$$

in which d_{50} = the mean stone size in feet.

This equation does not apply to grouted riprap (n = .023 to .030), or to very shallow flow (hydraulic radius is less than or equal to 2 times the maximum rock size) where the roughness coefficient will be greater than indicated by the formula.

5.4.2 Rock Size and Lining Dimensions

Table 5-5 summarizes riprap requirements for a stable channel lining based on the following relationship which resulted from Smith and Murray's model studies (24):

$$\frac{VS^{0.17}}{d_{50}^{\ 0.5}\ (S_s-1)^{.66}} = 5.8 \qquad \text{(Equation 5-4)}$$

in which, V = mean channel velocity in feet per second

S = longitudinal channel slope in feet per foot

S_s = Specific gravity of rock (minimum S_s = 2.50)

d_{50} = rock size in feet for which 50 percent of the riprap by weight is smaller.

The rock sizing requirements in Table 5-5 are based on the rock having a specific gravity of 2.5 or more. Rock having specific gravity less than 2.5 is considered unacceptable.

Table 5-5 represents a significant departure from past practices by recognizing that rock size does not need to be increased for steeper channel side slopes, provided the side slopes are no steeper than 2h:1v (24). Rock lined side slopes steeper than 2h:1v are considered unacceptable because of stability, safety, and maintenance considerations. Proper bedding is required both along the side slopes and the channel bottom for a stable lining. The riprap blanket thickness should be <u>at least</u> 1.75 times d_{50} (at least 2.0 times d_{50} in sandy soils) and should extend up the side slopes at least one foot above the design water surface. At the upstream and downstream termination of a riprap lining, the thickness should be increased 50 percent for at least 3 feet to prevent under cutting.

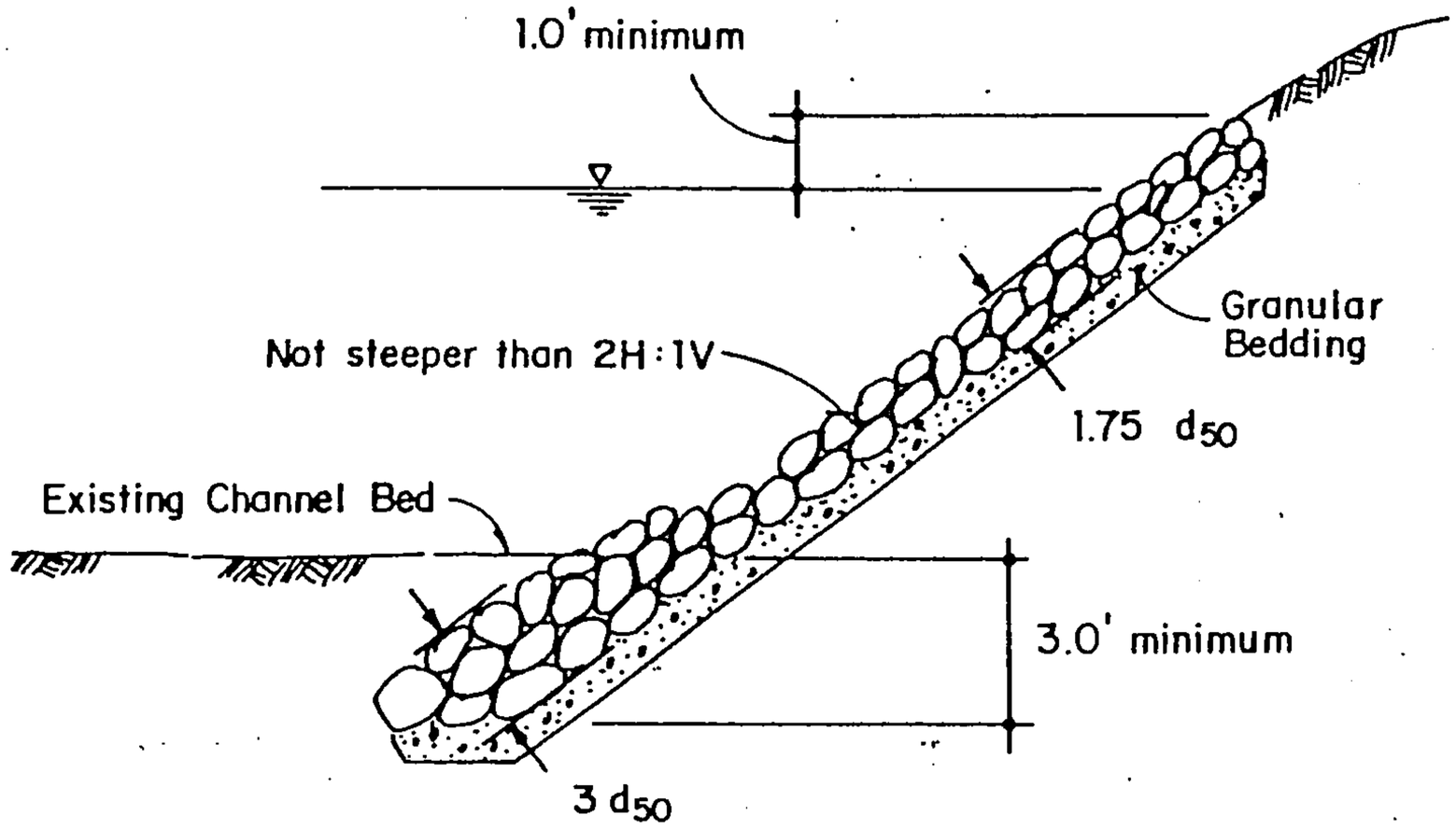


FIGURE 5-4a. TOE PROTECTION RIPRAP CHANNEL LINING

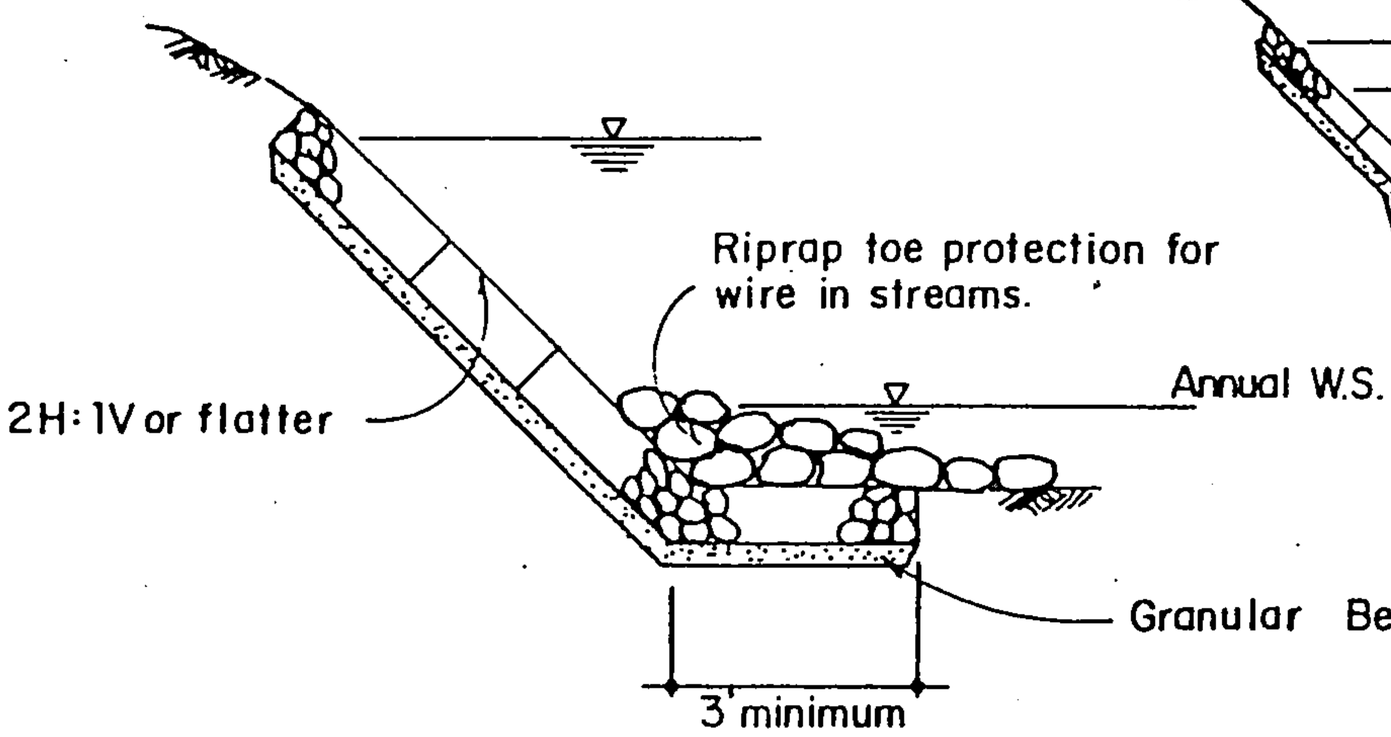


FIGURE 5-4b.

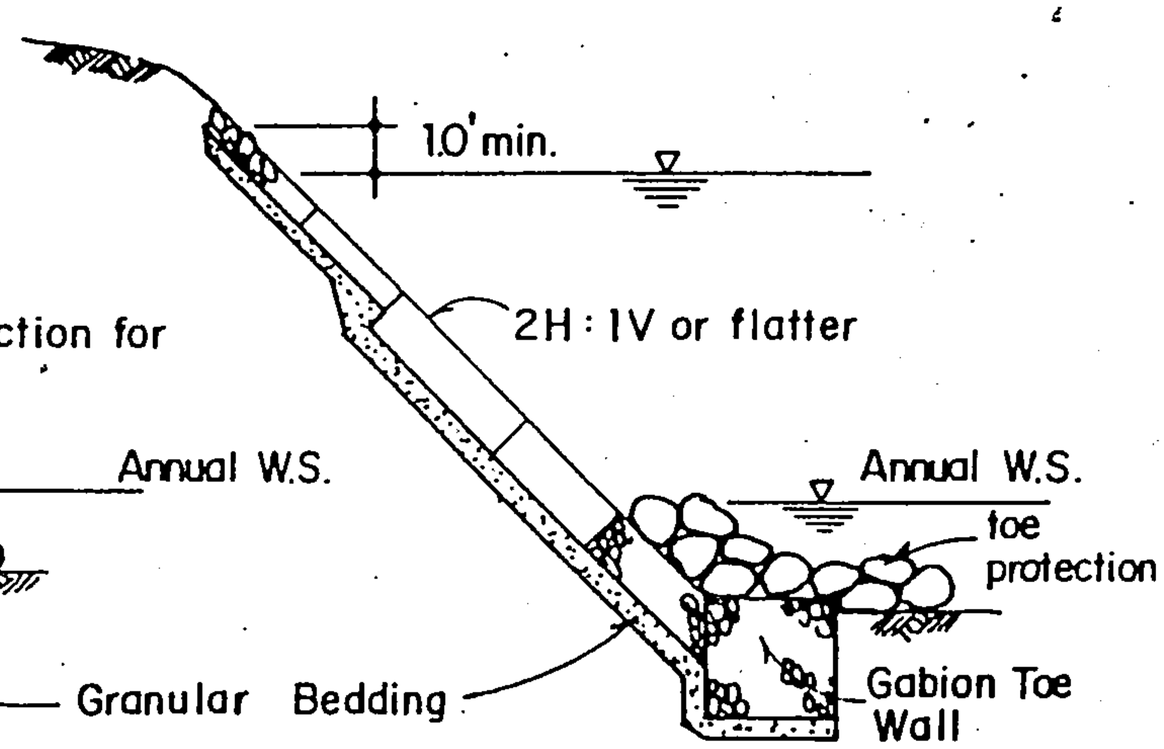


FIGURE 5-4c.

TOE PROTECTION WIRE ENCLOSED ROCK LINING

UPSTREAM RIPRAP

BOTTOM WIDTH=40' 59+03

Given Input Data:

Shape	Trapezoidal
Solving for	Depth of Flow
Flowrate	787.0000 cfs
Slope	0.0242 ft/ft
Manning's n	0.0350
Height	68.0000 in
Bottom width	480.0000 in
Left slope	0.3333 ft/ft
Right slope	0.3333 ft/ft

Computed Results:

Depth	22.4695 in → 1.9'
Velocity	9.2136 fps
Flow area	85.4176 ft2
Flow perimeter	622.1223 in
Hydraulic radius	19.7713 in
Top width	614.8304 in
Area	323.0096 ft2
Perimeter	910.1085 in

From Table 5-5

Bottom width = b

b < 90 ⇒ VH riprap

b > 90' ⇒ H riprap

BOTTOM WIDTH=90'

Given Input Data:

Shape	Trapezoidal
Solving for	Depth of Flow
Flowrate	787.0000 cfs
Slope	0.0242 ft/ft
Manning's n	0.0350
Height	68.0000 in
Bottom width	1080.0000 in
Left slope	0.3333 ft/ft
Right slope	0.3333 ft/ft

Computed Results:

Depth	14.1059 in → 1.2'
Velocity	7.1584 fps
Flow area	109.9401 ft2
Flow perimeter	1169.2216 in
Hydraulic radius	13.5401 in
Top width	1164.6439 in
Area	606.3430 ft2
Perimeter	1510.1085 in

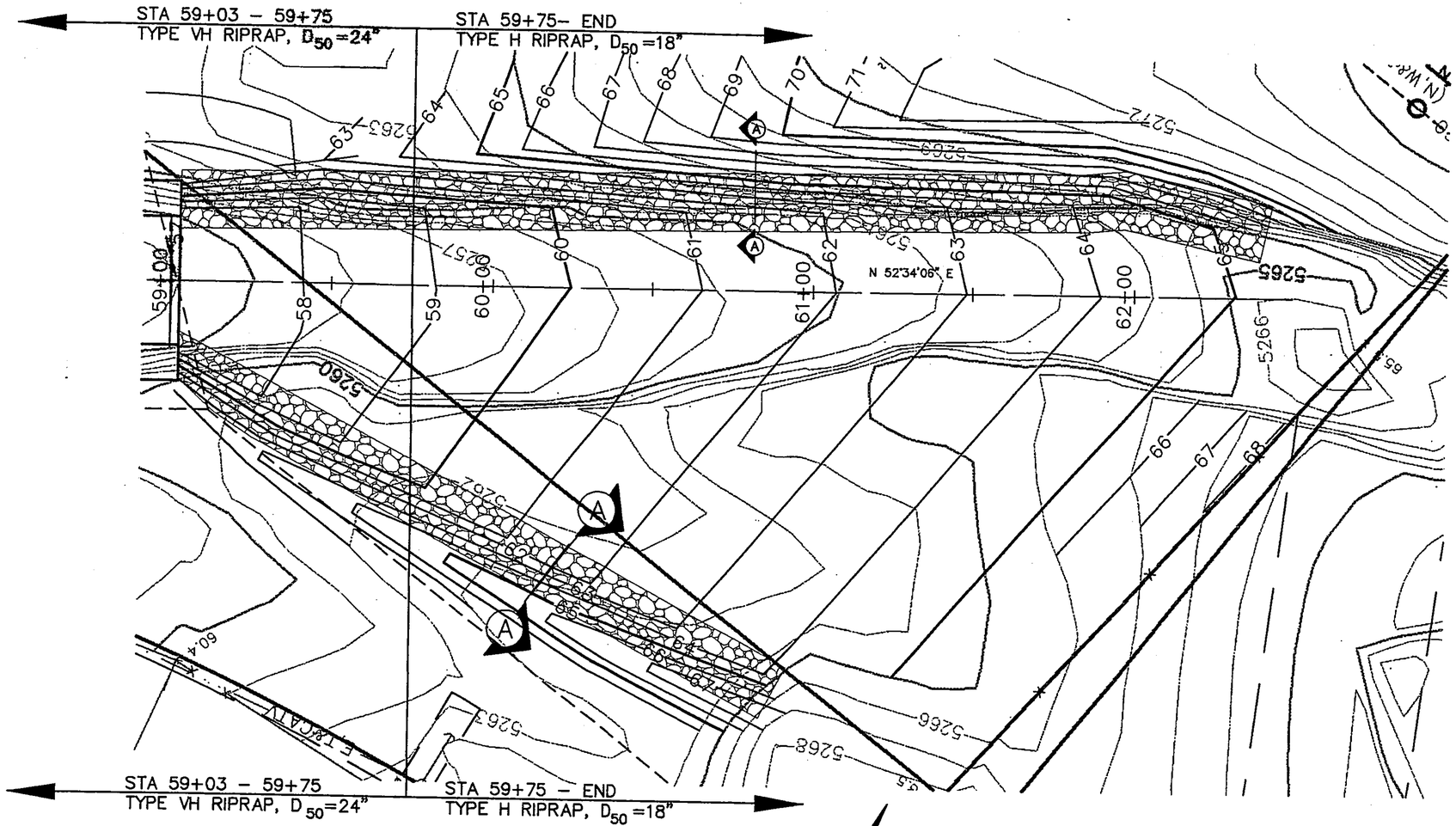
BOTTOM WIDTH=150'

Given Input Data:

Shape	Trapezoidal
Solving for	Depth of Flow
Flowrate	787.0000 cfs
Slope	0.0242 ft/ft
Manning's n	0.0350
Height	68.0000 in
Bottom width	1800.0000 in
Left slope	0.3333 ft/ft
Right slope	0.3333 ft/ft

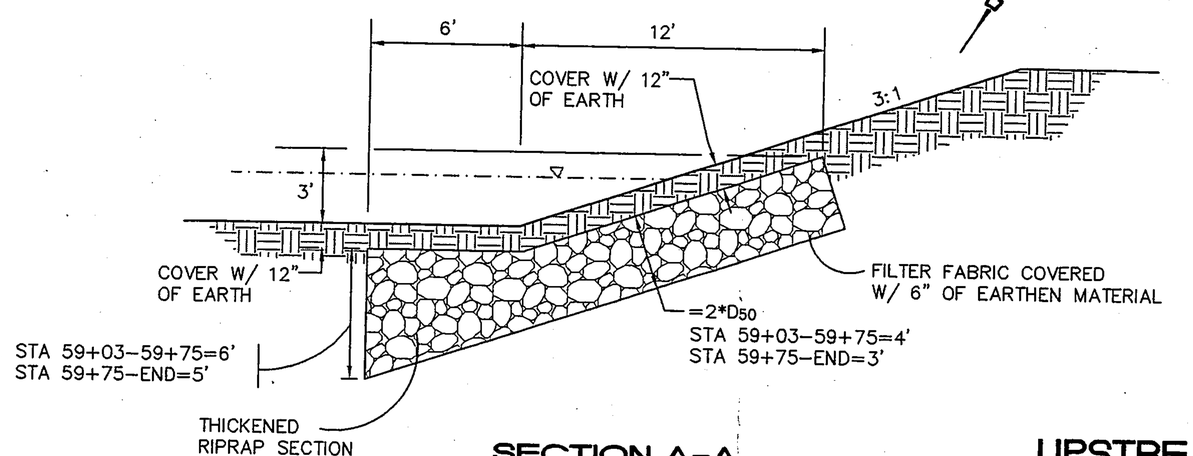
Computed Results:

Depth	10.4223 in → 0.9'
Velocity	5.9377 fps
Flow area	132.5424 ft2
Flow perimeter	1865.9225 in
Hydraulic radius	10.2288 in
Top width	1862.5402 in
Area	946.3430 ft2
Perimeter	2230.1085 in



PLAN

1"=40'

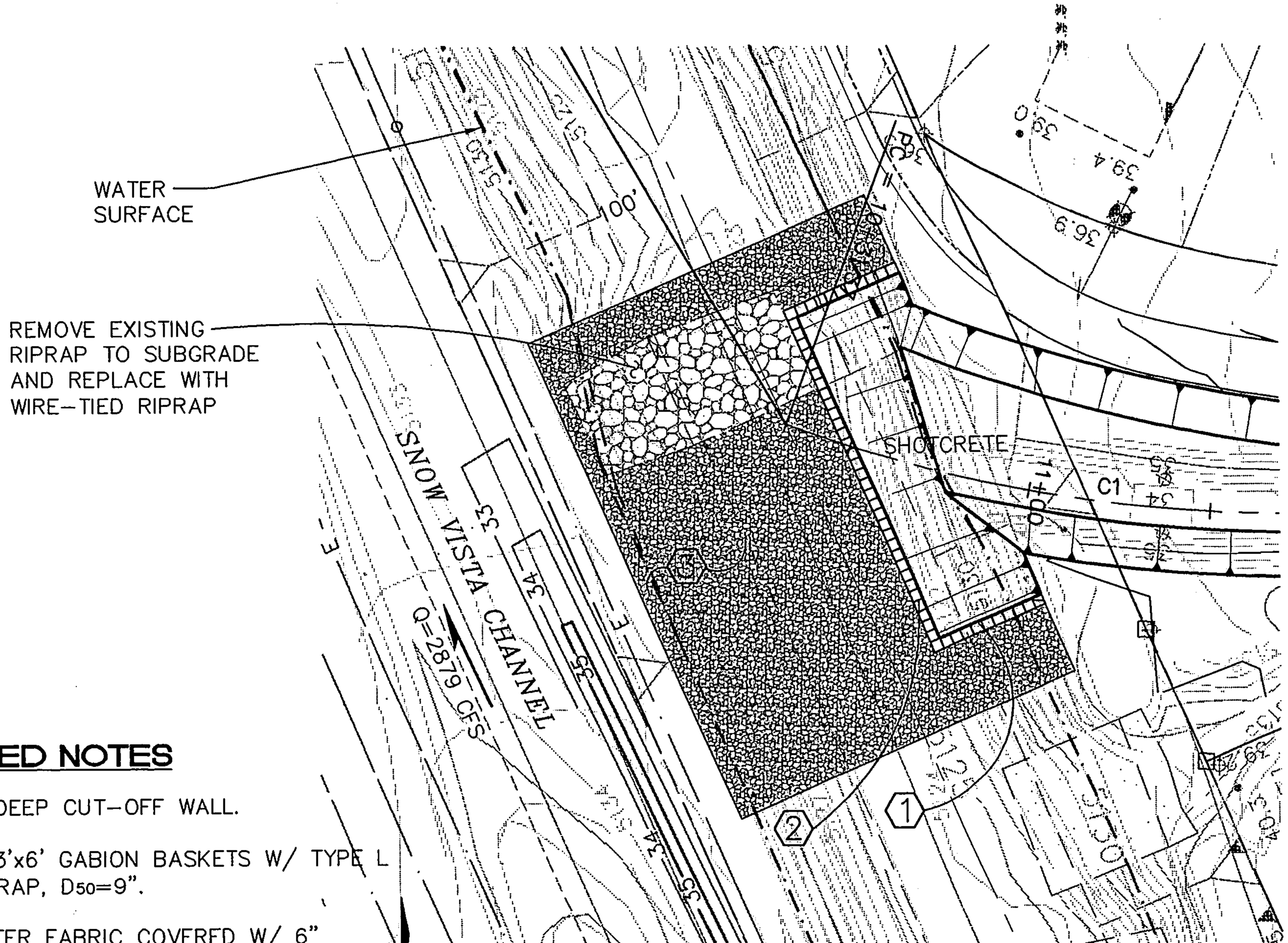


SECTION A–A

1"=8'

UPSTREAM RIPRAP PLAN & SECTION

Appendix H



KEYED NOTES

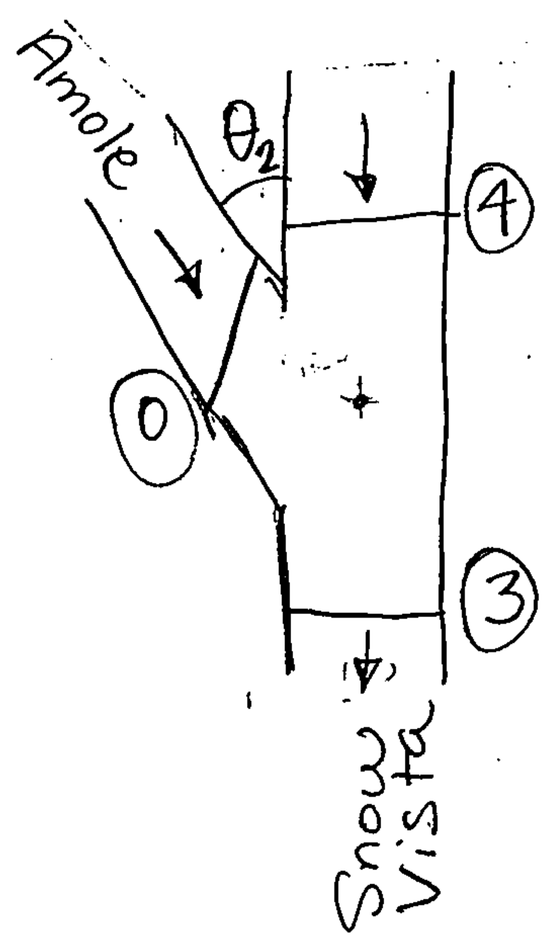
1. 5' DEEP CUT-OFF WALL.
2. 3'x3'x6' GABION BASKETS W/ TYPE L RIPRAP, D_{50}=9".
3. FILTER FABRIC COVERED W/ 6" EARTHEN MATERIAL, 1.5' THICK WIRE-TIED RIPRAP TYPE L, D_{50}=9".

CONFLUENCE EXHIBIT

1"=40'

AMOLE ARROYO / SNOW VISTA CONFLUENCE

Momentum Balance Check



$$SF_3 = SF_4 \cos\theta_1 - F_{f4-3} + W_{4-3} + SF_0 \cos\theta_2 - F_{f0-3} + W_{x0-3} \quad \text{(Eq. 1)}$$

▸ SF = specific force

$$= \frac{Q^2 \beta}{gA} + A\bar{y} \quad \text{(Eq. 2)}$$

▸ F_f = friction force

$$F_{f4-3} = \bar{S}_{f4-3} \frac{L_{4-3}}{2}\left[A_4 \cos\theta_1 + A_3 \frac{Q_4}{Q_3}\right] \quad \text{(Eq. 3)}$$

$$F_{f0-3} = \bar{S}_{f0-3} \frac{L_{0-3}}{2}\left[A_0 \cos\theta_2 + A_3 \frac{Q_0}{Q_3}\right] \quad \text{(Eq. 4)}$$

▸ W_x = weight force

$$W_{x4-3} = S_{o\,4-3} \frac{L_{4-3}}{2}\left[A_4 \cos\theta_1 + A_3 \frac{Q_4}{Q_3}\right] \quad \text{(Eq. 5)}$$

$$W_{x0-3} = S_{o\,0-3} \frac{L_{0-3}}{2}\left[A_0 \cos\theta_2 + A_3 \frac{Q_0}{Q_3}\right] \quad \text{(Eq. 6)}$$

Sectional Properties (from HECRAS)

Section	0	3	4
Q (cfs)	1223	2879	1692
A (ft^2)	63.0	441.5	459.6
y (ft)	1.8	6.9	8.0
$\bar{y}$ (ft)	0.9	3.5	4.0
Bottom elev (ft)	29.8	23.8	24.1
E.G. elev (ft)	37.5	31.3	32.3
S_f	.03		.006

- $S_{f4-3} = \frac{32.3-31.3}{50} = .02$
- $S_{f0-3} = \frac{37.5-31.3}{50} = .124$
- $S_{o\,4-3} = \frac{24.1-23.8}{50} = .006$
- $S_{o\,0-3} = \frac{29.8-23.8}{50} = .12$

Definition of Terms

Q = flow rate

β = momentum coefficient, assumed = 1.0

g = acceleration of gravity = 32.2 $\frac{ft}{s^2}$

A = flow area

$\bar{y}$ = depth from water surface to centroid of area

L = length between sections

$L_{4-3} = L_{0-3} = 50'$

θ = angle between flow paths

$\theta_1 = 0$; $\theta_2 = 52.2°$

$\bar{S}_f$ = Energy grade line (EGL) slope
= Friction slope

S_o = Slope of channel bottom

ISAACSON & ARFMAN, P.A.

SUBJECT Momentum Balance JOB NO. 1241

BY ANW DATE 8/29/03 SHEET NO. 1 OF 2

Eq. 2:

$$SF_3 = \frac{2879^2}{32.2 \cdot 441.5} + 441.5 \cdot 3.5 = 2128$$

$$SF_0 = \frac{1223^2}{32.2 \cdot 63} + 63 \cdot 0.9 = 794$$

$$SF_4 = \frac{1692^2}{32.2 \cdot 459.6} + 459.6 \cdot 4.0 = 2031$$

Eq 3:

$$F_{f4-3} = .02 \cdot 25 \left[\overbrace{459.6 + 441.5 \cdot \frac{1692}{2879}}^{719} \right] = 360 \qquad 108$$

Eq 4:

$$F_{f0-3} = .124 \cdot 25 \left[\overbrace{63 \cdot \cos 52.2^\circ + 441.5 \cdot \frac{1223}{2879}}^{226} \right] = 702 \qquad 170$$

Eq 5: $W_{x4-3} = .006 \cdot 25 [719] = 108$ (from Eq 3)

Eq 6: $W_{x0-3} = .12 \cdot 25 [226] = 678$ (from Eq 4)

Substituting into Eq. 1

$$2128 \stackrel{?}{=} 2031 - 360 + 108 + 794 \cdot \cos 52.2^\circ - 702 + 678$$

$$2128 \neq 2242$$

Deviation $\approx 5\%$ $\Rightarrow$ OK

Possible reasons for deviation

- Friction slope was estimated in these calculations without consideration of "flow-weighting".
- $Q_0 + Q_4 \neq Q_3$ – peak flow rates were used in HEC-RAS input

Appendix I

TABLE III -1
HYDROLOGIC SUMMARY
AMOLE ARROYO BASIN

AP NO.	MAP NO.	DESCRIPTION	VARIABLE	EXISTING FACILITIES			PROPOSED DMP FACILITIES	
				EXISTING	DEVEX	EXISTING CAPACITY	DMP	FUTURE CAPACITY
1	6	AMOLE ARROYO OUT @ WESTGATE	Q (cfs)	73.2	73.5	74	73.5	74
			Tvol (AF)	418	449		449	
			Runoff (in)	0.17	0.62		0.62	
			cfs/ac	0.01	0.02		0.02	
2	6	AMOLE ARROYO BELOW POWERLINE JUNCTION	Q (cfs)	562	1161	N/A	255	N/A
			Tvol (AF)	489	558		556	
			Runoff (in)	0.22	0.81		0.64	
			cfs/ac	0.04	0.28		0.06	
2.1	6	AMOLE ARROYO AT CBC AT DELGADO	Q (cfs)	652	1525	1026	575	1026
			Tvol (AF)	494	577	(bank full)	574	(bank full)
			Runoff (in)	0.22	0.84		0.67	
			cfs/ac	0.05	0.36		0.13	
2.2	6	AMOLE ARROYO AT EAST WESTGATE CROSSING	Q (cfs)	620	1535	N/A	693	N/A
			Tvol (AF)	497	582		580	
			Runoff (in)	0.22	0.84		0.68	
			cfs/ac	0.05	0.36		0.16	
3	7	AMOLE ARROYO AND SNOW VISTA CONFLUENCE	Q (cfs)	1990	3463	N/A	2825	N/A
			Tvol (AF)	603	769		767	
			Runoff (in)	0.29	1.06		0.94	
			cfs/ac	0.14	0.63		0.51	
3.1	7	AMOLE ARROYO ABOVE SACATE BLANCO CONFLUENCE	Q (cfs)	2237	4016	N/A	3526	N/A
			Tvol (AF)	639	814		814	
			Runoff (in)	0.29	1.11		0.98	
			cfs/ac	0.15	0.68		0.61	
4	7	AMOLE ARROYO INTO AMOLE DETENTION FACILITY	Q (cfs)	3022	6089	1500 cfs channel	5293	4650
			Tvol (AF)	657	950	4235 cfs chute	925	
			Runoff (in)	0.31	1.18	(bank full)	1.08	
			cfs/ac	0.19	0.89	3000 cfs channel	0.81	
						7480 cfs chute		

Notes/Legend

AP - Analysis Point - See Figures this report, maps in Volume II and detail hydrology in Volume III.
Q - Peak discharge rate
Tvol - Total runoff volume (includes truncated volumes)
Dvol - Maximum detained volume
Runoff - inches of runoff

cfs/ac - peak discharge rate per acre of contributing area.
Existing - Existing land use and existing drainage facilities.
DEVEX - Fully developed land use and existing drainage facilities.
Capacity - Design capacity.
DMP - Proposed improvements in place, fully developed land use.

