City of Albuquerque

P.O. BOX 1293 ALBUQUERQUE, NEW MEXICO 87103

June 5, 2003

Scott Steffen, PE
Bohannan Huston, Inc.
7500 Jefferson NE
Albuquerque, NM 87109

Re: Gibson Corridor – 118th St to Amole Arroyo DMP
Engineer's Stamp dated 5-8-03 (N9/D4)

Dear Mr. Steffen,

Based upon the information provided in your submittal dated 5-9-03, the above referenced Master Plan cannot be approved until the following comments are addressed.

- On the land treatment map, Basins DB9, DB11 and DB12 infer residential development but the Rio Bravo Sector Plan designates these basins as commercial zoning. Please revise the map.

- It should be noted that the Drainage Study for the construction of the Amole Arroyo revised the Amole-Hubbell slightly to include basin SBB60104 into the Amole watershed. This report modifies the basin delineation (portions of SBB60101, SBB60102 and SBB60105) even more; therefore, AMAFCA approval is required as well.

- Basin DB4 (Gibson) should be broken up at AP2 to be consistent with the AHYMO model.

- It would be more prudent to include Basins DB1 and DB2 into the Gibson system. It would better balance the analysis points AP12 and AP9. Plus once the El Rancho units 10 and 11 develop, the eastern portion of DB2 would be more apt to be developed.

- The Amole Arroyo (with applicable analysis points denoted) from the Snow Vista confluence to your southerly entry point should be included your model. What improvements are needed in the Amole in this reach?

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: Lynn Mazur, AMAFCA
file

MASTER DRAINAGE STUDY

For the Gibson Boulevard Corridor Between 118th Street and the Amole Arroyo

MAY 8, 2003

Prepared for:
Curb, Inc.
6301 Indian School NE
Suite 208
Albuquerque, NM 87109

Bohannan △ Huston Inc.

▲ ENGINEERING
▲ ADVANCED TECHNOLOGIES
▲ SPATIAL DATA

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MASTER DRAINAGE STUDY
FOR THE
GIBSON BOULEVARD CORRIDOR
BETWEEN 118TH STREET AND THE AMOLE ARROYO

May 8, 2003

Prepared for:

CURB INC.
6301 INDIAN SCHOOL NE, SUITE 208
ALBUQUERQUE, NM 87110

By:

BOHANNAN HUSTON, INC.
COURTYARD I
7500 JEFFERSON STREET NE
ALBUQUERQUE, NM 87109

SCOTT J. STEFFEN
NEW MEXICO
14664
REGISTERED PROFESSIONAL ENGINEER

PREPARED BY:

5/8/03

Scott J. Steffen, P.E. Date

Bohannan Huston Inc.

I. INTRODUCTION

This drainage study establishes a Drainage Management Plan (DMP) for the future Gibson Boulevard corridor between 118th Street and the Amole Arroyo in the southwest quadrant of Albuquerque, New Mexico. The drainage area covered by the DMP is approximately 300 acres of residential, commercial, and special use zoned property that bound the north and south side of the future Gibson Boulevard between 118th Street to the west and the Amole Arroyo to the east. The DMP area is in the Amole Arroyo Watershed and encompassed by the Amole-Hubbell Drainage Management Plan.

II. PURPOSE

The Amole-Hubbell Drainage Management Plan addresses drainage issues in the Amole Arroyo Watershed and outlines a combination of runoff constraints, facility upgrades, and new facilities to accommodate existing and developed runoff in the watershed. The Amole-Hubbell Drainage Management Plan does not address storm drain facilities required to convey developed runoff from specific developments to the facilities discussed in the Plan. This DMP will address the developed storm runoff for the 300 acre area and identify necessary backbone storm drain infrastructure to adequately convey the flow from future developments to the existing Amole Arroyo facilities.

Approval of this Drainage Management Plan, and the associated storm drain facilities, provides a basis for determining shared storm drain infrastructure requirements for approximately 300 acres of land and allows for the phased implementation of the storm drain system. This Master plan does not address the historic drainage patterns, site specific plans for future developments, or interim requirements for individual developments. An approved grading and drainage plan will be required for each development.

III. METHODOLOGY

Existing and proposed site hydrological conditions were analyzed for the 100-year, 6-hour storm in accordance with the revised Section 22.2, Hydrology, of the Development Process Manual (DPM) for the City of Albuquerque, dated January 1993. The Arid-lands Hydrologic Model (AHYMO) was utilized to determine peak flow rates for design of the storm drainage improvements within the projects. The 100-year, 6-hour storm is used as the design event. The results are included in **Appendix A.** Street capacities were analyzed using Manning's equation, consistent with the revised DPM Section 22.2. The storm sewer system is analyzed using current DPM methods for gravity flow conditions. All data and calculations supporting this study are located in **Appendix B.**

In addition, the hydrologic analysis is based on the approved drainage report: *Amole-Hubbell Drainage Management Plan, Volume I, Final Facilities Plan Report* dated July 22, 1999, prepared by Leedshill-Herkenhoff, Inc.

IV. EXISTING CONDITIONS

A. Topography

The DMP area is currently undeveloped land with grades ranging from approximately 1% to 9%. The area generally slopes from northwest to southeast. Soils in the area have an SCS soil classification of BCC (Bluepoint loamy fine sand). BCC soils consist of deep, somewhat excessively drained soils formed in sandy alluvial soils, with rapid permeability, slow runoff characteristics, and severe hazard for wind erosion. Vegetation is light consisting mostly of native grasses.

As designated on Panel 336 of 825 (Map number 35001C0336D) of the National Flood Insurance Program, Flood Insurance Rate Maps published by FEMA for Bernalillo County, New Mexico, effective date September 20, 1996, there is an existing flood hazard zone (zone AO) within the DMP area. This flood hazard zone coincides with the existing Amole Arroyo in the northeast corner of the area. This flood hazard will be removed through the LOMR process with FEMA's acceptance of the Amole Arroyo realignment that is being constructed with the El Rancho Grande Unit 8 Subdivision, which is outside of the DMP area. See the FEMA Floodplain exhibit provided at the end of the report text.

V. LAND TREATMENTS

The percent impervious land treatment for the developed condition in the DMP area was determined from Table A-5 of the DPM, Section 22.2. All basins with residential zoning were analyzed using 20% type 'B', 20% type 'C', and 60% type 'D'. All basins with commercial or special use zoning were analyzed using 10% type 'B' and 90% type 'D'. See **Plate 1**, the Developed Conditions Land Treatment Exhibit, for an illustration of land treatment values.

VI. PROPOSED DEVELOPED CONDITIONS

The DMP area is in the Amole Arroyo Watershed and encompassed by the Amole-Hubbell Drainage Management Plan (Plan). Specifically, the DMP area covers portions of the Amole Arroyo and Sacate Blanco Basins in the Amole-Hubbell Plan (Plan). See **Plate 2**, Basin Map Overlay: Gibson Boulevard Corridor DMP versus Amole-Hubbell DMP, for a comparison of the Amole-Hubbell Plan basins and the DMP area.

The developed condition for the DMP area is based on the findings presented in the Plan. The Plan allows for full discharge of developed flows from the Amole Arroyo and Sacate Blanco Basins to the Amole and Hubbell Lake storage facilities. See excerpts of the Amole-Hubbell DMP in **Appendix C**. In addition, the Plan identifies the South Powerline Channel facility as a proposed Amole-Hubbell DMP solution that will collect flows from the area south of the existing Westgate Dam, east of the Ceja Mesa, and west of the future 118th Street alignment, conveying the flows south to the Rio Bravo Channel. This DMP assumes that future development to the west of 118th

Street will include construction of the South Powerline Channel. Therefore, developed flows from that area do not need to be included in the proposed storm drain solutions for the DMP area. However, temporary facilities will have to be constructed as development in the DMP area pushes west towards 118th Street to address existing flows from the area west of 118th Street until such time of the construction of the South Powerline Channel. This DMP does not address these interim requirements for existing flows that enter the DMP area from the west. This is left to the site specific drainage reports that are required as individual developments occur in the DMP area.

Developed runoff from the DMP area will be conveyed through two storm drain systems to the Amole Arroyo. First, the southern reach in the analysis consists of basins south of Gibson Boulevard and the western basins (DB1 and DB2) north of Gibson Boulevard. Second, the northern reach in the analysis consists of the basins east of Basin DB2 and north of Gibson Boulevard. See **Plate 3**, Developed Conditions Basin Map, for basin and storm drain locations. Storm drain sizes (based on normal depth analysis) and approximate lengths are also shown on the Basin Map.

Basins DB1, DB2, and that portion of Gibson Boulevard along the frontage of these basins, contribute 243 cubic feet per second (cfs) of flow to the southern storm drain system (AP2, Basin Map). The flow is conveyed south in a storm drain in the proposed southern extension of Messina Drive, where it combines with flows from Basins DB5 and DB6 at AP5 (494 cfs). From this point, the storm drain follows the southern boundary of the DMP area to the future Blake Road alignment, combining with flows from Basins DB7 and DB8 (AP7, 685 cfs). East of Blake Road the storm drain collects flows from Basins DB9 and DB10, discharging 783 cfs to the Amole Arroyo at AP9.

Basin DB3 and the eastern portion of DB4 (Gibson Boulevard between AP2 and Blake Road) contribute 153 cfs of flow to the northern storm drain system at the intersection of Gibson Boulevard and Blake Road (AP10). The northern system continues east of Blake Road, collecting flow from Basins DB11, DB12, DB13 (future 98th Street north of Gibson), and DB14 (Gibson

Boulevard between Blake Road and the Amole Arroyo). The storm drain discharges 311 cfs (AP12) to the Amole Arroyo at Gibson Road.

The improvements for the Amole Arroyo identified in the Amole-Hubbell DMP for that reach of the Arroyo where the proposed storm drain outfalls are located have not been constructed to date. Therefore, the requirements for the two storm drain outfalls to the Amole Arroyo are not described in this report. These requirements will be identified in the site specific drainage report(s) for the development(s) that will construct these improvements.

It is likely that residential development will occur in the DMP area east of Blake Road prior to the construction of the storm drain outfalls to the Amole Arroyo. This would require the construction of interim facilities to accept developed flows from any such developments. These facilities may include temporary retention ponds that would remain in place until all downstream storm drain improvements identified in this DMP are in place. The drainage reports for individual developments would identify these facilities.

VII. CONCLUSION

This Drainage Management Plan identifies the backbone public storm drain infrastructure required to allow the phased development of approximately 300 acres of land along the future Gibson Boulevard corridor between 118th Street and the Amole Arroyo. The DMP is based on the proposed drainage solutions in the Amole-Hubbell DMP and specific storm drain needs in the DMP area. The improvements proposed in this Master plan provide public storm drain outfall(s) to the Amole Arroyo for future developments. Approval of this plan provides a basis for determining shared storm drain infrastructure requirements for the area and allows for the planning and construction of phased improvements of the ultimate system.

FEMA EXHIBIT
GIBSON BOULEVARD CORRIDOR
APRIL 2003

APPENDICES

APPENDIX A	-	AHYMO INPUT AND SUMMARY FILES FOR DEVELOPED CONDITIONS
APPENDIX B	-	STREET FLOW IN GIBSON BOULEVARD STORM DRAIN HYDRAULIC CALCULATIONS
APPENDIX C	-	EXCERPTS FROM AMOLE-HUBBELL DMP

APPENDIX A

AHYMO INPUT AND SUMMARY FILES
DEVELOPED CONDITIONS

SUMMARY FILE: GIBSON BLVD CORRIDOR, BETWEEN 118TH STREET AND THE AMOLE ARROYO,
100-YEAR, 6-HOUR STORM

AHYMO PROGRAM SUMMARY TABLE (AHYMO_97) - - VERSION: 1997.02c RUN DATE (MON/DAY/YR) =04/03/2003
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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 EL RANCHO GRANDE MASTER DRAINAGE STUDY / DEVELOPED CONDITIONS										
START										TIME= .00
RAINFALL TYPE= 1										RAIN6= 2.200
S COMPUTE DEVELOPED CONDITIONS, RESIDENTIAL NORTH OF GIBSON										
COMPUTE NM HYD	DB1	-	5	.02872	66.36	2.319	1.51376	1.500	3.610	PER IMP= 60.00
COMPUTE NM HYD	DB2	-	10	.06605	152.56	5.333	1.51376	1.500	3.609	PER IMP= 60.00
COMPUTE NM HYD	DB3	-	20	.05392	124.54	4.353	1.51376	1.500	3.609	PER IMP= 60.00
S COMPUTE DEVELOPED CONDITIONS, GIBSON BOULEVARD WEST OF BLAKE										
COMPUTE NM HYD	DB4	-	25	.02053	54.31	2.014	1.83975	1.500	4.134	PER IMP= 90.00
S COMPUTE DEVELOPED CONDITIONS, RESIDENTIAL SOUTH OF GIBSON										
COMPUTE NM HYD	DB5	-	35	.03931	90.80	3.173	1.51376	1.500	3.609	PER IMP= 60.00
COMPUTE NM HYD	DB6	-	40	.07674	177.22	6.195	1.51376	1.500	3.608	PER IMP= 60.00
COMPUTE NM HYD	DB7	-	45	.05347	123.50	4.317	1.51376	1.500	3.609	PER IMP= 60.00
COMPUTE NM HYD	DB8	-	50	.03606	83.30	2.911	1.51376	1.500	3.609	PER IMP= 60.00
S COMPUTE DEVELOPED CONDITIONS, COMMERCIAL SOUTH OF GIBSON										
COMPUTE NM HYD	DB9	-	55	.01805	47.74	1.771	1.83975	1.500	4.134	PER IMP= 90.00
COMPUTE NM HYD	DB10	-	60	.01682	44.51	1.651	1.83975	1.500	4.134	PER IMP= 90.00
S COMPUTE DEVELOPED CONDITIONS, COMMERCIAL NORTH OF GIBSON										
COMPUTE NM HYD	DB11	-	65	.04033	106.69	3.957	1.83975	1.500	4.133	PER IMP= 90.00
COMPUTE NM HYD	DB12	-	70	.00506	13.40	.496	1.83975	1.500	4.138	PER IMP= 90.00
S COMPUTE DEVELOPED CONDITIONS, 98TH ST NORTH OF GIBSON										
COMPUTE NM HYD	DB13	-	75	.00646	17.09	.634	1.83975	1.500	4.137	PER IMP= 90.00
S COMPUTE DEVELOPED CONDITIONS, GIBSON BLVD EAST OF BLAKE										
COMPUTE NM HYD	DB14	-	80	.00850	22.49	.834	1.83975	1.500	4.135	PER IMP= 90.00
*S FLOW TO AP1: ROUTE BASIN DB1 THROUGH SD										
ROUTE	PIPE	5	6	.02872	65.70	2.319	1.51378	1.500	3.574	
DIVIDE HYD	DB2A	10	11	.03303	76.28	2.666	1.51375	1.500	3.609	
	DB2B	and	12	.03303	76.28	2.666	1.51375	1.500	3.609	
ADD HYD	AP1	6&11	13	.06175	141.98	4.985	1.51375	1.500	3.593	
*S FLOW TO AP2: DIVIDE BASIN DB2, ADD TO DB1, ROUTE THROUGH SD										
ROUTE	PIPE	13	14	.06175	140.38	4.985	1.51376	1.500	3.552	
ADD HYD	BASIN12	14&12	15	.09478	216.66	7.652	1.51375	1.500	3.572	
DIVIDE HYD	DB4A	25	26	.01660	26.00	1.629	1.83974	1.400	2.447	
	DB4B	and	27	.00392	28.31	.385	1.83974	1.500	11.273	
ADD HYD	AP2	15&26	16	.11138	242.66	9.281	1.56234	1.500	3.404	
*S FLOW TO AP3 5: ROUTE BASIN DB5 THROUGH SD										
ROUTE	PIPE	16	17	.11138	237.13	9.281	1.56235	1.550	3.327	
ROUTE	PIPE	35	36	.03931	89.64	3.173	1.51377	1.500	3.563	
DIVIDE HYD	DB6A	40	41	.06583	100.00	5.315	1.51376	1.400	2.374	
	DB6B	and	42	.01091	77.22	.881	1.51376	1.500	11.059	

revise

ADD HYD	AP3 36&41	38	.10513	189.64	8.488	1.51376	1.500	2.818
*S FLOW TO AP5: DIVIDE BASIN DB6, ADD TO DB5, DB1, AND DB2								
ROUTE	PIPE 38	39	.10513	188.44	8.488	1.51376	1.550	2.801
ADD HYD	AP4 39&42	43	.11604	262.76	9.369	1.51376	1.500	3.538
ADD HYD	AP5 17&43	44	.22742	493.86	18.649	1.53755	1.500	3.393
*S FLOW TO AP6: ADD BASIN DB7 TO AP5								
ROUTE	PIPE 44	46	.22742	490.96	18.649	1.53755	1.500	3.373
ADD HYD	AP6 46&45	47	.28089	614.46	22.966	1.53302	1.500	3.418
*S FLOW TO AP7: ADD BASIN DB8 TO AP6								