TABLE III-3
HYDROLOGIC SUMMARY
SNOW VISTA BASIN

AP NO.	MAP NO.	DESCRIPTION	VARIABLE	EXISTING FACILITIES			PROPOSED DMP FACILITIES	
				EXISTING	DEVEX	EXISTING CAPACITY	DMP	FUTURE CAPACITY
21.1	4	SNOW VISTA SEDIMENTATION BASIN	Q (cfs)	233	423	484	423	484
			Tvol (AF)	17.1	53.8		53.8	
			Dvol (AF)	4.0	6.4		6.4	
			Runoff (in)	0.76	2.07		2.07	
			cfs/ac	0.62	1.36		1.36	
21	4	SNOW VISTA CHANNEL AT HEAD	Q (cfs)	167	388	290	388	375
			Tvol (AF)	17.1	53.8	2530	53.18 *	
			Runoff (in)	0.76	2.07	(bank full)	2.07	
			cfs/ac	0.62	1.25		1.25	
22	4	SNOW VISTA BELOW SECTION LINE JUNCTION	Q (cfs)	407	747	810	747	810
			Tvol (AF)	41.5	95	4595	95 *	
			Runoff (in)	0.86	1.97	(bank full)	1.97	
			cfs/ac	0.70	1.29		1.29	
22.1	4	SNOW VISTA BELOW SAGE CROSSING	Q (cfs)	642	916	850	916	930
			Tvol (AF)	49.3	114.4	3850	114.4 *	
			Runoff (in)	0.83	1.93	(bank full)	1.93	
			cfs/ac	0.90	1.29		1.29	
22.2	4	SNOW VISTA BELOW INLET FROM WESTGATE	Q (cfs)	812	1031	990	1031	1050
			Tvol (AF)	57	121.7	3700	121.7 *	
			Runoff (in)	0.90	1.92	(bank full)	1.92	
			cfs/ac	1.07	1.36		1.36	
23	4	SNOW VISTA BELOW BENAVIDES INLET	Q (cfs)	1864	2050	1200	2050	2100
			Tvol (AF)	99	167.5	5230	167.5	
			Runoff (in)		1.88	(bank full)	1.88	
			cfs/ac		1.92		1.92	
24	7	SNOW VISTA AT ENTRANCE TO AMOLE ARROYO	Q (cfs)	1814	2083	1200	2083	2100
			Tvol (AF)	105.7	183.4	2600	183.4	
			Runoff (in)	1.10	1.87	(bank full)	1.87	
			cfs/ac	1.57	1.77		1.77	

Notes/Legend

AP - Analysis Point - See Figures this report, maps in Volume II and detail hydrology in Volume III.
Q - Peak discharge rate
Tvol - Total runoff volume
Dvol - Maximum detained volume
Runoff - inches of runoff
cfs/ac - peak discharge rate per acre of contributing area.
Existing - Existing land use and existing drainage facilities.
DEVEX - Fully developed land use and existing drainage facilities.
Capacity - Design capacity.
DMP - Proposed improvements in place, fully developed land use.

* Existing channel has excess capacity without additional freeboard. No improvements are necessary.

City of Albuquerque
P.O. BOX 1293 ALBUQUERQUE, NEW MEXICO 87103

April 3, 2003

Fred Arfman, PE
Isaacson & Arfman
128 Monroe NE
Albuquerque, NM 87108

Re: Amole Arroyo Drainage Report
Engineer's Stamp dated 2-20-03, (M9/D23)

Dear Mr. Arfman,

Based upon the information provided in your submittal dated 2-24-03, the above referenced report is approved as a minor revision to the Amole-Hubbell DMP, pending AMAFCA approval. Prior to Work Order release, please address the following comments and resubmit the report.

- The profile provided states that at Sta 53+00, the existing box culverts are to remain but the profile shows a design elevation lower than existing. Please rectify this.

- Please update the summary of the confluence to include water surface elevations upstream and downstream, and provide momentum analysis. A hydraulic jump has to occur somewhere at this confluence because the supercritical Amole mixes with the subcritical Snow Vista and that energy must go somewhere.

If you have any questions, you can contact me at 924-3986.

Sincerely,

Bradley L. Bingham, PE
Sr. Engineer, Planning Dept
Development and Building Services

C: file

THE CITY OF ALBUQUERQUE IS AN EQUAL OPPORTUNITY/REASONABLE ACCOMMODATION EMPLOYER

DESIGN REPORT

FOR

AMOLE ARROYO

INCLUDING REVISIONS TO
THE AMOLE-HUBBELL
DRAINAGE MANAGEMENT PLAN

ALBUQUERQUE, NEW MEXICO

FEBRUARY 2003

RECEIVED
FEB 2 4 2003
HYDROLOGY SECTION

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

FRED C. ARFMAN
STATE OF NEW MEXICO
7322
PROFESSIONAL ENGINEER

Fred C. Arfman 2.20.03

Fred C. Arfman, PE **Date**

I. INTRODUCTION

The Amole Arroyo will be improved between the southwest corner of Westgate Heights and the Snow Vista Channel (see Location Map on page 2). The easterly portion of the Amole Arroyo will be realigned through the existing 100-foot City of Albuquerque right-of-way through the proposed El Rancho Grande Subdivision.

These improvements are in accordance with the *Amole-Hubbell Drainage Management Plan, Volume I* (DMP), by Leedshill-Herkenhoff, Inc., Alternative 2, with the following exceptions:

- The proposed El Rancho Grande, Units 6 and 7 and an offsite portion of Westgate Heights is included in the Amole Basin instead of the Snow Vista Basin.
- A 70-acre portion of DMP Basin 60104 is proposed to be included in the Amole Arroyo Basin instead of the Sacate Blanco Basin. This change reflects a revision to the proposed Gibson Blvd alignment.

In addition to the channel improvements, a bridge crossing structure at the Del Ray Road extension will be constructed as part of this project.

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Location Map 2

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VI. Summary 12

APPENDICES

Appendix A: AHYMO Files for 100-Year Storm--Including Portion of Basin 60104
- Amole Arroyo and Snow Vista--Including Portion of Basin 60104
- Amole Arroyo and Snow Vista--Excluding Portion of Basin 60104

Appendix B: Basin Map--Portion of DMP Basin 60104

Appendix C: HEC-RAS Profiles and Summary Tables
- Amole Arroyo and Snow Vista--Including Portion of Basin 60104
- Amole Arroyo and Snow Vista--Excluding Portion of Basin 60104

Appendix D: Summary of Channel Depth Including Superelevation
- Amole Arroyo--Including Portion of Basin 60104
- Amole Arroyo--Excluding Portion of Basin 60104

Appendix E: Centerline Radius and Easement Curve Length Calculations

Appendix F: Slug Flow Calculations and References

Appendix G: Excerpts from Amole-Hubbell Drainage Management Plan, Volume I

POCKETS

AHYMO Files and HEC-RAS Files
Amole Arroyo Plan & Profile Exhibits
Confluence Exhibit

LOCATION MAP

SCALE:
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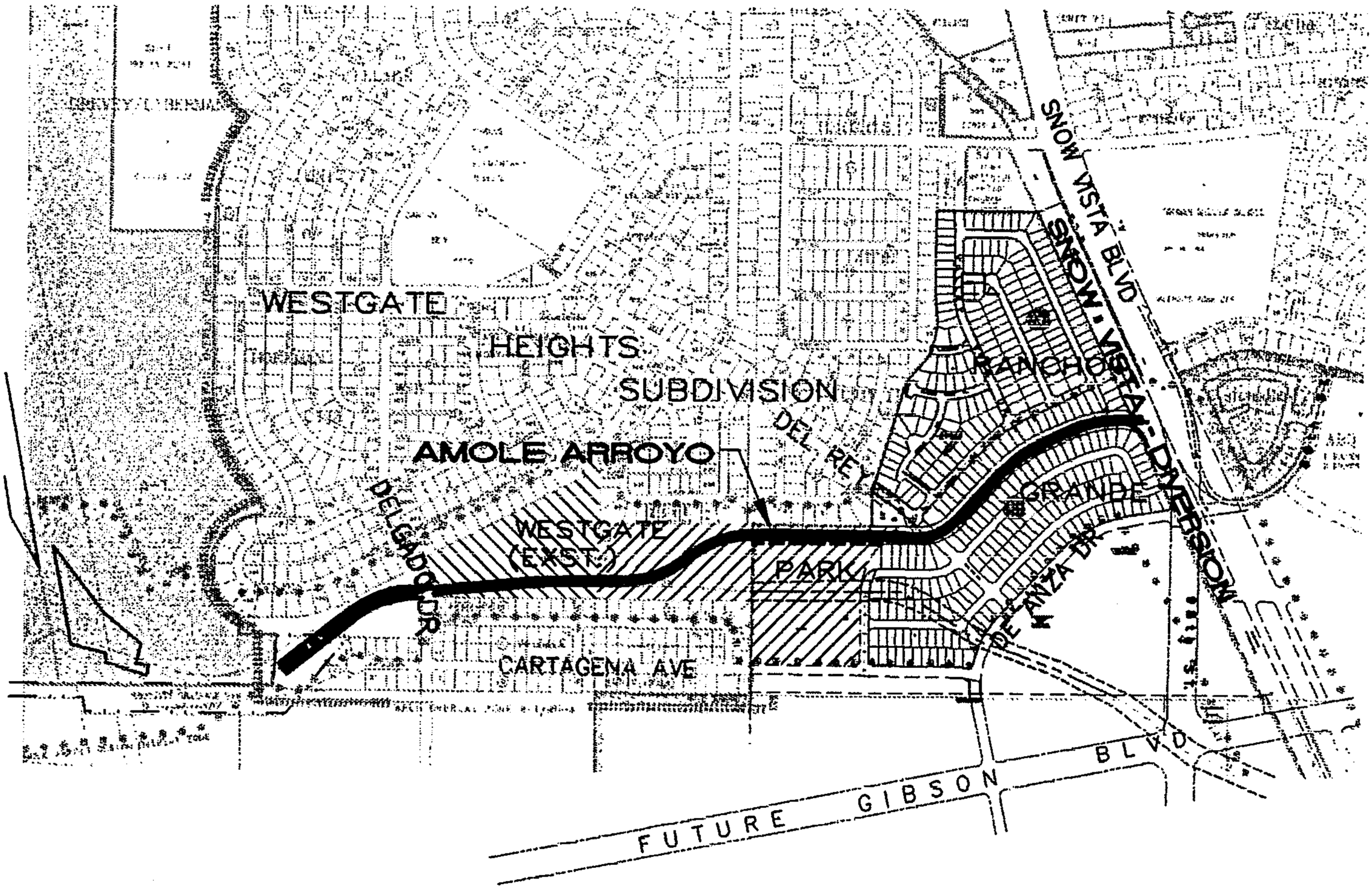
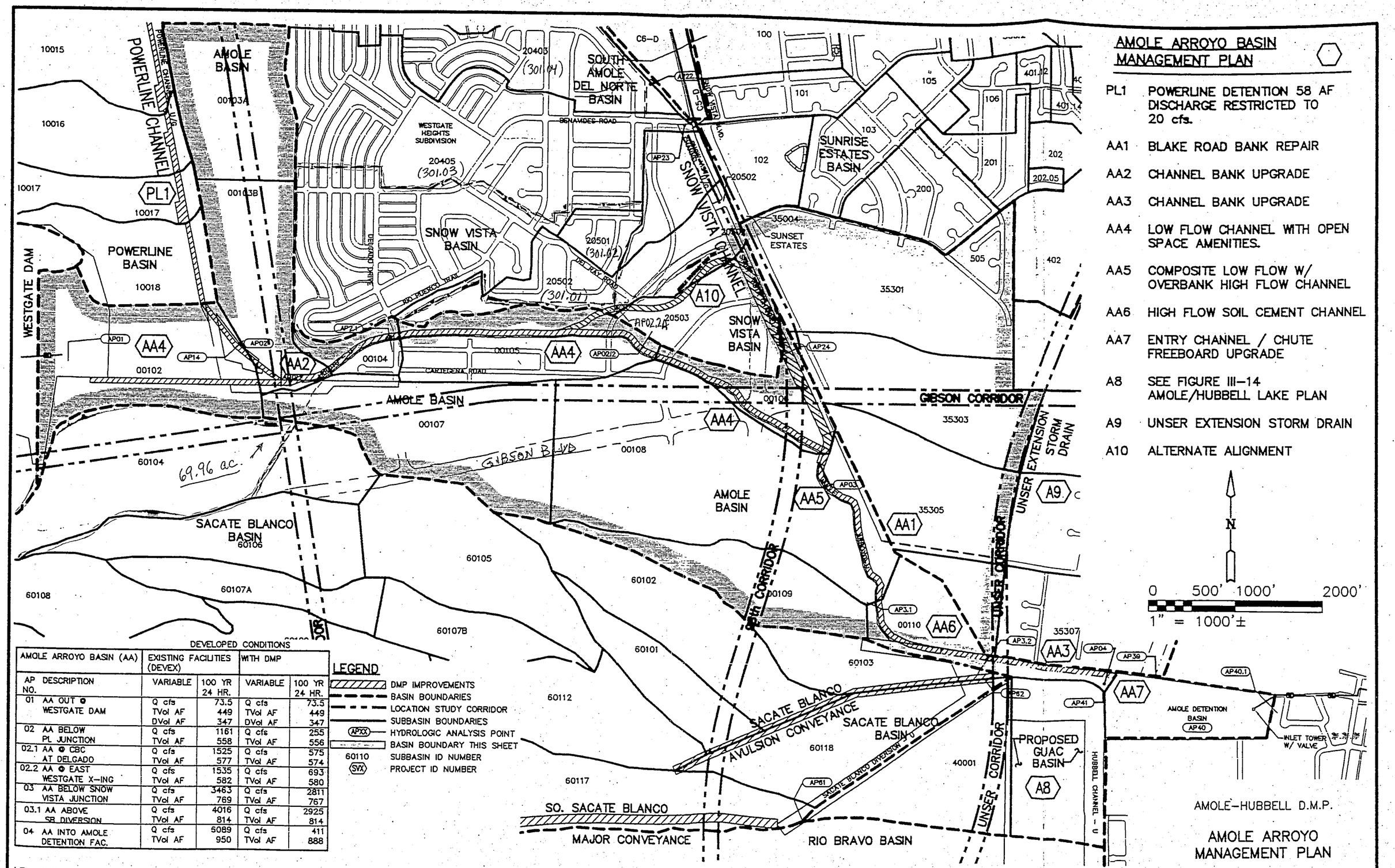


II. BASIN REVISIONS

The proposed El Rancho Grande subdivision development, Units 6 and 7 and a portion of Westgate Heights will drain to the realigned Amole Arroyo instead of the Snow Vista Channel. Therefore, the AHYMO runs from the DMP were modified to include these areas in the Amole Arroyo basin and exclude them from the Snow Vista basin. Also, a 70-acre portion of DMP Basin 60104 is proposed to drain to the Amole Arroyo because of revisions to the proposed location of Gibson Boulevard. See Appendix B for an enlarged basin map.

The DMP basin map on page 4 shows the revised limits of the basins. The El Rancho Grande subdivisions on-site and off-site basins are shown on pages 5-6. The table below lists the changes.

Area Changes to the Amole Arroyo Basins		
El Rancho Grande Units 6 & 7	Basins 210-280 & 600	+ 32.1 ac
El Rancho Grande Offsite	Basins A-L	+120.9 ac.
DMP	Portion of Basin 20405 added to Basin 00105	+ 5.8 ac.
	Total Excluding Portion of Basin 60104	+158.8 ac.
DMP	Portion of Basin 60104	+70.0 ac.
	Total Including Portion of Basin 60104	+228.8 ac.
Area Changes to the Snow Vista Basins		
DMP	Basin 20501 (=301.02)	- 25.0 ac.
DMP	Basin 20502 (=301.01)	- 44.2 ac.
DMP	Basin 20405 (=301.03)	- 91.1 ac.
El Rancho Grande Unit 6	Basin 500	+ 1.4 ac.
	Total	-158.8 ac.



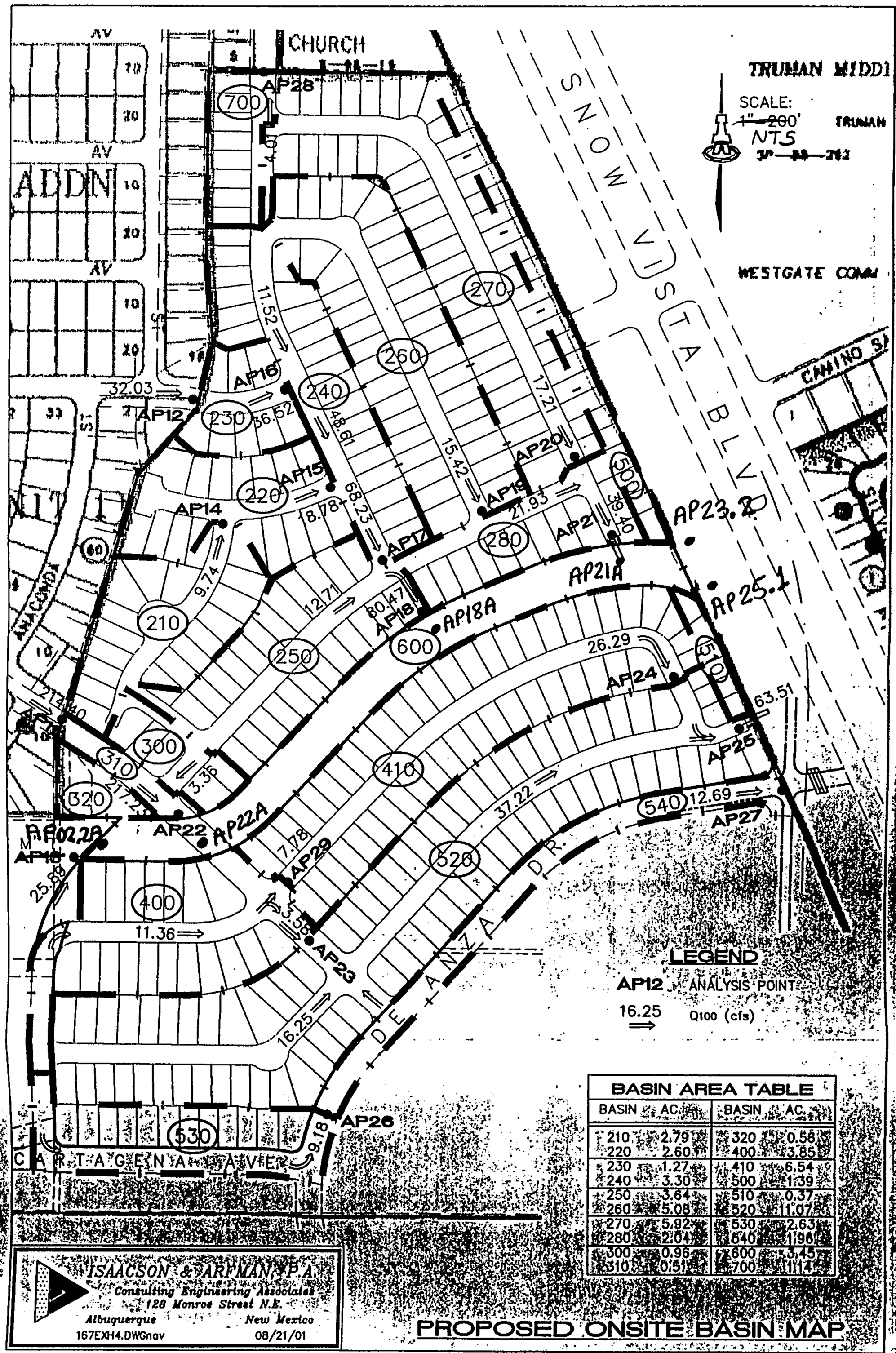
DEVELOPED CONDITIONS

AMOLE ARROYO BASIN (AA)	EXISTING FACILITIES (DEVEX)		WITH DMP	
AP NO. DESCRIPTION	VARIABLE	100 YR 24 HR.	VARIABLE	100 YR 24 HR.
01 AA OUT @ WESTGATE DAM	Q cfs TVol AF DVol AF	73.5 449 347	Q cfs TVol AF DVol AF	73.5 449 347
02 AA BELOW PL JUNCTION	Q cfs TVol AF	1161 558	Q cfs TVol AF	255 556
02.1 AA @ CBC AT DELGADO	Q cfs TVol AF	1525 577	Q cfs TVol AF	575 574
02.2 AA @ EAST WESTGATE X-ING	Q cfs TVol AF	1535 582	Q cfs TVol AF	693 580
03 AA BELOW SNOW VISTA JUNCTION	Q cfs TVol AF	3463 769	Q cfs TVol AF	2811 767
03.1 AA ABOVE SB DIVERSION	Q cfs TVol AF	4016 814	Q cfs TVol AF	2925 814
04 AA INTO AMOLE DETENTION FAC.	Q cfs TVol AF	5089 950	Q cfs TVol AF	411 888

LEEDSHILL-HERKENHOFF, INC.

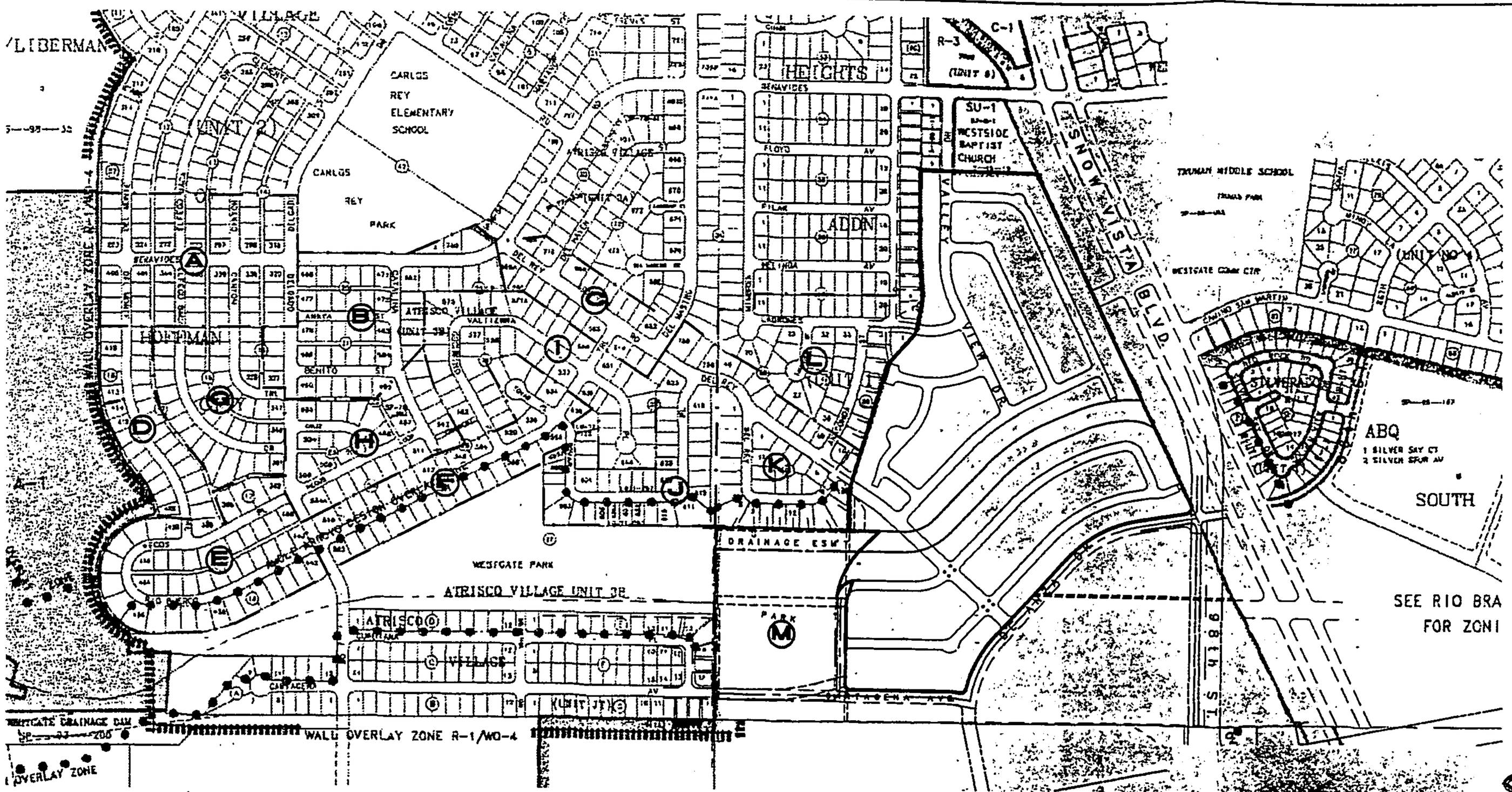
P:\95043\95043_32\DWG\C\AM-BASIN.dwg 6-9-99 KHK

FIGURE NO. III-1



BASIN	AC.	BASIN	AC.
210	2.79	320	0.56
220	2.60	400	3.85
230	1.27	410	6.54
240	3.30	500	1.39
250	3.64	510	0.37
260	5.08	520	11.07
270	5.92	530	2.63
280	2.04	540	1.96
300	0.96	600	3.45
310	0.51	700	1.14

PROPOSED ONSITE BASIN MAP



BASIN AREA TABLE

BASIN	AC.	BASIN	AC.
A	14.14	H	8.44
B	12.32	I	11.89
C	5.95	J	10.63
D	6.33	K	9.80
E	12.65	L	10.30
F	9.66	M	11.00
G	8.80		

OFFSITE BASIN MAP

ISAACSON & ARFMAN, P.A.
Consulting Engineering Associates
128 Monroe Street N.E.
Albuquerque New Mexico
08/23/01

III. FLOW RATE REVISIONS

The AHYMO runs from the DMP were modified to include these additional areas in the Amole Basins and exclude them from the Snow Vista Basins, and to include the proposed addition of the 70-acre portion of Basin 60104. See Appendix A for AHYMO Summary Tables. The table below summarizes the revised flows versus the DMP flow rates at the analysis points shown on pages 4-6. The DMP flow rate summary tables for the Amole Basin and the Snow Vista Basin are included in Appendix G.

Flow Rate Summary Table

Analysis Point	Flow Rate (cfs)		
	DMP	Revised Incl. Basin 60104	Revised Excl. Basin 60104
AP02.1 (Delgado)	652	787	652
AP02.2A (West of Del Rey)	693	914	701
AP22A (Sta 25+00)	N/A	1129	916
AP18A (Sta 17+00)	N/A	1195	976
AP21A (Sta 12+50)	N/A	1237	1013
AP25 (Amole outfall to Snow Vista)	N/A	1245	1021
AP 23 (Snow Vista north of subdivision)	2050	1723	1723
AP23.2 (Snow Vista north of confluence)	2143	1692	1692
AP25.1 (Snow Vista south of confluence)	N/A	2879	2655

IV. CHANNEL DESIGN

Centerline Radii and Easement Curves

The horizontal alignment was laid out with a minimum centerline radius of 265 feet. The horizontal curves have easement curves upstream

and downstream per the City of Albuquerque Development Process Manual (DPM). See Appendix E for calculations.

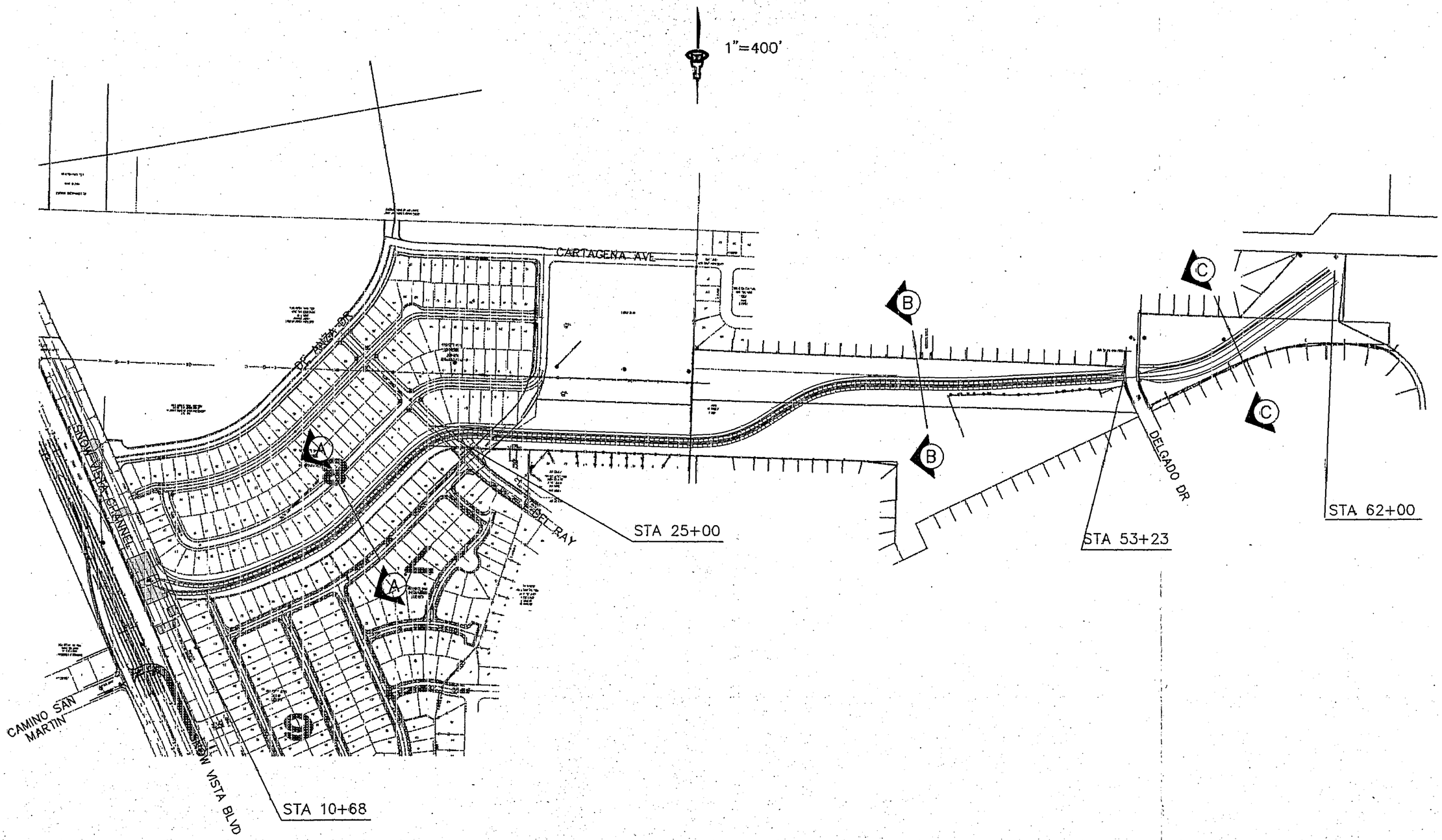
Hydraulic Analysis

HEC-RAS was used to model the Amole Arroyo and the Snow Vista Channel. The stations in HEC-RAS correspond to those shown on the plan & profile exhibits in the back pocket. Summary tables and water surface profiles are shown in Appendix C. The superelevation depths on the curves were calculated and added to the water depths, and a tabulation of the total water depths in the Amole Arroyo are included in Appendix D. Freeboard is 2 feet minimum throughout the project. The channel depth will vary between 4.5 feet and 6 feet as shown on the plan and sections on pages 9-10. From the west end of the project to the Delgado crossing, the channel will have shotcrete-lined sides, an earthen bottom and three shotcrete drop structures. The remaining portion of the channel will be completely lined with shotcrete. The flows are mixed west of the Delgado crossing and supercritical in the remaining reach.

Slug Flows

Waves generated by slug flows "are the result of transition from supercritical laminar to subcritical turbulent state of flow," (*Open Channel Hydraulics*, Chow). Theoretically, slug flow can occur when the Froude number is greater than 2 and the slope of the channel is greater than 12 divided by the Reynolds number. An experiment by Mayer showed that, in actuality, slug waves were formed only on slopes greater than two percent and for Reynolds number between 1000 and 4000 (Chow).