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	PAGE = 2 NOTATION
ROUTE	PIPE	47	51	.28089	610.93	22.966	1.53302	1.550	3.398	
ADD HYD	AP7	51&50	52	.31695	684.69	25.877	1.53083	1.550	3.375	
*S FLOW TO AP8: ADD BASIN DB9 TO AP7										
ROUTE	PIPE	52	56	.31695	694.96	25.877	1.53083	1.550	3.426	
ADD HYD	AP8	56&55	57	.33500	736.64	27.648	1.54747	1.550	3.436	
*S FLOW TO AP9: ADD BASIN DB10 TO AP8										
ROUTE	PIPE	57	61	.33500	744.52	27.648	1.54747	1.550	3.473	
ADD HYD	AP9	61&60	62	.35182	783.37	29.298	1.56144	1.550	3.479	
*S FLOW TO AP10: ADD BASIN DB3 TO GIBSON										
ADD HYD	AP10	20&27	22	.05784	152.85	4.738	1.53587	1.500	4.129	
*S FLOW TO AP11: ADD BASIN DB11 TO AP10										
ROUTE	PIPE	22	66	.05784	151.42	4.738	1.53588	1.500	4.091	
ADD HYD	AP11	66&65	67	.09817	258.11	8.695	1.66071	1.500	4.108	
DIVIDE HYD	DB14A	80	81	.00777	15.00	.763	1.83972	1.450	3.015	
	DB14B	and	82	.00072	7.49	.071	1.83972	1.500	16.170	
ADD HYD	AP11	81&67	83	.10594	273.11	9.458	1.67384	1.500	4.028	
*S FLOW TO AP12: ADD BASINS DB12 AND DB13 TO AP11										
ADD HYD	BASIN13	83&75	76	.11240	290.20	10.091	1.68337	1.500	4.034	
ADD HYD	BASIN12	76&70	77	.11746	303.60	10.588	1.69010	1.500	4.039	
ADD HYD	AP12	77&82	78	.11818	311.09	10.659	1.69102	1.500	4.113	
FINISH										

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OUTPUT FILE: GIBSON BLVD CORRIDOR BETWEEN 118TH STREET AND THE AMOLE ARROYO

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*
*S EL RANCHO GRANDE MASTER DRAINAGE STUDY / DEVELOPED CONDITIONS
* 03-19-03
START                RAINFALL BEGINS AT 0.00 HOURS
*                      100 YEAR RETURN PERIOD
*******************************************************************************
*
*       :::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
*       ::                       MISC. DATA                            ::
*       ::        RAINFALL RETURN PERIOD_____________  100-YEAR        ::
*       ::        RAINFALL DURATION__________________  6-HOUR          ::
*       ::            ZONE 1                                           ::
*       ::
*       ::        RAINFALL DEPTHS: 1 HOUR (P60)___  1.90 INCHES        ::
*       ::        (UNADJUSTED)     6 HOUR (P360)__  2.20 INCHES        ::
*       ::                        24 HOUR (P1440)_  2.60 INCHES        ::
*       ::                                                             ::
*       ::        RAINFALL DATA TAKEN FROM NOAA.                       ::
*       ::                                                             ::
*       ::                HYDROGRAPH METHODOLOGY                       ::
*       ::                                                             ::
*       ::        CITY OF ALBQ. DPM VOL. 2, SECTION 22.2 July, 1997    ::
*       ::        INITIAL ABSTRACTION - INFILTRATION METHOD            ::
*       ::        Tc CALCULATIONS PER C.O.A. DPM 22.2-B.4              ::
*       ::        AMAFCA AHYMO VERSION MARCH 20,1992                   ::
*       ::                                                             ::
*       :::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
*                              BEGIN  ANALYSIS
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RAINFALL               TYPE=1 RAIN QUARTER=0.0 RAIN ONE=1.90
                       RAIN SIX=2.20 RAIN DAY=2.60 DT=0.05

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                    .0156   .0181   .0208   .0236   .0266   .0296   .0329
                    .0363   .0399   .0438   .0479   .0523   .0570   .0622
                    .0702   .0791   .1048   .1653   .2695   .4307   .6627
                    .9800  1.2302  1.3432  1.4376  1.5203  1.5943  1.6612
                   1.7223  1.7783  1.8299  1.8775  1.9215  1.9622  1.9709
                   1.9789  1.9863  1.9933  1.9998  2.0059  2.0117  2.0173
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                   2.1636  2.1654  2.1672  2.1690  2.1708  2.1726  2.1743
                   2.1760  2.1777  2.1794  2.1811  2.1828  2.1844  2.1860
                   2.1876  2.1892  2.1908  2.1924  2.1939  2.1955  2.1970
                   2.1985  2.2000

*
*********************************************************************
*S* COMPUTE DEVELOPED CONDITIONS, RESIDENTIAL NORTH OF GIBSON
*********************************************************************
**** COMPUTE AND PRINT NM HYD DATA FOR BASIN DB1  *********
COMPUTE NM HYD         ID=5 HYD=DB1  AREA=0.028724 PER A=0.0 PER B=20.0
                                 PER C=20.0 PER D=60.0  TP=.133  RAINFALL=-1

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     K =   .118216HR     TP =    .133000HR     K/TP RATIO =    .888844     SHAPE CONSTANT, N =  3.990548
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     UNIT PEAK =    30.628     CFS    UNIT VOLUME =     1.001          B =    354.54        P60 = 1.9000
     AREA =        .011490 SQ MI     IA =      .42500 INCHES     INF =    1.04000 INCHES PER HOUR
     RUNOFF COMPUTED BY INITIAL ABSTRACTION/INFILTRATION NUMBER METHOD - DT =   .050000

PRINT HYD                    ID=5    CODE=1

                                         HYDROGRAPH FROM AREA DB1

    RUNOFF VOLUME =      1.51376 INCHES      =        2.3190 ACRE-FEET
    PEAK DISCHARGE RATE =        66.36 CFS   AT    1.500 HOURS   BASIN AREA =    .0287 SQ. MI.

*
**** COMPUTE AND PRINT NM HYD DATA FOR BASIN DB2  *********
COMPUTE NM HYD        ID=10 HYD=DB2  AREA=0.066052 PER A=0.0 PER B=20.0
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     AREA =        .039631 SQ MI     IA =      .10000 INCHES     INF =     .04000 INCHES PER HOUR
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     K =   .118112HR     TP =    .133000HR     K/TP RATIO =    .888058      SHAPE CONSTANT, N =  3.994330
     UNIT PEAK =    70.480     CFS    UNIT VOLUME =     1.001          B =    354.79        P60 = 1.9000
     AREA =        .026421 SQ MI     IA =      .42500 INCHES     INF =    1.04000 INCHES PER HOUR
     RUNOFF COMPUTED BY INITIAL ABSTRACTION/INFILTRATION NUMBER METHOD - DT =   .050000

PRINT HYD                    ID=10    CODE=1

                                         HYDROGRAPH FROM AREA DB2

    RUNOFF VOLUME =      1.51376 INCHES      =        5.3326 ACRE-FEET
    PEAK DISCHARGE RATE =       152.56 CFS   AT    1.500 HOURS   BASIN AREA =    .0661 SQ. MI.

*
**** COMPUTE AND PRINT NM HYD DATA FOR BASIN DB3  *********
COMPUTE NM HYD        ID=20 HYD=DB3  AREA=0.053916 PER A=0.0 PER B=20.0
                                     PER C=20.0 PER D=60.0  TP=.133  RAINFALL=-1

     K =   .072485HR     TP =    .133000HR     K/TP RATIO =    .545000      SHAPE CONSTANT, N =  7.106420
     UNIT PEAK =    128.01     CFS    UNIT VOLUME =     .9991          B =    526.28        P60 = 1.9000
     AREA =        .032350 SQ MI     IA =      .10000 INCHES     INF =     .04000 INCHES PER HOUR
     RUNOFF COMPUTED BY INITIAL ABSTRACTION/INFILTRATION NUMBER METHOD - DT =   .050000

     K =   .118216HR     TP =    .133000HR     K/TP RATIO =    .888844      SHAPE CONSTANT, N =  3.990548
     UNIT PEAK =    57.490     CFS    UNIT VOLUME =     1.001          B =    354.54        P60 = 1.9000
     AREA =        .021566 SQ MI     IA =      .42500 INCHES     INF =    1.04000 INCHES PER HOUR
     RUNOFF COMPUTED BY INITIAL ABSTRACTION/INFILTRATION NUMBER METHOD - DT =   .050000

PRINT HYD                    ID=20    CODE=1

                                         HYDROGRAPH FROM AREA DB3

    RUNOFF VOLUME =      1.51376 INCHES      =        4.3528 ACRE-FEET
    PEAK DISCHARGE RATE =       124.54 CFS   AT    1.500 HOURS   BASIN AREA =    .0539 SQ. MI.

*
*****************************************************************
*S* COMPUTE DEVELOPED CONDITIONS, GIBSON BOULEVARD WEST OF BLAKE
*****************************************************************
**** COMPUTE AND PRINT NM HYD DATA FOR DB4  *********
COMPUTE NM HYD        ID=25 HYD=DB4  AREA=0.020526 PER A=0.0 PER B=10.0
                                     PER C=0.0 PER D=90.0  TP=.133  RAINFALL=-1

     K =   .072485HR     TP =    .133000HR     K/TP RATIO =    .545000      SHAPE CONSTANT, N =  7.106420
     UNIT PEAK =    73.098     CFS    UNIT VOLUME =     .9990          B =    526.28        P60 = 1.9000
     AREA =        .018473 SQ MI     IA =      .10000 INCHES     INF =     .04000 INCHES PER HOUR
     RUNOFF COMPUTED BY INITIAL ABSTRACTION/INFILTRATION NUMBER METHOD - DT =   .050000
```

```
     K =    .130466HR     TP =    .133000HR     K/TP RATIO =    .980950     SHAPE CONSTANT, N =  3.599935
     UNIT PEAK =    5.0551     CFS    UNIT VOLUME =     .9985        B =    327.55       P60 = 1.9000
     AREA =      .002053 SQ MI     IA =     .50000 INCHES     INF =    1.25000 INCHES PER HOUR
     RUNOFF COMPUTED BY INITIAL ABSTRACTION/INFILTRATION NUMBER METHOD - DT =    .050000

PRINT HYD                    ID=25    CODE=1

                                        HYDROGRAPH FROM AREA DB4

    RUNOFF VOLUME =      1.83975 INCHES      =        2.0140 ACRE-FEET
    PEAK DISCHARGE RATE =       54.31 CFS   AT    1.500 HOURS    BASIN AREA =    .0205 SQ. MI.


*
*********************************************************************
*S* COMPUTE DEVELOPED CONDITIONS, RESIDENTIAL SOUTH OF GIBSON
*********************************************************************
**** COMPUTE AND PRINT NM HYD DATA FOR DB5   *********
COMPUTE NM HYD        ID=35 HYD=DB5  AREA=0.039306 PER A=0.0 PER B=20.0
                                PER C=20.0 PER D=60.0  TP=.133  RAINFALL=-1

     K =    .072485HR     TP =    .133000HR     K/TP RATIO =    .545000     SHAPE CONSTANT, N =  7.106420
     UNIT PEAK =    93.319     CFS    UNIT VOLUME =     .9990        B =    526.28       P60 = 1.9000
     AREA =      .023584 SQ MI     IA =     .10000 INCHES     INF =     .04000 INCHES PER HOUR
     RUNOFF COMPUTED BY INITIAL ABSTRACTION/INFILTRATION NUMBER METHOD - DT =    .050000

     K =    .118216HR     TP =    .133000HR     K/TP RATIO =    .888844     SHAPE CONSTANT, N =  3.990548
     UNIT PEAK =    41.911     CFS    UNIT VOLUME =    1.001         B =    354.54       P60 = 1.9000
     AREA =      .015722 SQ MI     IA =     .42500 INCHES     INF =    1.04000 INCHES PER HOUR
     RUNOFF COMPUTED BY INITIAL ABSTRACTION/INFILTRATION NUMBER METHOD - DT =    .050000

PRINT HYD                    ID=35    CODE=1

                                        HYDROGRAPH FROM AREA DB5

    RUNOFF VOLUME =      1.51376 INCHES      =        3.1733 ACRE-FEET
    PEAK DISCHARGE RATE =       90.80 CFS   AT    1.500 HOURS    BASIN AREA =    .0393 SQ. MI.


*
**** COMPUTE AND PRINT NM HYD DATA FOR DB6   *********
COMPUTE NM HYD        ID=40 HYD=DB6  AREA=0.076738 PER A=0.0 PER B=20.0
                                PER C=20.0 PER D=60.0  TP=.133  RAINFALL=-1

     K =    .072709HR     TP =    .133000HR     K/TP RATIO =    .546685     SHAPE CONSTANT, N =  7.078377
     UNIT PEAK =    181.73     CFS    UNIT VOLUME =     .9991        B =    524.96       P60 = 1.9000
     AREA =      .046043 SQ MI     IA =     .10000 INCHES     INF =     .04000 INCHES PER HOUR
     RUNOFF COMPUTED BY INITIAL ABSTRACTION/INFILTRATION NUMBER METHOD - DT =    .050000

     K =    .117797HR     TP =    .133000HR     K/TP RATIO =    .885695     SHAPE CONSTANT, N =  4.005727
     UNIT PEAK =    82.058     CFS    UNIT VOLUME =    1.001         B =    355.55       P60 = 1.9000
     AREA =      .030695 SQ MI     IA =     .42500 INCHES     INF =    1.04000 INCHES PER HOUR
     RUNOFF COMPUTED BY INITIAL ABSTRACTION/INFILTRATION NUMBER METHOD - DT =    .050000

PRINT HYD                    ID=40    CODE=1

                                        HYDROGRAPH FROM AREA DB6

    RUNOFF VOLUME =      1.51376 INCHES      =        6.1953 ACRE-FEET
    PEAK DISCHARGE RATE =      177.22 CFS   AT    1.500 HOURS    BASIN AREA =    .0767 SQ. MI.


*
**** COMPUTE AND PRINT NM HYD DATA FOR BASIN DB7   *********
COMPUTE NM HYD        ID=45 HYD=DB7  AREA=0.053466 PER A=0.0 PER B=20.0
                                PER C=20.0 PER D=60.0  TP=.133  RAINFALL=-1

     K =    .072485HR     TP =    .133000HR     K/TP RATIO =    .545000     SHAPE CONSTANT, N =  7.106420
     UNIT PEAK =    126.94     CFS    UNIT VOLUME =     .9991        B =    526.28       P60 = 1.9000
     AREA =      .032080 SQ MI     IA =     .10000 INCHES     INF =     .04000 INCHES PER HOUR
```

```
RUNOFF COMPUTED BY INITIAL ABSTRACTION/INFILTRATION NUMBER METHOD - DT =   .050000


K =    .118216HR     TP =    .133000HR    K/TP RATIO =    .888844     SHAPE CONSTANT, N =  3.990548
UNIT PEAK =    57.010     CFS    UNIT VOLUME =     1.001        B =    354.54        P60 = 1.9000
AREA =       .021386 SQ MI     IA =      .42500 INCHES      INF =    1.04000 INCHES PER HOUR
RUNOFF COMPUTED BY INITIAL ABSTRACTION/INFILTRATION NUMBER METHOD - DT =   .050000

PRINT HYD                 ID=45    CODE=1

                                       HYDROGRAPH FROM AREA DB7


RUNOFF VOLUME =      1.51376 INCHES       =        4.3165 ACRE-FEET
PEAK DISCHARGE RATE =       123.50 CFS   AT    1.500 HOURS    BASIN AREA =    .0535 SQ. MI.


*
**** COMPUTE AND PRINT NM HYD DATA FOR BASIN DB8  *********
COMPUTE NM HYD        ID=50 HYD=DB8  AREA=0.036062 PER A=0.0 PER B=20.0
                              PER C=20.0 PER D=60.0  TP=.133  RAINFALL=-1

K =    .072485HR     TP =    .133000HR    K/TP RATIO =    .545000     SHAPE CONSTANT, N =  7.106420
UNIT PEAK =    85.618     CFS    UNIT VOLUME =     .9990        B =    526.28        P60 = 1.9000
AREA =       .021637 SQ MI     IA =      .10000 INCHES      INF =     .04000 INCHES PER HOUR
RUNOFF COMPUTED BY INITIAL ABSTRACTION/INFILTRATION NUMBER METHOD - DT =   .050000


K =    .118216HR     TP =    .133000HR    K/TP RATIO =    .888844     SHAPE CONSTANT, N =  3.990548
UNIT PEAK =    38.452     CFS    UNIT VOLUME =     1.001        B =    354.54        P60 = 1.9000
AREA =       .014425 SQ MI     IA =      .42500 INCHES      INF =    1.04000 INCHES PER HOUR
RUNOFF COMPUTED BY INITIAL ABSTRACTION/INFILTRATION NUMBER METHOD - DT =   .050000

PRINT HYD                 ID=50    CODE=1

                                       HYDROGRAPH FROM AREA DB8


RUNOFF VOLUME =      1.51376 INCHES       =        2.9114 ACRE-FEET
PEAK DISCHARGE RATE =        83.30 CFS   AT    1.500 HOURS    BASIN AREA =    .0361 SQ. MI.


*
*****************************************************************
*S* COMPUTE DEVELOPED CONDITIONS, COMMERCIAL SOUTH OF GIBSON
*****************************************************************
**** COMPUTE AND PRINT NM HYD DATA FOR BASIN DB9  *********
COMPUTE NM HYD        ID=55 HYD=DB9  AREA=0.018045 PER A=0.0 PER B=10.0
                              PER C=0.0 PER D=90.0  TP=.133  RAINFALL=-1

K =    .072485HR     TP =    .133000HR    K/TP RATIO =    .545000     SHAPE CONSTANT, N =  7.106420
UNIT PEAK =    64.263     CFS    UNIT VOLUME =     .9990        B =    526.28        P60 = 1.9000
AREA =       .016240 SQ MI     IA =      .10000 INCHES      INF =     .04000 INCHES PER HOUR
RUNOFF COMPUTED BY INITIAL ABSTRACTION/INFILTRATION NUMBER METHOD - DT =   .050000


K =    .130466HR     TP =    .133000HR    K/TP RATIO =    .980950     SHAPE CONSTANT, N =  3.599935
UNIT PEAK =    4.4441     CFS    UNIT VOLUME =     .9981        B =    327.55        P60 = 1.9000
AREA =       .001805 SQ MI     IA =      .50000 INCHES      INF =    1.25000 INCHES PER HOUR
RUNOFF COMPUTED BY INITIAL ABSTRACTION/INFILTRATION NUMBER METHOD - DT =   .050000

PRINT HYD                 ID=55    CODE=1

                                       HYDROGRAPH FROM AREA DB9


RUNOFF VOLUME =      1.83975 INCHES       =        1.7706 ACRE-FEET
PEAK DISCHARGE RATE =        47.74 CFS   AT    1.500 HOURS    BASIN AREA =    .0180 SQ. MI.


*
**** COMPUTE AND PRINT NM HYD DATA FOR BASIN DB10  *********
COMPUTE NM HYD        ID=60 HYD=DB10  AREA=0.0168227 PER A=0.0 PER B=10.0
                              PER C=0.0 PER D=90.0  TP=.133  RAINFALL=-1

K =    .072485HR     TP =    .133000HR    K/TP RATIO =    .545000     SHAPE CONSTANT, N =  7.106420
```

```
     UNIT PEAK =   59.910     CFS   UNIT VOLUME =    .9990       B =   526.28       P60 = 1.9000
     AREA =       .015140 SQ MI    IA =    .10000 INCHES    INF =    .04000 INCHES PER HOUR
     RUNOFF COMPUTED BY INITIAL ABSTRACTION/INFILTRATION NUMBER METHOD - DT =   .050000

     K =   .130466HR    TP =   .133000HR    K/TP RATIO =   .980950    SHAPE CONSTANT, N =  3.599935
     UNIT PEAK =   4.1431     CFS   UNIT VOLUME =    .9981       B =   327.55       P60 = 1.9000
     AREA =       .001682 SQ MI    IA =    .50000 INCHES    INF =   1.25000 INCHES PER HOUR
     RUNOFF COMPUTED BY INITIAL ABSTRACTION/INFILTRATION NUMBER METHOD - DT =   .050000

PRINT HYD                  ID=60   CODE=1

                                   HYDROGRAPH FROM AREA DB10

    RUNOFF VOLUME =     1.83975 INCHES      =        1.6506 ACRE-FEET
    PEAK DISCHARGE RATE =       44.51 CFS   AT   1.500 HOURS   BASIN AREA =   .0168 SQ. MI.

*
***************************************************************
*S* COMPUTE DEVELOPED CONDITIONS, COMMERCIAL NORTH OF GIBSON
***************************************************************
**** COMPUTE AND PRINT NM HYD DATA FOR BASIN DB11  *********
COMPUTE NM HYD        ID=65 HYD=DB11  AREA=0.04033 PER A=0.0 PER B=10.0
                                   PER C=0.0 PER D=90.0  TP=.133  RAINFALL=-1

     K =   .072485HR    TP =   .133000HR    K/TP RATIO =   .545000    SHAPE CONSTANT, N =  7.106420
     UNIT PEAK =   143.63     CFS   UNIT VOLUME =    .9991       B =   526.28       P60 = 1.9000
     AREA =       .036297 SQ MI    IA =    .10000 INCHES    INF =    .04000 INCHES PER HOUR
     RUNOFF COMPUTED BY INITIAL ABSTRACTION/INFILTRATION NUMBER METHOD - DT =   .050000

     K =   .130466HR    TP =   .133000HR    K/TP RATIO =   .980950    SHAPE CONSTANT, N =  3.599935
     UNIT PEAK =   9.9324     CFS   UNIT VOLUME =    .9999       B =   327.55       P60 = 1.9000
     AREA =       .004033 SQ MI    IA =    .50000 INCHES    INF =   1.25000 INCHES PER HOUR
     RUNOFF COMPUTED BY INITIAL ABSTRACTION/INFILTRATION NUMBER METHOD - DT =   .050000

PRINT HYD                  ID=65   CODE=1

                                   HYDROGRAPH FROM AREA DB11

    RUNOFF VOLUME =     1.83975 INCHES      =        3.9572 ACRE-FEET
    PEAK DISCHARGE RATE =      106.69 CFS   AT   1.500 HOURS   BASIN AREA =   .0403 SQ. MI.

*
**** COMPUTE AND PRINT NM HYD DATA FOR BASIN DB12  *********
COMPUTE NM HYD        ID=70 HYD=DB12  AREA=0.0050586 PER A=0.0 PER B=10.0
                                   PER C=0.0 PER D=90.0  TP=.133  RAINFALL=-1

     K =   .072485HR    TP =   .133000HR    K/TP RATIO =   .545000    SHAPE CONSTANT, N =  7.106420
     UNIT PEAK =   18.015     CFS   UNIT VOLUME =    .9985       B =   526.28       P60 = 1.9000
     AREA =       .004553 SQ MI    IA =    .10000 INCHES    INF =    .04000 INCHES PER HOUR
     RUNOFF COMPUTED BY INITIAL ABSTRACTION/INFILTRATION NUMBER METHOD - DT =   .050000

     K =   .130466HR    TP =   .133000HR    K/TP RATIO =   .980950    SHAPE CONSTANT, N =  3.599935
     UNIT PEAK =   1.2458     CFS   UNIT VOLUME =    .9902       B =   327.55       P60 = 1.9000
     AREA =       .000506 SQ MI    IA =    .50000 INCHES    INF =   1.25000 INCHES PER HOUR
     RUNOFF COMPUTED BY INITIAL ABSTRACTION/INFILTRATION NUMBER METHOD - DT =   .050000

PRINT HYD                  ID=70   CODE=1

                                   HYDROGRAPH FROM AREA DB12

    RUNOFF VOLUME =     1.83975 INCHES      =         .4963 ACRE-FEET
    PEAK DISCHARGE RATE =       13.40 CFS   AT   1.500 HOURS   BASIN AREA =   .0051 SQ. MI.

*
***************************************************************
*S* COMPUTE DEVELOPED CONDITIONS, 98TH ST NORTH OF GIBSON
***************************************************************
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```
**** COMPUTE AND PRINT NM HYD DATA FOR BASIN DB13  *********
COMPUTE NM HYD        ID=75 HYD=DB13  AREA=0.006457 PER A=0.0 PER B=10.0
                                PER C=0.0 PER D=90.0  TP=.133  RAINFALL=-1

     K =   .072485HR    TP =   .133000HR    K/TP RATIO =   .545000     SHAPE CONSTANT, N =  7.106420
     UNIT PEAK =   22.995    CFS   UNIT VOLUME =    .9986       B =   526.28       P60 = 1.9000
     AREA =      .005811 SQ MI    IA =    .10000 INCHES     INF =    .04000 INCHES PER HOUR
     RUNOFF COMPUTED BY INITIAL ABSTRACTION/INFILTRATION NUMBER METHOD - DT =   .050000

     K =   .130466HR    TP =   .133000HR    K/TP RATIO =   .980950     SHAPE CONSTANT, N =  3.599935
     UNIT PEAK =   1.5902    CFS   UNIT VOLUME =    .9927       B =   327.55       P60 = 1.9000
     AREA =      .000646 SQ MI    IA =    .50000 INCHES     INF =   1.25000 INCHES PER HOUR
     RUNOFF COMPUTED BY INITIAL ABSTRACTION/INFILTRATION NUMBER METHOD - DT =   .050000

PRINT HYD                 ID=75   CODE=1

                                       HYDROGRAPH FROM AREA DB13

    RUNOFF VOLUME =     1.83975 INCHES      =         .6336 ACRE-FEET
    PEAK DISCHARGE RATE =        17.09 CFS   AT    1.500 HOURS    BASIN AREA =    .0065 SQ. MI.

*
*************************************************************
*S* COMPUTE DEVELOPED CONDITIONS, GIBSON BLVD EAST OF BLAKE
*************************************************************
**** COMPUTE AND PRINT NM HYD DATA FOR BASIN DB14  *********
COMPUTE NM HYD        ID=80 HYD=DB14  AREA=0.008497 PER A=0.0 PER B=10.0
                                PER C=0.0 PER D=90.0  TP=.133  RAINFALL=-1

     K =   .072485HR    TP =   .133000HR    K/TP RATIO =   .545000     SHAPE CONSTANT, N =  7.106420
     UNIT PEAK =   30.260    CFS   UNIT VOLUME =    .9988       B =   526.28       P60 = 1.9000
     AREA =      .007647 SQ MI    IA =    .10000 INCHES     INF =    .04000 INCHES PER HOUR
     RUNOFF COMPUTED BY INITIAL ABSTRACTION/INFILTRATION NUMBER METHOD - DT =   .050000

     K =   .130466HR    TP =   .133000HR    K/TP RATIO =   .980950     SHAPE CONSTANT, N =  3.599935
     UNIT PEAK =   2.0926    CFS   UNIT VOLUME =    .9946       B =   327.55       P60 = 1.9000
     AREA =      .000850 SQ MI    IA =    .50000 INCHES     INF =   1.25000 INCHES PER HOUR
     RUNOFF COMPUTED BY INITIAL ABSTRACTION/INFILTRATION NUMBER METHOD - DT =   .050000

PRINT HYD                 ID=80   CODE=1

                                       HYDROGRAPH FROM AREA DB14

    RUNOFF VOLUME =     1.83975 INCHES      =         .8337 ACRE-FEET
    PEAK DISCHARGE RATE =        22.49 CFS   AT    1.500 HOURS    BASIN AREA =    .0085 SQ. MI.

*
**************************************************
*S FLOW TO AP1: ROUTE BASIN DB1 THROUGH SD
**************************************************
COMPUTE RATING CURVE  CID=1 VS NO=1 CODE=-1 SLP=0.03
                      DIAM=2.5 FT   N=0.013

                       RATING CURVE PIPE SECTION  1.0
```

WATER SURFACE ELEV	FLOW AREA SQ FT	FLOW RATE CFS	MAX WIDTH FT
.00	.00	.00	.00
.13	.10	.37	1.11
.26	.27	1.62	1.53
.39	.49	3.76	1.82
.52	.74	6.76	2.03
.65	1.02	10.56	2.19
.78	1.31	15.07	2.32
.91	1.62	20.19	2.41
1.04	1.94	25.81	2.47
1.17	2.26	31.82	2.50
1.30	2.59	38.08	2.50
1.43	2.91	44.46	2.50
1.56	3.23	50.80	2.50
1.69	3.54	56.93	2.50

1.82	3.84	62.68	2.50
1.95	4.12	67.82	2.50
2.08	4.37	72.10	2.50
2.21	4.60	75.16	2.50
2.35	4.78	76.42	2.50
2.50	4.91	76.42	2.50

COMPUTE TRAVEL TIME ID=6 REACH NO=1 NO VS=1 L=800 FT
SLOPE=0.03

TRAVEL TIME TABLE
REACH= 1.0

WATER DEPTH FEET	AVERAGE AREA SQ.FT.	FLOW RATE CFS	TRAVEL TIME HRS
.130	.098	.37	.0582
.261	.271	1.62	.0373
.391	.490	3.76	.0290
.521	.741	6.76	.0244
.651	1.017	10.56	.0214
.782	1.312	15.07	.0193
.912	1.620	20.19	.0178
1.042	1.937	25.81	.0167
1.173	2.261	31.82	.0158
1.303	2.586	38.08	.0151
1.433	2.910	44.46	.0145
1.563	3.229	50.80	.0141
1.694	3.540	56.93	.0138
1.824	3.837	62.68	.0136
1.954	4.117	67.82	.0135
2.084	4.373	72.10	.0135
2.215	4.599	75.16	.0136
2.345	4.783	76.42	.0139
2.500	4.909	76.42	.0143

ROUTE ID=6 HYD NO=PIPE INFLOW ID=5
PRINT HYD ID=6 CODE=1

HYDROGRAPH FROM AREA PIPE

RUNOFF VOLUME = 1.51378 INCHES = 2.3190 ACRE-FEET
PEAK DISCHARGE RATE = 65.70 CFS AT 1.500 HOURS BASIN AREA = .0287 SQ. MI.

*
DIVIDE HYD ID=10 PER=-50 IDI=11 HYD=DB2A
IDII=12 HYD=DB2B

*
ADD HYD ID=13 HYD=AP1 ID I=6 ID II=11
PRINT HYD ID=13 CODE=1

HYDROGRAPH FROM AREA AP1

RUNOFF VOLUME = 1.51375 INCHES = 4.9853 ACRE-FEET
PEAK DISCHARGE RATE = 141.98 CFS AT 1.500 HOURS BASIN AREA = .0618 SQ. MI.

*
****
*S FLOW TO AP2: DIVIDE BASIN DB2, ADD TO DB1, ROUTE THROUGH SD
****
COMPUTE RATING CURVE CID=1 VS NO=1 CODE=-1 SLP=0.03
DIAM=3.5 FT N=0.013

RATING CURVE PIPE SECTION 1.0

WATER SURFACE ELEV	FLOW AREA SQ FT	FLOW RATE CFS	MAX WIDTH FT
.00	.00	.00	.00
.18	.19	.91	1.56
.36	.53	3.97	2.14
.55	.96	9.22	2.54
.73	1.45	16.59	2.84
.91	1.99	25.91	3.07
1.09	2.57	36.96	3.25

1.28	3.17	49.52	3.37
1.46	3.80	63.31	3.45
1.64	4.43	78.05	3.49
1.82	5.07	93.41	3.50
2.01	5.70	109.05	3.50
2.19	6.33	124.60	3.50
2.37	6.94	139.65	3.50
2.55	7.52	153.75	3.50
2.74	8.07	166.36	3.50
2.92	8.57	176.86	3.50
3.10	9.01	184.37	3.50
3.28	9.37	187.45	3.50
3.50	9.62	187.45	3.50

```
COMPUTE TRAVEL TIME    ID=14    REACH NO=1 NO VS=1 L=870  FT
                                SLOPE=0.03
```

TRAVEL TIME TABLE
REACH= 1.0

WATER DEPTH FEET	AVERAGE AREA SQ.FT.	FLOW RATE CFS	TRAVEL TIME HRS
.182	.191	.91	.0506
.365	.532	3.97	.0324
.547	.961	9.22	.0252
.730	1.453	16.59	.0212
.912	1.994	25.91	.0186
1.094	2.571	36.96	.0168
1.277	3.175	49.52	.0155
1.459	3.797	63.31	.0145
1.641	4.431	78.05	.0137
1.824	5.069	93.41	.0131
2.006	5.704	109.05	.0126
2.189	6.330	124.60	.0123
2.371	6.938	139.65	.0120
2.553	7.520	153.75	.0118
2.736	8.069	166.36	.0117
2.918	8.571	176.86	.0117
3.101	9.014	184.37	.0118
3.283	9.374	187.45	.0121
3.500	9.621	187.45	.0124

```
ROUTE                  ID=14   HYD NO=PIPE   INFLOW ID=13
PRINT HYD              ID=14   CODE=1

                                  HYDROGRAPH FROM AREA PIPE

    RUNOFF VOLUME =      1.51376 INCHES      =        4.9853 ACRE-FEET
    PEAK DISCHARGE RATE =      140.38 CFS   AT    1.500 HOURS    BASIN AREA =    .0618 SQ. MI.

*
ADD HYD                  ID=15 HYD=BASIN12 ID I=14 ID II=12
PRINT HYD                   ID=15    CODE=1

                                  HYDROGRAPH FROM AREA BASIN12

    RUNOFF VOLUME =      1.51375 INCHES      =        7.6515 ACRE-FEET
    PEAK DISCHARGE RATE =      216.66 CFS   AT    1.500 HOURS    BASIN AREA =    .0948 SQ. MI.