AMOLE ARROYO



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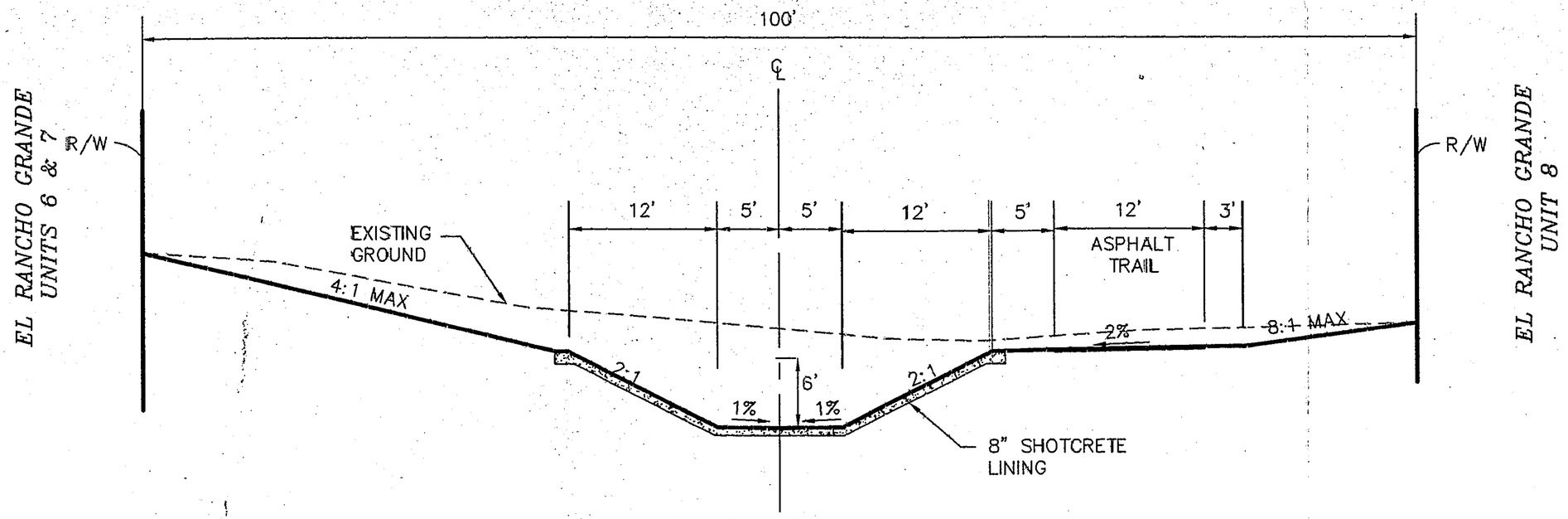
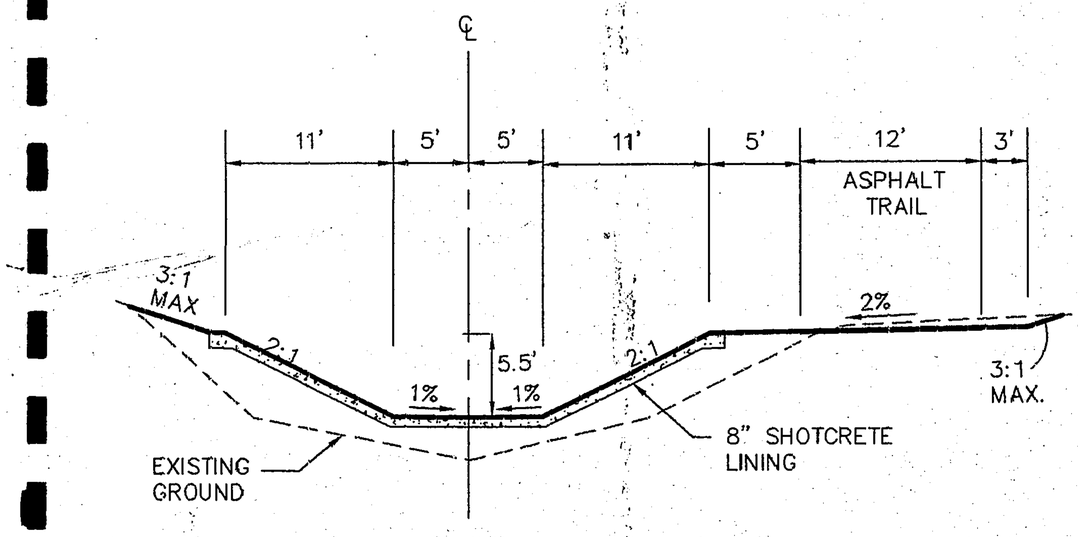
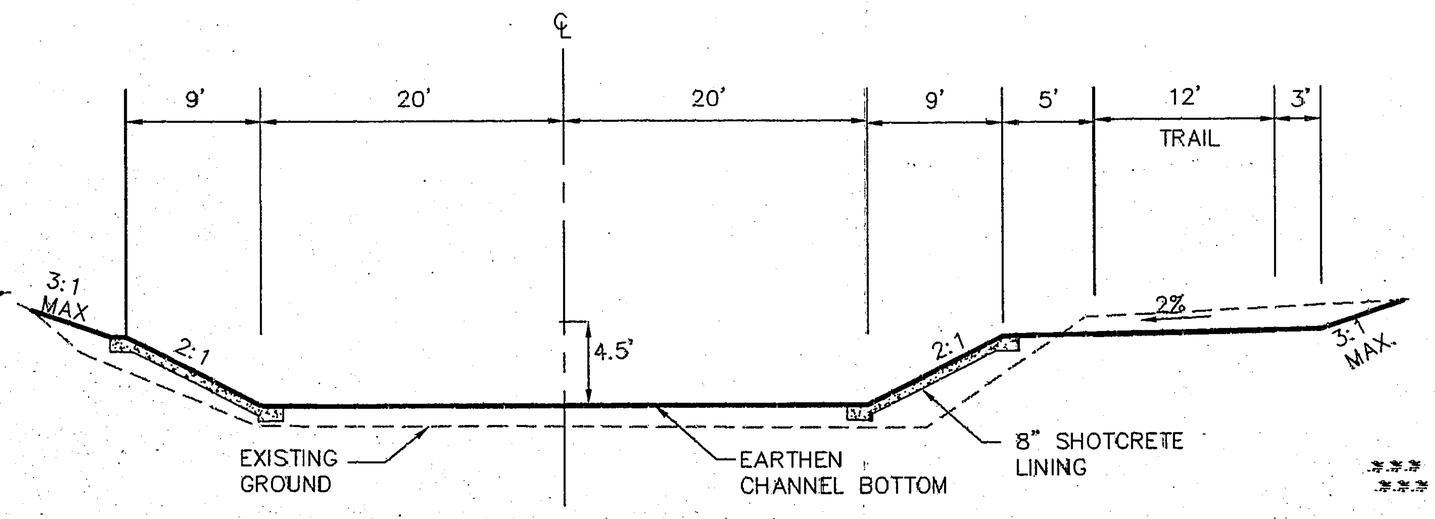


AMOLE ARROYO
SECTION A-A STA 10+68 – STA 25+00
1"=10'



AMOLE ARROYO
SECTION B-B STA 25+00– STA 53+23
1"=10'



AMOLE ARROYO
SECTION C-C STA 53+23– STA 62+00±
1"=10'

The areas where slug waves possibly could occur in the Amole Arroyo channel are at the drop structures (3:1 slope) west of the Delgado crossing. Calculations for a typical drop structure indicate that slug flow will not form (See Appendix F).

Confluence

The Amole Arroyo and Snow Vista Channel confluence was analyzed using the momentum method in HEC-RAS. No hydraulic jump will occur at the junction as shown on the profile of the Snow Vista and the Amole Arroyo and in the summary tables in Appendix C. There is an existing riprap check structure at the confluence, of which a portion is proposed to remain. The rundown from the Amole Arroyo is proposed to be shotcreted to the invert of the Snow Vista Channel with riprap gabion baskets tied to the 5-foot deep cutoff wall along the rundown. The bottom and sides of the Snow Vista Channel through the confluence will have tied riprap. See the confluence exhibit in the back Pocket.

Snow Vista Channel Freeboard

The hydraulic analysis shows that the Snow Vista Channel does not have adequate freeboard on the east side downstream of the confluence. An earthen berm will be constructed with the El Rancho Grande, Unit 8 construction by the developer. The added flows from Basin 60104 increase the water depth in the Snow Vista Channel by approximately 0.2 feet.

V. ESTIMATED COST OF ADDING BASIN 60104

In the Amole Arroyo, the added flows from the 70-acre portion of Basin 60104 results in a 0.5-foot deeper channel section between the west end of the

El Rancho Grande development and the Delgado crossing. See the tabulation of water depths in Appendix D for determination of needed channel depth.

The unit price for shotcrete was estimated as 1.15 times the unit price for 8" RPCC from the City Engineer's Estimated Unit Prices--$7.40/square foot. The cost of shotcrete due to the addition of Basin 60104 is as follows:

Width of added channel lining per foot of channel = 2.24 ft
Length of channel (Sta 25+00 - Sta 52+60) = 2760 ft

Added cost: 6182 SF shotcrete x $7.40/SF = $46,000

It should be noted that the cost estimate prepared by AMAFCA for the cost sharing allocating between AMAFCA, Curb, Inc., and the City of Albuquerque was based on a 6.5-foot channel depth. Since the channel depths have been reduced throughout the entire reach, the total project cost will be significantly lower than originally estimated.

VI. SUMMARY

The Amole Arroyo will be improved from the Snow Vista Channel to approximately one mile west per the plan and sections shown on pages 9-10. The addition of the 70-acre portion of the DMP Basin 60104 will result in an additional cost of $46,000.

The required improvements include:

- 4.5-foot deep channel with shotcrete check structures and side slope shotcrete lining west of the existing Delgado box culvert
- 5.5-foot deep shotcrete lining from Sta 53+23 to Sta 25+00
- 6-foot deep shotcrete lining from Sta 25+00 to Snow Vista Channel
- tied riprap confluence structure per the plan in back pocket
- crossing structure at the proposed Del Ray Road extension.

Appendix A

AMOLE BASIN--Portion of Basin 60104 Included

AHYMO SUMMARY TABLE (AHYMO194) - AMAFCA Hydrologic Model - January, 1994 RUN DATE (MON/DAY/YR) =02/11/2003
INPUT FILE = 1241DEVR.DAT USER NO.= ISCARFNM.I01

COMMAND	HYDROGRAPH IDENTIFICATION	FROM ID NO.	TO ID NO.	AREA (SQ MI)	PEAK DISCHARGE (CFS)	RUNOFF VOLUME (AC-FT)	RUNOFF (INCHES)	TIME TO PEAK (HOURS)	CFS PER ACRE	NOTATION


```
START                                                                  TIME=      .00
*S
*S      AMOLE ARROYO AND HUBBLE LAKE SYSTEM
*S
*S
*S THE DRAINAGE MANAGEMENT PLAN AHYMO FILE AA_DMP2.DAT WAS MODIFIED TO
*S INCLUDE UNITS 6 & 7 OF EL RANCHO GRANDE SUBDIVISION ALONG WITH
*S A 120.9-ACRE PORTION OF OFFSITE FLOWS FROM WESTGATE HEIGHTS. A 5.8-
*S ACRE OF BASIN 20502 (=301.01) WAS INCLUDED IN BASIN 00105.
*S IT ALSO INCLUDES A 69.4-ACRE PORTION OF THE DMP SACATE BLANCO BASIN
*S 60104.
*S
*S REVISED FILE DATA:
*S FILE NAME: 1241DEVR.DAT
*S BY: ASA NILSSON-WEBER
*S LAST REVISION: 2/7/03
*S
*S ORIGINAL FILE DATA:
*S 100-YR, 24-HR STORM WITH SEDIMENT
*S FILE NAME: AA_DMP2.DAT LOW FLOW ALT
*S BY: RICHARD STOCKTON / KAREN JACOBSEN
*S LAST REVISION: 3-10-99
*S
*S*************************************************************************
*S THE PURPOSE OF THIS MODEL IS TO CALCULATE THE RUNOFF FROM THE AMOLE ARROYO,
*S FROM WESTGATE DAM THROUGH TO THE HUBBLE LAKE DETENTION FACILITY.  THIS RUN
*S USES THE RECALL HYD COMMAND TO INPUT HYDOGRAPHS FROM POWERLINE CHANNEL (PL),
*S SNOW VISTA CHANNEL (SV), SACATE BLANCO CHANNEL (SB), AMOLE DEL NORTE CHANNEL
*S (AN), RIO BRAVO (RB), AND THE BORREGA CHANNEL (BR).  THIS RUN ALSO CALCULATES
*S RUNOFF FROM SUB-BASINS ADJACENT TO THE CHANNEL THAT ARE NOT INCLUDED IN THE
*S ABOVE MENTIONED HYDROGRAPHS.
*S
*S*********************************************************************
*S
*S IMPORTANT NOTE1: ROUTE RESERVOIR DOES NOT INCLUDE ALL OF THE VOLUME FROM
*S                  WESTGATE DAM. THEREFORE, ADD ** 278 AC.FT ** OF VOLUME
*S                  TO ALL OF THE HYDROGRAPHS PUBLISHED IN THIS RUN.
*S                  THIS WILL ACCOUNT FOR THE VOLUME OF RUNOFF
```

```
*S                    TRUNCATED FROM WESTGATE DAM.
*S
*S*********************************************************************
*S
*S IMPORTANT NOTE2: ROUTE RESERVOIR DOES NOT INCLUDE ALL OF THE VOLUME FROM
*S                  POWERLINE CHANNEL. THEREFORE, ADD ** 55.4 AC.FT ** OF VOLUME
*S                  TO THE AFFECTED HYDROGRAPHS PUBLISHED IN THIS RUN.
*S                  THIS WILL ACCOUNT FOR THE VOLUME OF RUNOFF
*S                  TRUNCATED FROM THE POWERLINE ALTERNATIVE.
*S
*S*********************************************************************
*S
*S IMPORTANT NOTE3: N/A
*S
*S*********************************************************************
*S
*S IMPORTANT NOTE4: ROUTE RESERVOIR DOES NOT INCLUDE ALL OF THE VOLUME FROM
*S                  AMOLE DEL NORTE. THEREFORE, ADD ** 3.2 AC.FT ** OF VOLUME
*S                  TO THE AFFECTED HYDROGRAPHS PUBLISHED IN THIS RUN.
*S                  THIS WILL ACCOUNT FOR THE VOLUME OF RUNOFF
*S                  TRUNCATED FROM THE AMOLE DEL NORTE ALTERNATIVE.
*S*********************************************************************
*S ANALYSIS ASSUMPTIONS:
*S*********************************************************************
*S 1. ALL LAND IN THIS BASIN IS MODELED AS DEVELOPED CONDITION.
*S
*S 2. A BULKING FACTOR OF 15% HAS BEEN ADDED TO EACH UNDEVELOPED SUB-BASIN AND
*S    A BULKING FACTOR OF 6% HAS BEEN ADDED TO EACH DEVELOPED SUB-BASIN LIKELY
*S    TO PRODUCE SEDIMENT.  A BULKING FACTOR OF 3% HAS BEEN ADDED TO EACH
*S    DEVELOPED SUB-BASIN THAT COULD PROBIBLY PRODUCE SOME SEDIMENT, SUCH AS PAR
*S    AND SCHOOL PLAY GROUNDS.   AND, NO BULKING FACTOR FOR WELL
*S    DEFINED RESIDENTIAL DEVELOPMENTS.
*S
*S 3. BOTH THE AMOLE DETENTION FACILITY AND HUBBELL LAKE DETENTION FACILITY
*S    PRINCIPAL SPILLWAYS ARE MODELED CLOSED.  THESE TWO FACILITIES ARE
*S    REPRESENTATED AS AP40.1 AND AP 50.1, RESPECTIVELY ON THE SUPPLEMENTAL
*S    MAPPING AND REPORT.
*S
*S 4. THE AMOLE BASIN HAS FREE DISCHARGE TO THE AMOLE ARROYO.  POWERLINE
*S    HAS A RESTRICTED DISCHARGE OF 20 AND SNOW VISTA IS FREE DISCHARGE.
*S    THE RUNOFF IS CONVEYED IN A HIGH FLOW CHANNEL TO THE AMOLE DETENTION FACIL
*S
*S 5. THIS ALTERNATIVE INCLUDES THE GUAC DETENTION BASIN.
*S
*S 6. THIS ALTERNATIVE INCLUDES BASINS 35301, 35303, AND 35305 FROM THE
*S    AN_DMP.DAT FILE AS A RESULT OF THE UNSER EXTENSION.
*S*********************************************************************
*S100 YEAR 24HR STORM DEVELOPED CONDITION
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                                                                                                                  *
                                                                                                                  *
                                                                                                                  *
                                FROM  TO                        PEAK          RUNOFF                TIME TO    CFS       PAGE =    3
                   HYDROGRAPH    ID   ID          AREA      DISCHARGE        VOLUME       RUNOFF       PEAK     PER
COMMAND          IDENTIFICATION  NO.  NO.       (SQ MI)       (CFS)         (AC-FT)    (INCHES)    (HOURS)   ACRE      NOTATION

RAINFALL  TYPE= 2                                                                                                   RAIN24=   2.660
*S RECALL OUTFLOW HYDROGRAPH FROM THE WESTGATE DAM
*S  HYD NO. WG100D1B.HYD IS ***** AP 01 *****
RECALL HYD         WG_DMP.HYD    -     5       5.15730        73.47      170.999       .62169     7.050     .022
*S ROUTE FLOW TO AP02
ROUTE                 WG101.5    5    11       5.15730        73.47      170.672       .62050     6.950     .022
*S CALCULATE FLOW FROM SUB-BASIN 00102
*S GENERATION OF SEDIMENT LIKELY, BULK FLOWS 6%
SEDIMENT BULK                                                                                                       PK BF =    1.06
COMPUTE NM HYD        102.00    -     2        .11190       218.60        9.283      1.55544     1.500    3.052 PER IMP=  47.00
*S ADD THE ROUTED FLOW FROM SUB-BASIN WG101.5 TO THE FLOW FROM SUB-BASIN 00102.
ADD HYD               102.10 11& 2    3       5.26920       254.43      179.955       .64035     1.500     .075
*S RECALL OUTFLOW HYDROGRAPH FROM POWERLINE CHANNEL
*S
*S IMPORTANT NOTE2: ROUTE RESERVOIR DOES NOT INCLUDE ALL OF THE VOLUME FROM
*S                  POWERLINE CHANNEL. THEREFORE, ADD ** 20.6 AC.FT ** OF VOLUME
*S                  TO THE AFFECTED HYDROGRAPHS PUBLISHED IN THIS RUN.
*S                  THIS WILL ACCOUNT FOR THE VOLUME OF RUNOFF
*S                  TRUNCATED FROM THE POWERLINE ALTERNATIVE. THE TOTAL
*S                  TRUNCATED VOLUME TO THIS POINT IS 289.6 AC FT
*S
RECALL HYD       PL_DMP1.HYD    -    11       1.20470        19.34       42.699       .66457    29.900     .025
ADD HYD               102.10 11& 3    3       6.47390       256.59      222.654       .64486     1.500     .062
*S HYD=102.1 IS *** AP02 *****
*S ROUTE FLOW IN THE AMOLE ARROYO TO 900 FEET EAST OF POWERLINE CHANNEL.
ROUTE                 102.50    3    12       6.47390       257.32      222.483       .64437     1.550     .062
*S
*S GENERATION OF SEDIMENT LIKELY, BULK FLOWS 6%
SEDIMENT BULK                                                                                                       PK BF =    1.06
COMPUTE NM HYD        00103A    -     2        .07170       162.04        6.475      1.69326     1.500    3.531 PER IMP=  49.00
*S ROUTE FLOW THROUGH SUB-BASIN 00103B TO THE AMOLE ARROYO.
ROUTE               00103A.5    2    11        .07170       100.85        6.475      1.69325     1.600    2.198
*S CALCULATE FLOW FROM SUB-BASIN 00103B
*S GENERATION OF SEDIMENT LIKELY, BULK FLOWS 6%
SEDIMENT BULK                                                                                                       PK BF =    1.06
COMPUTE NM HYD        00103B    -     2        .12070       202.77       10.858      1.68669     1.600    2.625 PER IMP=  49.00
*S ADD THE ROUTE FLOW FROM SUB-BASIN 00103A.5 TO THE FLOW
*S FROM SUB-BASIN 00103B.
ADD HYD             00103B.1 11& 2    3        .19240       303.62       17.333      1.68913     1.600    2.466
*S ADD THE COMBINED FLOW FROM SUB-BASIN 00103B.1 TO THE ROUTED FLOW
*S IN THE AMOLE ARROYO.
ADD HYD             00103B.2 12& 3    4       6.66630       544.09      239.816       .67452     1.550     .128
*S CALCULATE THE FLOW FROM SUB-BASIN 60104.
```

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                                FROM  TO                    PEAK        RUNOFF                 TIME TO    CFS       PAGE =    4
                   HYDROGRAPH    ID   ID        AREA     DISCHARGE     VOLUME      RUNOFF       PEAK     PER
COMMAND          IDENTIFICATION  NO.  NO.     (SQ MI)      (CFS)       (AC-FT)    (INCHES)    (HOURS)   ACRE      NOTATION