*
DIVIDE HYD                  ID=25    Q=26    IDI=26 HYD=DB4A
                                                   IDII=27   HYD=DB4B

*
ADD HYD                  ID=16 HYD=AP2 ID I=15 ID II=26
PRINT HYD                   ID=16    CODE=1

                                  HYDROGRAPH FROM AREA AP2

    RUNOFF VOLUME =      1.56234 INCHES      =        9.2805 ACRE-FEET
    PEAK DISCHARGE RATE =      242.66 CFS   AT    1.500 HOURS    BASIN AREA =    .1114 SQ. MI.
```

```
*
**************************************************
*S FLOW TO AP3: ROUTE BASIN DB5 THROUGH SD
**************************************************
COMPUTE RATING CURVE   CID=1 VS NO=1 CODE=-1 SLP=0.03
                       DIAM=4.0 FT    N=0.013

                                      RATING CURVE PIPE SECTION  1.0
                                          WATER        FLOW         FLOW          MAX
                                         SURFACE       AREA         RATE          WIDTH
                                          ELEV         SQ FT        CFS           FT
                                            .00          .00          .00           .00
                                            .21          .25         1.31          1.78
                                            .42          .69         5.67          2.44
                                            .63         1.25        13.17          2.91
                                            .83         1.90        23.69          3.25
                                           1.04         2.60        36.99          3.51
                                           1.25         3.36        52.77          3.71
                                           1.46         4.15        70.70          3.85
                                           1.67         4.96        90.39          3.94
                                           1.88         5.79       111.43          3.99
                                           2.08         6.62       133.36          4.00
                                           2.29         7.45       155.69          4.00
                                           2.50         8.27       177.89          4.00
                                           2.71         9.06       199.38          4.00
                                           2.92         9.82       219.51          4.00
                                           3.13        10.54       237.52          4.00
                                           3.34        11.20       252.50          4.00
                                           3.54        11.77       263.23          4.00
                                           3.75        12.24       267.63          4.00
                                           4.00        12.57       267.63          4.00
COMPUTE TRAVEL TIME    ID=17    REACH NO=1 NO VS=1 L=1775  FT
                                SLOPE=0.03

                                TRAVEL TIME TABLE
                                                 REACH=   1.0

                                WATER        AVERAGE      FLOW          TRAVEL
                                DEPTH        AREA         RATE          TIME
                                FEET         SQ.FT.       CFS           HRS
                                   .208         .250         1.31         .0944
                                   .417         .695         5.67         .0605
                                   .625        1.255        13.17         .0470
                                   .834        1.898        23.69         .0395
                                  1.042        2.604        36.99         .0347
                                  1.251        3.358        52.77         .0314
                                  1.459        4.146        70.70         .0289
                                  1.668        4.960        90.39         .0271
                                  1.876        5.788       111.43         .0256
                                  2.084        6.621       133.36         .0245
                                  2.293        7.451       155.69         .0236
                                  2.501        8.267       177.89         .0229
                                  2.710        9.062       199.38         .0224
                                  2.918        9.823       219.51         .0221
                                  3.127       10.539       237.52         .0219
                                  3.335       11.195       252.50         .0219
                                  3.544       11.773       263.23         .0221
                                  3.752       12.243       267.63         .0226
                                  4.000       12.566       267.63         .0232
ROUTE                  ID=17   HYD NO=PIPE   INFLOW ID=16
PRINT HYD              ID=17   CODE=1

                                          HYDROGRAPH FROM AREA PIPE


    RUNOFF VOLUME =      1.56235 INCHES     =        9.2806 ACRE-FEET
    PEAK DISCHARGE RATE =      237.13 CFS   AT    1.550 HOURS    BASIN AREA =    .1114 SQ. MI.


*
COMPUTE RATING CURVE   CID=1 VS NO=1 CODE=-1 SLP=0.03
                       DIAM=3.0 FT    N=0.013

                                      RATING CURVE PIPE SECTION  1.0
                                          WATER        FLOW         FLOW          MAX
                                         SURFACE       AREA         RATE          WIDTH
                                          ELEV         SQ FT        CFS           FT
```

.00	.00	.00	.00
.16	.14	.61	1.33
.31	.39	2.63	1.83
.47	.71	6.12	2.18
.63	1.07	11.00	2.44
.78	1.46	17.17	2.63
.94	1.89	24.50	2.78
1.09	2.33	32.83	2.89
1.25	2.79	41.97	2.96
1.41	3.26	51.74	2.99
1.56	3.72	61.92	3.00
1.72	4.19	72.29	3.00
1.88	4.65	82.60	3.00
2.03	5.10	92.58	3.00
2.19	5.53	101.93	3.00
2.35	5.93	110.29	3.00
2.50	6.30	117.25	3.00
2.66	6.62	122.23	3.00
2.81	6.89	124.27	3.00
3.00	7.07	124.27	3.00

```
COMPUTE TRAVEL TIME    ID=36   REACH NO=1 NO VS=1 L=1050  FT
                               SLOPE=0.03
```

TRAVEL TIME TABLE
REACH= 1.0

WATER DEPTH FEET	AVERAGE AREA SQ.FT.	FLOW RATE CFS	TRAVEL TIME HRS
.156	.140	.61	.0676
.313	.391	2.63	.0433
.469	.706	6.12	.0337
.625	1.068	11.00	.0283
.782	1.465	17.17	.0249
.938	1.889	24.50	.0225
1.094	2.332	32.83	.0207
1.251	2.790	41.97	.0194
1.407	3.255	51.74	.0184
1.563	3.724	61.92	.0175
1.720	4.191	72.29	.0169
1.876	4.650	82.60	.0164
2.032	5.097	92.58	.0161
2.189	5.525	101.93	.0158
2.345	5.928	110.29	.0157
2.501	6.297	117.25	.0157
2.658	6.622	122.23	.0158
2.814	6.887	124.27	.0162
3.000	7.069	124.27	.0166

```
ROUTE                  ID=36  HYD NO=PIPE   INFLOW ID=35
PRINT HYD              ID=36  CODE=1
```

HYDROGRAPH FROM AREA PIPE

```
RUNOFF VOLUME =      1.51377 INCHES      =       3.1733 ACRE-FEET
PEAK DISCHARGE RATE =      89.64 CFS   AT    1.500 HOURS   BASIN AREA =    .0393 SQ. MI.
```

```
*
DIVIDE HYD                ID=40    Q=100    IDI=41 HYD=DB6A
                                                   IDII=42   HYD=DB6B

*
ADD HYD                ID=38 HYD=AP3 ID I=36 ID II=41
PRINT HYD                 ID=38    CODE=1
```

HYDROGRAPH FROM AREA AP3

```
RUNOFF VOLUME =      1.51376 INCHES      =       8.4879 ACRE-FEET
PEAK DISCHARGE RATE =     189.64 CFS   AT    1.500 HOURS   BASIN AREA =    .1051 SQ. MI.
```

```
*
****************************************************************
*S FLOW TO AP5: DIVIDE BASIN DB6, ADD TO DB5, DB1, AND DB2
****************************************************************
```

```
COMPUTE RATING CURVE  CID=1 VS NO=1 CODE=-1 SLP=0.03
                      DIAM=4.0 FT   N=0.013
```

RATING CURVE PIPE SECTION 1.0

WATER SURFACE ELEV	FLOW AREA SQ FT	FLOW RATE CFS	MAX WIDTH FT
.00	.00	.00	.00
.21	.25	1.31	1.78
.42	.69	5.67	2.44
.63	1.25	13.17	2.91
.83	1.90	23.69	3.25
1.04	2.60	36.99	3.51
1.25	3.36	52.77	3.71
1.46	4.15	70.70	3.85
1.67	4.96	90.39	3.94
1.88	5.79	111.43	3.99
2.08	6.62	133.36	4.00
2.29	7.45	155.69	4.00
2.50	8.27	177.89	4.00
2.71	9.06	199.38	4.00
2.92	9.82	219.51	4.00
3.13	10.54	237.52	4.00
3.34	11.20	252.50	4.00
3.54	11.77	263.23	4.00
3.75	12.24	267.63	4.00
4.00	12.57	267.63	4.00

```
COMPUTE TRAVEL TIME   ID=39   REACH NO=1 NO VS=1 L=1050  FT
                              SLOPE=0.03
```

TRAVEL TIME TABLE

REACH= 1.0

WATER DEPTH FEET	AVERAGE AREA SQ.FT.	FLOW RATE CFS	TRAVEL TIME HRS
.208	.250	1.31	.0558
.417	.695	5.67	.0358
.625	1.255	13.17	.0278
.834	1.898	23.69	.0234
1.042	2.604	36.99	.0205
1.251	3.358	52.77	.0186
1.459	4.146	70.70	.0171
1.668	4.960	90.39	.0160
1.876	5.788	111.43	.0151
2.084	6.621	133.36	.0145
2.293	7.451	155.69	.0140
2.501	8.267	177.89	.0136
2.710	9.062	199.38	.0133
2.918	9.823	219.51	.0131
3.127	10.539	237.52	.0129
3.335	11.195	252.50	.0129
3.544	11.773	263.23	.0130
3.752	12.243	267.63	.0133
4.000	12.566	267.63	.0137

```
ROUTE                 ID=39  HYD NO=PIPE  INFLOW ID=38
PRINT HYD             ID=39  CODE=1
```

HYDROGRAPH FROM AREA PIPE

```
RUNOFF VOLUME =       1.51376 INCHES    =      8.4879 ACRE-FEET
PEAK DISCHARGE RATE =     188.44 CFS  AT   1.550 HOURS   BASIN AREA =   .1051 SQ. MI.
```

*

```
ADD HYD               ID=43 HYD=AP4 ID I=39 ID II=42
PRINT HYD                ID=43   CODE=1
```

HYDROGRAPH FROM AREA AP4

```
RUNOFF VOLUME =       1.51376 INCHES    =      9.3686 ACRE-FEET
PEAK DISCHARGE RATE =     262.76 CFS  AT   1.500 HOURS   BASIN AREA =   .1160 SQ. MI.
```

*

```
ADD HYD                    ID=44 HYD=AP5 ID I=17 ID II=43
PRINT HYD                     ID=44    CODE=1

                                              HYDROGRAPH FROM AREA AP5

    RUNOFF VOLUME =      1.53755 INCHES      =       18.6491 ACRE-FEET
    PEAK DISCHARGE RATE =      493.86 CFS   AT    1.500 HOURS   BASIN AREA =    .2274 SQ. MI.

*
****************************************************************
*S FLOW TO AP6: ADD BASIN DB7 TO AP5
****************************************************************
COMPUTE RATING CURVE  CID=1 VS NO=1 CODE=-1 SLP=0.03
                      DIAM=5.5 FT   N=0.013
```

RATING CURVE PIPE SECTION 1.0

WATER SURFACE ELEV	FLOW AREA SQ FT	FLOW RATE CFS	MAX WIDTH FT
.00	.00	.00	.00
.29	.47	3.05	2.44
.57	1.31	13.24	3.36
.86	2.37	30.79	3.99
1.15	3.59	55.38	4.47
1.43	4.92	86.46	4.83
1.72	6.35	123.37	5.10
2.01	7.84	165.28	5.30
2.29	9.38	211.32	5.42
2.58	10.94	260.50	5.49
2.87	12.52	311.77	5.50
3.15	14.09	363.98	5.50
3.44	15.63	415.88	5.50
3.73	17.13	466.12	5.50
4.01	18.57	513.17	5.50
4.30	19.92	555.27	5.50
4.59	21.17	590.30	5.50
4.87	22.26	615.37	5.50
5.16	23.15	625.67	5.50
5.50	23.76	625.67	5.50

```
COMPUTE TRAVEL TIME    ID=46    REACH NO=1 NO VS=1 L=900  FT
                                SLOPE=0.03
```

TRAVEL TIME TABLE
REACH= 1.0

WATER DEPTH FEET	AVERAGE AREA SQ.FT.	FLOW RATE CFS	TRAVEL TIME HRS
.287	.472	3.05	.0387
.573	1.314	13.24	.0248
.860	2.373	30.79	.0193
1.146	3.589	55.38	.0162
1.433	4.923	86.46	.0142
1.720	6.348	123.37	.0129
2.006	7.839	165.28	.0119
2.293	9.377	211.32	.0111
2.579	10.942	260.50	.0105
2.866	12.518	311.77	.0100
3.153	14.086	363.98	.0097
3.439	15.630	415.88	.0094
3.726	17.132	466.12	.0092
4.013	18.571	513.17	.0090
4.299	19.925	555.27	.0090
4.586	21.166	590.30	.0090
4.872	22.258	615.37	.0090
5.159	23.147	625.67	.0092
5.500	23.758	625.67	.0095

```
ROUTE                  ID=46   HYD NO=PIPE   INFLOW ID=44
PRINT HYD              ID=46   CODE=1

                                        HYDROGRAPH FROM AREA PIPE

    RUNOFF VOLUME =      1.53755 INCHES      =       18.6492 ACRE-FEET
    PEAK DISCHARGE RATE =      490.96 CFS   AT    1.500 HOURS   BASIN AREA =    .2274 SQ. MI.
```

```
*
ADD HYD                  ID=47 HYD=AP6 ID I=46 ID II=45
PRINT HYD                    ID=47   CODE=1

                                            HYDROGRAPH FROM AREA AP6

    RUNOFF VOLUME =      1.53302 INCHES      =       22.9656 ACRE-FEET
    PEAK DISCHARGE RATE =      614.46 CFS  AT    1.500 HOURS   BASIN AREA =   .2809 SQ. MI.

*
*****************************************************************
*S FLOW TO AP7: ADD BASIN DB8 TO AP6
*****************************************************************
*COMPUTE RATING CURVE  CID=1 VS NO=1 CODE=-1 SLP=0.03
*                       DIAM=6.0 FT   N=0.013
COMPUTE TRAVEL TIME   ID=51   REACH NO=1 NO VS=1 L=1100  FT
                              SLOPE=0.03

                              TRAVEL TIME TABLE
                                                 REACH=  1.0

                              WATER        AVERAGE      FLOW         TRAVEL
                              DEPTH        AREA         RATE         TIME
                              FEET         SQ.FT.       CFS          HRS
                                 .287          .472         3.05       .0473
                                 .573         1.314        13.24       .0303
                                 .860         2.373        30.79       .0235
                                1.146         3.589        55.38       .0198
                                1.433         4.923        86.46       .0174
                                1.720         6.348       123.37       .0157
                                2.006         7.839       165.28       .0145
                                2.293         9.377       211.32       .0136
                                2.579        10.942       260.50       .0128
                                2.866        12.518       311.77       .0123
                                3.153        14.086       363.98       .0118
                                3.439        15.630       415.88       .0115
                                3.726        17.132       466.12       .0112
                                4.013        18.571       513.17       .0111
                                4.299        19.925       555.27       .0110
                                4.586        21.166       590.30       .0110
                                4.872        22.258       615.37       .0111
                                5.159        23.147       625.67       .0113
                                5.500        23.758       625.67       .0116
ROUTE                    ID=51  HYD NO=PIPE  INFLOW ID=47
PRINT HYD                ID=51  CODE=1

                                            HYDROGRAPH FROM AREA PIPE

    RUNOFF VOLUME =      1.53302 INCHES      =       22.9657 ACRE-FEET
    PEAK DISCHARGE RATE =      610.93 CFS  AT    1.550 HOURS   BASIN AREA =   .2809 SQ. MI.

*
ADD HYD                  ID=52 HYD=AP7 ID I=51 ID II=50
PRINT HYD                    ID=52   CODE=1

                                            HYDROGRAPH FROM AREA AP7

    RUNOFF VOLUME =      1.53083 INCHES      =       25.8770 ACRE-FEET
    PEAK DISCHARGE RATE =      684.69 CFS  AT    1.550 HOURS   BASIN AREA =   .3170 SQ. MI.

*
*****************************************************************
*S FLOW TO AP8: ADD BASIN DB9 TO AP7
*****************************************************************
COMPUTE RATING CURVE  CID=1 VS NO=1 CODE=-1 SLP=0.03
                       DIAM=6.0 FT   N=0.013

                                 RATING CURVE PIPE SECTION  1.0
```

WATER SURFACE ELEV	FLOW AREA SQ FT	FLOW RATE CFS	MAX WIDTH FT
.00	.00	.00	.00
.31	.56	3.85	2.67
.63	1.56	16.70	3.67
.94	2.82	38.83	4.36
1.25	4.27	69.84	4.87
1.56	5.86	109.05	5.27
1.88	7.55	155.58	5.56
2.19	9.33	208.45	5.78
2.50	11.16	266.51	5.92
2.81	13.02	328.53	5.99
3.13	14.90	393.19	6.00
3.44	16.76	459.03	6.00
3.75	18.60	524.49	6.00
4.06	20.39	587.85	6.00
4.38	22.10	647.18	6.00
4.69	23.71	700.29	6.00
5.00	25.19	744.47	6.00
5.32	26.49	776.08	6.00
5.63	27.55	789.07	6.00
6.00	28.27	789.07	6.00

COMPUTE TRAVEL TIME ID=56 REACH NO=1 NO VS=1 L=875 FT
SLOPE=0.03

TRAVEL TIME TABLE
REACH= 1.0

WATER DEPTH FEET	AVERAGE AREA SQ.FT.	FLOW RATE CFS	TRAVEL TIME HRS
.313	.562	3.85	.0355
.625	1.564	16.70	.0228
.938	2.824	38.83	.0177
1.251	4.271	69.84	.0149
1.563	5.859	109.05	.0131
1.876	7.554	155.58	.0118
2.189	9.329	208.45	.0109
2.501	11.159	266.51	.0102
2.814	13.022	328.53	.0096
3.127	14.897	393.19	.0092
3.439	16.764	459.03	.0089
3.752	18.601	524.49	.0086
4.065	20.388	587.85	.0084
4.377	22.101	647.18	.0083
4.690	23.712	700.29	.0082
5.003	25.189	744.47	.0082
5.315	26.489	776.08	.0083
5.628	27.547	789.07	.0085
6.000	28.274	789.07	.0087

ROUTE ID=56 HYD NO=PIPE INFLOW ID=52
PRINT HYD ID=56 CODE=1

HYDROGRAPH FROM AREA PIPE

RUNOFF VOLUME = 1.53083 INCHES = 25.8770 ACRE-FEET
PEAK DISCHARGE RATE = 694.96 CFS AT 1.550 HOURS BASIN AREA = .3170 SQ. MI.

*
ADD HYD ID=57 HYD=AP8 ID I=56 ID II=55
PRINT HYD ID=57 CODE=1

HYDROGRAPH FROM AREA AP8

RUNOFF VOLUME = 1.54747 INCHES = 27.6476 ACRE-FEET
PEAK DISCHARGE RATE = 736.64 CFS AT 1.550 HOURS BASIN AREA = .3350 SQ. MI.

*
****
*S FLOW TO AP9: ADD BASIN DB10 TO AP8
****
*COMPUTE RATING CURVE CID=1 VS NO=1 CODE=-1 SLP=0.002