*S BULK FLOWS 6%
SEDIMENT BULK                                                                                                   PK BF =    1.06
COMPUTE NM HYD        D60104    -     2        .10900       228.92       8.785     1.51117      1.500   3.282 PER IMP=  40.00
*S ADD THE FLOWS FROM SUB-BASIN 60104 TO SUB-BASIN 00103B.2.
ADD HYD             00103B.3  2& 4   5       6.77530       749.55     248.601      .68798      1.550    .173
*S ROUTE FLOW FROM SUB-BASIN 00103B.3 IN THE AMOLE ARROYO TO
*S DELGADO STREET.
ROUTE               00103B.5    5   11       6.77530       750.90     248.534      .68779      1.550    .173
*S
*S CALCULATE FLOW FROM SUB-BASIN 00104
*S GENERATION OF SEDIMENT LIKELY, BULK FLOWS 6%
SEDIMENT BULK                                                                                                   PK BF =    1.06
COMPUTE NM HYD        104.00    -     2        .01830        40.11       1.617     1.65724      1.500   3.424 PER IMP=  49.00
*S ADD THE FLOW FROM SUB-BASIN 00104 TO THE ROUTED FLOW IN THE AMOLE ARROYO.
*S HYD NO. 00104.1 IS ***** AP 02.1 *****
ADD HYD               104.10 11& 2   3       6.79360       786.70     250.151      .69041      1.550    .181
*S ROUTE FLOW FROM SUB-BASIN 00104 IN THE AMOLE ARROYO TO 2990 FEET EAST
*S FOR SNOW VISTA CHANNEL
 ROUTE                 104.50    3   11       6.79360       766.69     249.549      .68874      1.600    .176
*S
*S CALCULATE FLOW FROM SUB-BASIN 00105
*S GENERATION OF SEDIMENT LIKELY, BULK FLOWS 6%
SEDIMENT BULK                                                                                                   PK BF =    1.06
COMPUTE NM HYD        105.00    -     2        .08581       181.91       7.484     1.63539      1.500   3.312 PER IMP=  49.00
*S ADD THE FLOW FROM SUB-BASIN 00105 TO THE ROUTED FLOW IN THE AMOLE ARROYO.
*S HYD NO. 00105.1 IS ***** AP 02.2A *****
ADD HYD               105.10 11& 2  41       6.87941       913.53     257.034      .70055      1.550    .207
*S*************************************************************
*S***            EL RANCHO GRANDE SUBDIVISION                ****
*S***             UNITS SIX, SEVEN, & EIGHT                  ****
*S***                DEVELOPED CONDITIONS                    ****
*S*************************************************************
*S*************** OFFSITE BASINS *******************
*S
*S  BASIN A (102)
COMPUTE NM HYD        102.00    -     2        .02210        45.19       1.774     1.50473      1.500   3.195 PER IMP=  42.00
*S  ~~~~~~~~~  AP1  ~~~~~~~~~
ROUTE                 102.20    3     2        .02210        43.14       1.774     1.50475      1.550   3.050
*S  BASIN B (103)
COMPUTE NM HYD        103.00    -     3        .01926        39.39       1.546     1.50472      1.500   3.195 PER IMP=  42.00
ADD HYD               103.10  2& 3    1        .04136        78.57       3.319     1.50472      1.550   2.968
*S  ~~~~~~~~~  AP2  ~~~~~~~~~
ROUTE                 103.20    1     3        .04136        79.71       3.319     1.50473      1.550   3.011
```

COMMAND	HYDROGRAPH IDENTIFICATION	FROM ID NO.	TO ID NO.	AREA (SQ MI)	PEAK DISCHARGE (CFS)	RUNOFF VOLUME (AC-FT)	RUNOFF (INCHES)	TIME TO PEAK (HOURS)	CFS PER ACRE	NOTATION
*S BASIN C (104)										
COMPUTE NM HYD	104.00	-	4	.00929	19.01	.746	1.50473	1.500	3.197	PER IMP= 42.00
ADD HYD	104.10	3& 4	1	.05065	96.81	4.065	1.50471	1.550	2.986	
*S ~~~~~~~~~ AP3 ~~~~~~~~~										
ROUTE	104.20	1	4	.05065	94.44	4.065	1.50473	1.600	2.913	
*S BASIN D (110)										
*S ~~~~~~~~~ AP4 ~~~~~~~~~										
COMPUTE NM HYD	110.00	-	5	.00989	20.23	.794	1.50473	1.500	3.196	PER IMP= 42.00
*S BASIN E (111)										
COMPUTE NM HYD	111.00	-	6	.01977	40.43	1.587	1.50473	1.500	3.195	PER IMP= 42.00
ADD HYD	111.10	5& 6	1	.02966	60.66	2.380	1.50470	1.500	3.196	
*S ~~~~~~~~~ AP5 ~~~~~~~~~										
ROUTE	111.20	1	6	.02966	54.53	2.380	1.50473	1.550	2.873	
*S BASIN F (112)										
COMPUTE NM HYD	112.00	-	7	.01510	30.88	1.212	1.50472	1.500	3.196	PER IMP= 42.00
ADD HYD	112.10	6& 7	1	.04476	82.31	3.592	1.50471	1.550	2.873	
*S ~~~~~~~~~ AP6 ~~~~~~~~~										
ROUTE	112.20	1	7	.04476	78.22	3.592	1.50472	1.600	2.731	
*S BASIN G (120)										
*S ~~~~~~~~~ AP8 ~~~~~~~~~										
COMPUTE NM HYD	120.00	-	8	.01375	28.12	1.103	1.50473	1.500	3.196	PER IMP= 42.00
*S BASIN H (121)										
COMPUTE NM HYD	121.00	-	9	.01319	26.98	1.059	1.50472	1.500	3.196	PER IMP= 42.00
ADD HYD	121.10	8& 9	1	.02694	55.10	2.162	1.50470	1.500	3.196	
*S ~~~~~~~~~ AP9 ~~~~~~~~~										
ROUTE	121.20	1	9	.02694	53.66	2.162	1.50476	1.550	3.112	
*S BASIN I (122)										
COMPUTE NM HYD	122.00	-	10	.01858	38.00	1.491	1.50472	1.500	3.195	PER IMP= 42.00
ADD HYD	122.10	9&10	1	.04552	89.31	3.653	1.50472	1.500	3.066	
*S ~~~~~~~~~ AP7 ~~~~~~~~~										
ROUTE	122.20	1	10	.04552	85.57	3.653	1.50474	1.550	2.937	
ADD HYD	104.30	4&10	10	.09617	179.19	7.718	1.50472	1.550	2.911	
*S BASIN J (130)										
COMPUTE NM HYD	130.00	-	11	.01661	33.97	1.333	1.50473	1.500	3.196	PER IMP= 42.00
ADD HYD	130.10	10&11	1	.11278	209.75	9.051	1.50472	1.550	2.906	
*S ~~~~~~~~~ AP10 ~~~~~~~~~										
ROUTE	130.20	1	11	.11278	206.48	9.051	1.50472	1.600	2.861	
*S BASIN K (131)										
COMPUTE NM HYD	131.00	-	12	.01532	31.33	1.229	1.50472	1.500	3.196	PER IMP= 42.00
ADD HYD	131.10	11&12	1	.12810	229.34	10.280	1.50472	1.550	2.797	
*S ~~~~~~~~~ AP11 ~~~~~~~~~										
ROUTE	131.20	1	12	.12810	219.98	10.280	1.50472	1.600	2.683	
*S BASIN L (140)										

COMMAND	HYDROGRAPH IDENTIFICATION	FROM ID NO.	TO ID NO.	AREA (SQ MI)	PEAK DISCHARGE (CFS)	RUNOFF VOLUME (AC-FT)	RUNOFF (INCHES)	TIME TO PEAK (HOURS)	CFS PER ACRE	NOTATION
*S ~~~~~~~~~ AP12 ~~~~~~~~~										
COMPUTE NM HYD	140.00	-	13	.01609	32.91	1.291	1.50472	1.500	3.196	PER IMP= 42.00
*S										
*S*************** ONSITE BASINS ******************										
*S										
COMPUTE NM HYD	300.00	-	38	.00150	3.45	.144	1.80120	1.500	3.594	PER IMP= 57.88
COMPUTE NM HYD	310.00	-	39	.00080	1.85	.077	1.80120	1.500	3.610	PER IMP= 57.88
COMPUTE NM HYD	320.00	-	40	.00087	2.01	.084	1.80120	1.500	3.606	PER IMP= 57.88
ADD HYD	310.10	12&39	15	.12890	221.26	10.357	1.50655	1.600	2.682	
ADD HYD	310.20	38&15	16	.13040	223.67	10.501	1.50994	1.600	2.680	
ADD HYD	310.30	41&16	1	7.00981	1122.53	267.535	.71561	1.600	.250	
*S ~~~~~~~~~ AP22 ~~~~~~~~~										
ROUTE	310.40	1	39	7.00981	1127.58	267.426	.71532	1.600	.251	
*S ~~~~~~~~~ AP22A ~~~~~~~~~										
ADD HYD	310.A	39&40	1	7.01068	1128.98	267.510	.71545	1.600	.252	
*S ROUTE FLOW IN THE AMOLE ARROYO TO AP18										
ROUTE	310.B	1	11	7.01068	1132.06	267.350	.71502	1.600	.252	
*S ~~~~~~~~~ AP14 ~~~~~~~~~										
COMPUTE NM HYD	210.00	-	30	.00436	10.00	.419	1.80120	1.500	3.584	PER IMP= 57.88
COMPUTE NM HYD	220.00	-	31	.00408	9.36	.392	1.80120	1.500	3.584	PER IMP= 57.88
ADD HYD	220.10	30&31	1	.00844	19.36	.811	1.80112	1.500	3.584	
*S ~~~~~~~~~ AP15 ~~~~~~~~~										
ROUTE	220.20	1	31	.00844	19.00	.811	1.80131	1.500	3.518	
COMPUTE NM HYD	230.00	-	32	.00208	4.78	.200	1.80120	1.500	3.590	PER IMP= 57.88
ADD HYD	230.10	13&32	1	.01817	37.68	1.491	1.53863	1.500	3.241	
*S ~~~~~~~~~ AP16 ~~~~~~~~~										
ROUTE	230.20	1	32	.01817	37.87	1.491	1.53867	1.500	3.257	
COMPUTE NM HYD	240.00	-	33	.00516	11.83	.496	1.80120	1.500	3.583	PER IMP= 57.88
ADD HYD	240.10	32&33	1	.02333	49.70	1.987	1.59669	1.500	3.329	
ROUTE	240.20	1	33	.02333	49.54	1.987	1.59672	1.500	3.318	
ADD HYD	240.30	31&33	1	.03177	68.54	2.798	1.65103	1.500	3.371	
*S ~~~~~~~~~ AP17 ~~~~~~~~~										
ROUTE	240.40	1	33	.03177	67.88	2.798	1.65105	1.550	3.338	
COMPUTE NM HYD	250.00	-	34	.00569	13.05	.547	1.80120	1.500	3.583	PER IMP= 57.88
*S ~~~~~~~~~ AP 18 ~~~~~~~~~										
ADD HYD	250.10	33&34	34	.03746	80.87	3.344	1.67383	1.500	3.373	
*S ~~~~~~~~~ AP18A ~~~~~~~~~										
ADD HYD	250.A	34&11	1	7.04814	1195.54	270.694	.72012	1.600	.265	
*S ROUTE FLOW IN THE AMOLE ARROYO TO AP21										
ROUTE	250.B	1	34	7.04814	1196.70	270.580	.71982	1.600	.265	
COMPUTE NM HYD	260.00	-	35	.00793	18.18	.762	1.80120	1.500	3.582	PER IMP= 57.88
*S ~~~~~~~~~ AP19 ~~~~~~~~~										
ROUTE	260.10	36	35	.00793	16.19	.762	1.80126	1.550	3.190	
COMPUTE NM HYD	270.00	-	36	.00926	21.22	.890	1.80120	1.500	3.581	PER IMP= 57.88

COMMAND	HYDROGRAPH IDENTIFICATION	FROM ID NO.	TO ID NO.	AREA (SQ MI)	PEAK DISCHARGE (CFS)	RUNOFF VOLUME (AC-FT)	RUNOFF (INCHES)	TIME TO PEAK (HOURS)	CFS PER ACRE	NOTATION
*S ~~~~~~~~~ AP20 ~~~~~~~~~										
ROUTE	270.10	37	36	.00926	17.89	.890	1.80124	1.550	3.019	
COMPUTE NM HYD	280.00	-	37	.00319	7.32	.306	1.80120	1.500	3.587	PER IMP= 57.88
ADD HYD	280.10	35&37	1	.01112	22.70	1.068	1.80116	1.550	3.190	

COMMAND	HYDROGRAPH IDENTIFICATION	FROM ID NO.	TO ID NO.	AREA (SQ MI)	PEAK DISCHARGE (CFS)	RUNOFF VOLUME (AC-FT)	RUNOFF (INCHES)	TIME TO PEAK (HOURS)	CFS PER ACRE	NOTATION
ROUTE	280.20	1	37	.01112	23.15	1.068	1.80123	1.550	3.253	
ADD HYD	280.30	36&37	1	.02038	41.04	1.958	1.80117	1.550	3.147	
*S ~~~~~~~~~ AP21 ~~~~~~~~~										
ROUTE	280.40	1	37	.02038	40.79	1.958	1.80121	1.550	3.127	
*S ~~~~~~~~~ AP21A ~~~~~~~~~										
ADD HYD	280.A	37&34	1	7.06852	1236.84	272.538	.72294	1.600	.273	
*S ROUTE FLOW IN THE AMOLE ARROYO TO SNOW VISTA CHANNEL										
ROUTE	250.B	1	34	7.06852	1236.69	272.533	.72292	1.600	.273	
COMPUTE NM HYD	600.00	-	49	.00539	11.55	.471	1.63961	1.500	3.349	PER IMP= 50.00
*S ~~~~~~~~~ AP25 ~~~~~~~~~										
ADD HYD	AP25	34&49	1	7.07391	1244.82	273.005	.72362	1.600	.275	

FINISH

SNOW VISTA BASIN--Portion of Basin 60104 Included

AHYMO SUMMARY TABLE (AHYMO194) - AMAFCA Hydrologic Model - January, 1994 RUN DATE (MON/DAY/YR) =02/11/2003
INPUT FILE = 1241SV.DAT USER NO.= ISCARFNM.I01

COMMAND	HYDROGRAPH IDENTIFICATION	FROM ID NO.	TO ID NO.	AREA (SQ MI)	PEAK DISCHARGE (CFS)	RUNOFF VOLUME (AC-FT)	RUNOFF (INCHES)	TIME TO PEAK (HOURS)	CFS PER ACRE	NOTATION
START										TIME= .00
*S THE DRAINAGE MANAGEMENT PLAN AHYMO FILE SV_DMP1.DAT WAS MODIFIED TO										
*S EXCLUDE UNITS 6 & 7 OF EL RANCHO GRANDE SUBDIVISION ALONG WITH										
*S A 120.9-ACRE PORTION OF OFFSITE FLOWS FROM WESTGATE HEIGHTS.										
*S BASINS 20501(=301.02) AND 20502 (=301.01) WERE ELIMINATED AND										
*S BASIN 20502 (=301.03) WAS REDUCED FROM 220 ACRES TO 128.9 ACRES.										
*S EL RANCHO GRANDE BASIN 500 WAS ADDED.										
*S										
*S NEW FILE DATA:										
*S FILE NAME : 1241SV.DAT										
*S BY: ASA NILSSON-WEBER										
*S LAST REVISION: 2/7/03										
*S										
*S SNOW VISTA										
*S WITH MANAGEMENT PLAN IN PLACE										
*S										
*S ORIGINAL FILE DATA:										
*S 100-YR, 24-HR STORM WITH NO SEDIMENT**										
*S FILE NAME : SV_DMP1.DAT										
*S BY: TOM BLAINE AND RICHARD STOCKTON/K. JACOBSEN										
*S LAST REVISION: 06-08-99 (PIPE FOR POND.71 CHANGED AND HYD=400)										
*S100 YEAR 24HR STORM DEVELOPED CONDITION										
RAINFALL TYPE= 2										RAIN24= 2.660
COMPUTE NM HYD	100.00	-	2	.13520	340.82	15.597	2.16311	1.500	3.939	PER IMP= 85.00
ROUTE RESERVOIR	100.10	2	5	.13520	111.60	15.611	2.16501	1.850	1.290	AC-FT= 4.075
ROUTE	100.20	5	3	.13520	112.75	15.611	2.16502	1.400	1.303	
ROUTE	100.30	3	10	.13520	114.14	15.611	2.16502	1.450	1.319	
COMPUTE NM HYD	110.00	-	2	.07170	181.36	8.272	2.16311	1.500	3.952	PER IMP= 85.00
ROUTE RESERVOIR	110.10	2	5	.07170	59.19	8.377	2.19060	2.600	1.290	AC-FT= .001
ROUTE	110.20	5	11	.07170	61.29	8.377	2.19061	1.400	1.336	
COMPUTE NM HYD	120.00	-	2	.04030	101.99	4.649	2.16311	1.500	3.954	PER IMP= 85.00
ROUTE RESERVOIR	120.10	2	5	.04030	33.30	4.654	2.16525	1.850	1.291	AC-FT= 1.219
ADD HYD	120.20	11& 5	12	.11200	94.58	13.031	2.18148	1.400	1.319	
ROUTE	120.30	12	11	.11200	95.88	13.031	2.18148	1.400	1.338	
COMPUTE NM HYD	130.00	-	2	.03770	95.41	4.349	2.16311	1.500	3.954	PER IMP= 85.00
ROUTE RESERVOIR	130.10	2	5	.03770	31.10	4.349	2.16310	1.850	1.289	AC-FT= 1.142
ADD HYD	130.20	11& 5	12	.14970	126.97	17.380	2.17685	1.400	1.325	
ADD HYD	130.30	10&12	12	.28490	238.38	32.991	2.17123	1.450	1.307	
ROUTE	130.40	12	90	.28490	241.75	32.991	2.17124	1.450	1.326	
COMPUTE NM HYD	140.00	-	2	.04300	105.07	4.718	2.05746	1.500	3.818	PER IMP= 79.00

COMMAND	HYDROGRAPH IDENTIFICATION	FROM ID NO.	TO ID NO.	AREA (SQ MI)	PEAK DISCHARGE (CFS)	RUNOFF VOLUME (AC-FT)	RUNOFF (INCHES)	TIME TO PEAK (HOURS)	CFS PER ACRE	NOTATION
ROUTE RESERVOIR	140.10	2	5	.04300	35.50	4.739	2.06628	1.800	1.290	AC-FT= 1.198
ROUTE	140.20	5	11	.04300	36.97	4.739	2.06630	1.400	1.343	
COMPUTE NM HYD	150.00	-	2	.02420	55.95	2.451	1.89898	1.500	3.612	PER IMP= 70.00
ROUTE RESERVOIR	150.10	2	5	.02420	19.99	2.456	1.90318	1.800	1.291	AC-FT= .589
ADD HYD	150.20	11& 5	12	.06720	56.96	7.195	2.00755	1.400	1.324	
COMPUTE NM HYD	170.00	-	70	.02853	65.96	2.889	1.89898	1.500	3.612	PER IMP= 70.00
ROUTE RESERVOIR	150.10	70	5	.02853	23.61	2.893	1.90140	1.800	1.293	AC-FT= .693
ADD HYD	170.20	12& 5	12	.09573	80.56	10.088	1.97591	1.400	1.315	
ROUTE	150.30	12	11	.09573	83.24	10.088	1.97592	1.400	1.359	
COMPUTE NM HYD	160.00	-	2	.02170	50.17	2.198	1.89898	1.500	3.612	PER IMP= 70.00
ROUTE RESERVOIR	160.10	2	5	.02170	15.89	2.198	1.89896	1.850	1.144	AC-FT= .888
ADD HYD	160.20	11& 5	12	.11743	94.99	12.286	1.96168	1.850	1.264	
ROUTE	170.40	12	11	.11743	94.99	12.286	1.96169	1.850	1.264	
COMPUTE NM HYD	180.00	-	2	.02810	64.96	2.846	1.89898	1.500	3.612	PER IMP= 70.00
ROUTE RESERVOIR	180.10	2	5	.02810	23.20	2.854	1.90432	1.800	1.290	AC-FT= .684
ADD HYD	180.20	11& 5	10	.14553	118.19	15.140	1.95061	1.850	1.269	
ROUTE	180.30	10	11	.14553	118.20	15.140	1.95061	1.850	1.269	
COMPUTE NM HYD	190.00	-	2	.03130	79.22	3.611	2.16311	1.500	3.955	PER IMP= 85.00
ROUTE RESERVOIR	190.10	2	5	.03130	25.80	3.611	2.16310	1.850	1.288	AC-FT= .950
ADD HYD	190.00	90& 5	1	.31620	267.54	36.602	2.17043	1.450	1.322	
ROUTE	190.20	1	10	.31620	271.17	36.602	2.17043	1.450	1.340	
ADD HYD	190.30	11&10	12	.46173	380.80	51.742	2.10114	1.450	1.289	
COMPUTE NM HYD	200.00	-	2	.02520	49.60	2.074	1.54349	1.500	3.075	PER IMP= 52.00
*S THE VOLUME FROM 200.1 IS THE SNOW VISTA POND VOLUME UNDER DEV. COND.										
*S HYD=200.1 IS *****AP 21.1*****										
ADD HYD	200.10	2&12	10	.48693	423.42	53.816	2.07228	1.450	1.359	
ROUTE RESERVOIR	200.20	10	3	.48693	387.71	53.814	2.07218	2.000	1.244	AC-FT= 6.455
*S HYD=200.2 IS *****AP 21*****										
MODIFY TIME	200.20	3	3	.48693	388.53	53.814	2.07218	1.950	1.247	
*s BEGIN ONSITE WATERSHED										
COMPUTE NM HYD	210.00	-	2	.00920	20.66	.871	1.77514	1.500	3.509	PER IMP= 61.00
ADD HYD	210.10	3& 2	10	.49613	393.57	54.685	2.06667	1.900	1.239	
ROUTE	210.20	10	11	.49613	393.76	54.684	2.06663	1.950	1.240	
COMPUTE NM HYD	220.00	-	2	.00800	17.97	.757	1.77514	1.500	3.510	PER IMP= 61.00
ADD HYD	220.10	11& 2	10	.50413	397.90	55.441	2.06200	1.950	1.233	
ROUTE	220.20	10	11	.50413	397.80	55.440	2.06198	1.900	1.233	
COMPUTE NM HYD	230.00	-	2	.00940	21.11	.890	1.77514	1.500	3.509	PER IMP= 61.00
ADD HYD	230.10	11& 2	10	.51353	403.48	56.330	2.05673	1.850	1.228	
ROUTE	230.20	10	11	.51353	404.02	56.330	2.05670	1.900	1.229	
COMPUTE NM HYD	240.00	-	2	.01450	32.56	1.373	1.77514	1.500	3.509	PER IMP= 61.00
*s END ONSITE WATERSHED										
ADD HYD	240.10	11& 2	10	.52803	412.58	57.702	2.04897	1.800	1.221	
COMPUTE NM HYD	250.00	-	2	.00220	5.04	.201	1.71016	1.500	3.582	PER IMP= 50.00
ADD HYD	250.10	10& 2	11	.53023	414.22	57.903	2.04756	1.800	1.221	
COMPUTE NM HYD	260.00	-	2	.01570	34.01	1.443	1.72289	1.500	3.385	PER IMP= 60.00

COMMAND	HYDROGRAPH IDENTIFICATION	FROM ID NO.	TO ID NO.	AREA (SQ MI)	PEAK DISCHARGE (CFS)	RUNOFF VOLUME (AC-FT)	RUNOFF (INCHES)	TIME TO PEAK (HOURS)	CFS PER ACRE	NOTATION
ROUTE	260.10	2	15	.01570	32.36	1.443	1.72292	1.550	3.221	
COMPUTE NM HYD	270.00	-	2	.01020	20.61	.841	1.54680	1.500	3.157	PER IMP= 50.00
ADD HYD	270.10	15& 2	16	.02590	52.62	2.284	1.65352	1.500	3.175	
DIVIDE HYD	270.20	16	15	.02035	25.79	1.795	1.65352	1.500	1.980	
	270.30	AND	3	.00555	26.84	.489	1.65352	1.500	7.556	
ROUTE	270.40	3	16	.00555	24.11	.489	1.65360	1.550	6.788	
COMPUTE NM HYD	280.00	-	2	.00220	5.42	.243	2.07506	1.500	3.850	PER IMP= 80.00
ADD HYD	280.10	16& 2	17	.00775	28.88	.733	1.77310	1.550	5.821	
ADD HYD	280.20	17&11	10	.53798	419.19	58.636	2.04361	1.750	1.217	
ROUTE	280.30	10	11	.53798	419.02	58.632	2.04348	1.750	1.217	
COMPUTE NM HYD	290.00	-	2	.00670	12.00	.421	1.17900	1.500	2.799	PER IMP= 25.00
ADD HYD	290.10	11& 2	10	.54468	424.08	59.053	2.03284	1.700	1.217	
COMPUTE NM HYD	300.00	-	2	.07090	179.34	8.179	2.16311	1.500	3.952	PER IMP= 85.00
ROUTE RESERVOIR	300.10	2	5	.07090	58.60	8.192	2.16634	1.850	1.291	AC-FT= 2.142
ROUTE	300.20	5	11	.07090	58.59	8.192	2.16636	2.350	1.291	
COMPUTE NM HYD	310.00	-	2	.08640	214.61	9.724	2.11028	1.500	3.881	PER IMP= 82.00
ROUTE RESERVOIR	310.10	2	5	.08640	71.30	9.826	2.13237	1.800	1.289	AC-FT= 2.505
ADD HYD	310.20	11& 5	12	.15730	129.89	18.018	2.14769	2.300	1.290	
ROUTE	310.30	12	11	.15730	129.89	18.018	2.14769	2.300	1.290	
ROUTE	310.40	11	13	.15730	129.89	18.018	2.14769	2.350	1.290	
COMPUTE NM HYD	320.00	-	2	.05470	122.45	5.283	1.81093	1.500	3.498	PER IMP= 65.00
ROUTE RESERVOIR	320.10	2	5	.05470	16.32	5.206	1.78457	2.100	.466	AC-FT= 3.035
ROUTE	320.20	5	11	.05470	16.32	5.205	1.78432	2.150	.466	
COMPUTE NM HYD	330.00	-	2	.02380	53.29	2.299	1.81093	1.500	3.498	PER IMP= 65.00
ADD HYD	330.10	11& 2	12	.07850	63.27	7.504	1.79239	1.500	1.259	
ADD HYD	330.20	12&13	14	.23580	190.99	25.522	2.02940	1.500	1.266	
ROUTE	330.30	14	12	.23580	189.79	25.521	2.02938	1.550	1.258	
ROUTE	330.40	12	11	.23580	190.04	25.521	2.02933	1.550	1.259	
ROUTE	330.50	15	17	.02035	25.49	1.795	1.65356	1.550	1.957	
ROUTE	330.60	17	16	.02035	25.11	1.795	1.65356	1.550	1.928	
COMPUTE NM HYD	340.00	-	2	.01550	31.31	1.279	1.54680	1.500	3.156	PER IMP= 50.00
ADD HYD	340.10	16& 2	15	.03585	55.01	3.073	1.60737	1.500	2.398	
ROUTE	340.20	15	16	.03585	54.76	3.073	1.60739	1.500	2.387	
ROUTE	340.30	16	15	.03585	54.42	3.073	1.60739	1.500	2.372	
COMPUTE NM HYD	350.00	-	2	.04830	97.54	3.985	1.54680	1.500	3.155	PER IMP= 50.00
ADD HYD	350.10	15& 2	16	.08415	151.96	7.058	1.57260	1.500	2.822	
ROUTE	350.20	16	15	.08415	151.86	7.058	1.57261	1.500	2.820	
ROUTE	350.30	15	16	.08415	150.38	7.058	1.57261	1.500	2.792	
COMPUTE NM HYD	360.00	-	2	.02080	42.01	1.716	1.54680	1.500	3.156	PER IMP= 50.00
ADD HYD	360.10	16& 2	15	.10495	192.40	8.774	1.56748	1.500	2.864	
ADD HYD	360.20	15&11	17	.34075	379.27	34.295	1.88709	1.500	1.739	
ROUTE	360.30	17	16	.34075	377.82	34.295	1.88708	1.500	1.732	
ADD HYD	360.40	16&10	15	.88543	741.01	93.348	1.97675	1.600	1.308	
COMPUTE NM HYD	370.00	-	2	.01830	36.97	1.510	1.54680	1.500	3.156	PER IMP= 50.00
ROUTE RESERVOIR	370.10	2	5	.01830	6.64	1.510	1.54678	2.050	.567	AC-FT= .768

COMMAND	HYDROGRAPH IDENTIFICATION	FROM ID NO.	TO ID NO.	AREA (SQ MI)	PEAK DISCHARGE (CFS)	RUNOFF VOLUME (AC-FT)	RUNOFF (INCHES)	TIME TO PEAK (HOURS)	CFS PER ACRE	NOTATION
*S HYD=AP22 IS *****AP 22*****										
ADD HYD	AP22	5&15	22	.90373	747.11	94.857	1.96804	1.600	1.292	
ROUTE	100.00	22	88	.90373	752.81	94.856	1.96801	1.600	1.302	
*S COMPUTE HYD FOR BASIN 301.61										
COMPUTE NM HYD	301.61	-	61	.03590	84.71	3.399	1.77514	1.500	3.687	PER IMP= 61.00
*S ROUTE ID=61 THROUGH POND.61										
ROUTE RESERVOIR	.61	61	1	.03590	26.35	3.411	1.78163	1.750	1.147	AC-FT= 1.154
*S ROUTE THIS FLOW DOWN THE 24" STORM DRAIN PIPE TO POND.62										
ROUTE	.61	1	11	.03590	26.36	3.411	1.78166	1.800	1.147	
*S HYDROGRAPH ID = 11 IS THE ROUTED FLOW OUT OF POND.61										
*S COMPUTE HYD FOR BASIN 301.62										
COMPUTE NM HYD	301.62	-	62	.03440	81.18	3.257	1.77514	1.500	3.687	PER IMP= 61.00
*S ROUTE ID=62 THROUGH POND.62										
ROUTE RESERVOIR	.62	62	1	.03440	25.02	3.267	1.78046	1.800	1.136	AC-FT= 1.098
*S ROUTED FLOW OUT OF POND.62										
*S ADD HYD ID=11 TO ID=1 AND ROUTE THIS FLOW THROUGH THE 30" STORM DRAIN										
*S TO POND.63										
ADD HYD	POND.62	1&11	1	.07030	51.38	6.678	1.78106	1.800	1.142	
ROUTE	.62	1	12	.07030	51.40	6.678	1.78107	1.800	1.142	
*S HYDROGRAPH ID = 12 IS THE ROUTED FLOW DOWN THE 30" STORM DRAIN PIPE										
*S COMPUTE HYD FOR BASIN 301.63										
COMPUTE NM HYD	301.63	-	63	.03440	81.18	3.257	1.77514	1.500	3.687	PER IMP= 61.00
*S ROUTE ID=63 THROUGH POND.63										
ROUTE RESERVOIR	.63	63	1	.03440	25.02	3.267	1.78046	1.800	1.136	AC-FT= 1.098
*S ROUTED FLOW OUT OF POND.63										
*S ADD HYD ID=12 TO ID=1 AND ROUTE THIS FLOW THROUGH THE 36" STORM DRAIN										
*S TO POND.64										
ADD HYD	POND.63	1&12	1	.10470	76.42	9.944	1.78086	1.800	1.140	
ROUTE	.63	1	13	.10470	76.44	9.944	1.78087	1.800	1.141	
*S HYDROGRAPH ID = 13 IS THE ROUTED FLOW DOWN THE 36" STORM DRAIN PIPE										
*S TO THE INLET OF POND.64 TO THIS STORM DRAIN PIPE										
*S COMPUTE HYD FOR BASIN 301.64										
COMPUTE NM HYD	301.64	-	64	.03440	81.18	3.257	1.77514	1.500	3.687	PER IMP= 61.00
*S ROUTE ID=64 THROUGH POND.64										
ROUTE RESERVOIR	.64	64	1	.03440	25.02	3.267	1.78046	1.800	1.136	AC-FT= 1.098
*S ROUTED FLOW OUT OF POND.64										
*S ADD HYD ID=13 TO ID=1 AND ROUTE THIS FLOW THROUGH THE 36" STORM DRAIN										
*S TO POND.65										
ADD HYD	POND.64	1&13	1	.13910	101.46	13.211	1.78076	1.800	1.140	
ROUTE	.64	1	14	.13910	101.46	13.211	1.78077	1.800	1.140	
*S HYDROGRAPH ID = 14 IS THE ROUTED FLOW DOWN THE 36" STORM DRAIN PIPE										
*S TO THE INLET OF POND.64 TO THIS STORM DRAIN PIPE										
*S COMPUTE HYD FOR BASIN 301.65										
COMPUTE NM HYD	301.65	-	65	.03440	81.18	3.257	1.77514	1.500	3.687	PER IMP= 61.00
*S ROUTE ID=65 THROUGH POND.65										

COMMAND	HYDROGRAPH IDENTIFICATION	FROM ID NO.	TO ID NO.	AREA (SQ MI)	PEAK DISCHARGE (CFS)	RUNOFF VOLUME (AC-FT)	RUNOFF (INCHES)	TIME TO PEAK (HOURS)	CFS PER ACRE	NOTATION
ROUTE RESERVOIR	.65	65	1	.03440	25.02	3.267	1.78046	1.800	1.136	AC-FT= 1.098
*S ROUTED FLOW OUT OF POND.65										
*S ADD HYD ID=14 TO ID=1 AND ROUTE THIS FLOW THROUGH THE 36" STORM DRAIN										
*S TO SNOW VISTA CHANNEL										
ADD HYD	POND.65	1&14	1	.17350	126.48	16.477	1.78070	1.800	1.139	
*S COMPUTE HYD FOR BASIN 301.05										
COMPUTE NM HYD	301.05	-	5	.03280	77.40	3.105	1.77514	1.500	3.687	PER IMP= 61.00
*S TOTAL FLOW AT AP-22.1 IN SNOW VISTA CHANNEL										
ADD HYD	301.00	88& 1	3	1.07723	870.85	111.334	1.93785	1.600	1.263	
*S HYD=AP22.1 IS *****AP 22.1*****										
ADD HYD	AP22.1	3& 5	2	1.11003	916.28	114.439	1.93304	1.600	1.290	
ROUTE	301.60	2	1	1.11003	925.36	114.436	1.93299	1.600	1.303	
*S COMPUTE HYD FOR BASIN 301.04										
COMPUTE NM HYD	301.04	-	4	.07660	180.72	7.252	1.77515	1.500	3.686	PER IMP= 61.00
*S HYD=AP22.2 IS *****AP 22.2*****										
ADD HYD	AP22.2	1& 4	1	1.18663	1031.47	121.688	1.92280	1.600	1.358	
ROUTE	300.00	1	9	1.18663	1037.20	121.687	1.92278	1.600	1.366	
*S COMPUTE HYD FOR BASIN 301.71										
COMPUTE NM HYD	301.71	-	71	.06940	163.75	6.570	1.77514	1.500	3.687	PER IMP= 61.00
*S ROUTE THIS FLOW DOWN THE 60" STORM DRAIN PIPE LINE TO 301.72										
ROUTE	.71	71	11	.06940	167.38	6.570	1.77515	1.500	3.769	
*S COMPUTE HYD FOR BASIN 301.72										
COMPUTE NM HYD	301.72	-	72	.04220	99.58	3.995	1.77514	1.500	3.687	PER IMP= 61.00
*S ADD BASIN 301.71 AND ROUTE THIS FLOW DOWN THE 60" STORM DRAIN PIPE LINE TO 3										
ADD HYD	301.72	72&11	2	.11160	266.96	10.566	1.77514	1.500	3.738	
ROUTE	.71	2	11	.11160	269.93	10.566	1.77515	1.500	3.779	
*S COMPUTE HYD FOR BASIN 301.74										
COMPUTE NM HYD	301.74	-	74	.00910	21.88	.830	1.71015	1.500	3.757	PER IMP= 50.00
*S ADD BASIN 301.72 AND BASIN 301.74										
ADD HYD	301.74	74&11	11	.12070	291.81	11.396	1.77024	1.500	3.778	
COMPUTE NM HYD	301.73	-	73	.01940	45.78	1.837	1.77514	1.500	3.688	PER IMP= 61.00
*S ADD HYDGRAPHS FROM										
ADD HYD	301.73	73&11	4	.14010	337.60	13.232	1.77092	1.500	3.765	
*S COMPUTE HYD FOR BASIN 301.03										
COMPUTE NM HYD	301.03	-	3	.20140	474.78	19.067	1.77514	1.500	3.683	PER IMP= 61.00
*S HYDROGRAPH ID 73 IS THE INFLOW TO THE SNOW VISTA CHANNEL AT AP-23										
ADD HYD	301.03	3& 4	73	.34150	812.38	32.300	1.77341	1.500	3.717	
*S HYD=AP23 IS *****AP 23*****										
ADD HYD	AP23	9&73	1	1.52813	1722.67	153.987	1.88940	1.500	1.761	
ROUTE	400.00	1	2	1.52813	1726.23	153.986	1.88939	1.500	1.765	
ROUTE	500.00	2	3	1.52813	1709.18	153.982	1.88934	1.550	1.748	
ROUTE	600.00	3	4	1.52813	1717.19	153.981	1.88933	1.550	1.756	
ROUTE	700.00	4	2	1.52813	1688.08	153.972	1.88922	1.550	1.726	
*S BASIN 500 EL RANCHO GRANDE										
COMPUTE NM HYD	500.00	-	44	.00217	4.70	.197	1.69924	1.500	3.386	PER IMP= 57.88

COMMAND	HYDROGRAPH IDENTIFICATION	FROM ID NO.	TO ID NO.	AREA (SQ MI)	PEAK DISCHARGE (CFS)	RUNOFF VOLUME (AC-FT)	RUNOFF (INCHES)	TIME TO PEAK (HOURS)	CFS PER ACRE	NOTATION
*S	*****AP23.2*****									
ADD HYD	AP23.2	2&44	3	1.53030	1692.26	154.169	1.88895	1.550	1.728	
*S RECALL AMOLE ARROYO OUTFLOW HYDROGRAPH										
RECALL HYD	AP25	-	1	7.07391	1244.82	273.005	.72362	1.600	.275	
*S ADD FLOWS AT AP23.2 AND AP25										
*S	*****AP25.1*****									
ADD HYD	AP25.1	1& 3	5	8.60421	2878.70	427.173	.93088	1.600	.523	
ROUTE	800.00	5	4	8.60421	2800.54	426.153	.92866	1.600	.509	
*S COMPUTE HYD FOR BASIN 301.00										
COMPUTE NM HYD	300.00	-	1	.05156	121.66	4.881	1.77514	1.500	3.687	PER IMP= 61.00
ROUTE RESERVOIR	.01	1	5	.05156	42.85	4.881	1.77514	1.750	1.298	AC-FT= 1.790
*S HYD=AP24 IS *****AP 24*****										
ADD HYD	AP24	5& 4	2	8.65577	2843.27	431.034	.93370	1.600	.513	
ROUTE	SV_DMP2.HYD	2	66	8.65577	2840.01	430.287	.93208	1.650	.513	
FINISH										

AMOLE BASIN--Portion of Basin 60104 Excluded

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AHYMO SUMMARY TABLE (AHYMO194) - AMAFCA Hydrologic Model - January, 1994          RUN DATE (MON/DAY/YR) =02/11/2003
INPUT FILE = 1241dev2.dat                                                                  USER NO.= ISCARFNM.I01

                                FROM  TO                    PEAK        RUNOFF                TIME TO    CFS       PAGE =    1
                   HYDROGRAPH   ID    ID        AREA     DISCHARGE     VOLUME      RUNOFF      PEAK     PER
COMMAND          IDENTIFICATION NO.   NO.     (SQ MI)     (CFS)       (AC-FT)    (INCHES)   (HOURS)   ACRE      NOTATION

START                                                                                                   TIME=        .00
*S
*S      AMOLE ARROYO AND HUBBLE LAKE SYSTEM
*S
*S
*S
*S THE DRAINAGE MANAGEMENT PLAN AHYMO FILE AA_DMP2.DAT WAS MODIFIED TO
*S INCLUDE UNITS 6 & 7 OF EL RANCHO GRANDE SUBDIVISION ALONG WITH
*S A 120.9-ACRE PORTION OF OFFSITE FLOWS FROM WESTGATE HEIGHTS. A 5.8-
*S ACRE PORTION OF BASIN 20502 (=301.01) WAS INCLUDED IN BASIN 00105.
*S
*S REVISED FILE DATA:
*S FILE NAME: 1241DEV2.DAT
*S BY: ASA NILSSON-WEBER
*S LAST REVISION: 2/7/03
*S
*S ORIGINAL FILE DATA:
*S 100-YR, 24-HR STORM WITH SEDIMENT
*S FILE NAME: AA_DMP2.DAT LOW FLOW ALT
*S BY: RICHARD STOCKTON / KAREN JACOBSEN
*S LAST REVISION: 3-10-99
*S
*S*************************************************************************
*S THE PURPOSE OF THIS MODEL IS TO CALCULATE THE RUNOFF FROM THE AMOLE ARROYO,
*S FROM WESTGATE DAM THROUGH TO THE HUBBLE LAKE DETENTION FACILITY.  THIS RUN
*S USES THE RECALL HYD COMMAND TO INPUT HYDOGRAPHS FROM POWERLINE CHANNEL (PL),
*S SNOW VISTA CHANNEL (SV), SACATE BLANCO CHANNEL (SB), AMOLE DEL NORTE CHANNEL
*S (AN), RIO BRAVO (RB), AND THE BORREGA CHANNEL (BR).  THIS RUN ALSO CALCULATES
*S RUNOFF FROM SUB-BASINS ADJACENT TO THE CHANNEL THAT ARE NOT INCLUDED IN THE
*S ABOVE MENTIONED HYDROGRAPHS.
*S
*S*********************************************************************
*S
*S IMPORTANT NOTE1: ROUTE RESERVOIR DOES NOT INCLUDE ALL OF THE VOLUME FROM
*S                  WESTGATE DAM. THEREFORE, ADD ** 278 AC.FT ** OF VOLUME
*S                  TO ALL OF THE HYDROGRAPHS PUBLISHED IN THIS RUN.
*S                  THIS WILL ACCOUNT FOR THE VOLUME OF RUNOFF
*S                  TRUNCATED FROM WESTGATE DAM.
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```
*S
*S*********************************************************************
*S
*S IMPORTANT NOTE2: ROUTE RESERVOIR DOES NOT INCLUDE ALL OF THE VOLUME FROM
*S                  POWERLINE CHANNEL. THEREFORE, ADD ** 55.4 AC.FT ** OF VOLUME
*S                  TO THE AFFECTED HYDROGRAPHS PUBLISHED IN THIS RUN.
*S                  THIS WILL ACCOUNT FOR THE VOLUME OF RUNOFF
*S                  TRUNCATED FROM THE POWERLINE ALTERNATIVE.
*S
*S*********************************************************************
*S
*S IMPORTANT NOTE3: N/A
*S
*S*********************************************************************
*S
*S IMPORTANT NOTE4: ROUTE RESERVOIR DOES NOT INCLUDE ALL OF THE VOLUME FROM
*S                  AMOLE DEL NORTE. THEREFORE, ADD ** 3.2 AC.FT ** OF VOLUME
*S                  TO THE AFFECTED HYDROGRAPHS PUBLISHED IN THIS RUN.
*S                  THIS WILL ACCOUNT FOR THE VOLUME OF RUNOFF
*S                  TRUNCATED FROM THE AMOLE DEL NORTE ALTERNATIVE.
*S*********************************************************************
*S ANALYSIS ASSUMPTIONS:
*S*********************************************************************
*S 1. ALL LAND IN THIS BASIN IS MODELED AS DEVELOPED CONDITION.
*S
*S 2. A BULKING FACTOR OF 15% HAS BEEN ADDED TO EACH UNDEVELOPED SUB-BASIN AND
*S    A BULKING FACTOR OF 6% HAS BEEN ADDED TO EACH DEVELOPED SUB-BASIN LIKELY
*S    TO PRODUCE SEDIMENT.  A BULKING FACTOR OF 3% HAS BEEN ADDED TO EACH
*S    DEVELOPED SUB-BASIN THAT COULD PROBIBLY PRODUCE SOME SEDIMENT, SUCH AS PAR
*S    AND SCHOOL PLAY GROUNDS.   AND, NO BULKING FACTOR FOR WELL
*S    DEFINED RESIDENTIAL DEVELOPMENTS.
*S
*S 3. BOTH THE AMOLE DETENTION FACILITY AND HUBBELL LAKE DETENTION FACILITY
*S    PRINCIPAL SPILLWAYS ARE MODELED CLOSED.  THESE TWO FACILITIES ARE
*S    REPRESENTATED AS AP40.1 AND AP 50.1, RESPECTIVELY ON THE SUPPLEMENTAL
*S    MAPPING AND REPORT.
*S
*S 4. THE AMOLE BASIN HAS FREE DISCHARGE TO THE AMOLE ARROYO.  POWERLINE
*S    HAS A RESTRICTED DISCHARGE OF 20 AND SNOW VISTA IS FREE DISCHARGE.
*S    THE RUNOFF IS CONVEYED IN A HIGH FLOW CHANNEL TO THE AMOLE DETENTION FACIL
*S
*S 5. THIS ALTERNATIVE INCLUDES THE GUAC DETENTION BASIN.
*S
*S 6. THIS ALTERNATIVE INCLUDES BASINS 35301, 35303, AND 35305 FROM THE
*S    AN_DMP.DAT FILE AS A RESULT OF THE UNSER EXTENSION.
*S*********************************************************************
*S100 YEAR 24HR STORM DEVELOPED CONDITION
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                                FROM  TO                    PEAK        RUNOFF                TIME TO   CFS
                  HYDROGRAPH    ID    ID        AREA     DISCHARGE     VOLUME      RUNOFF      PEAK    PER
COMMAND         IDENTIFICATION  NO.   NO.      (SQ MI)     (CFS)      (AC-FT)    (INCHES)   (HOURS)  ACRE     NOTATION

RAINFALL  TYPE= 2                                                                                          RAIN24=    2.660
*S RECALL OUTFLOW HYDROGRAPH FROM THE WESTGATE DAM
*S  HYD NO. WG100D1B.HYD IS ***** AP 01 *****
RECALL HYD        WG_DMP.HYD    -     5       5.15730       73.47     170.999      .62169    7.050    .022
*S ROUTE FLOW TO AP02
ROUTE                WG101.5    5    11       5.15730       73.47     170.672      .62050    6.950    .022
*S CALCULATE FLOW FROM SUB-BASIN 00102
*S GENERATION OF SEDIMENT LIKELY, BULK FLOWS 6%
SEDIMENT BULK                                                                                              PK BF =     1.06
COMPUTE NM HYD        102.00    -     2        .11190      218.60       9.283     1.55544    1.500    3.052 PER IMP=   47.00
*S ADD THE ROUTED FLOW FROM SUB-BASIN WG101.5 TO THE FLOW FROM SUB-BASIN 00102.
ADD HYD               102.10 11& 2    3       5.26920      254.43     179.955      .64035    1.500    .075
*S RECALL OUTFLOW HYDROGRAPH FROM POWERLINE CHANNEL
*S
*S IMPORTANT NOTE2: ROUTE RESERVOIR DOES NOT INCLUDE ALL OF THE VOLUME FROM
*S                  POWERLINE CHANNEL. THEREFORE, ADD ** 20.6 AC.FT ** OF VOLUME
*S                  TO THE AFFECTED HYDROGRAPHS PUBLISHED IN THIS RUN.
*S                  THIS WILL ACCOUNT FOR THE VOLUME OF RUNOFF
*S                  TRUNCATED FROM THE POWERLINE ALTERNATIVE. THE TOTAL
*S                  TRUNCATED VOLUME TO THIS POINT IS 289.6 AC FT
*S
RECALL HYD        PL_DMP1.HYD   -    11       1.20470       19.34      42.699      .66457   29.900    .025
ADD HYD               102.10 11& 3    3       6.47390      256.59     222.654      .64486    1.500    .062
*S HYD=102.1 IS *** AP02 *****
*S ROUTE FLOW IN THE AMOLE ARROYO TO 900 FEET EAST OF POWERLINE CHANNEL.
ROUTE                 102.50    3    12       6.47390      257.32     222.483      .64437    1.550    .062
*S
*S GENERATION OF SEDIMENT LIKELY, BULK FLOWS 6%
SEDIMENT BULK                                                                                              PK BF =     1.06
COMPUTE NM HYD        00103A    -     2        .07170      162.04       6.475     1.69326    1.500    3.531 PER IMP=   49.00
*S ROUTE FLOW THROUGH SUB-BASIN 00103B TO THE AMOLE ARROYO.
ROUTE               00103A.5    2    11        .07170      100.85       6.475     1.69325    1.600    2.198
*S CALCULATE FLOW FROM SUB-BASIN 00103B
*S GENERATION OF SEDIMENT LIKELY, BULK FLOWS 6%
SEDIMENT BULK                                                                                              PK BF =     1.06
COMPUTE NM HYD        00103B    -     2        .12070      202.77      10.858     1.68669    1.600    2.625 PER IMP=   49.00
*S ADD THE ROUTE FLOW FROM SUB-BASIN 00103A.5 TO THE FLOW
*S FROM SUB-BASIN 00103B.
ADD HYD             00103B.1 11& 2    3        .19240      303.62      17.333     1.68913    1.600    2.466
*S ADD THE COMBINED FLOW FROM SUB-BASIN 00103B.1 TO THE ROUTED FLOW
*S IN THE AMOLE ARROYO.
ADD HYD             00103B.2 12& 3    4       6.66630      544.09     239.816      .67452    1.550    .128
*S ROUTE FLOW FROM SUB-BASIN 00103B.1 IN THE AMOLE ARROYO TO
*S DELGADO STREET.
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                                FROM  TO                    PEAK        RUNOFF                 TIME TO    CFS
                  HYDROGRAPH     ID   ID        AREA     DISCHARGE     VOLUME      RUNOFF       PEAK     PER
COMMAND         IDENTIFICATION   NO.  NO.     (SQ MI)      (CFS)       (AC-FT)    (INCHES)    (HOURS)   ACRE      NOTATION

ROUTE                00103B.5    4   11      6.66630       537.98      239.749      .67433      1.550    .126
*S
*S CALCULATE FLOW FROM SUB-BASIN 00104
*S GENERATION OF SEDIMENT LIKELY, BULK FLOWS 6%
SEDIMENT BULK                                                                                          PK BF =    1.06
COMPUTE NM HYD        104.00    -    2       .01830        40.11        1.617     1.65724      1.500   3.424 PER IMP=  49.00
*S ADD THE FLOW FROM SUB-BASIN 00104 TO THE ROUTED FLOW IN THE AMOLE ARROYO.
*S HYD NO. 00104.1 IS ***** AP 02.1 *****
ADD HYD               104.10 11& 2   3      6.68460       573.79      241.367      .67702      1.550    .134
*S ROUTE FLOW FROM SUB-BASIN 00104 IN THE AMOLE ARROYO TO 2990 FEET EAST
*S FOR SNOW VISTA CHANNEL
ROUTE                 104.50    3   11      6.68460       568.71      240.764      .67533      1.600    .133
*S
*S CALCULATE FLOW FROM SUB-BASIN 00105
*S GENERATION OF SEDIMENT LIKELY, BULK FLOWS 6%
SEDIMENT BULK                                                                                          PK BF =    1.06
COMPUTE NM HYD        105.00    -    2       .08581       181.91        7.484     1.63539      1.500   3.312 PER IMP=  49.00
*S ADD THE FLOW FROM SUB-BASIN 00105 TO THE ROUTED FLOW IN THE AMOLE ARROYO.
*S HYD NO. 00105.1 IS ***** AP 02.2A *****
ADD HYD               105.10 11& 2  41      6.77041       700.88      248.249      .68750      1.600    .162
*S*************************************************************
*S***             EL RANCHO GRANDE SUBDIVISION              ****
*S***              UNITS SIX, SEVEN, & EIGHT                ****
*S***                 DEVELOPED CONDITIONS                  ****
*S*************************************************************
*S*************** OFFSITE BASINS *******************
*S
*S  BASIN A (102)
COMPUTE NM HYD        102.00    -    2       .02210        45.19        1.774     1.50473      1.500   3.195 PER IMP=  42.00
*S  ~~~~~~~~~  AP1  ~~~~~~~~~
ROUTE                 102.20    3    2       .02210        43.14        1.774     1.50475      1.550   3.050
*S  BASIN B (103)
COMPUTE NM HYD        103.00    -    3       .01926        39.39        1.546     1.50472      1.500   3.195 PER IMP=  42.00
ADD HYD               103.10  2& 3   1       .04136        78.57        3.319     1.50472      1.550   2.968
*S  ~~~~~~~~~  AP2  ~~~~~~~~~
ROUTE                 103.20    1    3       .04136        79.71        3.319     1.50473      1.550   3.011
*S  BASIN C (104)
COMPUTE NM HYD        104.00    -    4       .00929        19.01         .746     1.50473      1.500   3.197 PER IMP=  42.00
ADD HYD               104.10  3& 4   1       .05065        96.81        4.065     1.50471      1.550   2.986
*S  ~~~~~~~~~  AP3  ~~~~~~~~~
ROUTE                 104.20    1    4       .05065        94.44        4.065     1.50473      1.600   2.913
*S  BASIN D (110)
*S  ~~~~~~~~~  AP4  ~~~~~~~~~
COMPUTE NM HYD        110.00    -    5       .00989        20.23         .794     1.50473      1.500   3.196 PER IMP=  42.00
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COMMAND	HYDROGRAPH IDENTIFICATION	FROM ID NO.	TO ID NO.	AREA (SQ MI)	PEAK DISCHARGE (CFS)	RUNOFF VOLUME (AC-FT)	RUNOFF (INCHES)	TIME TO PEAK (HOURS)	CFS PER ACRE	NOTATION
*S BASIN E (111)										
COMPUTE NM HYD	111.00	-	6	.01977	40.43	1.587	1.50473	1.500	3.195	PER IMP= 42.00
ADD HYD	111.10	5& 6	1	.02966	60.66	2.380	1.50470	1.500	3.196	
*S ~~~~~~~~~ AP5 ~~~~~~~~~										
ROUTE	111.20	1	6	.02966	54.53	2.380	1.50473	1.550	2.873	
*S BASIN F (112)										
COMPUTE NM HYD	112.00	-	7	.01510	30.88	1.212	1.50472	1.500	3.196	PER IMP= 42.00
ADD HYD	112.10	6& 7	1	.04476	82.31	3.592	1.50471	1.550	2.873	
*S ~~~~~~~~~ AP6 ~~~~~~~~~										
ROUTE	112.20	1	7	.04476	78.22	3.592	1.50472	1.600	2.731	
*S BASIN G (120)										
*S ~~~~~~~~~ AP8 ~~~~~~~~~										
COMPUTE NM HYD	120.00	-	8	.01375	28.12	1.103	1.50473	1.500	3.196	PER IMP= 42.00
*S BASIN H (121)										
COMPUTE NM HYD	121.00	-	9	.01319	26.98	1.059	1.50472	1.500	3.196	PER IMP= 42.00
ADD HYD	121.10	8& 9	1	.02694	55.10	2.162	1.50470	1.500	3.196	
*S ~~~~~~~~~ AP9 ~~~~~~~~~										
ROUTE	121.20	1	9	.02694	53.66	2.162	1.50476	1.550	3.112	
*S BASIN I (122)										
COMPUTE NM HYD	122.00	-	10	.01858	38.00	1.491	1.50472	1.500	3.195	PER IMP= 42.00
ADD HYD	122.10	9&10	1	.04552	89.31	3.653	1.50472	1.500	3.066	
*S ~~~~~~~~~ AP7 ~~~~~~~~~										
ROUTE	122.20	1	10	.04552	85.57	3.653	1.50474	1.550	2.937	
ADD HYD	104.30	4&10	10	.09617	179.19	7.718	1.50472	1.550	2.911	
*S BASIN J (130)										
COMPUTE NM HYD	130.00	-	11	.01661	33.97	1.333	1.50473	1.500	3.196	PER IMP= 42.00
ADD HYD	130.10	10&11	1	.11278	209.75	9.051	1.50472	1.550	2.906	
*S ~~~~~~~~~ AP10 ~~~~~~~~~										
ROUTE	130.20	1	11	.11278	206.48	9.051	1.50472	1.600	2.861	
*S BASIN K (131)										
COMPUTE NM HYD	131.00	-	12	.01532	31.33	1.229	1.50472	1.500	3.196	PER IMP= 42.00
ADD HYD	131.10	11&12	1	.12810	229.34	10.280	1.50472	1.550	2.797	
*S ~~~~~~~~~ AP11 ~~~~~~~~~										
ROUTE	131.20	1	12	.12810	219.98	10.280	1.50472	1.600	2.683	
*S BASIN L (140)										
*S ~~~~~~~~~ AP12 ~~~~~~~~~										
COMPUTE NM HYD	140.00	-	13	.01609	32.91	1.291	1.50472	1.500	3.196	PER IMP= 42.00
*S										
*S*************** ONSITE BASINS *******************										
*S										
COMPUTE NM HYD	300.00	-	38	.00150	3.45	.144	1.80120	1.500	3.594	PER IMP= 57.88
COMPUTE NM HYD	310.00	-	39	.00080	1.85	.077	1.80120	1.500	3.610	PER IMP= 57.88
COMPUTE NM HYD	320.00	-	40	.00087	2.01	.084	1.80120	1.500	3.606	PER IMP= 57.88
ADD HYD	310.10	12&39	15	.12890	221.26	10.357	1.50655	1.600	2.682	

COMMAND	HYDROGRAPH IDENTIFICATION	FROM ID NO.	TO ID NO.	AREA (SQ MI)	PEAK DISCHARGE (CFS)	RUNOFF VOLUME (AC-FT)	RUNOFF (INCHES)	TIME TO PEAK (HOURS)	CFS PER ACRE	NOTATION
ADD HYD	310.20	38&15	16	.13040	223.67	10.501	1.50994	1.600	2.680	
ADD HYD	310.30	41&16	1	6.90081	924.55	258.750	.70304	1.600	.209	
*S ~~~~~~~~~ AP22 ~~~~~~~~~										
ROUTE	310.40	1	39	6.90081	915.06	258.641	.70275	1.600	.207	
*S ~~~~~~~~~ AP22A ~~~~~~~~~										
ADD HYD	310.A	39&40	1	6.90168	916.46	258.725	.70289	1.600	.207	
*S ROUTE FLOW IN THE AMOLE ARROYO TO AP18										
ROUTE	310.B	1	11	6.90168	912.77	258.565	.70245	1.600	.207	
*S ~~~~~~~~~ AP14 ~~~~~~~~~										
COMPUTE NM HYD	210.00	-	30	.00436	10.00	.419	1.80120	1.500	3.584	PER IMP= 57.88
COMPUTE NM HYD	220.00	-	31	.00408	9.36	.392	1.80120	1.500	3.584	PER IMP= 57.88
ADD HYD	220.10	30&31	1	.00844	19.36	.811	1.80112	1.500	3.584	
*S ~~~~~~~~~ AP15 ~~~~~~~~~										