```
*                         DIAM=6.0 FT   N=0.013
COMPUTE TRAVEL TIME    ID=61    REACH NO=1 NO VS=1 L=975  FT
                                SLOPE=0.06
```

TRAVEL TIME TABLE
REACH= 1.0

WATER DEPTH FEET	AVERAGE AREA SQ.FT.	FLOW RATE CFS	TRAVEL TIME HRS
.313	.562	3.85	.0396
.625	1.564	16.70	.0254
.938	2.824	38.83	.0197
1.251	4.271	69.84	.0166
1.563	5.859	109.05	.0146
1.876	7.554	155.58	.0132
2.189	9.329	208.45	.0121
2.501	11.159	266.51	.0113
2.814	13.022	328.53	.0107
3.127	14.897	393.19	.0103
3.439	16.764	459.03	.0099
3.752	18.601	524.49	.0096
4.065	20.388	587.85	.0094
4.377	22.101	647.18	.0092
4.690	23.712	700.29	.0092
5.003	25.189	744.47	.0092
5.315	26.489	776.08	.0092
5.628	27.547	789.07	.0095
6.000	28.274	789.07	.0097

```
ROUTE                  ID=61   HYD NO=PIPE  INFLOW ID=57
PRINT HYD              ID=61   CODE=1
```

HYDROGRAPH FROM AREA PIPE

```
RUNOFF VOLUME =      1.54747 INCHES      =      27.6476 ACRE-FEET
PEAK DISCHARGE RATE =      744.52 CFS  AT   1.550 HOURS   BASIN AREA =   .3350 SQ. MI.
```

```
*
ADD HYD                 ID=62 HYD=AP9 ID I=61 ID II=60
PRINT HYD                   ID=62   CODE=1
```

HYDROGRAPH FROM AREA AP9

```
RUNOFF VOLUME =      1.56144 INCHES      =      29.2982 ACRE-FEET
PEAK DISCHARGE RATE =      783.37 CFS  AT   1.550 HOURS   BASIN AREA =   .3518 SQ. MI.
```

```
*
*****************************************************
*S FLOW TO AP10: ADD BASIN DB3 TO GIBSON
*****************************************************
ADD HYD                 ID=22 HYD=AP10 ID I=20 ID II=27
PRINT HYD                   ID=22   CODE=1
```

HYDROGRAPH FROM AREA AP10

```
RUNOFF VOLUME =      1.53587 INCHES      =       4.7378 ACRE-FEET
PEAK DISCHARGE RATE =      152.85 CFS  AT   1.500 HOURS   BASIN AREA =   .0578 SQ. MI.
```

```
*
*****************************************************
*S FLOW TO AP11: ADD BASIN DB11 TO AP10
*****************************************************
COMPUTE RATING CURVE   CID=1 VS NO=1 CODE=-1 SLP=0.03
                       DIAM=3.5 FT   N=0.013
```

RATING CURVE PIPE SECTION 1.0

WATER SURFACE ELEV	FLOW AREA SQ FT	FLOW RATE CFS	MAX WIDTH FT
.00	.00	.00	.00

.18	.19	.91	1.56
.36	.53	3.97	2.14
.55	.96	9.22	2.54
.73	1.45	16.59	2.84
.91	1.99	25.91	3.07
1.09	2.57	36.96	3.25
1.28	3.17	49.52	3.37
1.46	3.80	63.31	3.45
1.64	4.43	78.05	3.49
1.82	5.07	93.41	3.50
2.01	5.70	109.05	3.50
2.19	6.33	124.60	3.50
2.37	6.94	139.65	3.50
2.55	7.52	153.75	3.50
2.74	8.07	166.36	3.50
2.92	8.57	176.86	3.50
3.10	9.01	184.37	3.50
3.28	9.37	187.45	3.50
3.50	9.62	187.45	3.50

COMPUTE TRAVEL TIME ID=66 REACH NO=1 NO VS=1 L=1060 FT
SLOPE=0.03

TRAVEL TIME TABLE
REACH= 1.0

WATER DEPTH FEET	AVERAGE AREA SQ.FT.	FLOW RATE CFS	TRAVEL TIME HRS
.182	.191	.91	.0616
.365	.532	3.97	.0395
.547	.961	9.22	.0307
.730	1.453	16.59	.0258
.912	1.994	25.91	.0227
1.094	2.571	36.96	.0205
1.277	3.175	49.52	.0189
1.459	3.797	63.31	.0177
1.641	4.431	78.05	.0167
1.824	5.069	93.41	.0160
2.006	5.704	109.05	.0154
2.189	6.330	124.60	.0150
2.371	6.938	139.65	.0146
2.553	7.520	153.75	.0144
2.736	8.069	166.36	.0143
2.918	8.571	176.86	.0143
3.101	9.014	184.37	.0144
3.283	9.374	187.45	.0147
3.500	9.621	187.45	.0151

ROUTE ID=66 HYD NO=PIPE INFLOW ID=22
PRINT HYD ID=66 CODE=1

HYDROGRAPH FROM AREA PIPE

RUNOFF VOLUME = 1.53588 INCHES = 4.7378 ACRE-FEET
PEAK DISCHARGE RATE = 151.42 CFS AT 1.500 HOURS BASIN AREA = .0578 SQ. MI.

*
ADD HYD ID=67 HYD=AP11 ID I=66 ID II=65
PRINT HYD ID=67 CODE=1

HYDROGRAPH FROM AREA AP11

RUNOFF VOLUME = 1.66071 INCHES = 8.6949 ACRE-FEET
PEAK DISCHARGE RATE = 258.11 CFS AT 1.500 HOURS BASIN AREA = .0982 SQ. MI.

*
DIVIDE HYD ID=80 Q=15 IDI=81 HYD=DB14A
IDII=82 HYD=DB14B

*
ADD HYD ID=83 HYD=AP11 ID I=81 ID II=67
PRINT HYD ID=83 CODE=1

HYDROGRAPH FROM AREA AP11

```
    RUNOFF VOLUME =      1.67384 INCHES      =        9.4576 ACRE-FEET
    PEAK DISCHARGE RATE =       273.11 CFS   AT    1.500 HOURS    BASIN AREA =    .1059 SQ. MI.


*
*****************************************************
*S FLOW TO AP12: ADD BASINS DB12 AND DB13 TO AP11
*****************************************************
ADD HYD                     ID=76 HYD=BASIN13 ID I=83 ID II=75
PRINT HYD                      ID=76   CODE=1

                                          HYDROGRAPH FROM AREA BASIN13


    RUNOFF VOLUME =      1.68337 INCHES      =       10.0912 ACRE-FEET
    PEAK DISCHARGE RATE =       290.20 CFS   AT    1.500 HOURS    BASIN AREA =    .1124 SQ. MI.


*
ADD HYD                     ID=77 HYD=BASIN12 ID I=76 ID II=70
PRINT HYD                      ID=77   CODE=1

                                          HYDROGRAPH FROM AREA BASIN12


    RUNOFF VOLUME =      1.69010 INCHES      =       10.5875 ACRE-FEET
    PEAK DISCHARGE RATE =       303.60 CFS   AT    1.500 HOURS    BASIN AREA =    .1175 SQ. MI.


*
ADD HYD                     ID=78 HYD=AP12 ID I=77 ID II=82
PRINT HYD                      ID=78   CODE=1

                                          HYDROGRAPH FROM AREA AP12


    RUNOFF VOLUME =      1.69102 INCHES      =       10.6585 ACRE-FEET
    PEAK DISCHARGE RATE =       311.09 CFS   AT    1.500 HOURS    BASIN AREA =    .1182 SQ. MI.


*
FINISH

    NORMAL PROGRAM FINISH          END TIME (HR:MIN:SEC) = 16:35:24
```

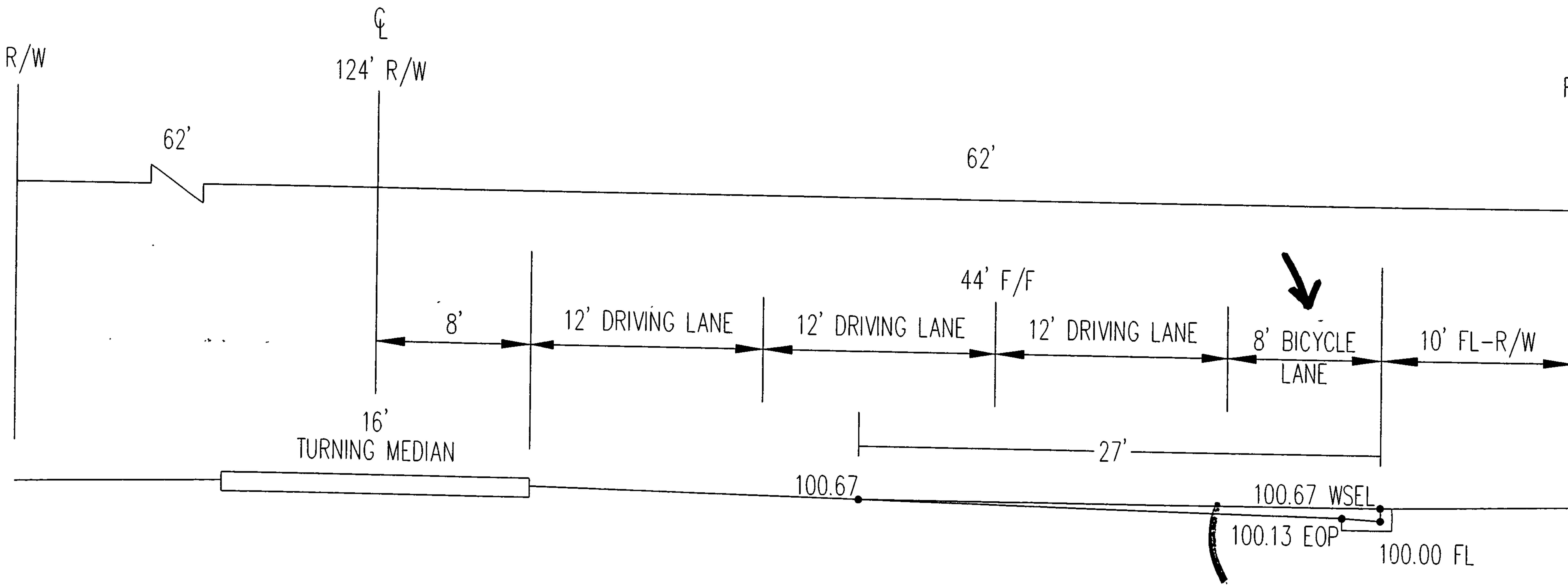
```
INPUT FILE: GIBSON BLVD CORRIDOR BETWEEN 118TH STREET AND THE AMOLE ARROYO

*INPUT - 100-YEAR, 6-HOUR STORM
*
*S EL RANCHO GRANDE MASTER DRAINAGE STUDY / DEVELOPED CONDITIONS
* 03-19-03
START                RAINFALL BEGINS AT 0.00 HOURS
*                      100 YEAR RETURN PERIOD
*******************************************************************************
*
*      ::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
*      ::                        MISC. DATA                         ::
*      ::         RAINFALL RETURN PERIOD______________ 100-YEAR     ::
*      ::         RAINFALL DURATION___________________    6-HOUR    ::
*      ::         ZONE 1                                            ::
*      ::         RAINFALL DEPTHS: 1 HOUR (P60)___  1.90 INCHES     ::
*      ::         (UNADJUSTED)     6 HOUR (P360)__  2.20 INCHES     ::
*      ::                         24 HOUR (P1440)_  2.60 INCHES     ::
*      ::                                                           ::
*      ::         RAINFALL DATA TAKEN FROM NOAA.                    ::
*      ::                                                           ::
*      ::                 HYDROGRAPH METHODOLOGY                    ::
*      ::                                                           ::
*      ::         CITY OF ALBQ. DPM VOL. 2, SECTION 22.2 July, 1997 ::
*      ::         INITIAL ABSTRACTION - INFILTRATION METHOD         ::
*      ::         Tc CALCULATIONS PER C.O.A. DPM 22.2-B.4           ::
*      ::         AMAFCA AHYMO VERSION MARCH 20,1992                ::
*      ::                                                           ::
*      ::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
*                              BEGIN  ANALYSIS
*******************************************************************************
*
RAINFALL              TYPE=1 RAIN QUARTER=0.0 RAIN ONE=1.90
                      RAIN SIX=2.20 RAIN DAY=2.60 DT=0.05
*
******************************************************************
*S* COMPUTE DEVELOPED CONDITIONS, RESIDENTIAL NORTH OF GIBSON
******************************************************************
**** COMPUTE AND PRINT NM HYD DATA FOR BASIN DB1  *********
COMPUTE NM HYD        ID=5 HYD=DB1  AREA=0.028724 PER A=0.0 PER B=20.0
                      PER C=20.0 PER D=60.0  TP=.133  RAINFALL=-1
PRINT HYD               ID=5   CODE=1
*
**** COMPUTE AND PRINT NM HYD DATA FOR BASIN DB2  *********
COMPUTE NM HYD        ID=10 HYD=DB2  AREA=0.066052 PER A=0.0 PER B=20.0
                      PER C=20.0 PER D=60.0  TP=.133  RAINFALL=-1
PRINT HYD               ID=10   CODE=1
*
**** COMPUTE AND PRINT NM HYD DATA FOR BASIN DB3  *********
COMPUTE NM HYD        ID=20 HYD=DB3  AREA=0.053916 PER A=0.0 PER B=20.0
                      PER C=20.0 PER D=60.0  TP=.133  RAINFALL=-1
PRINT HYD               ID=20   CODE=1
*
******************************************************************
*S* COMPUTE DEVELOPED CONDITIONS, GIBSON BOULEVARD WEST OF BLAKE
******************************************************************
**** COMPUTE AND PRINT NM HYD DATA FOR DB4  *********
COMPUTE NM HYD        ID=25 HYD=DB4  AREA=0.020526 PER A=0.0 PER B=10.0
                      PER C=0.0 PER D=90.0  TP=.133  RAINFALL=-1
PRINT HYD               ID=25   CODE=1
*
******************************************************************
*S* COMPUTE DEVELOPED CONDITIONS, RESIDENTIAL SOUTH OF GIBSON
******************************************************************
**** COMPUTE AND PRINT NM HYD DATA FOR DB5  *********
COMPUTE NM HYD        ID=35 HYD=DB5  AREA=0.039306 PER A=0.0 PER B=20.0
                      PER C=20.0 PER D=60.0  TP=.133  RAINFALL=-1
PRINT HYD               ID=35   CODE=1
*
**** COMPUTE AND PRINT NM HYD DATA FOR DB6  *********
COMPUTE NM HYD        ID=40 HYD=DB6  AREA=0.076738 PER A=0.0 PER B=20.0
                      PER C=20.0 PER D=60.0  TP=.133  RAINFALL=-1
PRINT HYD               ID=40   CODE=1
*
**** COMPUTE AND PRINT NM HYD DATA FOR BASIN DB7  *********
COMPUTE NM HYD        ID=45 HYD=DB7  AREA=0.053466 PER A=0.0 PER B=20.0
                      PER C=20.0 PER D=60.0  TP=.133  RAINFALL=-1
PRINT HYD               ID=45   CODE=1
*
```

```
**** COMPUTE AND PRINT NM HYD DATA FOR BASIN DB8  *********
COMPUTE NM HYD        ID=50 HYD=DB8  AREA=0.036062 PER A=0.0 PER B=20.0
                      PER C=20.0 PER D=60.0  TP=.133  RAINFALL=-1
PRINT HYD               ID=50   CODE=1
*
*************************************************************
*S* COMPUTE DEVELOPED CONDITIONS, COMMERCIAL SOUTH OF GIBSON
*************************************************************
**** COMPUTE AND PRINT NM HYD DATA FOR BASIN DB9  *********
COMPUTE NM HYD        ID=55 HYD=DB9  AREA=0.018045 PER A=0.0 PER B=10.0
                      PER C=0.0 PER D=90.0  TP=.133  RAINFALL=-1
PRINT HYD               ID=55   CODE=1
*
**** COMPUTE AND PRINT NM HYD DATA FOR BASIN DB10  *********
COMPUTE NM HYD        ID=60 HYD=DB10  AREA=0.0168227 PER A=0.0 PER B=10.0
                      PER C=0.0 PER D=90.0  TP=.133  RAINFALL=-1
PRINT HYD               ID=60   CODE=1
*
*************************************************************
*S* COMPUTE DEVELOPED CONDITIONS, COMMERCIAL NORTH OF GIBSON
*************************************************************
**** COMPUTE AND PRINT NM HYD DATA FOR BASIN DB11  *********
COMPUTE NM HYD        ID=65 HYD=DB11  AREA=0.04033 PER A=0.0 PER B=10.0
                      PER C=0.0 PER D=90.0  TP=.133  RAINFALL=-1
PRINT HYD               ID=65   CODE=1
*
**** COMPUTE AND PRINT NM HYD DATA FOR BASIN DB12  *********
COMPUTE NM HYD        ID=70 HYD=DB12  AREA=0.0050586 PER A=0.0 PER B=10.0
                      PER C=0.0 PER D=90.0  TP=.133  RAINFALL=-1
PRINT HYD               ID=70   CODE=1
*
*************************************************************
*S* COMPUTE DEVELOPED CONDITIONS, 98TH ST NORTH OF GIBSON
*************************************************************
**** COMPUTE AND PRINT NM HYD DATA FOR BASIN DB13  *********
COMPUTE NM HYD        ID=75 HYD=DB13  AREA=0.006457 PER A=0.0 PER B=10.0
                      PER C=0.0 PER D=90.0  TP=.133  RAINFALL=-1
PRINT HYD               ID=75   CODE=1
*
*************************************************************
*S* COMPUTE DEVELOPED CONDITIONS, GIBSON BLVD EAST OF BLAKE
*************************************************************
**** COMPUTE AND PRINT NM HYD DATA FOR BASIN DB14  *********
COMPUTE NM HYD        ID=80 HYD=DB14  AREA=0.008497 PER A=0.0 PER B=10.0
                      PER C=0.0 PER D=90.0  TP=.133  RAINFALL=-1
PRINT HYD               ID=80   CODE=1
*
**************************************************
*S FLOW TO AP1: ROUTE BASIN DB1 THROUGH SD
**************************************************
COMPUTE RATING CURVE  CID=1 VS NO=1 CODE=-1 SLP=0.03
                      DIAM=2.5 FT   N=0.013
COMPUTE TRAVEL TIME   ID=6   REACH NO=1 NO VS=1 L=800  FT
                             SLOPE=0.03
ROUTE                 ID=6  HYD NO=PIPE  INFLOW ID=5
PRINT HYD             ID=6  CODE=1
*
DIVIDE HYD              ID=10   PER=-50   IDI=11 HYD=DB2A
                                          IDII=12  HYD=DB2B
*
ADD HYD                 ID=13 HYD=AP1 ID I=6 ID II=11
PRINT HYD               ID=13   CODE=1
*
*****************************************************************
*S FLOW TO AP2: DIVIDE BASIN DB2, ADD TO DB1, ROUTE THROUGH SD
*****************************************************************
COMPUTE RATING CURVE  CID=1 VS NO=1 CODE=-1 SLP=0.03
                      DIAM=3.5 FT   N=0.013
COMPUTE TRAVEL TIME   ID=14   REACH NO=1 NO VS=1 L=870  FT
                              SLOPE=0.03
ROUTE                 ID=14  HYD NO=PIPE  INFLOW ID=13
PRINT HYD             ID=14  CODE=1
*
ADD HYD                 ID=15 HYD=BASIN12 ID I=14 ID II=12
PRINT HYD               ID=15   CODE=1
*
DIVIDE HYD              ID=25   Q=26   IDI=26 HYD=DB4A
                                       IDII=27  HYD=DB4B
*
```

```
ADD HYD                     ID=16 HYD=AP2 ID I=15 ID II=26
PRINT HYD                   ID=16   CODE=1
*
*************************************************
*S FLOW TO AP3: ROUTE BASIN DB5 THROUGH SD
*************************************************
COMPUTE RATING CURVE  CID=1 VS NO=1 CODE=-1 SLP=0.03
                      DIAM=4.0 FT   N=0.013
COMPUTE TRAVEL TIME   ID=17    REACH NO=1 NO VS=1 L=1775  FT
                               SLOPE=0.03
ROUTE                 ID=17  HYD NO=PIPE  INFLOW ID=16
PRINT HYD             ID=17  CODE=1
*
COMPUTE RATING CURVE  CID=1 VS NO=1 CODE=-1 SLP=0.03
                      DIAM=3.0 FT   N=0.013
COMPUTE TRAVEL TIME   ID=36    REACH NO=1 NO VS=1 L=1050  FT
                               SLOPE=0.03
ROUTE                 ID=36  HYD NO=PIPE  INFLOW ID=35
PRINT HYD             ID=36  CODE=1
*
DIVIDE HYD              ID=40   Q=100   IDI=41 HYD=DB6A
                                        IDII=42  HYD=DB6B
*
ADD HYD                 ID=38 HYD=AP3 ID I=36 ID II=41
PRINT HYD               ID=38   CODE=1
*
***************************************************************
*S FLOW TO AP5: DIVIDE BASIN DB6, ADD TO DB5, DB1, AND DB2
***************************************************************
COMPUTE RATING CURVE  CID=1 VS NO=1 CODE=-1 SLP=0.03
                      DIAM=4.0 FT   N=0.013
COMPUTE TRAVEL TIME   ID=39    REACH NO=1 NO VS=1 L=1050  FT
                               SLOPE=0.03
ROUTE                 ID=39  HYD NO=PIPE  INFLOW ID=38
PRINT HYD             ID=39  CODE=1
*
ADD HYD                 ID=43 HYD=AP4 ID I=39 ID II=42
PRINT HYD               ID=43   CODE=1
*
ADD HYD                 ID=44 HYD=AP5 ID I=17 ID II=43
PRINT HYD               ID=44   CODE=1
*
***************************************************************
*S FLOW TO AP6: ADD BASIN DB7 TO AP5
***************************************************************
COMPUTE RATING CURVE  CID=1 VS NO=1 CODE=-1 SLP=0.03
                      DIAM=5.5 FT   N=0.013
COMPUTE TRAVEL TIME   ID=46    REACH NO=1 NO VS=1 L=900  FT
                               SLOPE=0.03
ROUTE                 ID=46  HYD NO=PIPE  INFLOW ID=44
PRINT HYD             ID=46  CODE=1
*
ADD HYD                 ID=47 HYD=AP6 ID I=46 ID II=45
PRINT HYD                ID=47   CODE=1
*
***************************************************************
*S FLOW TO AP7: ADD BASIN DB8 TO AP6
***************************************************************
*COMPUTE RATING CURVE  CID=1 VS NO=1 CODE=-1 SLP=0.03
*                      DIAM=6.0 FT   N=0.013
COMPUTE TRAVEL TIME   ID=51    REACH NO=1 NO VS=1 L=1100  FT
                               SLOPE=0.03
ROUTE                 ID=51  HYD NO=PIPE  INFLOW ID=47
PRINT HYD             ID=51  CODE=1
*
ADD HYD                 ID=52 HYD=AP7 ID I=51 ID II=50
PRINT HYD                ID=52   CODE=1
*
***************************************************************
*S FLOW TO AP8: ADD BASIN DB9 TO AP7
***************************************************************
COMPUTE RATING CURVE  CID=1 VS NO=1 CODE=-1 SLP=0.03
                      DIAM=6.0 FT   N=0.013
COMPUTE TRAVEL TIME   ID=56    REACH NO=1 NO VS=1 L=875  FT
                               SLOPE=0.03
ROUTE                 ID=56  HYD NO=PIPE  INFLOW ID=52
PRINT HYD             ID=56  CODE=1
*
ADD HYD                 ID=57 HYD=AP8 ID I=56 ID II=55
```

```
PRINT HYD                  ID=57   CODE=1
*
*****************************************************************
*S FLOW TO AP9: ADD BASIN DB10 TO AP8
*****************************************************************
*COMPUTE RATING CURVE  CID=1 VS NO=1 CODE=-1 SLP=0.002
*                      DIAM=6.0 FT   N=0.013
COMPUTE TRAVEL TIME    ID=61    REACH NO=1 NO VS=1 L=975  FT
                                SLOPE=0.06
ROUTE                  ID=61  HYD NO=PIPE  INFLOW ID=57
PRINT HYD              ID=61  CODE=1
*
ADD HYD                 ID=62 HYD=AP9 ID I=61 ID II=60
PRINT HYD                ID=62   CODE=1
*
*****************************************************
*S FLOW TO AP10: ADD BASIN DB3 TO GIBSON
*****************************************************
ADD HYD                  ID=22 HYD=AP10 ID I=20 ID II=27
PRINT HYD                ID=22   CODE=1
*
*****************************************************
*S FLOW TO AP11: ADD BASIN DB11 TO AP10
*****************************************************
COMPUTE RATING CURVE  CID=1 VS NO=1 CODE=-1 SLP=0.03
                      DIAM=3.5 FT   N=0.013
COMPUTE TRAVEL TIME    ID=66    REACH NO=1 NO VS=1 L=1060  FT
                                SLOPE=0.03
ROUTE                  ID=66  HYD NO=PIPE  INFLOW ID=22
PRINT HYD              ID=66  CODE=1
*
ADD HYD                  ID=67 HYD=AP11 ID I=66 ID II=65
PRINT HYD                ID=67   CODE=1
*
DIVIDE HYD               ID=80   Q=15   IDI=81 HYD=DB14A
                                          IDII=82  HYD=DB14B
*
ADD HYD                  ID=83 HYD=AP11 ID I=81 ID II=67
PRINT HYD                ID=83   CODE=1
*
*****************************************************
*S FLOW TO AP12: ADD BASINS DB12 AND DB13 TO AP11
*****************************************************
ADD HYD                  ID=76 HYD=BASIN13 ID I=83 ID II=75
PRINT HYD                ID=76   CODE=1
*
ADD HYD                  ID=77 HYD=BASIN12 ID I=76 ID II=70
PRINT HYD                ID=77   CODE=1
*
ADD HYD                  ID=78 HYD=AP12 ID I=77 ID II=82
PRINT HYD                ID=78   CODE=1
*
FINISH
```



CROSS SECTIONAL AREA = 7.942 SF
(WATER SURFACE ELEVATION ALLOWING 1 LANE OPEN)

MANNING'S EQUATION:

Use: n=0.017

$Q = 1.486/n\,(A\,R^{2/3}S^{1/2})$

$A = 7.492$ ft

$R = A/WP = 7.942/27.671 = 0.2870$

FOR S= 3%:

$Q = 1.486/0.017\,(7.942)\,(0.2870)^{2/3}(0.03)^{1/2}$

Q= 52.3 cfs

FOR S= 5%: **Q= 67.5 cfs**

FOR S= 7%: **Q= 79.9 cfs**

GIBSON BOULEVARD CORRIDOR

STREET CAPACITIES

NOT TO SCALE

:\DOCUME~1\lmendez\LOCALS~1\Temp\GIBSON_XSECTION_1_1_9587.sv$
April 04, 2003 - 09:22 AM
Layout1

Bohannan ▲ Huston Inc.
Courtyard I 7500 Jefferson St. NE Albuquerque, NM 87109-4335
ENGINEERING ▲ SPATIAL DATA ▲ ADVANCED TECHNOLOGIES

APPENDIX B

GIBSON BOULEVARD STREET FLOWS AND
STORM DRAIN HYDRAULIC CALCULATIONS

Storm Drain Analysis: Analysis Point #1

==

Drainage Structure Analyzer

Pipe Hydraulic Analysis

Date: Wednesday, May 07, 2003 08:37:59 AM

==

Input Data

Shape	Circular
Material	RC C76-A
Roughness	0.013000
Method	Manning
Flow Rate	142.0 cfs
Slope	2.500%
Size (W x T):	42.00 x 3.5000

Output Results

Flow Rate	142.0 cfs
Slope	2.500%
d/D	0.74
Capacity	159.1 cfs
Velocity	18.69 ft/s
Depth	2.58 ft
Critical Depth	3.36 ft
Size (W x T):	42.00 x 3.5000

Storm Drain Analysis: Analysis Point #2

==
Drainage Structure Analyzer

Pipe Hydraulic Analysis

Date: Wednesday, May 07, 2003 08:38:39 AM
==

Input Data

Shape	Circular
Material	RC C76-A
Roughness	0.013000
Method	Manning
Flow Rate	243.0 cfs
Slope	3.000%
Size (W x T):	48.00 x 4.0000

Output Results

Flow Rate	243.0 cfs
Slope	3.000%
d/D	0.80
Capacity	248.8 cfs
Velocity	22.57 ft/s
Depth	3.20 ft
Critical Depth	3.92 ft
Size (W x T):	48.00 x 4.0000

Storm Drain Analysis: Analysis Point #3

===
Drainage Structure Analyzer

Pipe Hydraulic Analysis

Date: Wednesday, May 07, 2003 08:39:18 AM
===

Input Data

Shape	Circular
Material	RC C76-A
Roughness	0.013000
Method	Manning
Flow Rate	190.0 cfs
Slope	3.000%
Size (W x T):	48.00 x 4.0000

Output Results

Flow Rate	190.0 cfs
Slope	3.000%
d/D	0.65
Capacity	248.8 cfs
Velocity	21.81 ft/s
Depth	2.62 ft
Critical Depth	3.81 ft
Size (W x T):	48.00 x 4.0000

Storm Drain Analysis: Analysis Point #4

==
Drainage Structure Analyzer

Pipe Hydraulic Analysis

Date: Wednesday, May 07, 2003 08:39:42 AM
==

Input Data

Shape	Circular
Material	RC C76-A
Roughness	0.013000
Method	Manning
Flow Rate	263.0 cfs
Slope	2.000%
Size (W x T):	54.00 x 4.5000

Output Results

Flow Rate	263.0 cfs
Slope	2.000%
d/D	0.77
Capacity	278.1 cfs
Velocity	19.89 ft/s
Depth	3.49 ft
Critical Depth	4.31 ft
Size (W x T):	54.00 x 4.5000

Storm Drain Analysis: Analysis Point #5

==
Drainage Structure Analyzer

Pipe Hydraulic Analysis

Date: Wednesday, May 07, 2003 08:40:06 AM
==

Input Data

Shape	Circular
Material	RC C76-A
Roughness	0.013000
Method	Manning
Flow Rate	494.0 cfs
Slope	2.500%
Size (W x T):	66.00 x 5.5000

Output Results

Flow Rate	494.0 cfs
Slope	2.500%
d/D	0.76
Capacity	531.0 cfs
Velocity	25.39 ft/s
Depth	4.20 ft
Critical Depth	5.36 ft
Size (W x T):	66.00 x 5.5000

Storm Drain Analysis: Analysis Point #6

```
===================================================================
Drainage Structure Analyzer

Pipe Hydraulic Analysis

Date:  Wednesday, May 07, 2003 08:40:40 AM
===================================================================

Input Data
----------
Shape                                      Circular
Material                                   RC C76-A
Roughness                                  0.013000
Method                                      Manning
Flow Rate                                     614.0 cfs
Slope                                        3.500%
Size (W x T):                        66.00 x 5.5000

Output Results
--------------
Flow Rate                                     614.0 cfs
Slope                                        3.500%
d/D                                            0.80
Capacity                                      628.2 cfs
Velocity                                      30.14 ft/s
Depth                                          4.40 ft
Critical Depth                                 5.44 ft
Size (W x T):                        66.00 x 5.5000
```

Storm Drain Analysis: Analysis Point #7

===
Drainage Structure Analyzer

Pipe Hydraulic Analysis

Date: Wednesday, May 07, 2003 08:41:10 AM
===

Input Data

Shape	Circular
Material	RC C76-A
Roughness	0.013000
Method	Manning
Flow Rate	685.0 cfs
Slope	3.000%
Size (W x T):	72.00 x 6.0000

Output Results

Flow Rate	685.0 cfs
Slope	3.000%
d/D	0.77
Capacity	733.5 cfs
Velocity	29.48 ft/s
Depth	4.59 ft
Critical Depth	5.90 ft
Size (W x T):	72.00 x 6.0000

Storm Drain Analysis: Analysis Point #8

==
Drainage Structure Analyzer

Pipe Hydraulic Analysis

Date: Wednesday, May 07, 2003 08:41:32 AM
==

Input Data

Shape	Circular
Material	RC C76-A
Roughness	0.013000
Method	Manning
Flow Rate	737.0 cfs
Slope	3.000%
Size (W x T):	72.00 x 6.0000

Output Results

Flow Rate	737.0 cfs
Slope	3.000%
d/D	0.82
Capacity	733.5 cfs
Velocity	29.58 ft/s
Depth	4.94 ft
Critical Depth	5.92 ft
Size (W x T):	72.00 x 6.0000

Storm Drain Analysis: Analysis Point #10

==
Drainage Structure Analyzer

Pipe Hydraulic Analysis

Date: Wednesday, May 07, 2003 08:41:56 AM
==

Input Data

Shape	Circular
Material	RC C76-A
Roughness	0.013000
Method	Manning
Flow Rate	153.0 cfs
Slope	2.500%
Size (W x T):	42.00 x 3.5000

Output Results

Flow Rate	153.0 cfs
Slope	2.500%
d/D	0.79
Capacity	159.1 cfs
Velocity	18.83 ft/s
Depth	2.75 ft
Critical Depth	3.39 ft
Size (W x T):	42.00 x 3.5000

Storm Drain Analysis: Analysis Point #11

==
Drainage Structure Analyzer

Pipe Hydraulic Analysis

Date: Wednesday, May 07, 2003 08:42:23 AM
==

```
Input Data
----------
Shape                                   Circular
Material                                RC C76-A
Roughness                               0.013000
Method                                   Manning
Flow Rate                                  273.0 cfs
Slope                                     2.500%
Size (W x T):                     54.00 x 4.5000