ROUTE	220.20	1	31	.00844	19.00	.811	1.80131	1.500	3.518	
COMPUTE NM HYD	230.00	-	32	.00208	4.78	.200	1.80120	1.500	3.590	PER IMP= 57.88
ADD HYD	230.10	13&32	1	.01817	37.68	1.491	1.53863	1.500	3.241	
*S ~~~~~~~~~ AP16 ~~~~~~~~~										
ROUTE	230.20	1	32	.01817	37.87	1.491	1.53867	1.500	3.257	
COMPUTE NM HYD	240.00	-	33	.00516	11.83	.496	1.80120	1.500	3.583	PER IMP= 57.88
ADD HYD	240.10	32&33	1	.02333	49.70	1.987	1.59669	1.500	3.329	
ROUTE	240.20	1	33	.02333	49.54	1.987	1.59672	1.500	3.318	
ADD HYD	240.30	31&33	1	.03177	68.54	2.798	1.65103	1.500	3.371	
*S ~~~~~~~~~ AP17 ~~~~~~~~~										
ROUTE	240.40	1	33	.03177	67.88	2.798	1.65105	1.550	3.338	
COMPUTE NM HYD	250.00	-	34	.00569	13.05	.547	1.80120	1.500	3.583	PER IMP= 57.88
*S ~~~~~~~~~ AP 18 ~~~~~~~~~										
ADD HYD	250.10	33&34	34	.03746	80.87	3.344	1.67383	1.500	3.373	
*S ~~~~~~~~~ AP18A ~~~~~~~~~										
ADD HYD	250.A	34&11	1	6.93914	976.24	261.909	.70769	1.600	.220	
*S ROUTE FLOW IN THE AMOLE ARROYO TO AP21										
ROUTE	250.B	1	34	6.93914	973.23	261.795	.70739	1.600	.219	
COMPUTE NM HYD	260.00	-	35	.00793	18.18	.762	1.80120	1.500	3.582	PER IMP= 57.88
*S ~~~~~~~~~ AP19 ~~~~~~~~~										
ROUTE	260.10	36	35	.00793	16.19	.762	1.80126	1.550	3.190	
COMPUTE NM HYD	270.00	-	36	.00926	21.22	.890	1.80120	1.500	3.581	PER IMP= 57.88
*S ~~~~~~~~~ AP20 ~~~~~~~~~										
ROUTE	270.10	37	36	.00926	17.89	.890	1.80124	1.550	3.019	
COMPUTE NM HYD	280.00	-	37	.00319	7.32	.306	1.80120	1.500	3.587	PER IMP= 57.88
ADD HYD	280.10	35&37	1	.01112	22.70	1.068	1.80116	1.550	3.190	
ROUTE	280.20	1	37	.01112	23.15	1.068	1.80123	1.550	3.253	
ADD HYD	280.30	36&37	1	.02038	41.04	1.958	1.80117	1.550	3.147	
*S ~~~~~~~~~ AP21 ~~~~~~~~~										
ROUTE	280.40	1	37	.02038	40.79	1.958	1.80121	1.550	3.127	
*S ~~~~~~~~~ AP21A ~~~~~~~~~										

COMMAND	HYDROGRAPH IDENTIFICATION	FROM ID NO.	TO ID NO.	AREA (SQ MI)	PEAK DISCHARGE (CFS)	RUNOFF VOLUME (AC-FT)	RUNOFF (INCHES)	TIME TO PEAK (HOURS)	CFS PER ACRE	NOTATION
ADD HYD	280.A	37&34	1	6.95952	1013.37	263.753	.71059	1.600	.228	
*S ROUTE FLOW IN THE AMOLE ARROYO TO SNOW VISTA CHANNEL										
ROUTE	250.B	1	34	6.95952	1012.86	263.748	.71058	1.600	.227	
COMPUTE NM HYD	600.00	-	49	.00539	11.55	.471	1.63961	1.500	3.349	PER IMP= 50.00
*S ~~~~~~~~~ AP25 ~~~~~~~~~										
ADD HYD	AP25X	34&49	1	6.96491	1020.99	264.220	.71130	1.600	.229	
FINISH										

SNOW VISTA BASIN--Portion of Basin 60104 Excluded

AHYMO SUMMARY TABLE (AHYMO194) - AMAFCA Hydrologic Model - January, 1994 RUN DATE (MON/DAY/YR) =02/11/2003
INPUT FILE = 1241sv2.dat USER NO.= ISCARFNM.I01

PAGE = 1

COMMAND	HYDROGRAPH IDENTIFICATION	FROM ID NO.	TO ID NO.	AREA (SQ MI)	PEAK DISCHARGE (CFS)	RUNOFF VOLUME (AC-FT)	RUNOFF (INCHES)	TIME TO PEAK (HOURS)	CFS PER ACRE	NOTATION
START										TIME= .00
*S										
*S THE DRAINAGE MANAGEMENT PLAN AHYMO FILE SV_DMP1.DAT WAS MODIFIED TO										
*S EXCLUDE UNITS 6 & 7 OF EL RANCHO GRANDE SUBDIVISION ALONG WITH										
*S A 120.9-ACRE PORTION OF OFFSITE FLOWS FROM WESTGATE HEIGHTS.										
*S BASINS 20501(=301.02) AND 20502 (=301.01) WERE ELIMINATED AND										
*S BASIN 20502 (=301.03) WAS REDUCED FROM 220 ACRES TO 128.9 ACRES.										
*S EL RANCHO GRANDE BASIN 500 WAS ADDED.										
*S										
*S NEW FILE DATA:										
*S FILE NAME : 1241SV.DAT										
*S BY: ASA NILSSON-WEBER										
*S LAST REVISION: 2/7/03										
*S										
*S SNOW VISTA										
*S WITH MANAGEMENT PLAN IN PLACE										
*S										
*S ORIGINAL FILE DATA:										
*S 100-YR, 24-HR STORM WITH NO SEDIMENT**										
*S FILE NAME : SV_DMP1.DAT										
*S BY: TOM BLAINE AND RICHARD STOCKTON/K. JACOBSEN										
*S LAST REVISION: 06-08-99 (PIPE FOR POND.71 CHANGED AND HYD=400)										
*S100 YEAR 24HR STORM DEVELOPED CONDITION										
RAINFALL TYPE= 2										RAIN24= 2.660
COMPUTE NM HYD	100.00	-	2	.13520	340.82	15.597	2.16311	1.500	3.939	PER IMP= 85.00
ROUTE RESERVOIR	100.10	2	5	.13520	111.60	15.611	2.16501	1.850	1.290	AC-FT= 4.075
ROUTE	100.20	5	3	.13520	112.75	15.611	2.16502	1.400	1.303	
ROUTE	100.30	3	10	.13520	114.14	15.611	2.16502	1.450	1.319	
COMPUTE NM HYD	110.00	-	2	.07170	181.36	8.272	2.16311	1.500	3.952	PER IMP= 85.00
ROUTE RESERVOIR	110.10	2	5	.07170	59.19	8.377	2.19060	2.600	1.290	AC-FT= .001
ROUTE	110.20	5	11	.07170	61.29	8.377	2.19061	1.400	1.336	
COMPUTE NM HYD	120.00	-	2	.04030	101.99	4.649	2.16311	1.500	3.954	PER IMP= 85.00
ROUTE RESERVOIR	120.10	2	5	.04030	33.30	4.654	2.16525	1.850	1.291	AC-FT= 1.219
ADD HYD	120.20	11& 5	12	.11200	94.58	13.031	2.18148	1.400	1.319	
ROUTE	120.30	12	11	.11200	95.88	13.031	2.18148	1.400	1.338	
COMPUTE NM HYD	130.00	-	2	.03770	95.41	4.349	2.16311	1.500	3.954	PER IMP= 85.00
ROUTE RESERVOIR	130.10	2	5	.03770	31.10	4.349	2.16310	1.850	1.289	AC-FT= 1.142
ADD HYD	130.20	11& 5	12	.14970	126.97	17.380	2.17685	1.400	1.325	
ADD HYD	130.30	10&12	12	.28490	238.38	32.991	2.17123	1.450	1.307	
ROUTE	130.40	12	90	.28490	241.75	32.991	2.17124	1.450	1.326	

COMMAND	HYDROGRAPH IDENTIFICATION	FROM ID NO.	TO ID NO.	AREA (SQ MI)	PEAK DISCHARGE (CFS)	RUNOFF VOLUME (AC-FT)	RUNOFF (INCHES)	TIME TO PEAK (HOURS)	CFS PER ACRE	NOTATION
COMPUTE NM HYD	140.00	-	2	.04300	105.07	4.718	2.05746	1.500	3.818	PER IMP= 79.00
ROUTE RESERVOIR	140.10	2	5	.04300	35.50	4.739	2.06628	1.800	1.290	AC-FT= 1.198
ROUTE	140.20	5	11	.04300	36.97	4.739	2.06630	1.400	1.343	
COMPUTE NM HYD	150.00	-	2	.02420	55.95	2.451	1.89898	1.500	3.612	PER IMP= 70.00
ROUTE RESERVOIR	150.10	2	5	.02420	19.99	2.456	1.90318	1.800	1.291	AC-FT= .589
ADD HYD	150.20	11& 5	12	.06720	56.96	7.195	2.00755	1.400	1.324	
COMPUTE NM HYD	170.00	-	70	.02853	65.96	2.889	1.89898	1.500	3.612	PER IMP= 70.00
ROUTE RESERVOIR	150.10	70	5	.02853	23.61	2.893	1.90140	1.800	1.293	AC-FT= .693
ADD HYD	170.20	12& 5	12	.09573	80.56	10.088	1.97591	1.400	1.315	
ROUTE	150.30	12	11	.09573	83.24	10.088	1.97592	1.400	1.359	
COMPUTE NM HYD	160.00	-	2	.02170	50.17	2.198	1.89898	1.500	3.612	PER IMP= 70.00
ROUTE RESERVOIR	160.10	2	5	.02170	15.89	2.198	1.89896	1.850	1.144	AC-FT= .888
ADD HYD	160.20	11& 5	12	.11743	94.99	12.286	1.96168	1.850	1.264	
ROUTE	170.40	12	11	.11743	94.99	12.286	1.96169	1.850	1.264	
COMPUTE NM HYD	180.00	-	2	.02810	64.96	2.846	1.89898	1.500	3.612	PER IMP= 70.00
ROUTE RESERVOIR	180.10	2	5	.02810	23.20	2.854	1.90432	1.800	1.290	AC-FT= .684
ADD HYD	180.20	11& 5	10	.14553	118.19	15.140	1.95061	1.850	1.269	
ROUTE	180.30	10	11	.14553	118.20	15.140	1.95061	1.850	1.269	
COMPUTE NM HYD	190.00	-	2	.03130	79.22	3.611	2.16311	1.500	3.955	PER IMP= 85.00
ROUTE RESERVOIR	190.10	2	5	.03130	25.80	3.611	2.16310	1.850	1.288	AC-FT= .950
ADD HYD	190.00	90& 5	1	.31620	267.54	36.602	2.17043	1.450	1.322	
ROUTE	190.20	1	10	.31620	271.17	36.602	2.17043	1.450	1.340	
ADD HYD	190.30	11&10	12	.46173	380.80	51.742	2.10114	1.450	1.289	
COMPUTE NM HYD	200.00	-	2	.02520	49.60	2.074	1.54349	1.500	3.075	PER IMP= 52.00
*S THE VOLUME FROM 200.1 IS THE SNOW VISTA POND VOLUME UNDER DEV. COND.										
*S HYD=200.1 IS *****AP 21.1*****										
ADD HYD	200.10	2&12	10	.48693	423.42	53.816	2.07228	1.450	1.359	
ROUTE RESERVOIR	200.20	10	3	.48693	387.71	53.814	2.07218	2.000	1.244	AC-FT= 6.455
*S HYD=200.2 IS *****AP 21*****										
MODIFY TIME	200.20	3	3	.48693	388.53	53.814	2.07218	1.950	1.247	
*s BEGIN ONSITE WATERSHED										
COMPUTE NM HYD	210.00	-	2	.00920	20.66	.871	1.77514	1.500	3.509	PER IMP= 61.00
ADD HYD	210.10	3& 2	10	.49613	393.57	54.685	2.06667	1.900	1.239	
ROUTE	210.20	10	11	.49613	393.76	54.684	2.06663	1.950	1.240	
COMPUTE NM HYD	220.00	-	2	.00800	17.97	.757	1.77514	1.500	3.510	PER IMP= 61.00
ADD HYD	220.10	11& 2	10	.50413	397.90	55.441	2.06200	1.950	1.233	
ROUTE	220.20	10	11	.50413	397.80	55.440	2.06198	1.900	1.233	
COMPUTE NM HYD	230.00	-	2	.00940	21.11	.890	1.77514	1.500	3.509	PER IMP= 61.00
ADD HYD	230.10	11& 2	10	.51353	403.48	56.330	2.05673	1.850	1.228	
ROUTE	230.20	10	11	.51353	404.02	56.330	2.05670	1.900	1.229	
COMPUTE NM HYD	240.00	-	2	.01450	32.56	1.373	1.77514	1.500	3.509	PER IMP= 61.00
*s END ONSITE WATERSHED										
ADD HYD	240.10	11& 2	10	.52803	412.58	57.702	2.04897	1.800	1.221	
COMPUTE NM HYD	250.00	-	2	.00220	5.04	.201	1.71016	1.500	3.582	PER IMP= 50.00
ADD HYD	250.10	10& 2	11	.53023	414.22	57.903	2.04756	1.800	1.221	

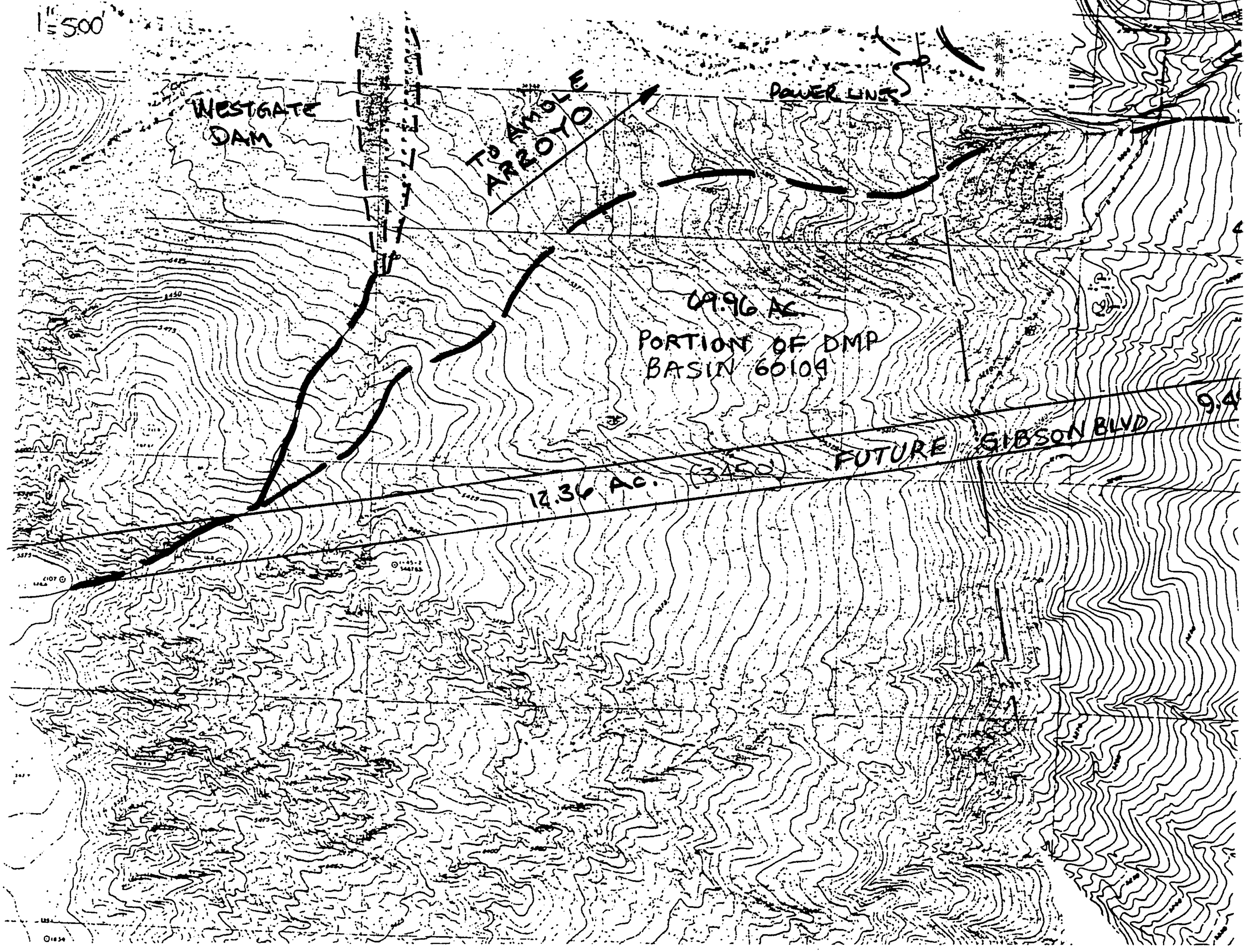
COMMAND	HYDROGRAPH IDENTIFICATION	FROM ID NO.	TO ID NO.	AREA (SQ MI)	PEAK DISCHARGE (CFS)	RUNOFF VOLUME (AC-FT)	RUNOFF (INCHES)	TIME TO PEAK (HOURS)	CFS PER ACRE	NOTATION
COMPUTE NM HYD	260.00	-	2	.01570	34.01	1.443	1.72289	1.500	3.385	PER IMP= 60.00
ROUTE	260.10	2	15	.01570	32.36	1.443	1.72292	1.550	3.221	
COMPUTE NM HYD	270.00	-	2	.01020	20.61	.841	1.54680	1.500	3.157	PER IMP= 50.00
ADD HYD	270.10	15& 2	16	.02590	52.62	2.284	1.65352	1.500	3.175	
DIVIDE HYD	270.20	16	15	.02035	25.79	1.795	1.65352	1.500	1.980	
	270.30	AND	3	.00555	26.84	.489	1.65352	1.500	7.556	
ROUTE	270.40	3	16	.00555	24.11	.489	1.65360	1.550	6.788	
COMPUTE NM HYD	280.00	-	2	.00220	5.42	.243	2.07506	1.500	3.850	PER IMP= 80.00
ADD HYD	280.10	16& 2	17	.00775	28.88	.733	1.77310	1.550	5.821	
ADD HYD	280.20	17&11	10	.53798	419.19	58.636	2.04361	1.750	1.217	
ROUTE	280.30	10	11	.53798	419.02	58.632	2.04348	1.750	1.217	
COMPUTE NM HYD	290.00	-	2	.00670	12.00	.421	1.17900	1.500	2.799	PER IMP= 25.00
ADD HYD	290.10	11& 2	10	.54468	424.08	59.053	2.03284	1.700	1.217	
COMPUTE NM HYD	300.00	-	2	.07090	179.34	8.179	2.16311	1.500	3.952	PER IMP= 85.00
ROUTE RESERVOIR	300.10	2	5	.07090	58.60	8.192	2.16634	1.850	1.291	AC-FT= 2.142
ROUTE	300.20	5	11	.07090	58.59	8.192	2.16636	2.350	1.291	
COMPUTE NM HYD	310.00	-	2	.08640	214.61	9.724	2.11028	1.500	3.881	PER IMP= 82.00
ROUTE RESERVOIR	310.10	2	5	.08640	71.30	9.826	2.13237	1.800	1.289	AC-FT= 2.505
ADD HYD	310.20	11& 5	12	.15730	129.89	18.018	2.14769	2.300	1.290	
ROUTE	310.30	12	11	.15730	129.89	18.018	2.14769	2.300	1.290	
ROUTE	310.40	11	13	.15730	129.89	18.018	2.14769	2.350	1.290	
COMPUTE NM HYD	320.00	-	2	.05470	122.45	5.283	1.81093	1.500	3.498	PER IMP= 65.00
ROUTE RESERVOIR	320.10	2	5	.05470	16.32	5.206	1.78457	2.100	.466	AC-FT= 3.035
ROUTE	320.20	5	11	.05470	16.32	5.205	1.78432	2.150	.466	
COMPUTE NM HYD	330.00	-	2	.02380	53.29	2.299	1.81093	1.500	3.498	PER IMP= 65.00
ADD HYD	330.10	11& 2	12	.07850	63.27	7.504	1.79239	1.500	1.259	
ADD HYD	330.20	12&13	14	.23580	190.99	25.522	2.02940	1.500	1.266	
ROUTE	330.30	14	12	.23580	189.79	25.521	2.02938	1.550	1.258	
ROUTE	330.40	12	11	.23580	190.04	25.521	2.02933	1.550	1.259	
ROUTE	330.50	15	17	.02035	25.49	1.795	1.65356	1.550	1.957	
ROUTE	330.60	17	16	.02035	25.11	1.795	1.65356	1.550	1.928	
COMPUTE NM HYD	340.00	-	2	.01550	31.31	1.279	1.54680	1.500	3.156	PER IMP= 50.00
ADD HYD	340.10	16& 2	15	.03585	55.01	3.073	1.60737	1.500	2.398	
ROUTE	340.20	15	16	.03585	54.76	3.073	1.60739	1.500	2.387	
ROUTE	340.30	16	15	.03585	54.42	3.073	1.60739	1.500	2.372	
COMPUTE NM HYD	350.00	-	2	.04830	97.54	3.985	1.54680	1.500	3.155	PER IMP= 50.00
ADD HYD	350.10	15& 2	16	.08415	151.96	7.058	1.57260	1.500	2.822	
ROUTE	350.20	16	15	.08415	151.86	7.058	1.57261	1.500	2.820	
ROUTE	350.30	15	16	.08415	150.38	7.058	1.57261	1.500	2.792	
COMPUTE NM HYD	360.00	-	2	.02080	42.01	1.716	1.54680	1.500	3.156	PER IMP= 50.00
ADD HYD	360.10	16& 2	15	.10495	192.40	8.774	1.56748	1.500	2.864	
ADD HYD	360.20	15&11	17	.34075	379.27	34.295	1.88709	1.500	1.739	
ROUTE	360.30	17	16	.34075	377.82	34.295	1.88708	1.500	1.732	
ADD HYD	360.40	16&10	15	.88543	741.01	93.348	1.97675	1.600	1.308	
COMPUTE NM HYD	370.00	-	2	.01830	36.97	1.510	1.54680	1.500	3.156	PER IMP= 50.00

COMMAND	HYDROGRAPH IDENTIFICATION	FROM ID NO.	TO ID NO.	AREA (SQ MI)	PEAK DISCHARGE (CFS)	RUNOFF VOLUME (AC-FT)	RUNOFF (INCHES)	TIME TO PEAK (HOURS)	CFS PER ACRE	NOTATION
ROUTE RESERVOIR	370.10	2	5	.01830	6.64	1.510	1.54678	2.050	.567	AC-FT= .768
*S HYD=AP22 IS *****AP 22*****										
ADD HYD	AP22	5&15	22	.90373	747.11	94.857	1.96804	1.600	1.292	
ROUTE	100.00	22	88	.90373	752.81	94.856	1.96801	1.600	1.302	
*S COMPUTE HYD FOR BASIN 301.61										
COMPUTE NM HYD	301.61	-	61	.03590	84.71	3.399	1.77514	1.500	3.687	PER IMP= 61.00
*S ROUTE ID=61 THROUGH POND.61										
ROUTE RESERVOIR	.61	61	1	.03590	26.35	3.411	1.78163	1.750	1.147	AC-FT= 1.154
*S ROUTE THIS FLOW DOWN THE 24" STORM DRAIN PIPE TO POND.62										
ROUTE	.61	1	11	.03590	26.36	3.411	1.78166	1.800	1.147	
*S HYDROGRAPH ID = 11 IS THE ROUTED FLOW OUT OF POND.61										
*S COMPUTE HYD FOR BASIN 301.62										
COMPUTE NM HYD	301.62	-	62	.03440	81.18	3.257	1.77514	1.500	3.687	PER IMP= 61.00
*S ROUTE ID=62 THROUGH POND.62										
ROUTE RESERVOIR	.62	62	1	.03440	25.02	3.267	1.78046	1.800	1.136	AC-FT= 1.098
*S ROUTED FLOW OUT OF POND.62										
*S ADD HYD ID=11 TO ID=1 AND ROUTE THIS FLOW THROUGH THE 30" STORM DRAIN										
*S TO POND.63										
ADD HYD	POND.62	1&11	1	.07030	51.38	6.678	1.78106	1.800	1.142	
ROUTE	.62	1	12	.07030	51.40	6.678	1.78107	1.800	1.142	
*S HYDROGRAPH ID = 12 IS THE ROUTED FLOW DOWN THE 30" STORM DRAIN PIPE										
*S COMPUTE HYD FOR BASIN 301.63										
COMPUTE NM HYD	301.63	-	63	.03440	81.18	3.257	1.77514	1.500	3.687	PER IMP= 61.00
*S ROUTE ID=63 THROUGH POND.63										
ROUTE RESERVOIR	.63	63	1	.03440	25.02	3.267	1.78046	1.800	1.136	AC-FT= 1.098
*S ROUTED FLOW OUT OF POND.63										
*S ADD HYD ID=12 TO ID=1 AND ROUTE THIS FLOW THROUGH THE 36" STORM DRAIN										
*S TO POND.64										
ADD HYD	POND.63	1&12	1	.10470	76.42	9.944	1.78086	1.800	1.140	
ROUTE	.63	1	13	.10470	76.44	9.944	1.78087	1.800	1.141	
*S HYDROGRAPH ID = 13 IS THE ROUTED FLOW DOWN THE 36" STORM DRAIN PIPE										
*S TO THE INLET OF POND.64 TO THIS STORM DRAIN PIPE										
*S COMPUTE HYD FOR BASIN 301.64										
COMPUTE NM HYD	301.64	-	64	.03440	81.18	3.257	1.77514	1.500	3.687	PER IMP= 61.00
*S ROUTE ID=64 THROUGH POND.64										
ROUTE RESERVOIR	.64	64	1	.03440	25.02	3.267	1.78046	1.800	1.136	AC-FT= 1.098
*S ROUTED FLOW OUT OF POND.64										
*S ADD HYD ID=13 TO ID=1 AND ROUTE THIS FLOW THROUGH THE 36" STORM DRAIN										
*S TO POND.65										
ADD HYD	POND.64	1&13	1	.13910	101.46	13.211	1.78076	1.800	1.140	
ROUTE	.64	1	14	.13910	101.46	13.211	1.78077	1.800	1.140	
*S HYDROGRAPH ID = 14 IS THE ROUTED FLOW DOWN THE 36" STORM DRAIN PIPE										
*S TO THE INLET OF POND.64 TO THIS STORM DRAIN PIPE										
*S COMPUTE HYD FOR BASIN 301.65										
COMPUTE NM HYD	301.65	-	65	.03440	81.18	3.257	1.77514	1.500	3.687	PER IMP= 61.00

COMMAND	HYDROGRAPH IDENTIFICATION	FROM ID NO.	TO ID NO.	AREA (SQ MI)	PEAK DISCHARGE (CFS)	RUNOFF VOLUME (AC-FT)	RUNOFF (INCHES)	TIME TO PEAK (HOURS)	CFS PER ACRE	NOTATION
*S ROUTE ID=65 THROUGH POND.65										
ROUTE RESERVOIR	.65	65	1	.03440	25.02	3.267	1.78046	1.800	1.136	AC-FT= 1.098
*S ROUTED FLOW OUT OF POND.65										
*S ADD HYD ID=14 TO ID=1 AND ROUTE THIS FLOW THROUGH THE 36" STORM DRAIN										
*S TO SNOW VISTA CHANNEL										
ADD HYD	POND.65	1&14	1	.17350	126.48	16.477	1.78070	1.800	1.139	
*S COMPUTE HYD FOR BASIN 301.05										
COMPUTE NM HYD	301.05	-	5	.03280	77.40	3.105	1.77514	1.500	3.687	PER IMP= 61.00
*S TOTAL FLOW AT AP-22.1 IN SNOW VISTA CHANNEL										
ADD HYD	301.00	88& 1	3	1.07723	870.85	111.334	1.93785	1.600	1.263	
*S HYD=AP22.1 IS *****AP 22.1*****										
ADD HYD	AP22.1	3& 5	2	1.11003	916.28	114.439	1.93304	1.600	1.290	
ROUTE	301.60	2	1	1.11003	925.36	114.436	1.93299	1.600	1.303	
*S COMPUTE HYD FOR BASIN 301.04										
COMPUTE NM HYD	301.04	-	4	.07660	180.72	7.252	1.77515	1.500	3.686	PER IMP= 61.00
*S HYD=AP22.2 IS *****AP 22.2*****										
ADD HYD	AP22.2	1& 4	1	1.18663	1031.47	121.688	1.92280	1.600	1.358	
ROUTE	300.00	1	9	1.18663	1037.20	121.687	1.92278	1.600	1.366	
*S COMPUTE HYD FOR BASIN 301.71										
COMPUTE NM HYD	301.71	-	71	.06940	163.75	6.570	1.77514	1.500	3.687	PER IMP= 61.00
*S ROUTE THIS FLOW DOWN THE 60" STORM DRAIN PIPE LINE TO 301.72										
ROUTE	.71	71	11	.06940	167.38	6.570	1.77515	1.500	3.769	
*S COMPUTE HYD FOR BASIN 301.72										
COMPUTE NM HYD	301.72	-	72	.04220	99.58	3.995	1.77514	1.500	3.687	PER IMP= 61.00
*S ADD BASIN 301.71 AND ROUTE THIS FLOW DOWN THE 60" STORM DRAIN PIPE LINE TO 3										
ADD HYD	301.72	72&11	2	.11160	266.96	10.566	1.77514	1.500	3.738	
ROUTE	.71	2	11	.11160	269.93	10.566	1.77515	1.500	3.779	
*S COMPUTE HYD FOR BASIN 301.74										
COMPUTE NM HYD	301.74	-	74	.00910	21.88	.830	1.71015	1.500	3.757	PER IMP= 50.00
*S ADD BASIN 301.72 AND BASIN 301.74										
ADD HYD	301.74	74&11	11	.12070	291.81	11.396	1.77024	1.500	3.778	
COMPUTE NM HYD	301.73	-	73	.01940	45.78	1.837	1.77514	1.500	3.688	PER IMP= 61.00
*S ADD HYDGRAPHS FROM										
ADD HYD	301.73	73&11	4	.14010	337.60	13.232	1.77092	1.500	3.765	
*S COMPUTE HYD FOR BASIN 301.03										
COMPUTE NM HYD	301.03	-	3	.20140	474.78	19.067	1.77514	1.500	3.683	PER IMP= 61.00
*S HYDROGRAPH ID 73 IS THE INFLOW TO THE SNOW VISTA CHANNEL AT AP-23										
ADD HYD	301.03	3& 4	73	.34150	812.38	32.300	1.77341	1.500	3.717	
*S HYD=AP23 IS *****AP 23*****										
ADD HYD	AP23	9&73	1	1.52813	1722.67	153.987	1.88940	1.500	1.761	
ROUTE	400.00	1	2	1.52813	1726.23	153.986	1.88939	1.500	1.765	
ROUTE	500.00	2	3	1.52813	1709.18	153.982	1.88934	1.550	1.748	
ROUTE	600.00	3	4	1.52813	1717.19	153.981	1.88933	1.550	1.756	
ROUTE	700.00	4	2	1.52813	1688.08	153.972	1.88922	1.550	1.726	
*S BASIN 500 EL RANCHO GRANDE										

COMMAND	HYDROGRAPH IDENTIFICATION	FROM ID NO.	TO ID NO.	AREA (SQ MI)	PEAK DISCHARGE (CFS)	RUNOFF VOLUME (AC-FT)	RUNOFF (INCHES)	TIME TO PEAK (HOURS)	CFS PER ACRE	NOTATION
COMPUTE NM HYD	500.00	-	44	.00217	4.70	.197	1.69924	1.500	3.386	PER IMP= 57.88
*S	*****AP23.2*****									
ADD HYD	AP23.2	2&44	3	1.53030	1692.26	154.169	1.88895	1.550	1.728	
*S RECALL AMOLE ARROYO OUTFLOW HYDROGRAPH										
RECALL HYD	AP25X	-	1	6.96491	1020.99	264.220	.71130	1.600	.229	
*S ADD FLOWS AT AP23.2 AND AP25										
*S	*****AP25.1*****									
ADD HYD	AP25.1	1& 3	5	8.49521	2654.87	418.389	.92344	1.600	.488	
ROUTE	800.00	5	4	8.49521	2574.23	417.368	.92118	1.600	.473	
*S COMPUTE HYD FOR BASIN 301.00										
COMPUTE NM HYD	300.00	-	1	.05156	121.66	4.881	1.77514	1.500	3.687	PER IMP= 61.00
ROUTE RESERVOIR	.01	1	5	.05156	42.85	4.881	1.77514	1.750	1.298	AC-FT= 1.790
*S HYD=AP24 IS *****AP 24*****										
ADD HYD	AP24	5& 4	2	8.54677	2616.95	422.249	.92633	1.600	.478	
ROUTE	SV_DMP2.HYD	2	66	8.54677	2624.45	421.502	.92470	1.650	.480	
FINISH										

Appendix B


1" = 500'
WESTGATE DAM
FORAGOLE ARROYO
POWER LINE
09.96 AC.
PORTION OF DMP
BASIN 60104
FUTURE GIBSON BLVD
12.36 AC.
(3450)

Appendix C

HEC-RAS Plan: 1/27/03 River: Amole Arroyo Reach: Rancho Gr-lined Profile: 100-yr

Reach	River Sta	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
		(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Rancho Gr-lined	6200	787.00	5262.93	5265.38	5265.13	5266.17	0.006105	7.17	109.72	49.78	0.85
Rancho Gr-lined	6100	787.00	5262.23	5264.48	5264.43	5265.44	0.008143	7.88	99.93	48.98	0.97
Rancho Gr-lined	6068	787.00	5262.01	5264.21	5264.21	5265.22	0.003888	8.06	97.64	48.80	1.00
Rancho Gr-lined	6050	787.00	5256.01	5256.90	5258.21	5263.87	0.082482	21.19	37.15	43.56	4.04
Rancho Gr-lined	6000	787.00	5255.66	5257.14	5257.86	5259.53	0.033823	12.42	63.36	45.90	1.86
Rancho Gr-lined	5900	787.00	5254.96	5257.35		5258.19	0.006608	7.36	106.93	49.55	0.88
Rancho Gr-lined	5818	787.00	5254.38	5256.39	5256.57	5257.62	0.005254	8.88	88.61	48.05	1.15
Rancho Gr-lined	5800	787.00	5248.38	5249.27	5250.58	5256.28	0.083247	21.25	37.04	43.55	4.06
Rancho Gr-lined	5700	787.00	5247.68	5250.13		5250.92	0.006076	7.16	109.89	49.79	0.85
Rancho Gr-lined	5600	787.00	5246.98	5249.23	5249.17	5250.19	0.008143	7.88	99.93	48.98	0.97
Rancho Gr-lined	5568	787.00	5246.76	5248.83	5248.96	5249.98	0.004770	8.61	91.41	48.28	1.10
Rancho Gr-lined	5550	787.00	5240.76	5241.65	5242.95	5248.65	0.083093	21.23	37.06	43.55	4.06
Rancho Gr-lined	5500	787.00	5239.31	5240.57	5241.51	5243.92	0.057488	14.69	53.59	45.04	2.37
Rancho Gr-lined	5400	787.00	5236.42	5237.84	5238.81	5241.23	0.011806	14.78	53.26	40.38	2.27
Rancho Gr-lined	5323	787.00	5234.20	5236.89	5237.95	5240.55	0.006690	15.35	51.28	19.10	1.65
Rancho Gr-lined	5261	914.00	5232.40	5235.24	5236.54	5239.68	0.007688	16.91	54.06	19.10	1.77
Rancho Gr-lined	5200	914.00	5230.63	5233.75	5235.29	5238.81	0.017635	18.06	50.62	22.47	2.12
Rancho Gr-lined	5100	914.00	5227.74	5230.66	5232.40	5236.71	0.022553	19.73	46.33	21.69	2.38
Rancho Gr-lined	5000	914.00	5226.38	5229.53	5231.05	5234.44	0.016892	17.78	51.41	22.61	2.08