Output Results
--------------
Flow Rate                                  273.0 cfs
Slope                                     2.500%
d/D                                         0.73
Capacity                                   310.9 cfs
Velocity                                   22.05 ft/s
Depth                                       3.27 ft
Critical Depth                              4.33 ft
Size (W x T):                     54.00 x 4.5000
```

APPENDIX C

EXCERPTS FROM THE AMOLE-HUBBELL DRAINAGE MANAGEMENT PLAN

B. AMOLE ARROYO BASIN

1. EVALUATION

a. Situation

Location: The Amole Arroyo drainage basin is shown on Figure III-1. The Amole Arroyo within this study area extends from the existing Westgate Dam to the Amole Detention Basin. The arroyo is currently a natural earthen arroyo with short reaches of constructed earth channel. Runoff is diverted into the Amole Arroyo at three locations, Powerline Channel, Snow Vista Channel and Sacate Blanco Diversion Channel. The natural drainage area below Westgate Dam which drains into the Amole Arroyo is relatively small, approximately 1.23 square miles of the 10.12 square mile total tributary area.

Stability: The stability of the Amole Arroyo was investigated in the Sediment Reconnaissance portion of this study. The Sediment Reconnaissance report is located in Volume III. Aerial mapping with specific Amole Arroyo sediment concerns illustrated are included in Volume II.

The existing sandy soil arroyo is unstable. Erosion and deposition occurs with each rainfall event resulting in steep or vertical banks up to 10 ft. tall in the eroding areas and a shallow meandering alignment in areas of deposition. Runoff from Powerline and Snow Vista Channels are primarily "Clean" water runoff from diversions which have limited sediment carrying capacity. Continued development will increase the clean water runoff, creating more erosion and subsequent deposition and render the arroyo less stable. The instabilities create several different problems; in the erosion areas, the steep banks are a safety hazard, in the deposition areas, the shallow channel is a potential avulsion hazard and in both areas, the channel will migrate endangering existing and proposed developments.

Open Space Arroyo: The Amole Arroyo is designated as an "Open Space" Arroyo as listed in the Rank III, Amole Arroyo Corridor Plan (Corridor Plan) adopted by AMAFCA and the City of Albuquerque. Guidelines in the Corridor Plan establish an overall concept for the improvements to the arroyo. These guidelines encourage channel improvements to be compatible with the "Open Space" designation allowing recreational uses within the corridor and limiting improvements to those which have minimal impact. Drainage improvements established by this DMP control the drainage and channel parameters.

Rio Bravo Sector Plan: Near the eastern end of the Amole Arroyo, from the Snow Vista confluence to the Amole Detention Facility, the Rio Bravo Sector Plan, a Rank II development plan for future development, has been adopted by the City. It proposes a site layout that includes a large commercial/retail center, high and low density housing, parks and schools. In the developed conditions model, the proposed land uses from this sector plan are incorporated. Part of this plan is the extension of Unser Boulevard from Arenal Rd. to Rio Bravo Blvd. Extension. Portions of the drainage area that generates runoff to the Amole Del

Norte Channel will be diverted to the Amole Arroyo by a collection system in the Unser Boulevard Extension. This diversion is incorporated into the DMP. Drainage basins 35301, 35303 and 35305 are diverted into the Amole Arroyo in the Unser Blvd. Extension storm drain. The drainage area and general corridor location are shown on Figure III-1.

b. Problem Description

The Amole Arroyo upstream of the Snow Vista confluence has significant vertical channel banks that are unstable and present a danger to the public. These banks indicate the channel is in a degrading state due to "clean" water runoff from upstream Powerline Diversion and Westgate Heights and are unstable. The Amole Arroyo through Westgate Heights has a constructed or graded channel adjacent to existing development that conveys flows in what appears to be in a state of sediment equilibrium or slight aggradation. Above the Delgado crossing, aggradation is evident.

A potential avulsion of the Amole Arroyo has been identified at southwest corner of Westgate Heights. The development is slightly lower than the arroyo and a potential exists for the arroyo to overflow into the development during high flows. This situation is aggravated by local grading to prevent vehicular traffic in the bottom of the arroyo and vegetative growth. The channel was cleaned and capacity restored in the winter of 1998-1999.

Downstream of the Snow Vista confluence, the Amole Arroyo transitions from a well defined, deep rectangular channel to a wide shallow meandering channel. The meandering ends at the Sacate Blanco confluence. The meandering arroyo is susceptible to aggradation due to relatively flat slopes.

A potential avulsion exists where the extension of Blake Road crosses the Amole Arroyo. Proposed Interim temporary control measures include raising the road grade of Blake Road on each side of the arroyo to equal the adjacent bank height and still maintain a 25 mile per hour design speed. This local regrading was performed in the winter of 1998-1999. A permanent solution is still required.

In the earthen portion of the Amole Arroyo at the entrance into the Amole Detention Facility, a channel deficiency has been identified where a localized area has channel banks that are lower than the remaining channel. To mitigate this deficiency, the channel was cleaned and capacity restored in 1998-1999.

The geomorphology conducted by Ayres Associates as part of the Sediment Reconnaissance indicates that the soils in the Amole Arroyo are erosive and the present arroyo is unstable. (See Sediment Reconnaissance Report in Volume III).

c. Existing Facility Data

The existing Amole Arroyo is, for the most part, a natural, migrating arroyo with areas of aggradation and degradation. See Table III-1 for hydrologic data and approximate existing channel capacity.

The Amole Arroyo enters the Amole Detention Dam via a concrete transition channel and chute with an energy dissipator. The design flow rate was 4235 cfs (RD-14). The predicted flow with DMP facilities in place is 4111 cfs. Preliminary calculations indicate that from 0.5' to 1.4' of additional freeboard may be required on the entry channel and chute to satisfy current freeboard criteria. The predicted flows do not exceed the "bank full" capacity.

d. Existing Right-of-Way

AMAFCA has Right-of-Way (ROW) and drainage easements for the existing Amole Arroyo except through Westgate Heights which is City of Albuquerque ROW. From the Westgate Dam to the Powerline Channel confluence, AMAFCA has a 100 foot ROW. AMAFCA has an 80 foot wide "floating easement" from Westgate Heights to the Sacate Blanco confluence ROW. ROW has been dedicated from Del Rey Rd. to the Snow Vista Channel. However, the present arroyo alignment is south of this ROW.

The "floating easement" was based on the 100-year floodplain maps. The "floating easement" location does not conform to the present alignment of the Amole Arroyo in all locations due to continued erosion/sedimentation. The "floating easement" allows AMAFCA access to the arroyo for maintenance.

Sufficient ROW appears to be available for constructing a stable Amole Arroyo in the current alignment. Additional ROW may be required for public amenities such as trails, etc. For the purpose of evaluating alternatives, it is assumed that the existing ROW ownership is adequate.

ROW for the alignment proposed in the Rio Bravo Sector Plan is partially in place. ROW would be required west of Del Rey Rd. and for the alignment along the 98th Street corridor. It is assumed that this ROW would be provided by property owners during development if the Rio Bravo Sector Plan alignment is followed.

e. Developed Conditions Data

Results from the Developed Conditions Existing Facilities (DEVEX) analysis (see Chapter II of this Volume and Volume III) indicates the Amole Arroyo does not have the capacity and/or stability to safely convey the 100 year developed conditions design storm. The alternatives evaluated are intended to provide for a safe conveyance system for the design storm. Hydrologic results presented in the Developed Conditions Existing Facilities analysis were used to develop hydraulic alternative solutions. Developed conditions runoff values with existing facilities for various analysis points along the arroyo are presented in Table III-1.

f. Criteria

The Amole Arroyo Corridor Plan (Corridor Plan) designates the Amole Arroyo as an open space arroyo.

The criteria is to provide a drainage management plan which:

✦ Provides a stable conveyance system that has the capacity to convey the 100 year event and meets the City of Albuquerque's Design Process Manual requirements. A stable conveyance system in this situation is one which does not significantly degrade or aggrade for the range of flows expected.

✦ Conforms to the Corridor Plan and Sector Plans - visually natural ("not manmade"), allow for biking, hiking and equestrian trails.

g. Alternative Evaluation

The arroyo is currently an unstable arroyo which means it is aggradating, degradating, and meandering with each rainfall event. Therefore, a suitable method of stabilizing the arroyo will be required to provide for a safe public use facility.

The arroyo alignment from the Del Ray Road crossing to the Sacate Blanco confluence has not been established. There are two possible generic alignments. The first is to convey flows to the Snow Vista Channel alignment using the dedicated ROW north of the present alignment, then down adjacent to the existing powerlines and 98th St. Corridor to the Sacate Blanco confluence in the Rio Bravo Sector Plan proposed alignment. ROW for this alignment downstream from the Snow Vista confluence has not been dedicated. A portion of the Snow Vista Channel requires reconstruction for this configuration. The other is to use the existing natural alignment. In either case the channel treatment could be similar.

The Amole Arroyo Corridor Plan (Corridor Plan) identifies several alternative channel treatments for a long term drainage solution. Available channel treatment options identified in the Corridor Plan include "gabions (grade control structures), prudent line, rip rap, soil cement, and earth tone tinted concrete". Additional options investigated include combinations of detention and a low flow channel and composite channels (low flow with overbank high flow). These alternatives were evaluated for applicability in providing a long term stable drainage solution as well as satisfying the Corridor Plan requirements for the Amole Arroyo from Westgate Dam to the Sacate Blanco Diversion convergence. Combinations of these different methods of creating a stable channel could be used.

Below the Sacate Blanco Diversion convergence, the Amole Arroyo is channelized and changes character. Alternatives for the proposed improvements from the Sacate Blanco Diversion to the Amole Detention Facility are limited due to the high flow rates.

Nine potential alternates and combinations of treatments were identified for the Amole Arroyo. Four of these were discarded following the initial evaluation. These are discussed in subsection (3). Five alternates were explored in more detail in the following subsections (1) and (2).

(1) Five feasible and potentially prudent alternatives were explored in detail for the Amole Arroyo system meeting the criteria. These alternates are shown schematically in Figures Alternate 1 through Alternate 5. Generalized channel treatments used in these alternates are:

(a) Low Flow Channel Section: This channel section is a soil cement (or tinted concrete) channel designed similar to AMAFCA's San Antonio Channel. (See typical section on drawings.) This channel section includes the opportunity for meanders, vegetated sediment pools, varying cross sections and other measures to provide a "naturalistic" feel. The reduced flow rate, accomplished by upstream detention, allows a relatively small channel width providing adequate space for trails and other amenities.

(b) High Flow Composite Channel Section: This channel concept incorporates a stabilized soil cement or tinted concrete low flow section for recurring flows and a stabilized overbank flow area for larger events. (See typical section on Alternative drawings.) The recurring flow channel could be similar to the naturalistic treatment of the Low Flow section. Providing stability for the overbank flow includes:

- buried riprap along the channel edge for velocity transition,
- buried grade control structures to control local erosion,
- landscape grasses, forbs and shrubbery capable of resisting the shallow infrequent flows,
- trails and public amenities consistent with the shallow infrequent overbank flow, and
- freeboard conforming to FEMA levee requirements (3' minimum, 4' adjacent to structures which restrict flow).

(c) High Flow Stabilized Channel: This section is proposed only where flow depths and velocities are such that the composite channel is not feasible. The proposed section is a trapezoidal soil cement or tinted concrete channel over 6' deep. (See typical section on Alternative drawings. This section can be softened by use of exposed soil cement ledges, varying section, etc. This section is used below the confluence with Sacate Blanco for all alternatives.

(d) Amole/Snow Vista Pond: Two alternatives incorporate a detention pond at the Amole Arroyo and Snow Vista Channel confluence. Two pond configurations were evaluated: one, the pond location is on the Snow Vista Channel above the confluence with the Amole Arroyo. Runoff from the Snow Vista Channel could be discharged from the pond at a rate of 50 cfs. Runoff from the Amole Arroyo would be conveyed in the arroyo. This would result in a 131 AF detention pond on approximately 30 acres. The combined flow rate below the confluence is 450 cfs.

The second configuration is to locate the pond at the confluence such that the pond detains both the Snow Vista and Amole Arroyo flows. The end result is approximately 35 acres for the pond, a detention volume of 166 AF, and an overall reduction in the downstream low flow channel size. The flow exiting the pond is limited to a peak flow of 150 cfs. This option is included in the alternatives which include low flow channel section below the confluence. A pond at the Amole

Arroyo/Snow Vista confluence does not conform to the Rio Bravo Sector Plan (RD-58). The Sector Plan proposes a high density "urban center" for this vicinity which may not be consistent with a large detention pond/open space facility.

(2) The Alternates are:

(a) Alternate 1: Low Flow channel section from Westgate to Sacate Blanco confluence and a high flow stabilized channel to the Amole Basin. This requires 51 AF detention on Powerline and 166 AF detention at Snow Vista/Amole confluence.

(b) Alternate 2: Low Flow channel section from Westgate to confluence with Snow Vista, high flow composite section to Sacate Blanco and high flow stabilized channel to the Amole Basin. This requires 51 AF detention on Powerline and follows the Rio Bravo Sector Plan alignment.

(c) Alternate 3: High flow composite section from Powerline to Snow Vista and low flow section from Snow Vista and Sacate Blanco and high flow section to the Amole Basin. This requires 232 AF detention at Snow Vista.

(d) Alternate 4: High flow composite section from Westgate to Sacate Blanco and high flow section to the Amole Basin. No detention is required. The alignment follows Rio Bravo Sector Plan alignment.

(e) Alternate 5: Low flow section from Westgate to Snow Vista, High flow composite section Snow Vista to Sacate Blanco and high flow section to Amole Basin. This requires 51 AF detention on Powerline and follows AMAFCA "floating easement" alignment.

These alternates are summarized on Table III and shown schematically on the Alterative drawings (Figures Alternative 1 to Alternative 5).

(3) Several Channel Alternatives were investigated and discarded. These included:

(a) Grade Control Structures: Grade control structures are helpful in reducing the channel velocity and erosion potential. The Amole Arroyo is a relatively steep channel which would require grade control structures to be placed about every 200 feet or so, depending on the drop height. Grade control structures can be made of different materials such as rip rap, gabions, concrete, and soil cement. Of these building materials, riprap and gabions are recommended for limited use only due to their rodent habitat potential. After investigating the hydraulic advantages and disadvantages, and long term maintenance requirements, the grade control alternative was eliminated from further consideration for the following reasons:

TABLE III
SUMMARY OF ALTERNATES

	Powerline Detention	Westgate to Snow Vista	Snow Vista Detention	Snow Vista to Sacate Blanco	Sacate Blanco to Rundown	Conceptual Project Cost	Comments
Alt. 1	Yes 58 AF $1,230,000	Low Flow, Section $1,147,000	Yes 166 AF 35 Ac Row $2,656,000	Low Flow Section $427,000	High Flow Section $735,000	$6,195,000 Crossing Struct. $2,975,000 Total = $9,170,000	
Alt. 2	Yes 58 AF $1,230,000	Low Flow, Section $1,304,000	None	High Flow Composite Section $2,111,000	High Flow Section $845,000	$5,490,000 Crossing Struct. $4,131,000 Total = $9,621,000	Utilizes Arroyo ROW proposed in Rio Bravo Sector Plan
Alt. 3	None	High Flow Composite Section $2,262,000	Yes 232 AF 50 Ac ROW $3,734,000	Low Flow Section $427,000	High Flow Section $735,000	$7,158,000 Crossing Struct. $3,377,000 Total = $10,535,000	
Alt. 4	None	High Flow Composite $2,754,000	None	High Flow Composite $2,220,000	High Flow Section $845,000	$5,819,000 Crossing Struct. $4,533,000 Total = $10,352,000	Utilizes Arroyo ROW proposed in Rio Bravo Sector Plan
Alt. 5	Yes 58 AF $1,230,000	Low Flow Section $1,521,000	None	High Flow Composite $1,493,000	High Flow Section $845,000	$5,089,000 Crossing Struct. $5,098,000 Total = $10,187,000	Similar to Alt. 2 Utilizes existing AMAFCA "Floating Easement"