Rancho Gr-lined	4900	914.00	5225.02	5228.28	5229.69	5232.75	0.014830	16.96	53.88	23.04	1.95
Rancho Gr-lined	4800	914.00	5223.67	5226.99	5228.34	5231.25	0.013876	16.56	55.20	23.27	1.89
Rancho Gr-lined	4700	914.00	5220.67	5223.66	5225.33	5229.35	0.020767	19.15	47.72	21.95	2.29
Rancho Gr-lined	4600	914.00	5217.67	5220.52	5222.34	5226.99	0.024757	20.40	44.80	21.41	2.49
Rancho Gr-lined	4500	914.00	5214.67	5217.45	5219.34	5224.36	0.027141	21.09	43.35	21.14	2.59
Rancho Gr-lined	4400	914.00	5211.67	5214.42	5216.34	5221.56	0.028440	21.44	42.63	21.00	2.65
Rancho Gr-lined	4300	914.00	5208.67	5211.40	5213.33	5218.68	0.029197	21.65	42.23	20.92	2.69
Rancho Gr-lined	4200	914.00	5205.67	5208.39	5210.34	5215.74	0.029595	21.75	42.02	20.88	2.70
Rancho Gr-lined	4100	914.00	5202.67	5205.38	5207.34	5212.79	0.029918	21.84	41.86	20.85	2.72
Rancho Gr-lined	4000	914.00	5199.67	5202.38	5204.34	5209.79	0.029918	21.84	41.86	20.85	2.72
Rancho Gr-lined	3900	914.00	5196.67	5199.39	5201.33	5206.77	0.029836	21.81	41.90	20.86	2.71
Rancho Gr-lined	3800	914.00	5194.92	5197.86	5199.59	5203.82	0.022114	19.59	46.65	21.75	2.36
Rancho Gr-lined	3700	914.00	5193.17	5196.22	5197.84	5201.60	0.019151	18.60	49.13	22.21	2.20
Rancho Gr-lined	3600	914.00	5191.42	5194.52	5196.09	5199.65	0.017945	18.17	50.30	22.41	2.14
Rancho Gr-lined	3500	914.00	5189.67	5192.79	5194.33	5197.83	0.017529	18.02	50.73	22.49	2.11
Rancho Gr-lined	3400	914.00	5186.96	5189.92	5191.62	5195.78	0.021630	19.44	47.03	21.82	2.33
Rancho Gr-lined	3300	914.00	5184.25	5187.13	5188.91	5193.44	0.023968	20.17	45.32	21.51	2.45
Rancho Gr-lined	3200	914.00	5181.54	5184.37	5186.20	5190.96	0.025427	20.60	44.37	21.33	2.52
Rancho Gr-lined	3100	914.00	5178.83	5181.64	5183.49	5188.38	0.026224	20.83	43.88	21.24	2.55

HEC-RAS Plan: 1/27/03 River: Amole Arroyo Reach: Rancho Gr-lined Profile: 100-yr (Continued)

Reach	River Sta	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
		(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Rancho Gr-lined	3000	914.00	5176.12	5178.92	5180.79	5185.74	0.026696	20.96	43.60	21.19	2.57
Rancho Gr-lined	2900	914.00	5172.32	5174.99	5176.99	5182.71	0.031730	22.30	40.99	20.69	2.79
Rancho Gr-lined	2800	914.00	5168.52	5171.13	5173.18	5179.35	0.034614	23.00	39.73	20.44	2.91
Rancho Gr-lined	2700	914.00	5164.72	5167.30	5169.39	5175.79	0.036267	23.39	39.07	20.31	2.97
Rancho Gr-lined	2600	914.00	5160.92	5163.48	5165.59	5172.13	0.037157	23.59	38.74	20.25	3.01
Rancho Gr-lined	2500	1129.00	5157.12	5160.19	5162.33	5168.27	0.028655	22.82	49.48	22.27	2.70
Rancho Gr-lined	2470	1129.00	5155.98	5159.01	5161.20	5167.39	0.030114	23.23	48.60	22.11	2.76
Rancho Gr-lined	2400	1129.00	5154.93	5158.15	5160.15	5165.24	0.023912	21.37	52.82	22.86	2.48
Rancho Gr-lined	2300	1129.00	5153.44	5156.87	5158.66	5162.81	0.018703	19.56	57.73	23.70	2.21
Rancho Gr-lined	2200	1129.00	5151.95	5155.49	5157.17	5160.90	0.016435	18.66	60.50	24.17	2.08
Rancho Gr-lined	2100	1129.00	5150.45	5154.05	5155.67	5159.23	0.015498	18.27	61.80	24.38	2.02
Rancho Gr-lined	2000	1129.00	5147.69	5151.05	5152.91	5157.33	0.020189	20.11	56.15	23.44	2.29
Rancho Gr-lined	1900	1129.00	5144.93	5148.17	5150.15	5155.09	0.023091	21.11	53.49	22.98	2.44
Rancho Gr-lined	1800	1129.00	5142.16	5145.34	5147.38	5152.66	0.024961	21.71	52.01	22.72	2.53
Rancho Gr-lined	1700	1195.00	5139.40	5142.70	5144.77	5150.07	0.024101	21.78	54.88	23.22	2.50
Rancho Gr-lined	1600	1195.00	5137.80	5141.29	5143.17	5147.61	0.019500	20.17	59.25	23.96	2.26
Rancho Gr-lined	1500	1195.00	5136.20	5139.80	5141.57	5145.60	0.017372	19.34	61.79	24.38	2.14
Rancho Gr-lined	1400	1195.00	5134.60	5138.24	5139.97	5143.84	0.016532	18.99	62.91	24.56	2.09
Rancho Gr-lined	1300	1195.00	5133.00	5136.46	5138.21	5142.16	0.017262	19.16	62.38	24.95	2.13
Rancho Gr-lined	1250	1237.00	5132.20	5136.10	5137.49	5140.47	0.011631	16.76	73.79	26.71	1.78
Rancho Gr-lined	1200	1237.00	5131.40	5134.01	5135.65	5139.60	0.019979	18.97	65.21	30.23	2.28
Rancho Gr-lined	1100	1237.00	5129.80	5131.71	5133.24	5137.36	0.025271	19.26	66.51	38.72	2.53
Rancho Gr-lined	1068	1237.00	5129.48	5130.38	5131.60	5136.44	0.068065	19.81	63.32	73.64	3.72

HEC-RAS Plan: 1/27/03 Profile: 100-yr

Reach	River Sta	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
		(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Units 6&7-unline	4300	1692.00	5133.00	5137.21	5136.50	5138.02	0.008607	7.22	234.19	76.31	0.73
Units 6&7-unline	4200	1692.00	5133.00	5136.15		5137.07	0.012209	7.71	219.49	84.58	0.84
Units 6&7-unline	4100	1692.00	5131.00	5135.69		5136.21	0.004363	5.77	293.11	79.98	0.53
Units 6&7-unline	4000	1692.00	5131.00	5135.17		5135.71	0.005157	5.88	287.60	86.84	0.57
Units 6&7-unline	3900	1692.00	5129.00	5134.90		5135.30	0.002811	5.08	333.32	79.05	0.44
Units 6&7-unline	3800	1692.00	5129.00	5134.57		5134.98	0.003092	5.15	328.23	81.91	0.45
Units 6&7-unline	3700	1692.00	5129.00	5134.24		5134.66	0.003014	5.20	325.12	78.50	0.45
Units 6&7-unline	3600	1692.00	5128.10	5134.01		5134.36	0.002426	4.70	360.13	86.30	0.40
Units 6&7-unline	3500	1692.00	5128.00	5133.73		5134.11	0.002697	4.95	341.97	82.12	0.43
Units 6&7-unline	3400	1692.00	5128.00	5133.14		5133.71	0.004764	6.04	280.12	78.10	0.56
Units 6&7-unline	3300	1692.00	5127.00	5132.86		5133.30	0.003411	5.32	318.14	81.61	0.47
Units 6&7-unline	3200	1692.00	5126.00	5132.70		5133.03	0.002174	4.62	366.36	82.60	0.39
Units 6&7-unline	3100	1692.00	5124.00	5132.50		5132.67	0.000738	3.25	521.33	87.91	0.23
Units 6&7-unline	3000	1692.00	5124.10	5132.31		5132.50	0.001022	3.54	478.50	91.15	0.27
Unit 8-unlined	2950	2879.00	5123.80	5130.88		5131.49	0.003227	6.27	459.08	87.54	0.48
Unit 8-unlined	2900	2879.00	5123.00	5129.41		5130.94	0.011766	9.92	290.21	73.71	0.88
Unit 8-unlined	2800	2879.00	5122.10	5129.00		5130.02	0.006651	8.12	354.57	79.24	0.68
Unit 8-unlined	2700	2879.00	5122.00	5128.17		5129.30	0.007699	8.52	337.94	78.46	0.72
Unit 8-unlined	2600	2879.00	5120.00	5127.94		5128.62	0.003534	6.63	434.25	81.20	0.51
Unit 8-unlined	2500	2879.00	5120.00	5127.29	5125.59	5128.18	0.005189	7.56	380.59	78.19	0.60
Unit 8-unlined	2400	2879.00	5119.80	5125.76		5127.36	0.011776	10.16	283.46	69.36	0.89
Unit 8-unlined	2300	2879.00	5117.00	5126.12		5126.59	0.002224	5.48	525.56	92.75	0.41
Unit 8-unlined	2200	2879.00	5116.90	5125.71		5126.31	0.003089	6.23	462.14	85.89	0.47
Unit 8-unlined	2100	2879.00	5116.60	5125.26		5125.96	0.003831	6.69	430.19	84.58	0.52
Unit 8-unlined	2000	2879.00	5116.30	5124.99	5122.25	5125.59	0.003004	6.21	463.44	84.42	0.47

Snow Vista - Including Portion of Basin 60104

HEC-RAS Plan: 1/27/03 River: Amole Arroyo Reach: Rancho Gr-lined Profile: 100-yr (Continued)

Reach	River Sta	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
		(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Rancho Gr-lined	3000	701.00	5176.12	5178.54	5180.19	5184.44	0.026873	19.48	35.99	19.70	2.54
Rancho Gr-lined	2900	701.00	5172.32	5174.62	5176.39	5181.36	0.032437	20.83	33.66	19.22	2.77
Rancho Gr-lined	2800	701.00	5168.52	5170.77	5172.59	5177.92	0.035285	21.46	32.67	19.01	2.88
Rancho Gr-lined	2700	701.00	5164.72	5166.95	5168.79	5174.30	0.036736	21.76	32.21	18.91	2.94
Rancho Gr-lined	2600	701.00	5160.92	5163.14	5164.99	5170.58	0.037367	21.90	32.01	18.87	2.96
Rancho Gr-lined	2500	916.00	5157.12	5159.92	5161.79	5166.78	0.026884	21.03	43.56	21.18	2.58
Rancho Gr-lined	2470	916.00	5155.98	5158.73	5160.65	5165.92	0.028661	21.52	42.57	20.99	2.66
Rancho Gr-lined	2400	916.00	5154.93	5157.88	5159.60	5163.78	0.021766	19.49	46.99	21.82	2.34
Rancho Gr-lined	2300	916.00	5153.44	5156.58	5158.11	5161.58	0.017313	17.95	51.03	22.54	2.10
Rancho Gr-lined	2200	916.00	5151.95	5155.17	5156.62	5159.84	0.015741	17.34	52.82	22.86	2.01
Rancho Gr-lined	2100	916.00	5150.45	5153.70	5155.12	5158.25	0.015182	17.12	53.51	22.98	1.98
Rancho Gr-lined	2000	916.00	5147.69	5150.69	5152.36	5156.34	0.020497	19.07	48.02	22.00	2.28
Rancho Gr-lined	1900	916.00	5144.93	5147.82	5149.60	5154.07	0.023567	20.06	45.67	21.57	2.43
Rancho Gr-lined	1800	916.00	5142.16	5145.00	5146.83	5151.59	0.025389	20.60	44.47	21.35	2.52
Rancho Gr-lined	1700	976.00	5139.40	5142.37	5144.24	5148.96	0.024174	20.60	47.37	21.88	2.47
Rancho Gr-lined	1600	976.00	5137.80	5140.96	5142.63	5146.53	0.019158	18.95	51.51	22.63	2.21
Rancho Gr-lined	1500	976.00	5136.20	5139.45	5141.03	5144.58	0.017068	18.17	53.70	23.01	2.10
Rancho Gr-lined	1400	976.00	5134.60	5137.89	5139.43	5142.85	0.016290	17.87	54.62	23.17	2.05
Rancho Gr-lined	1300	976.00	5133.00	5136.12	5137.67	5141.18	0.017128	18.05	54.08	23.58	2.10
Rancho Gr-lined	1250	1013.00	5132.20	5135.77	5136.97	5139.53	0.011024	15.56	65.10	25.38	1.71
Rancho Gr-lined	1200	1013.00	5131.40	5133.72	5135.18	5138.70	0.020340	17.91	56.57	29.06	2.26
Rancho Gr-lined	1100	1013.00	5129.80	5131.49	5132.83	5136.42	0.025559	17.96	58.21	37.85	2.50
Rancho Gr-lined	1068	1013.00	5129.48	5130.28	5131.34	5135.47	0.068478	18.33	55.94	73.21	3.65

Amole Arroyo - Excluding Portion of Basin 60104

HEC-RAS Plan: 1/27/03 River: Amole Arroyo Reach: Rancho Gr-lined Profile: 100-yr

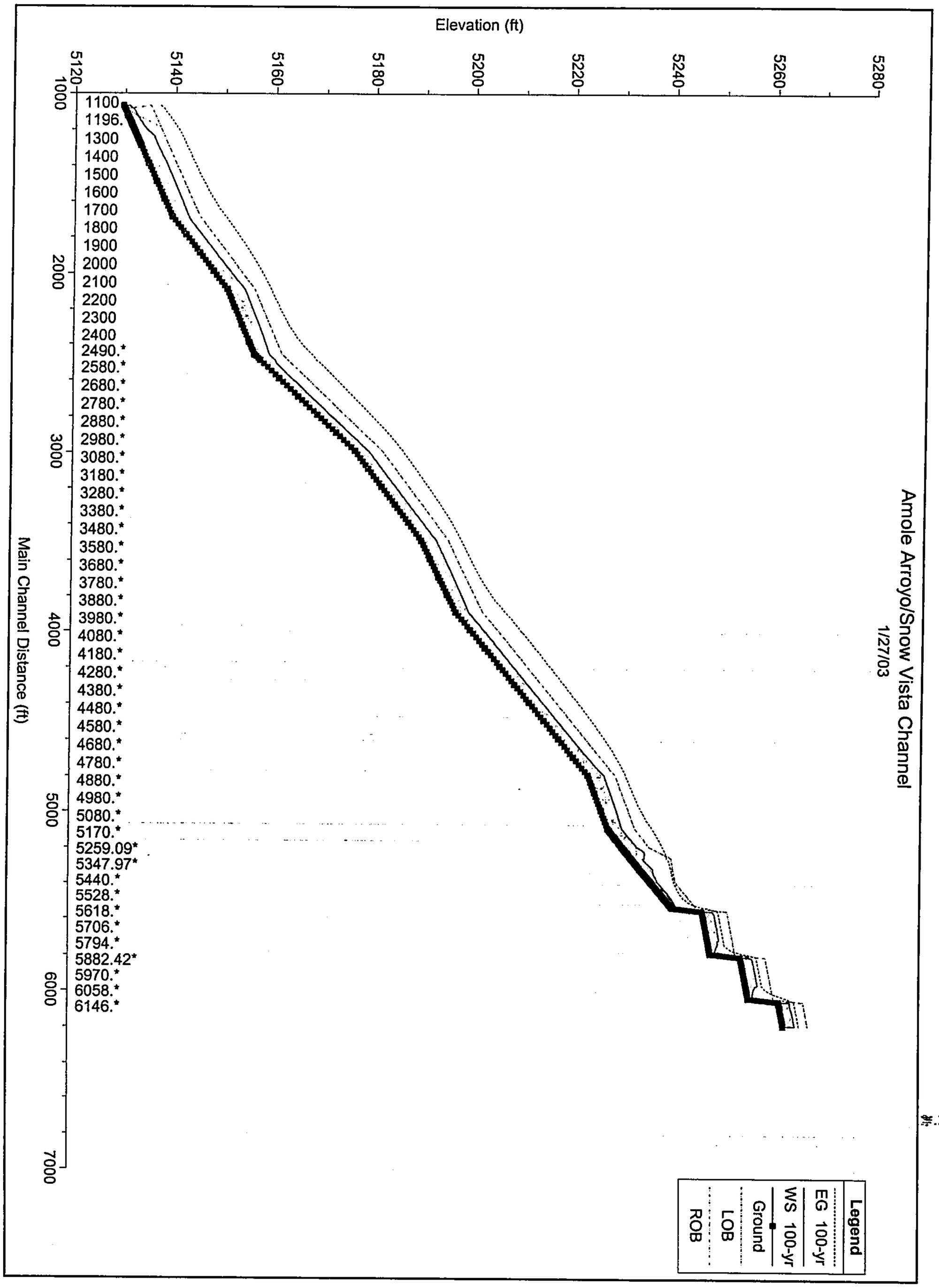
Reach	River Sta	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
		(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Rancho Gr-lined	6200	652.00	5262.93	5265.13	5264.88	5265.82	0.006018	6.68	97.57	48.79	0.83
Rancho Gr-lined	6100	652.00	5262.23	5264.23	5264.18	5265.08	0.008249	7.40	88.14	48.01	0.96
Rancho Gr-lined	6068	652.00	5262.01	5263.96	5263.96	5264.86	0.004051	7.64	85.36	47.78	1.01
Rancho Gr-lined	6050	652.00	5256.01	5256.77	5257.96	5263.43	0.096540	20.71	31.48	43.03	4.27
Rancho Gr-lined	6000	652.00	5255.66	5257.03	5257.61	5258.95	0.029562	11.11	58.69	45.49	1.72
Rancho Gr-lined	5900	652.00	5254.96	5256.99	5256.91	5257.82	0.007872	7.29	89.48	48.12	0.94
Rancho Gr-lined	5818	652.00	5254.38	5256.23	5256.33	5257.24	0.004811	8.07	80.78	47.39	1.09
Rancho Gr-lined	5800	652.00	5248.38	5249.14	5250.33	5255.82	0.096958	20.74	31.44	43.03	4.28
Rancho Gr-lined	5700	652.00	5247.68	5249.88		5250.57	0.006018	6.68	97.57	48.79	0.83
Rancho Gr-lined	5600	652.00	5246.98	5248.98	5248.93	5249.83	0.008249	7.40	88.14	48.01	0.96
Rancho Gr-lined	5568	652.00	5246.76	5248.71	5248.71	5249.61	0.004051	7.64	85.36	47.78	1.01
Rancho Gr-lined	5550	652.00	5240.76	5241.52	5242.71	5248.18	0.096540	20.71	31.48	43.03	4.27
Rancho Gr-lined	5500	652.00	5239.31	5240.46	5241.26	5243.26	0.054090	13.43	48.53	44.59	2.27
Rancho Gr-lined	5400	652.00	5236.42	5237.68	5238.54	5240.69	0.012188	13.93	46.79	39.73	2.26
Rancho Gr-lined	5323	652.00	5234.20	5236.50	5237.51	5239.95	0.007486	14.92	43.71	19.08	1.74
Rancho Gr-lined	5261	701.00	5232.40	5234.53	5235.88	5239.17	0.010880	17.28	40.58	19.08	2.09
Rancho Gr-lined	5200	701.00	5230.63	5233.21	5234.70	5238.20	0.021303	17.93	39.09	20.32	2.28
Rancho Gr-lined	5100	701.00	5227.74	5230.21	5231.81	5235.83	0.025130	19.02	36.86	19.87	2.46
Rancho Gr-lined	5000	701.00	5226.38	5229.11	5230.45	5233.38	0.017128	16.59	42.27	20.93	2.06
Rancho Gr-lined	4900	701.00	5225.02	5227.86	5229.09	5231.70	0.014734	15.71	44.61	21.38	1.92
Rancho Gr-lined	4800	701.00	5223.67	5226.57	5227.74	5230.21	0.013705	15.31	45.79	21.59	1.85
Rancho Gr-lined	4700	701.00	5220.67	5223.24	5224.74	5228.28	0.021608	18.02	38.90	20.28	2.29
Rancho Gr-lined	4600	701.00	5217.67	5220.12	5221.74	5225.83	0.025714	19.18	36.56	19.81	2.49
Rancho Gr-lined	4500	701.00	5214.67	5217.07	5218.74	5223.12	0.027906	19.74	35.51	19.60	2.58
Rancho Gr-lined	4400	701.00	5211.67	5214.04	5215.74	5220.27	0.029011	20.02	35.02	19.50	2.63
Rancho Gr-lined	4300	701.00	5208.67	5211.03	5212.74	5217.34	0.029550	20.15	34.79	19.45	2.65
Rancho Gr-lined	4200	701.00	5205.67	5208.03	5209.74	5214.36	0.029755	20.20	34.71	19.43	2.66
Rancho Gr-lined	4100	701.00	5202.67	5205.03	5206.74	5211.38	0.029893	20.23	34.65	19.42	2.67
Rancho Gr-lined	4000	701.00	5199.67	5202.02	5203.74	5208.40	0.030031	20.26	34.59	19.41	2.67
Rancho Gr-lined	3900	701.00	5196.67	5199.02	5200.74	5205.42	0.030170	20.30	34.54	19.40	2.68
Rancho Gr-lined	3800	701.00	5194.92	5197.50	5198.99	5202.51	0.021424	17.97	39.02	20.30	2.28
Rancho Gr-lined	3700	701.00	5193.17	5195.84	5197.24	5200.38	0.018626	17.09	41.02	20.69	2.14
Rancho Gr-lined	3600	701.00	5191.42	5194.13	5195.49	5198.50	0.017694	16.78	41.78	20.84	2.09
Rancho Gr-lined	3500	701.00	5189.67	5192.39	5193.74	5196.73	0.017503	16.71	41.94	20.87	2.08
Rancho Gr-lined	3400	701.00	5186.96	5189.51	5191.03	5194.65	0.022140	18.18	38.56	20.21	2.32
Rancho Gr-lined	3300	701.00	5184.25	5186.73	5188.32	5192.26	0.024562	18.86	37.16	19.93	2.43
Rancho Gr-lined	3200	701.00	5181.54	5183.99	5185.61	5189.72	0.025868	19.22	36.48	19.79	2.49
Rancho Gr-lined	3100	701.00	5178.83	5181.26	5182.90	5187.10	0.026513	19.39	36.16	19.73	2.52

Amole Arroyo - Exclusing Portion of Basin 60104

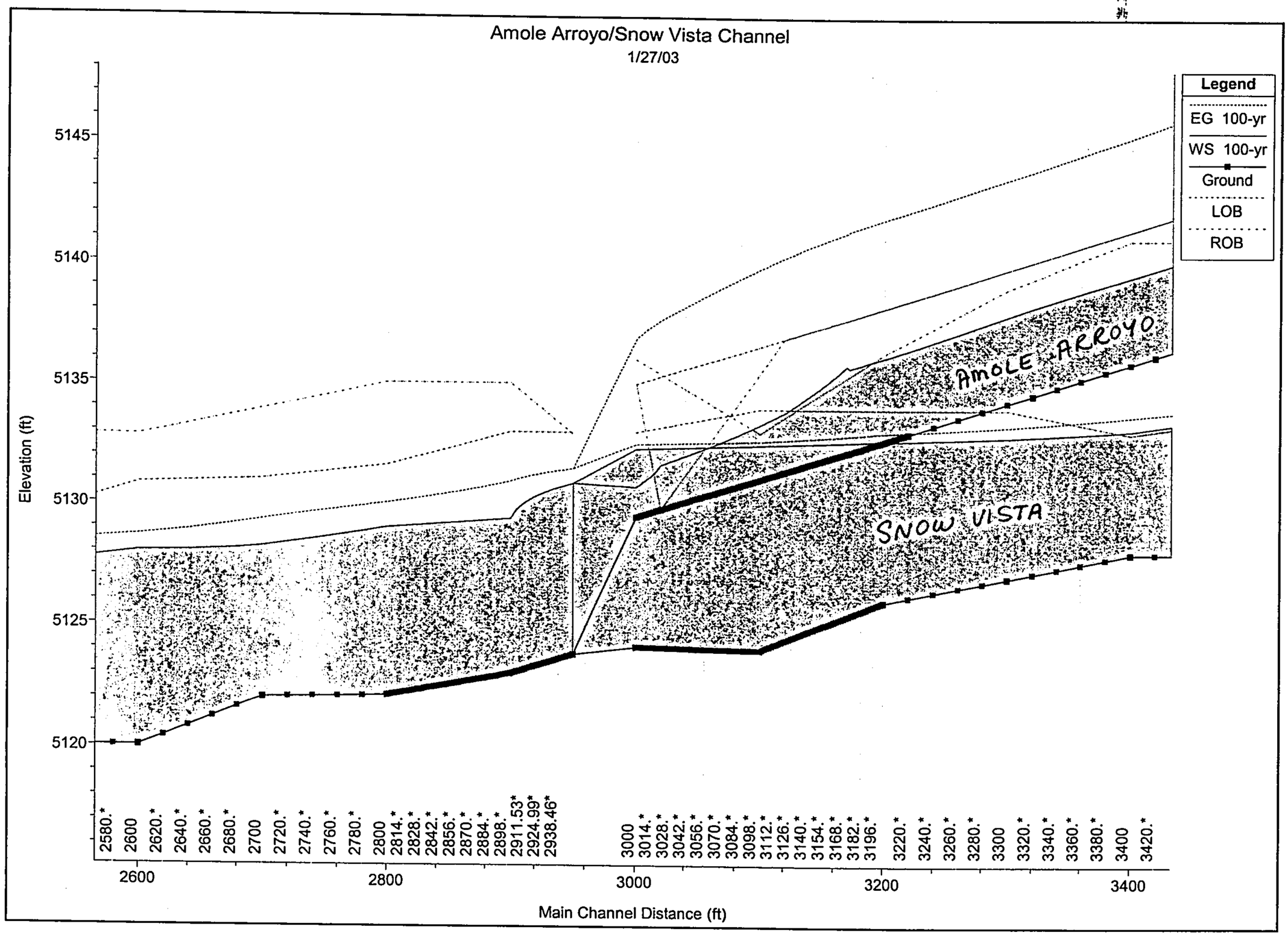
HEC-RAS Plan: 1/27/03 Profile: 100-yr

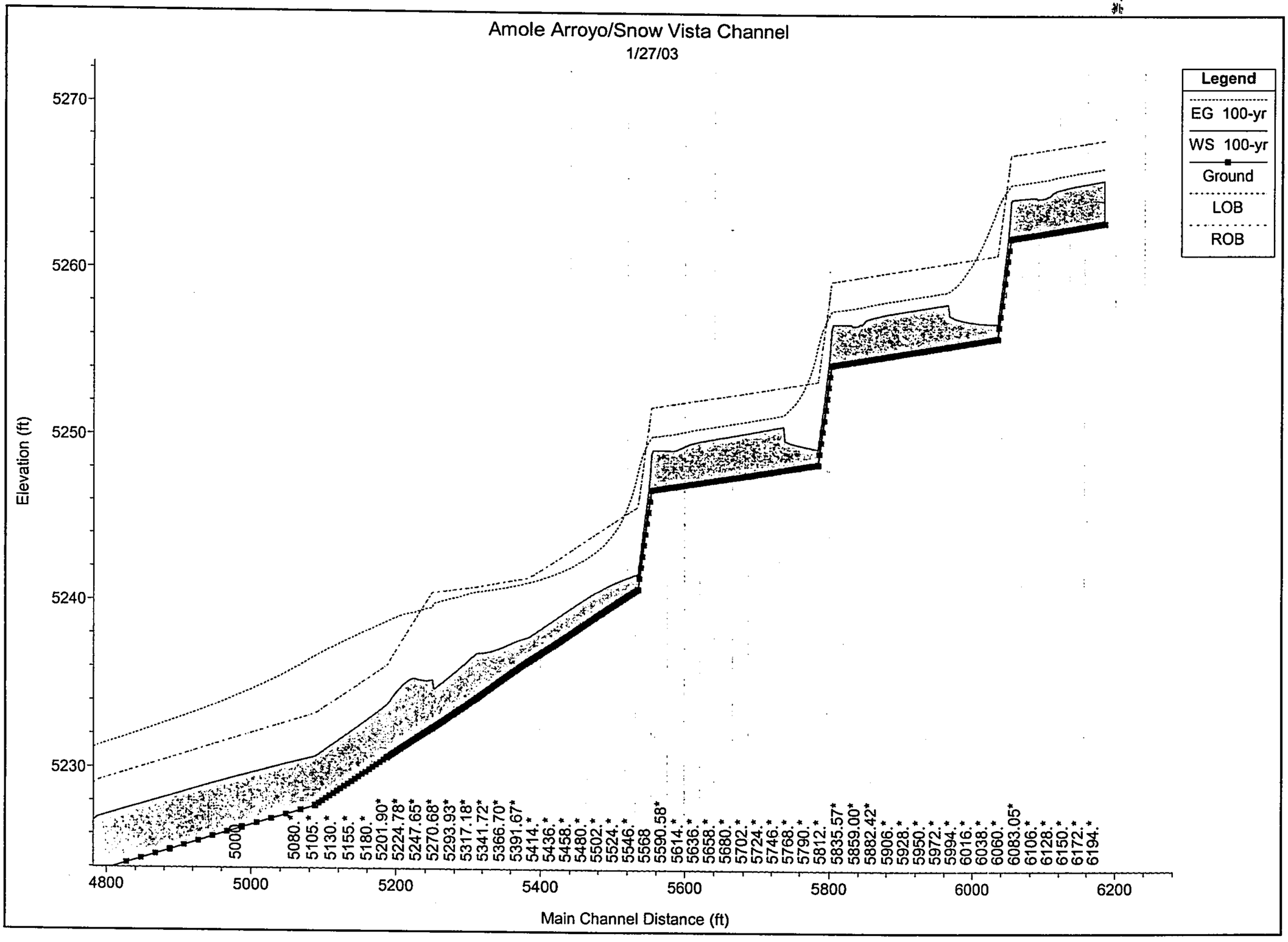
Reach	River Sta	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
		(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Units 6&7-unline	4300	1692.00	5133.00	5137.23	5136.51	5138.03	0.008467	7.18	235.57	76.48	0.72
Units 6&7-unline	4200	1692.00	5133.00	5136.14		5137.07	0.012229	7.71	219.36	84.56	0.84
Units 6&7-unline	4100	1692.00	5131.00	5135.69		5136.20	0.004381	5.78	292.68	79.94	0.53
Units 6&7-unline	4000	1692.00	5131.00	5135.17		5135.71	0.005170	5.89	287.34	86.82	0.57
Units 6&7-unline	3900	1692.00	5129.00	5134.89		5135.29	0.002826	5.09	332.71	78.99	0.44
Units 6&7-unline	3800	1692.00	5129.00	5134.55		5134.96	0.003135	5.18	326.59	81.75	0.46
Units 6&7-unline	3700	1692.00	5129.00	5134.21		5134.63	0.003087	5.24	322.60	77.99	0.45
Units 6&7-unline	3600	1692.00	5128.10	5133.97		5134.32	0.002494	4.74	356.73	85.90	0.41
Units 6&7-unline	3500	1692.00	5128.00	5133.68		5134.07	0.002792	5.01	337.98	81.56	0.43
Units 6&7-unline	3400	1692.00	5128.00	5133.06		5133.65	0.005129	6.19	273.43	76.63	0.57
Units 6&7-unline	3300	1692.00	5127.00	5132.73		5133.20	0.003726	5.49	308.05	80.45	0.49
Units 6&7-unline	3200	1692.00	5126.00	5132.53		5132.89	0.002410	4.80	352.83	81.26	0.41
Units 6&7-unline	3100	1692.00	5124.00	5132.29		5132.46	0.000817	3.37	502.67	86.62	0.25
Units 6&7-unline	3000	1692.00	5124.10	5132.04		5132.26	0.001178	3.72	454.80	89.30	0.29
Unit 8-unlined	2950	2655.00	5123.80	5130.61		5131.19	0.003201	6.10	435.49	86.18	0.48
Unit 8-unlined	2900	2655.00	5123.00	5129.08		5130.62	0.012683	9.96	266.64	71.29	0.91
Unit 8-unlined	2800	2655.00	5122.10	5128.74		5129.72	0.006647	7.93	334.82	77.54	0.67
Unit 8-unlined	2700	2655.00	5122.00	5127.90		5128.99	0.007855	8.38	316.82	76.58	0.73
Unit 8-unlined	2600	2655.00	5120.00	5127.66		5128.31	0.003494	6.45	411.90	79.71	0.50
Unit 8-unlined	2500	2655.00	5120.00	5127.03	5125.35	5127.87	0.005125	7.36	360.51	76.42	0.60
Unit 8-unlined	2400	2655.00	5119.80	5125.44		5127.04	0.012560	10.16	261.34	67.13	0.91
Unit 8-unlined	2300	2655.00	5117.00	5125.80		5126.25	0.002234	5.35	496.24	91.13	0.40
Unit 8-unlined	2200	2655.00	5116.90	5125.40		5125.97	0.003083	6.10	435.50	83.51	0.47
Unit 8-unlined	2100	2655.00	5116.60	5124.95		5125.62	0.003869	6.58	403.74	82.12	0.52
Unit 8-unlined	2000	2655.00	5116.30	5124.67	5122.01	5125.25	0.003003	6.08	436.90	82.29	0.46

Snow Vista - Excluding Portion of Basin 60104



AMOLE ARROYO


Amole Arroyo/Snow Vista Channel
1/27/03
Legend
EG 100-yr
WS 100-yr
Ground
LOB
ROB
AMOLE ARROYO
SNOW VISTA
Elevation (ft)
5145
5140
5135
5130
5125
5120
2580.* 2600 2620.* 2640.* 2660.* 2680.* 2700 2720.* 2740.* 2760.* 2780.* 2800 2814.* 2828.* 2842.* 2856.* 2870.* 2884.* 2898.* 2911.53* 2924.99* 2938.46* 3000 3014.* 3028.* 3042.* 3056.* 3070.* 3084.* 3098.* 3112.* 3126.* 3140.* 3154.* 3168.* 3182.* 3196.* 3220.* 3240.* 3260.* 3280.* 3300 3320.* 3340.* 3360.* 3380.* 3400 3420.*
2600
2800
3000
3200
3400
Main Channel Distance (ft)



AMOLE ARROYO
Drop Structures West of Delgado

Appendix D

Amole Arroyo--Depth of Channel Including Superelevation
Portion of Basin 60104 Included

Superelevation: $S = 1.3V^2(b+2zD)/2gr$ (*COA DPM*)

S = superelevation
V = velocity
b = channel bottom width
D = depth of flow for equiv. straight reach
R = channel radius
z = cotangent of channel side slope = 2
g = gravity = 32.2 ft/s^2

Station	R (ft)	V (ft/s)	b (ft)	D (ft)	S (ft)	Total Depth (ft)	Q	%
11+00	400	19.1	31.1	1.8	0.7	2.5		
12+00	400	20.1	19.8	2.5	0.6	3.1	1237	1.6%
12+50	700	18.7	14.6	3.6	0.3	3.9		
13+00	700	19.0	11.1	3.5	0.3	3.8		
14+00	700	19.0	10.0	3.6	0.3	3.9		
15+00	1400	19.4	10.0	3.6	0.1	3.7	1195	
16+00				3.5		3.5		
17+00	700	23.9	10.0	3.3	0.4	3.7		
18+00	700	22.0	10.0	3.2	0.3	3.5		
19+00	1400	21.6	10.0	3.2	0.2	3.4		2.76
20+00				3.3		3.3		
21+00				3.4		3.4	1129	
22+00				3.7		3.7		
23+00	500	19.3	10.0	3.4	0.4	3.8		1.49
24+00	265	21.0	10.0	3.2	0.8	4.0		
24+50	265	23.1	10.0	3.0	0.9	3.9	6' channel depth	
25+00	500	22.7	10.0	3.1	0.5	3.6		
26+00				2.6		2.6	5.5' channel depth	
27+00				2.6		2.6		3.8
28+00				2.6		2.6		
29+00				2.7		2.7		
30+00				2.8		2.8		
31+00				2.8		2.8		
32+00				2.8		2.8		
33+00				2.9		2.9		2.71
34+00				3.0		3.0		
35+00				3.1		3.1		
36+00	500	18.2	10.0	3.1	0.3	3.4		
37+00	500	18.6	10.0	3.0	0.3	3.3		
38+00	1000	19.6	10.0	2.9	0.2	3.1		
39+00	1000	21.8	10.0	2.7	0.2	2.9		
40+00	500	21.8	10.0	2.7	0.4	3.1		
41+00	500	21.8	10.0	2.7	0.4	3.1		
42+00	1000	21.8	10.0	2.7	0.2	2.9		
43+00				2.7		2.7		
44+00				2.8		2.8		

Station	R (ft)	V (ft/s)	b (ft)	D (ft)	S (ft)	Total Depth (ft)
44+00				2.8		2.8
45+00				2.8		2.8
46+00	3000	20.4	10.0	2.9	0.1	3.0
47+00				3.0		3.0
48+00				3.3		3.3
49+00				3.3		3.3
50+00				3.1		3.1
51+00				2.9		2.9
52+00				3.1		3.1
52+61				2.8		2.8
53+23				2.7		2.7
54+00	1000	14.8	40.0	1.4	0.2	1.6
55+00	1000	14.7	40.0	1.3	0.2	1.5
55+50	500	21.1	40.0	0.9	0.8	1.7
55+68	500	8.6	40.0	2.1	0.1	2.2
56+00	500	7.9	40.0	2.2	0.1	2.3
57+00	1000	7.2	40.0	2.4	0.1	2.5
58+00				0.9		0.9
58+18				2.0		2.0
59+00				2.4		2.4
60+00				1.5		1.5
60+50				0.9		0.9
60+68				2.2		2.2
61+00				2.3		2.3
62+00				2.4		2.4

4.5' channel depth

Amole Arroyo--Depth of Channel Including Superelevation
Portion of Basin 60104 Excluded

Superelevation: $S = 1.3V^2(b+2zD)/2gr$ (*COA DPM*)

S = superelevation
V = velocity
b = channel bottom width
D = depth of flow for equiv. straight reach
R = channel radius
z = cotangent of channel side slope = 2
g = gravity = 32.2 ft/s^2

Station	R (ft)	V (ft/s)	b (ft)	D (ft)	S (ft)	Total Depth (ft)
11+00	400	17.4	31.1	1.7	0.6	2.3
12+00	400	17.9	19.8	2.3	0.5	2.8
12+50	700	15.6	14.6	3.6	0.2	3.8
13+00	700	18.1	11.1	3.1	0.2	3.3
14+00	700	17.9	10.0	3.3	0.2	3.5
15+00	1400	18.2	10.0	3.2	0.1	3.3
16+00				3.2		3.2
17+00	700	20.6	10.0	3.0	0.3	3.3
18+00	700	20.6	10.0	2.8	0.3	3.1
19+00	1400	20.0	10.0	2.9	0.1	3.0
20+00				3.0		3.0
21+00				3.2		3.2
22+00				3.2		3.2
23+00	500	18.0	10.0	3.1	0.3	3.4
24+00	265	19.5	10.0	3.0	0.6	3.6
24+50	265	21.0	10.0	2.8	0.7	3.5
25+00	500	21.0	10.0	2.8	0.4	3.2
26+00				2.2		2.2
27+00				2.2		2.2
28+00				2.2		2.2
29+00				2.3		2.3
30+00				2.4		2.4
31+00				2.4		2.4
32+00				2.5		2.5
33+00				2.5		2.5
34+00				2.6		2.6
35+00				2.7		2.7
36+00	500	16.8	10.0	2.7	0.2	2.9
37+00	500	17.1	10.0	2.7	0.2	2.9
38+00	1000	18.0	10.0	2.6	0.1	2.7
39+00	1000	20.3	10.0	2.4	0.2	2.6
40+00	500	20.3	10.0	2.4	0.3	2.7
41+00	500	20.2	10.0	2.4	0.3	2.7
42+00	1000	20.2	10.0	2.4	0.2	2.6
43+00				2.4		2.4
44+00				2.4		2.4

6' channel depth

5' channel depth

	45+00				2.4		2.4
	46+00	3000	19.8	10.0	2.5	0.1	2.6
	47+00				2.6		2.6
	48+00				2.9		2.9
	49+00				2.8		2.8
	50+00				2.7		2.7
[illegible]	51+00				2.5		2.5
	52+00				2.6		2.6
	52+61				2.1		2.1
	53+23				2.3		2.3
	54+00	1000	13.9	40.0	1.2	0.2	1.4
	55+00	1000	13.4	40.0	1.1	0.2	1.3
	55+50	500	20.7	40.0	0.8	0.7	1.5
	55+68	500	7.6	40.0	1.9	0.1	2.0
	56+00	500	7.4	40.0	2.0	0.1	2.1
	57+00	1000	6.7	40.0	2.2	0.0	2.2
	58+00				0.8		0.8
	58+18				1.9		1.9
	59+00				2.0		2.0
	60+00				1.4		1.4
	60+50				0.8		0.8
	60+68				1.9		1.9
	61+00				2.0		2.0
	62+00				2.2		2.2

4.5' channel depth

Appendix E

Amole Arroyo--Easement Curve Length & Min. Centerline Radius

V =	velocity	24 fps
b =	bottom width	10 ft
z =	cotangent of channel side slope	2
D =	depth of flow for equiv. straight reach	4 ft

L_E = length of easement curve = $0.32*(b+2*z*D)*(V/D^{0.5})$

L_E = 100 ft

$R_{min.}$ = minimum centerline radius = Q*V/100

Station	Q (cfs)	V (fps)	$R_{min.}$ (ft)
10+68-17+00	1237	20	247
17+00-25+00	1129	23.2	262
25+00-53+23	914	21	192
53+23-62+00	797	21.2	169

→ Use 265 ft

Appendix F

Amole Arroyo--Slug Flow Analysis

Reference: *Design of Small Canal Structures*, U.S. Department of the Interior

Q =	flow	787 cfs		
d =	avg. water depth =	Area of water prism / Top width of water prism	9.28 / 13.2	0.7 ft
V =	velocity	15 fps		
b =	bottom width	40 ft		
L =	length of section	18 ft		
s =	avg. slope of energy gradient	0.044 ft/ft		
ϕ =	angle of inclination of the energy gradient	2.52 °		
wp =	wetted perimeter	26.8 ft		
g =	acceleration of gravity	32.2 ft/s^2		
d/wp =		0.03		

V = Vedernikov number $= 2/3(b/wp)(v/(g*d*\cos\phi)^{1/2}) =$ = 3.15

M^2 = Montuori number $= V^2/(g*s*L*\cos\phi)$ = 8.83

From Figure 2-45 ⟶ Zone of no slug flow
From Figure 2-46 ⟶ Zone of slug flow

"Waves are not likely to be generated in the structure, unless the plotted data falls within the slugging zone on both figures." (page 112) ⟶ No Slug Flows

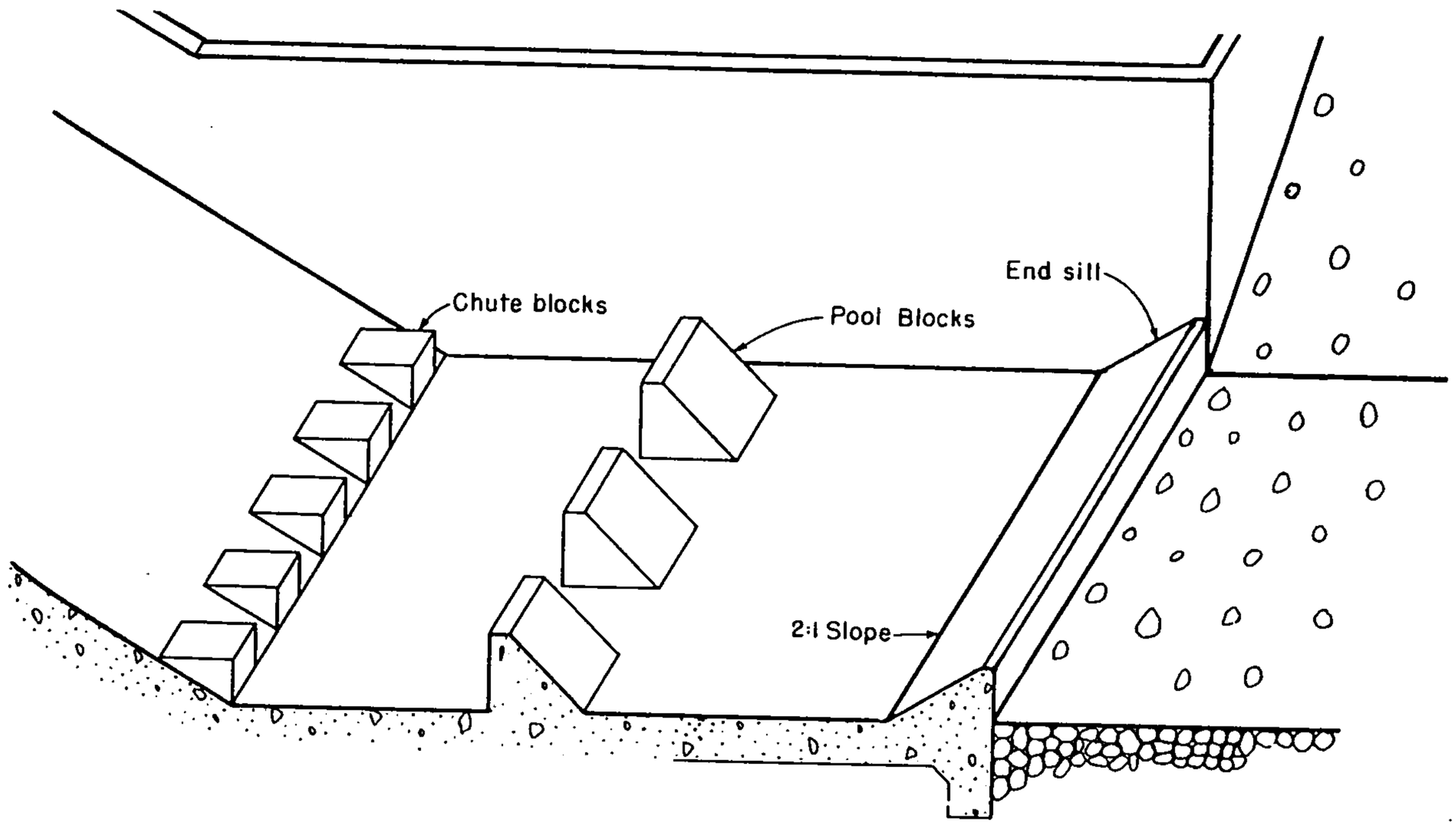


Figure 2-40. **Stilling pool with end sill. 103-D-1277**

Figures 2-45 and 2-46 have been developed to predict the possibility of slug flow occurring in a chute. The use of the figures requires the following operations:

(1) Divide the chute into a number of reaches as shown on figure 2-47. Point 1 should be at the beginning of the chute section.

(2) Using equation (6) or (7), with Q equal to 0.2, 0.5, and 1.0 times design Q, compute the water depth and energy levels at the points along the chute section that are to be checked for slugging. Use Manning's n = 0.010.

(3) Determine sL for the point to be checked (fig. 2-47).

(4) At the points to be considered:

a. Compute the Vedernikov number ($\underline{V}$) [10].

$$\underline{V} = \frac{2}{3} \times \frac{b}{wp} \times \frac{V}{\sqrt{gd \cos\theta}} \qquad (10)$$

b. Compute the square of the Montuori number ($\underline{M}$) [11].

$$\underline{M}^2 = \frac{V^2}{g\, sL \cos\theta} \qquad (11)$$

In equations (10) and (11)

b = bottom width of the chute section

d = average water depth in the chute section:

$$d = \frac{\text{Area of the water prism}}{\text{Top width of the water prism,}}$$

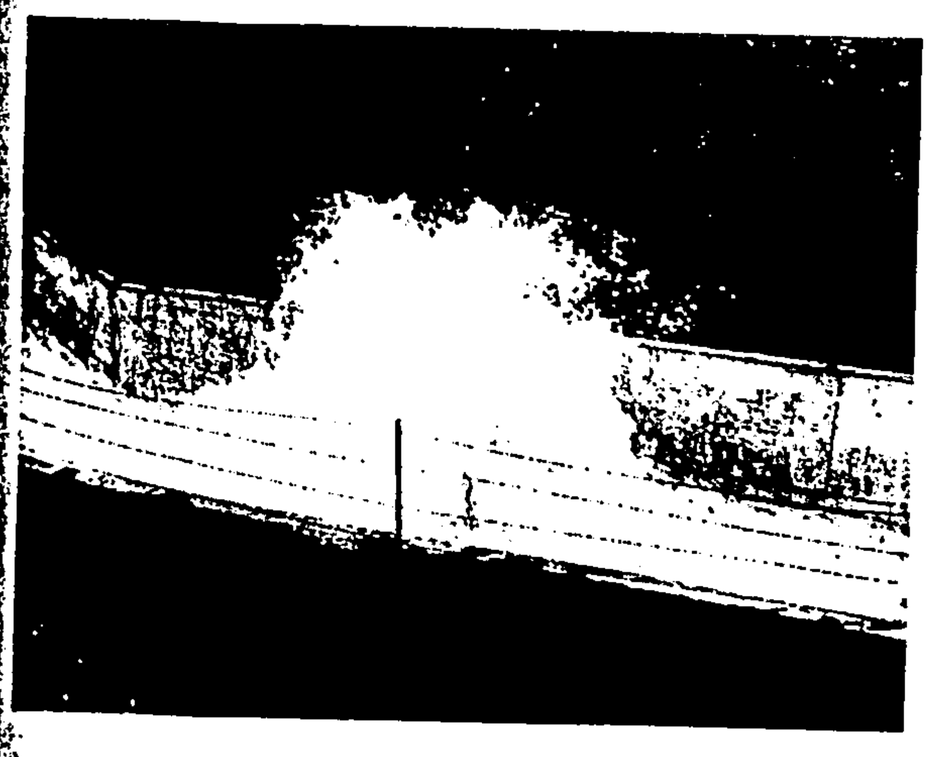


Figure 2-41. **Surging in a stilling pool caused by unstable flow in a chute structure. P222-117-36223**

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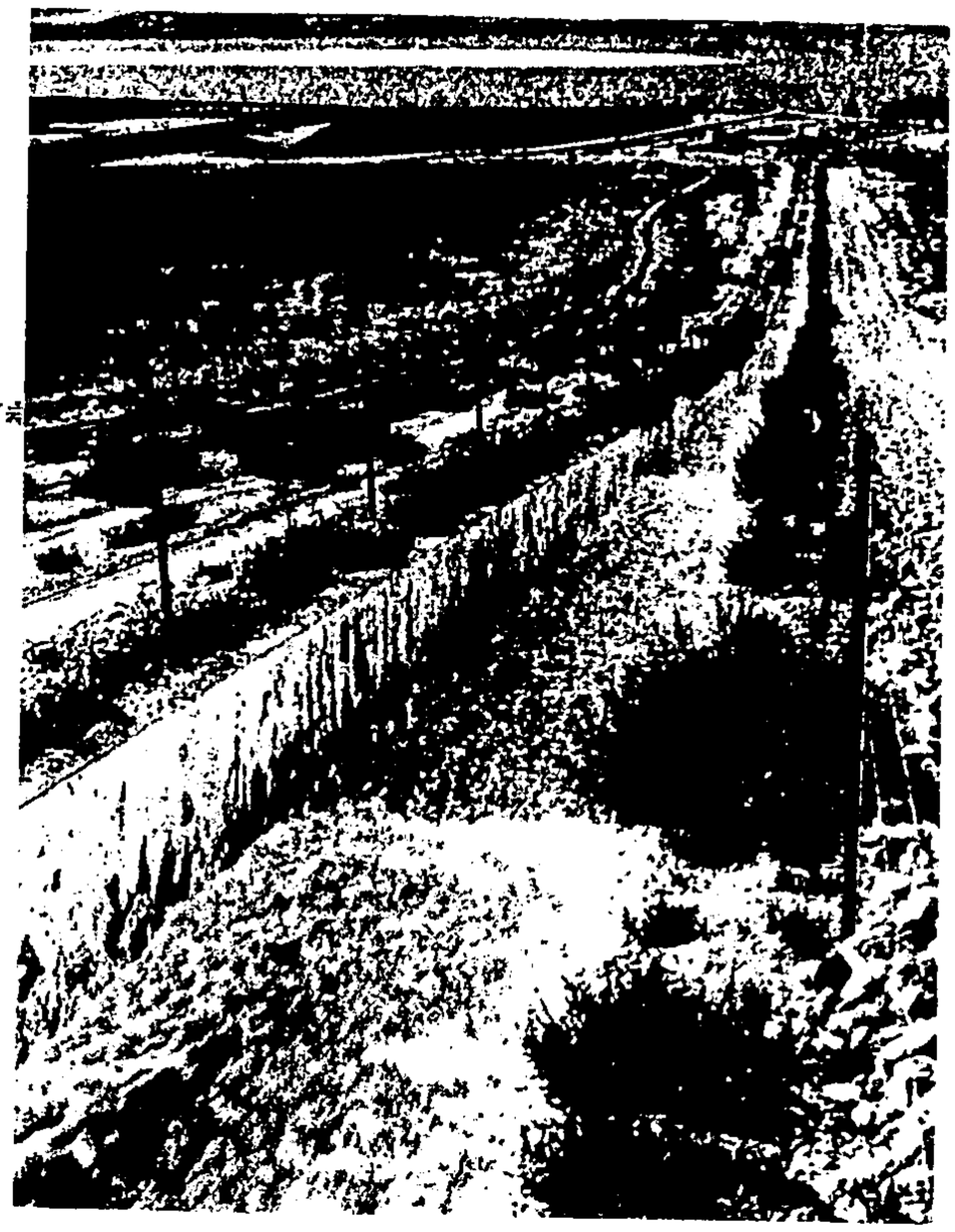

Figure 2-42. **Pulsating flow in steep chute. Flow is 57 cfs. P222-117-36208D**

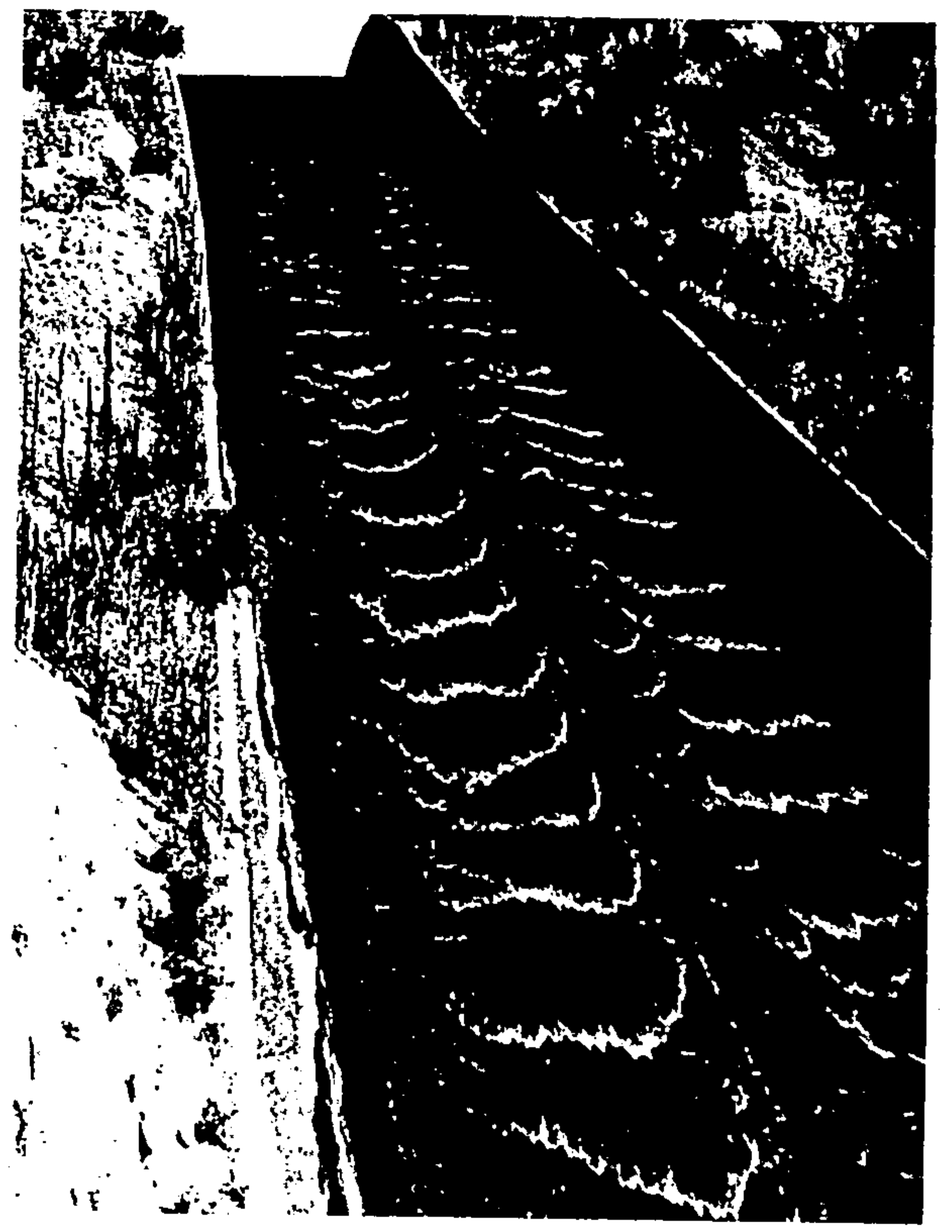

Figure 2-43. **Unstable flow at shallow depth. H-686-55D**

g = acceleration of gravity,
L = length of reach under consideration,
s = average slope of the energy gradient.

$$s = \tan \theta,$$

V = velocity,
wp = wetted perimeter of the section, and
θ = angle of inclination of the energy gradient.

(5) Plot the computed values on figure 2-45. If the plotted points fall within the slug flow zone, intermediate points may be checked to determine the point at which the waves begin to form.

(6) Compute the shape factor for the chute section.

$$\frac{d}{wp}$$

(7) Plot the computed value of $\frac{d}{wp}$ against the slope of the energy gradient, s, on figure 2-46.

Waves are not likely to be generated in the structure, unless the plotted data falls within the slugging zone on both figures 2-45 and 2-46.

If the charts indicate that slug flow will occur, the design may be modified to reduce the probability of waves being generated or the structure may be adapted to accommodate the

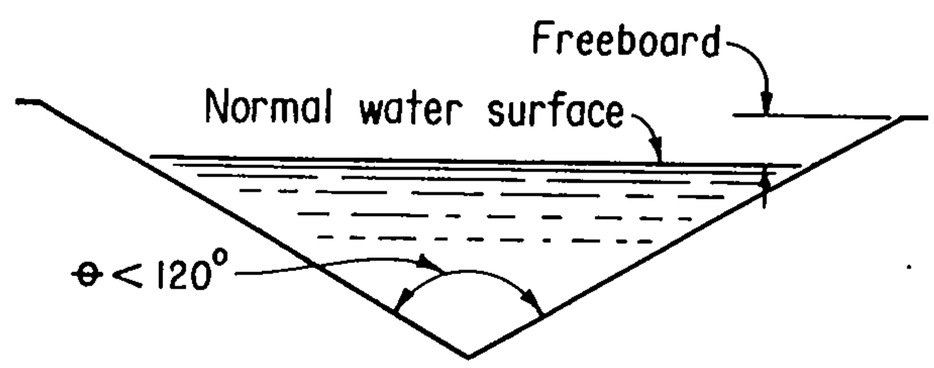

Figure 2-44. **Theoretical waveless chute section. Triangular shape prevents both cross waves and slug flow. 103-D-1278**

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surging flow that does occur. Possible design changes include:

(1) Divide the flow in the chute section with a wall down the center of the chute.

(2) Change the shape of the section. The theoretical waveless shapes could be considered.

(3) Reduce the length of the chute. A series of shorter chutes or drops could be considered.

(4) Steepen the chute.

(5) Replace the open channel chute section with pipe.

If these design changes are impractical, the chute section might be adapted to accommodate surging flow by:

(1) Increasing the freeboard of the chute walls.

(2) Providing a cover for the chute section to contain the waves, or

(3) Protecting the backfill around the chute section with riprap or paving.

Adaptations to the stilling pool could include:

(1) Designing the pool to provide for the momentary surge discharge. This would

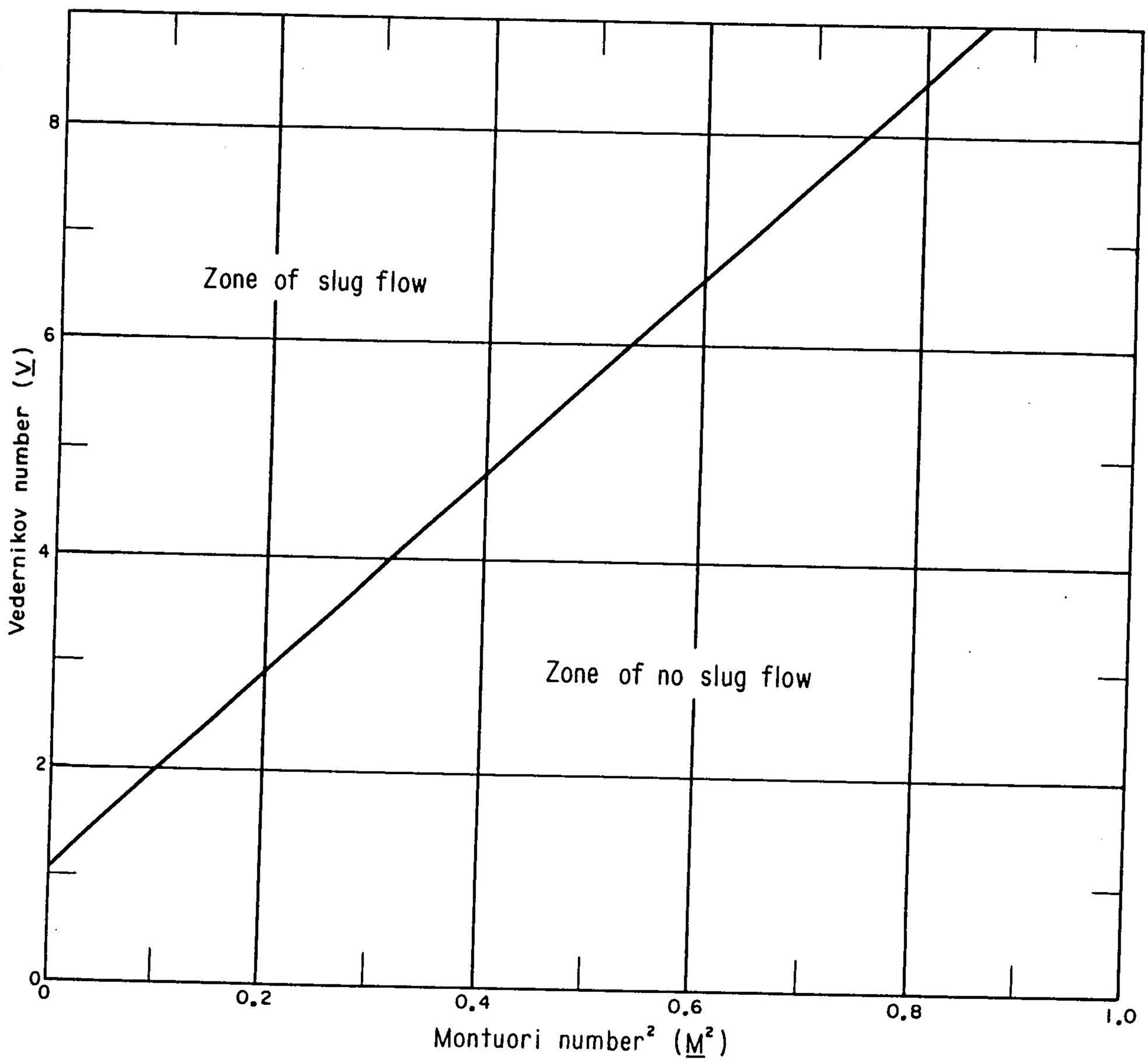

Figure 2-45. **Criteria for slug flow. 103-D-1279**

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provide a longer pool and higher pool walls to contain the surge.

(2) Provide additional riprap to protect the channel downstream and the backfill around the pool.

(3) Provide a surge suppressing device in the stilling pool. A baffle or weir wall in the pool could prevent flow from sweeping through the pool and outlet transition (fig. 2-48). Weir walls could also provide tailwater to submerge the surges. Rafts or other floating wave dampeners could be used.

(4) An energy dissipator less sensitive to surging could be used.

The study of wave action in chute structures is based largely on empirical data. If a serious wave problem in a structure is indicated, further studies should be undertaken to verify the extent of the problem and the effectiveness of the proposed solutions.

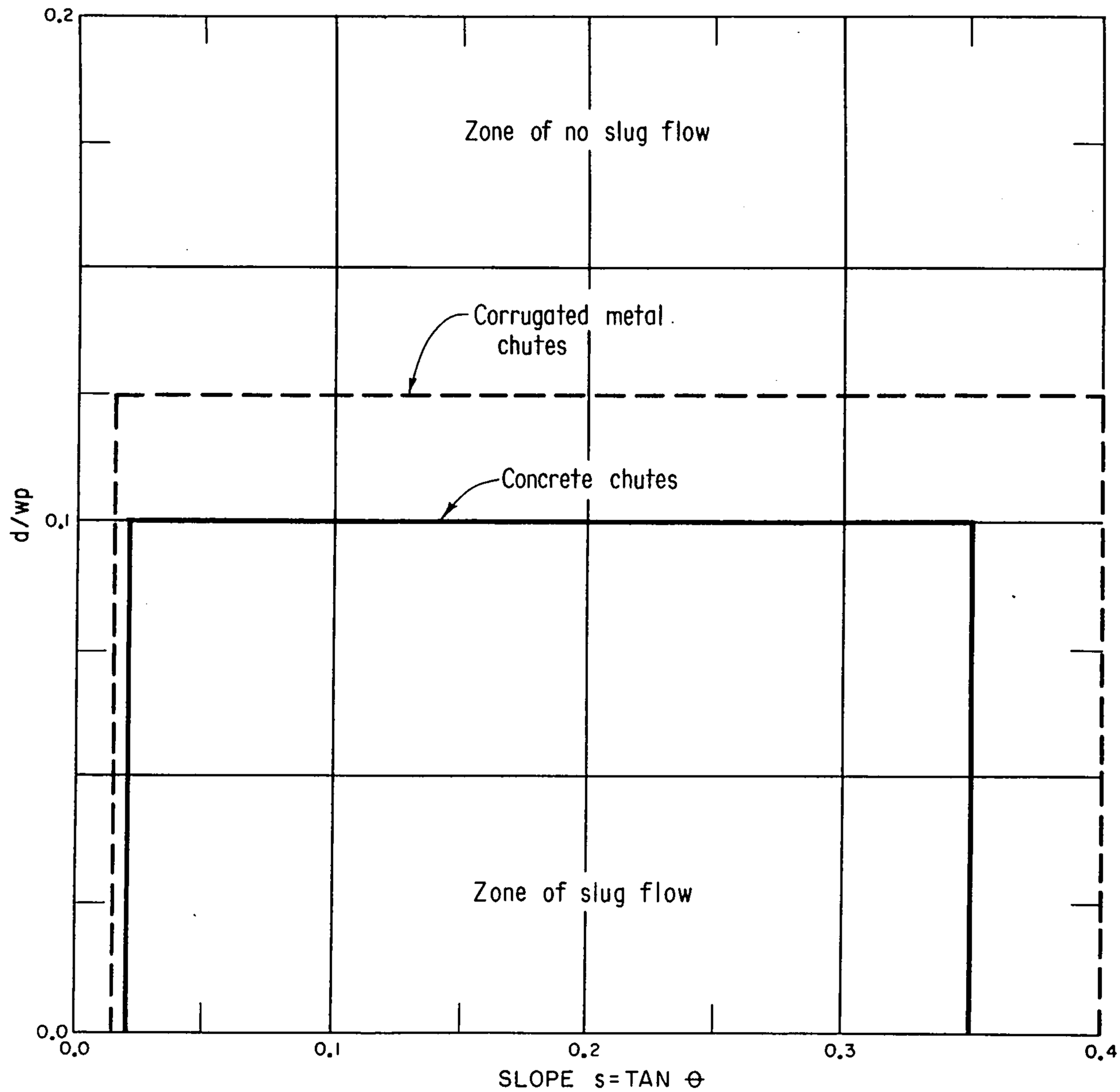

Figure 2-46. **Shape and slope criteria for slug flow. 103-D-1280**

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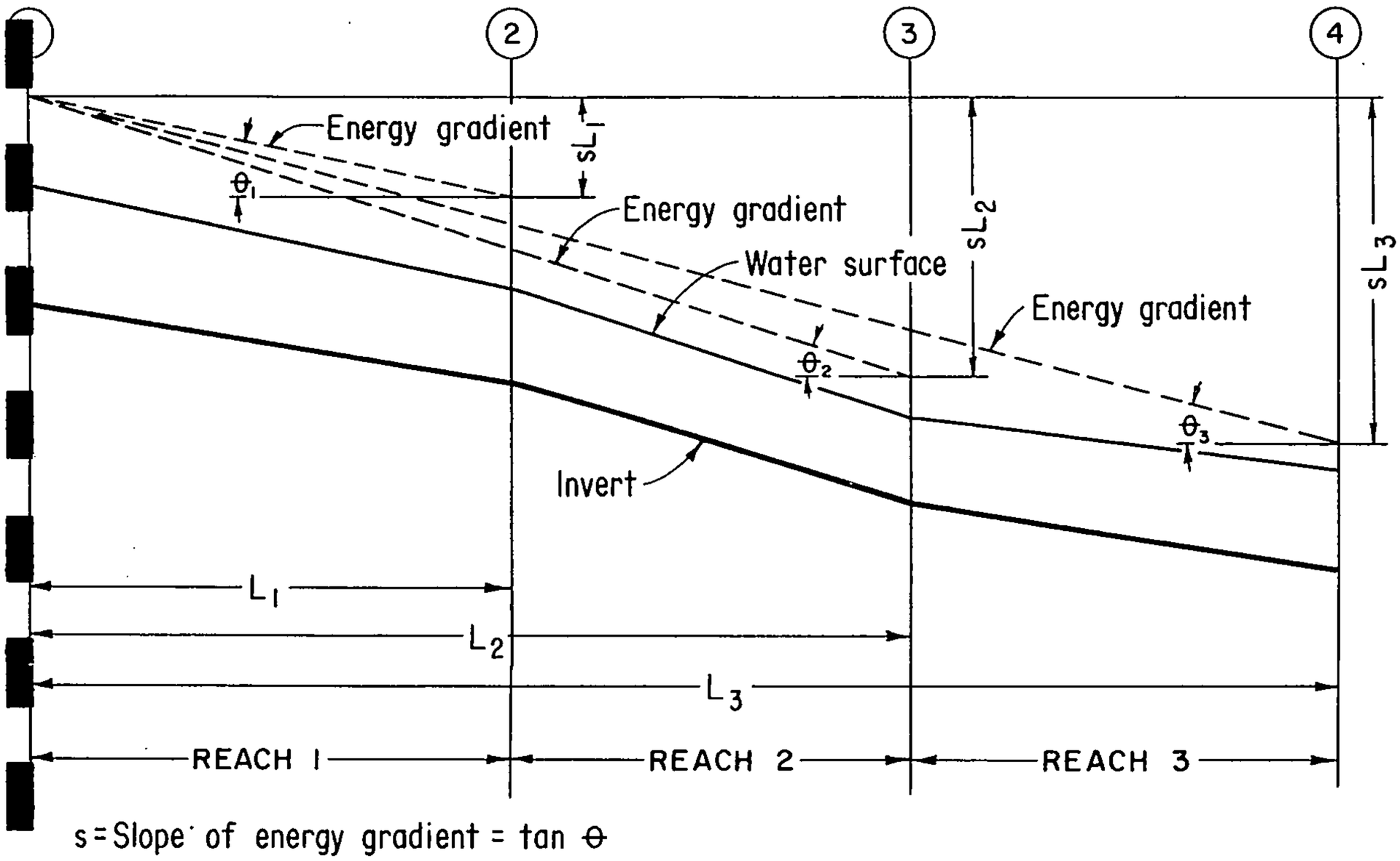

Figure 2-47. **Invert, water surface, and energy profiles of a chute structure. 103-D-1281**

2-35. *Design Procedure.*—

(1) Select and design the type of inlet to be used.

(2) Determine the energy gradient at the beginning of the chute section.

Figure 2-48. **Wave sweeping through the outlet transition of a stilling pool. Flow is 140 cfs. P222-117-36227**

(3) Compute the variables of flow down the chute section.

(4) Design the trajectory and the steep portion of the chute section.

(5) Assume an elevation for the floor of the stilling pool and compute the characteristics of flow upstream of the hydraulic jump.

Determine d_2 and the energy gradient after the hydraulic jump.

(6) Determine the energy gradient in the channel downstream and compare to the energy gradient after the jump.

(7) It may be necessary to assume a new pool invert elevation and to recompute the above values several times before a check in energy gradients is obtained.

(8) Review for proper operation at partial capacity.

(9) Determine the length of the pool and the height of the pool walls.

(10) Design the chute and floor blocks and the end sill or outlet transition as required.

(11) Check the possibility of waves developing on the structure.

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If an incoming surge of height h_2 approaches the junction from channel II, then it can be shown that

$$h = \frac{2h_2A_2}{Ic_2} \tag{19-84}$$

Similarly, if an incoming surge of height h_3 approaches the junction from channel III, then

$$h = \frac{2h_3A_3}{Ic_3} \tag{19-85}$$

By the above principle, it is possible to analyze surges in a complicated channel network. Such a method has been developed by Swain [32,33] for an approximate determination of surge flows in an interconnected system of estuarine channels in response to tidal variations. In this method, the friction barrier is assumed to be located at the middle of a channel reach. The surges are assumed to have small heights compared with the depth of flow, so that simplified equations can be applied. To further expedite the computation, it is desirable to have coincidental arrival of surges at a barrier or junction at some given instant. This is made possible by the use of a procedure that involves a modification of the true length of the channel reaches. The analytic method developed by Swain was actually applied to a problem for the determination of flows in interconnected estuarine channels in the Delta area of California east of Suisun Bay. The same problem was studied by the U.S. Bureau of Reclamation using an elaborate hydraulic model [34–36] and an electronic analog model [37]. The results of the Swain method were checked satisfactorily.

19-9. Pulsating Flow. When the slope of a channel becomes very steep, supercritical flow of uniform depth in the channel will break into a train of traveling waves or pulses, known as *pulsating flow*. Such an unsteady flow occurs in various situations and in each situation it has specific significance. When it occurs in inclined flumes and spillways, the increased height of the flow requires additional freeboard to prevent spillage, and the concentrated mass of the wavefronts calls for additional structural safety factors against transient pressures and stresses. In hydraulic models, presence of the flow often interferes with similarity conditions. On farm lands and unstabilized roads, the high scouring capacity of the flow causes surface erosions. In chemical processes, the effect of the flow will increase the mass-transfer rate between gas and liquid diffusion reactions.

There have been numerous studies on the phenomenon of pulsating flow. Most of them, however, were made primarily in connection with the investigation of the mechanism of instability of flow (Art. 8-8). An analytical and experimental study of pulsating flow which has long

interested hydraulic engineers was made by Thomas [38]. In this study pulsating flow was described as a flow consisting of two parts, a roughly tumbling head and a smooth tail section. The results of the study indicate that, for pulsating flow to occur in a wide rectangular channel, the channel slope must be more than 4 times the critical slope or the velocity more than twice the critical velocity. Another investigation was made by Mayer [39], who found that pulsating flow can be classified into two distinct types, namely, roll waves and slug flow.

According to Mayer, *roll waves* are characterized by transverse ridges of high vorticity. The regions between the crests are quiescent. The waves are initiated by finite as well as infinitesimal disturbances in the laminar boundary layer. The process can be enhanced by external causes, such as addition of water by rain, release of air bubbles in the upstream pool, roughening the channel entrance, or contact of the flow surface with disturbing air currents. For roll waves to form, however, the surface velocity of the undisturbed flow must be less than the wave velocity, and the channel slope must be supercritical. This requirement will ensure the breaking of waves at their downstream ends and thus allow a frontward steepening of wave configuration and subsequent increase of capillary effects. This process is primarily responsible for the formation of roll waves. In Mayer's experiment, no roll waves were observed on slopes of less than 3% and in no case was the Reynolds number in excess of 420.

Slug flows are characterized by surges of turbulent ridges with wave crests separated by highly agitated regions. In model channels, they are originated randomly at the side walls and in the channel as spotty bursts of turbulence, exhibiting characteristics similar to moving oblique hydraulic jumps. They are the result of transition from supercritical laminar to subcritical turbulent state of flow. For slug flows to form, the surface velocity must be greater than the wave velocity. This will ensure the steepening and breaking of waves at their upstream ends and thereby result in the development of moving hydraulic jumps. In Mayer's experiment, no slug waves were formed on slopes less than about 2%. The range of Reynolds number for slug flows was approximately 1,000 to 4,000. For Reynolds number greater than 4,000, the flow was thoroughly turbulent.

Considering a parabolic distribution of the velocity of a uniform flow in an inclined channel, the surface velocity given by Eq. (6-42) for $y = y_m$ is $gSy_m^2/2\nu$. The average velocity of the flow is given by Eq. (6-43) or $V = gSy_m^2/3\nu$. The surface velocity is, therefore, equal to 1.5 times the average velocity, or $1.5V$.

According to the previous description, a roll wave can be formed when the surface velocity is equal to or less than the absolute wave

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velocity, that is, when

$$1.5V \leqq V + c \tag{19-86}$$

or

$$V/c \leqq 2 \tag{19-87}$$

Since V/c is equal to the Froude number and since roll waves can be formed only on supercritical slopes, the range of Froude number for the formation of roll waves is $1 \leqq \mathbf{F} \leqq 2$. Solving Eq. (6-43) for S, it can be shown that $S = 3\mathbf{F}^2/\mathrm{R}$. Thus, the range of slope for the formation of roll waves is $3/\mathrm{R} \leqq S \leqq 12/\mathrm{R}$.

Slug flow can be formed when the surface velocity is greater than the wave velocity. Theoretically, therefore, the formation of slug flow will occur when $\mathbf{F} > 2$ and $S > 12/\mathrm{R}$.

PROBLEMS

19-1. Prove Eq. (19-11).

19-2. Prove Eq. (19-15).

19-3. Assuming the energy loss in the moving hydraulic jump to be negligible, Koch and Carstanjen [27] have derived the following equation for the wave velocity of a surge:

$$V_w = \sqrt{\left(\frac{V_1 - V_2}{4}\right)^2 + gy_1} \pm \frac{V_1 + 3V_2}{4} \tag{19-88}$$

where the positive sign is for type A and C surges and the negative sign is for type B and D surges (Fig. 19-2). Verify this equation.

19-4. Assuming an initial depth of 20 ft, an initial velocity of 15 fps, and a rectangular channel cross section, compute the velocity and overrun of the bore shown in Fig. 19-3 and estimate the distance traveled by the bore in 7 min.

19-5. Compute the heights, depths, and wave velocities of the two component surges produced in Example 19-3.

19-6. A positive surge 0.63 ft high and 51.72 ft deep is moving in still water 51.09 ft deep with a wave velocity of 41.70 fps toward the dead end of a channel. Determine the height and wave velocity of the reflected surge after the original surge hits the dead end.

19-7. Solve Example 19-1 if the original steady flow has a velocity of 10 fps and a depth of 50 ft.

19-8. Solve Example 19-3, if the step has a height of $F = 3$ ft.

19-9. Two positive surges 3 and 2 ft in height, respectively, move in opposite directions toward each other in a frictionless horizontal channel where the water is initially stationary at a depth of 30 ft. The high surge has a wave velocity of 30 fps and the low surge a wave velocity of 20 fps. Determine the flow condition after the surges meet.

19-10. Solve Example 19-1 if the channel has a slope of 0.01. The initial steady flow is assumed uniform.

19-11. Show that the celerity formula in the form of Eq. (18-45) applies only to positive surges and that the corresponding celerity formula for negative surges is

$$c = \sqrt{gy\left(1 - \frac{3h}{2y}\right)} \tag{19-89}$$

19-12. Referring to Example 19-5, show that the crest velocity $V_{w2} = \sqrt{gy_2}$, that the trough velocity $V_{w1} = 2\sqrt{gy_2}$, that the velocity of flow through the dam site is $\frac{2}{3}\sqrt{gy_2}$, and that the discharge through the dam site is $\frac{8}{27}\sqrt{g}\, y_2^{3/2}$.

19-13. Continue the computation of the example illustrated in Fig. 19-12, and determine the flow conditions at 420, 504, 552, 743, and 767 sec, respectively, after the load was suddenly thrown off.

19-14. Solve Example 19-6 if the equalization time is (*a*) 8 min and (*b*) 12 min. The discharge from the lock increases linearly from 0 to 10,000 cfs for the first 20% of the time and then decreases linearly to 0 for the remaining part of the time. Study the effect due to change in equalization time.

19-15. Solve Example 19-7 if the discharge is 1,000 cfs.

19-16. Three horizontal frictionless channels 4, 6, and 8 ft wide meet at a junction. The water in the channels has an initial stationary depth of 10 ft. When an incoming surge 0.4 ft high approaches the junction from the narrowest channel, determine the flow condition after the surge enters the junction. Compute the reflection coefficient of the junction.

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Appendix G

TABLE III -1
HYDROLOGIC SUMMARY
AMOLE ARROYO BASIN

AP NO.	MAP NO.	DESCRIPTION	VARIABLE	EXISTING FACILITIES			PROPOSED DMP FACILITIES	
				EXISTING	DEVEX	EXISTING CAPACITY	DMP	FUTURE CAPACITY
1	6	AMOLE ARROYO OUT @ WESTGATE	Q (cfs)	73.2	73.5	74	73.5	74
			Tvol (AF)	418	449		449	
			Runoff (in)	0.17	0.62		0.62	
			cfs/ac	0.01	0.02		0.02	
2	6	AMOLE ARROYO BELOW POWERLINE JUNCTION	Q (cfs)	562	1161	N/A	255	N/A
			Tvol (AF)	489	558		556	
			Runoff (in)	0.22	0.81		0.64	
			cfs/ac	0.04	0.28		0.06	
2.1	6	AMOLE ARROYO AT CBC AT DELGADO	Q (cfs)	652	1525	1026	575	1026
			Tvol (AF)	494	577	(bank full)	574	(bank full)
			Runoff (in)	0.22	0.84		0.67	
			cfs/ac	0.05	0.36		0.13	
2.2	6	AMOLE ARROYO AT EAST WESTGATE CROSSING	Q (cfs)	620	1535	N/A	693	N/A
			Tvol (AF)	497	582		580	
			Runoff (in)	0.22	0.84		0.68	
			cfs/ac	0.05	0.36		0.16	
3	7	AMOLE ARROYO AND SNOW VISTA CONFLUENCE	Q (cfs)	1990	3463	N/A	2825	N/A
			Tvol (AF)	603	769		767	
			Runoff (in)	0.29	1.06		0.94	
			cfs/ac	0.14	0.63		0.51	
3.1	7	AMOLE ARROYO ABOVE SACATE BLANCO CONFLUENCE	Q (cfs)	2237	4016	N/A	3526	N/A
			Tvol (AF)	639	814		814	
			Runoff (in)	0.29	1.11		0.98	
			cfs/ac	0.15	0.68		0.61	
4	7	AMOLE ARROYO INTO AMOLE DETENTION FACILITY	Q (cfs)	3022	6089	1500 cfs channel	5293	4650
			Tvol (AF)	657	950	4235 cfs chute	925	
			Runoff (in)	0.31	1.18	(bank full)	1.08	
			cfs/ac	0.19	0.89	3000 cfs channel	0.81	
						7480 cfs chute		

Notes/Legend

AP - Analysis Point - See Figures this report, maps in Volume II and detail hydrology in Volume III.
Q - Peak discharge rate
Tvol - Total runoff volume (includes truncated volumes)
Dvol - Maximum detained volume
Runoff - inches of runoff
cfs/ac - peak discharge rate per acre of contributing area.
Existing - Existing land use and existing drainage facilities.
DEVEX - Fully developed land use and existing drainage facilities.
Capacity - Design capacity.
DMP - Proposed improvements in place, fully developed land use.

TABLE III-3
HYDROLOGIC SUMMARY
SNOW VISTA BASIN

AP NO.	MAP NO.	DESCRIPTION	VARIABLE	EXISTING FACILITIES			PROPOSED DMP FACILITIES	
				EXISTING	DEVEX	EXISTING CAPACITY	DMP	FUTURE CAPACITY
21.1	4	SNOW VISTA SEDIMENTATION BASIN	Q (cfs)	233	423	484	423	484
			Tvol (AF)	17.1	53.8		53.8	
			Dvol (AF)	4.0	6.4		6.4	
			Runoff (in)	0.76	2.07		2.07	
			cfs/ac	0.62	1.36		1.36	
21	4	SNOW VISTA CHANNEL AT HEAD	Q (cfs)	167	388	290	388	375
			Tvol (AF)	17.1	53.8	2530	53.18 *	
			Runoff (in)	0.76	2.07	(bank full)	2.07	
			cfs/ac	0.62	1.25		1.25	
22	4	SNOW VISTA BELOW SECTION LINE JUNCTION	Q (cfs)	407	747	810	747	810
			Tvol (AF)	41.5	95	4595	95 *	
			Runoff (in)	0.86	1.97	(bank full)	1.97	
			cfs/ac	0.70	1.29		1.29	
22.1	4	SNOW VISTA BELOW SAGE CROSSING	Q (cfs)	642	916	850	916	930
			Tvol (AF)	49.3	114.4	3850	114.4 *	
			Runoff (in)	0.83	1.93	(bank full)	1.93	
			cfs/ac	0.90	1.29		1.29	
22.2	4	SNOW VISTA BELOW INLET FROM WESTGATE	Q (cfs)	812	1031	990	1031	1050
			Tvol (AF)	57	121.7	3700	121.7 *	
			Runoff (in)	0.90	1.92	(bank full)	1.92	
			cfs/ac	1.07	1.36		1.36	
23	4	SNOW VISTA BELOW BENAVIDES INLET	Q (cfs)	1864	2050	1200	2050	2100
			Tvol (AF)	99	167.5	5230	167.5	
			Runoff (in)		1.88	(bank full)	1.88	
			cfs/ac		1.92		1.92	
24	7	SNOW VISTA AT ENTRANCE TO AMOLE ARROYO	Q (cfs)	1814	2083	1200	2083	2100
			Tvol (AF)	105.7	183.4	2600	183.4	
			Runoff (in)	1.10	1.87	(bank full)	1.87	
			cfs/ac	1.57	1.77		1.77	

Notes/Legend

AP - Analysis Point - See Figures this report, maps in Volume II and detail hydrology in Volume III.
Q - Peak discharge rate
Tvol - Total runoff volume
Dvol - Maximum detained volume
Runoff - inches of runoff
cfs/ac - peak discharge rate per acre of contributing area.
Existing - Existing land use and existing drainage facilities.
DEVEX - Fully developed land use and existing drainage facilities.
Capacity - Design capacity.
DMP - Proposed improvements in place, fully developed land use.

* Existing channel has excess capacity without additional freeboard. No improvements are necessary.