- The average arroyo bed slope is 2.3 percent. Therefore, to obtain a stable average bed slope of 0.6 percent, 3 ft. high grade control structures would be placed, on average, at approximately 175 foot intervals. This is costly, both for construction and maintenance.

- The Amole Arroyo has two basic channel cross sections. First, the upper end is deeply incised with no well defined low flow channel from the Delgado CBC crossing to below the convergence with the Snow Vista Channel. The balance of the system transitions to a wide and shallow cross section with a defined low flow channel. In both cases, grade control structures would span from bank to bank making it difficult and costly to construct pedestrian, bike and equestrian trails.

(b) Prudent/Erosion Setback Limits: Prudent line erosion limits could be used to establish development limits and provide an area for the Amole Arroyo to continue to migrate and evolve. The Sediment Reconnaissance report in Volume III, indicates the Amole Arroyo is not a suitable candidate for a prudent line/erosion setback due to the following:

- The Arroyo carries "clean water" runoff from the Westgate Dam, the Powerline Diversion, the Snow Vista Diversion and from existing and future development in the basin. The "clean water" will continue to erode where it enters the channel and in steeper channel sections and deposit where the channel grade flattens, continuing the current unstable situation, essentially forever.

- The prudent line could feasibly be used in the lower reach of the Amole Arroyo from the Snow Vista Channel to the Sacate Blanco Diversion convergence in the current situation in which deposition of material eroded from the upper reach is deposited. However, when the upper reach is stabilized and when development occurs, the lower reach will exhibit the same erosion instabilities as the upper reach.

This option is not considered feasible for the Amole Arroyo.

(c) Runoff Constraints: The runoff from the northern portion of the Snow Vista Basin is being developed with a 1.29 cfs/acre runoff due to the limited capacity of the existing Snow Vista Channel. However, the existing development south of Sage Road was originally developed with "free discharge" which results in high flows in the Snow Vista Channel

Imposing runoff constraints in the Amole Basin does not appreciably reduce the flow rate in the Arroyo. (See Figure III-1). Most of the flow is from Snow Vista Diversion, Powerline Channel and developed areas in Westgate Heights.

Therefore, runoff constraints were not considered feasible.

(4) Recommended Alternative

The Recommended baseline alternative is:

- 51 AF detention on Powerline and a low flow channel from Westgate Dam to Snow Vista confluence.
- Composite channel from Snow Vista to Sacate Blanco. Developed alignment could be in the existing AMAFCA "floating easement", in the RBSP alignment or other alignment. The routing is not critical for the conveyance and can be established at the time development occurs.
- High flow channel from Sacate Blanco to Amole Basin.

Alternative 2 and Alternative 5 illustrate the proposed alternative. This conveyance alternative provides the following advantages:

- Upper low flow channel and mid reach composite channel compatible with Corridor Plan.
- Consistent with RBSP land use (no detention at Snow Vista).
- Alignment within existing AMAFCA easement within RBSP alignment or other compatible alignment.

2. PROPOSED MANAGEMENT PLAN

The Baseline Alternative described above is the proposed Management Plan. This proposed management plan is schematically shown on Figure III-1 and the Alternative 2 and Alternative 5 Figure. The hydrologic results for the Amole Arroyo with the proposed plan in place are contained in Table III-2.

The proposed improvements are:

a. Limit Flows into the Amole Arroyo from Powerline Diversion

Powerline Detention: Construct an additional 58 acre feet of detention storage on the Powerline Channel with a Q_{100} discharge limit of 20 cfs at the Amole Arroyo confluence. See the Powerline Basin section for specifics.

Priority - High (required to implement DMP solution and to stabilize Amole Arroyo)

b. Channel Improvements

Upper Reach Low Flow Channel: Construct low flow channel with open space appurtenances from Westgate Dam to the Snow Vista confluence. This channel would be designed to convey "clean" water discharges and use "naturalistic" construction in conformance with the Corridor Plan. Channel treatments to consider include meandering soil cement, concrete and riprap channel sections, silt traps, natural appearing drop structures, etc. A conceptual section of the low flow channel with recreational amenities is shown on Figure III-2 and on the Alternative drawings. If the low flow channel is assumed to be a trapezoidal section made of soil cement or concrete with 4:1 side slopes with the required freeboard, the approximate minimum bottom widths and channel depths to accommodate the predicted runoff are:

> Westgate Dam to Powerline - 74 cfs - 5 ft. bottom (4' deep channel)
> Powerline to Snow Vista - 575 to 693 cfs - 14 ft. bottom (4' deep channel)

Priority - High (required to implement DMP solution and stabilize Amole Arroyo)

Mid Reach Composite Channel: Construct composite channel from Snow Vista confluence to approximately Sacate Blanco. The proposed alignment is within the current AMAFCA "floating easement", or following the present alignment which is not within the floating easement, along the RBSP alignment or other alignment compatible with development. The composite channel consists of a low flow soil cement or tinted concrete "naturalistic" channel capable to conveying the 10-year runoff without overtopping. Less frequent higher flows would be conveyed in overbank areas as shallow low velocity flow. See conceptual section on Alternative Drawings 3 and 4 and on Figure III-2. The low flow portion is estimated to be approximately 4 feet deep with a 10 foot bottom width. The overbank flow area is approximately 70 feet wide with freeboard according to FEMA levee requirements. Freeboard is 3' with an additional 1' of freeboard required 100' before and after structures. Additional channel lining depth would also be required in curves, superelevations and conditions where back water conditions may be encountered.

Long term maintenance costs will be higher due to potential damage from storms greater than the 10-year frequency.

Priority - High

Lower Reach High Flow Channel: Construct a high flow soil cement or concrete channel from the Sacate Blanco confluence to the existing concrete channel transition at the inlet to Amole Dam. This trapezoidal channel is estimated to be 8 feet deep with a 30 foot bottom width. Naturalistic treatment could include exposed soil cement steps similar to the Callabacias Channel. This channel section is shown schematically on the Alternative drawings and on Figure III-2.

Priority - High.

Amole Rundown Upgrade: Construct additional freeboard for the existing rundown transition channel and chute. Provide additional freeboard using pinned curb or similar construction estimated to range from 0.5' to 1.4' high.

Priority - Low (concurrent with upstream development).

Crossing Structures: Numerous structures across the Amole Arroyo will require coordination, both for design and timing. These include major arterials such as Gibson, 98th and Unser as well as collector and local streets. Composite channels will require longer, and thus more costly, crossing structures.

The crossing structure design must be consistent with the hydraulic concept for the arroyo

Priority - Concurrent with development

Tributary Conveyances within the Amole Arroyo Basin must enter the proposed low flow channel via an underground conduit or by an open channel connection which is consistent with the open space design and AMAFCA approved. Improvement of these tributary conveyances should occur concurrently with development.

Priority - Low, (concurrent with Development)

c. **Interim Conditions**

Interim Urgent Improvements: Three improvements to the Amole Arroyo were identified in the existing conditions analysis (Volume III) which need to be constructed as soon as possible.

- Blake Road Crossing: The dirt road crossing of Blake Road of the Amole Arroyo is a potential avulsion hazard. Regrading of Blake Road to prevent the flow from diverting down Blake Rd. is proposed. AMAFCA is coordinating this work with Bernalillo County.

  Priority - Maintenance forces have corrected.

- Arroyo Channel Bank Height at Entrance to Detention Basin: The north bank of the earthen Amole Arroyo just upstream from the entrance to the Amole Detention Facility should be increased to safely convey the predicted existing conditions 100-year event and provide freeboard. Grading to accommodate local runoff must be incorporated.

  Priority - Maintenance forces have corrected.

- Arroyo Regrading at Westgate Heights: The existing earthen section at the southwestern corner of Westgate Heights has been graded to discourage vehicular traffic and trees and shrubs are growing in the channel. These conditions result in reduced arroyo capacity and the potential for avulsion. Regrading is proposed to provide adequate hydraulic capacity.

  Priority - Maintenance forces have corrected.

d. Land Use Issues

Runoff Constrains: Due to the capacity of the proposed DMP solution, runoff constraints are not proposed in the Amole Arroyo Basin.

Priority - N/A

Open Space/Recreational Facilities: Concurrent with Amole Arroyo improvements, construct public open space and recreational amenities as generally conforming to the Corridor Plan including:

Pedestrian/Equestrian Trails
Landscaping
Foot bridges.

Priority - Concurrent with Arroyo Improvements.

Right-of-Way: Investigate floating easements owned by AMAFCA and confirm status or convert into ROW. Obtain fee interest at time of platting.

Priority - High

e. Crossing Structures

Crossing structures for the Amole Arroyo include the proposed 118th Street corridor across the low flow channel Upper Reach, the proposed Gibson Corridor and 98th Street corridor across the Mid-Reach Composite Channel and the proposed Unser Corridor crossing the high flow channel for the Lower Reach. The composite channel requires a longer span bridge and thus a higher cost crossing structure.

f. Budget

Budget Estimate: The estimated project cost of the proposed DMP (Alternative 5) facilities is:

Low Flow Channel Upper Reach - $ 1,521,000
Composite Channel - Mid Reach - $1,492,000
High Flow Channel - Lower Reach - $845,000

Channel Right-of-Way should be available within in the existing Amole Arroyo ROW and easements with minor exceptions or dedicated during platting process.
Powerline Detention - See Powerline Section
Rundown Upgrade - $ 200,000
Crossing Structures -
Low Flow Channel Upper Reach - $534,000
Composite Channel - Mid-Reach - $1,837,000
High Flow Channel - Low Reach - $909,000

<u>Timing</u>: These facilities should be constructed prior to further significant development of the upstream watershed. This includes Powerline and Amole Basins which are essentially undeveloped and the Snow Vista Basin which is currently approximately 75 % developed.

TABLE III -1
HYDROLOGIC SUMMARY
AMOLE ARROYO BASIN

AP NO.	MAP NO.	DESCRIPTION	VARIABLE	EXISTING FACILITIES: EXISTING	EXISTING FACILITIES: DEVEX	EXISTING FACILITIES: EXISTING CAPACITY	PROPOSED DMP FACILITIES: DMP	PROPOSED DMP FACILITIES: 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 (bank full)	575	1026 (bank full)
			Tvol (AF)	494	577		574	
			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		

<u>Notes/Legend</u>

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.

AMOLE ARROYO BASIN MANAGEMENT PLAN

PL1 POWERLINE DETENTION 58 AF DISCHARGE RESTRICTED TO 20 cfs.

AA1 BLAKE ROAD BANK REPAIR

AA2 CHANNEL BANK UPGRADE

AA3 CHANNEL BANK UPGRADE

AA4 LOW FLOW CHANNEL WITH OPEN SPACE AMENITIES.

AA5 COMPOSITE LOW FLOW W/ OVERBANK HIGH FLOW CHANNEL

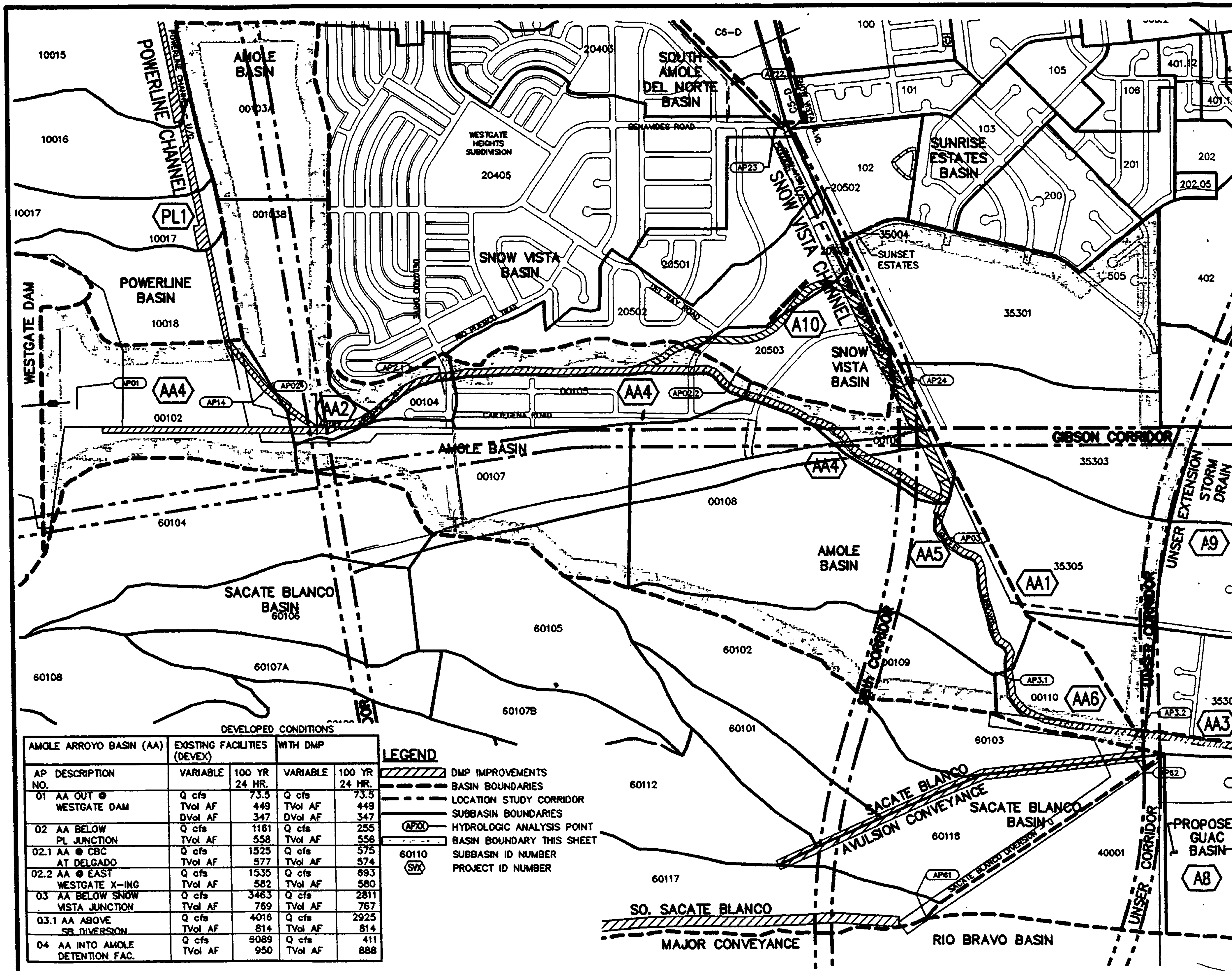
AA6 HIGH FLOW SOIL CEMENT CHANNEL

AA7 ENTRY CHANNEL / CHUTE FREEBOARD UPGRADE

A8 SEE FIGURE III-14 AMOLE/HUBBELL LAKE PLAN

A9 UNSER EXTENSION STORM DRAIN

A10 ALTERNATE ALIGNMENT



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	6089 950	Q cfs TVol AF	411 888

LEEDSHILL-HERKENHOFF, INC.

AMOLE-HUBBELL D.M.P.

AMOLE ARROYO MANAGEMENT PLAN

FIGURE NO. III-1

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

F. SACATE BLANCO BASIN

1. EVALUATION

a. Situation

Location: The Sacate Blanco Basin is the area south of the Amole Arroyo Basin and north of the Rio Bravo Basin. This area drains to the Sacate Blanco Arroyo and the Sacate Blanco Diversion Channel. The Sacate Blanco Basin is shown on Figure III-8. (Also see aerial mapping with contours in Volume II.)

Stability: The arroyos in the Sacate Blanco Basin, east of the powerlines, are deeply incised which indicates the arroyos are in a degrading state. Furthermore, sediment deposits at the Amole Arroyo confluence indicates aggradation at this location. Based on field observations, the sediment deposits have reduced the hydraulic capacity of the existing Sacate Blanco Diversion.

Avulsions: There are two avulsions located just upstream of the Sacate Blanco Diversion (east of the powerlines) that were caused by dirt roads that traverse the area (see Volume II, Sediment Reconnaissance, Mapping SR-6). The runoff captured by the road has incised the road in such a manner to create a channel. The flow carried by the avulsion historically would be conveyed to the head of the Sacate Blanco Diversion. Similar potential avulsions caused by roads exist within the upper portion of the basin.

Rio Bravo Sector Plan: Near the eastern end of the Sacate Blanco Basin (the Rio Bravo Sector Plan), a Rank II development plan for future development, has been adopted. It includes a site layout that provides for a large commercial/retail center, high and low density housing, parks and schools for the southwest side of the city. In the developed conditions hydrology model, the proposed land uses from this sector plan are incorporated. The Unser Blvd. Extension from Arenal to Rio Bravo Boulevard Extension included in this plan crosses the Amole Arroyo in the vicinity of the intersection with the existing Sacate Blanco Diversion.

Improvements: As development occurs in the Sacate Blanco Basin, the tributary arroyos and drainage divides will be established to conform to the development pattern. Minor modifications to alignments and detail are anticipated.

b. Problem Description

The Sacate Blanco Basin is currently undeveloped. All of the flow generated from the Sacate Blanco Basin reaches the Amole Arroyo either from the Sacate Blanco Diversion or the avulsion caused by an unimproved roadway. The Sacate Blanco Diversion Channel will require upgrading and stabilizing to convey the runoff from future "clean water" development.

The escarpment area west of the powerlines is very active in sediment generation; creating meandering, braided flows and avulsions. As development increases, these problems will become more prevalent. Avulsion control and sediment reduction from this basin will be required as part of the DMP solution.

c. **Existing Facility Data**

The Sacate Blanco Basin is currently undeveloped. Under existing conditions, the Sacate Blanco Diversion Channel has the capacity to convey the design storm. (See Table III-5.) The Sacate Blanco Diversion Channel was designed with a capacity of 853 cfs. The developed conditions existing facility (DEVEX) 100-year 24-hour runoff ranges from 1,070 cfs at the head to 2,380 cfs at the Amole Arroyo confluence. Bank full capacity of the diversion is approximately 1660 cfs.

d. **Existing Right-of-Way**

The Sacate Blanco Diversion Channel has a 150 ft ROW. Most of the other arroyos within this basin have 100 foot to 200 foot wide drainage easements dedicated to AMAFCA. These easements were dedicated as the result of a bulk land transfer. The easements are shown in the Right-of-Way Mapping in Volume II.

e. **Developed Conditions Data**

Results from the Developed Conditions Existing Facilities (DEVEX) analysis (see Table III-5 and Volume III) indicates the existing Sacate Blanco Diversion Channel does not have the capacity to safely convey the 100-year developed condition design storm runoff. The alternatives evaluated will provide for a safe conveyance system for the design storm. Hydrologic results presented in the Developed Conditions Existing Facilities analysis are used to develop hydraulic alternative solutions. Developed conditions runoff values with existing facilities (DEVEX) for various analysis points along the arroyo are presented in Table III-5.

f. **Criteria**

Provide modifications and improvements which:

- ✦ Reduce the developed conditions flow rate to within the capacity of the existing Sacate Blanco Diversion Channel and/or improve the channel capacity.
- ✦ Provide control for avulsions.
- ✦ Reduce the sediment load in the proposed Guac and existing Amole Detention Facilities.

g. Alternative Evaluation

South Powerline Diversion: A regional diversion facility parallel to the existing powerline easement is proposed which impacts the Sacate Blanco, Rio Bravo and Borrega Basins. This facility is proposed to collect, detain and convey the runoff from the areas west of the powerline easement. The diversion will eliminate many of the potential avulsion locations east of the powerline since the source of the sediment will be eliminated. The alternative to this diversion is to accommodate the sediment from the escarpment "bad lands" area and the resultant avulsions within each basin resulting in more complicated and costly improvements. See the South Powerline Basin for further information.

The following two alternatives have been developed to address the capacity issue of the diversion channel. Both alternatives assume the active avulsion above the diversion channel will be maintained in approximately its current path as a result of development. Conveyance from the avulsion point to the Amole Arroyo can be achieved by storm drains, streets or other systems. *Both alternates assume the South Powerline Diversion Channel is in place.*

Sacate Blanco Outfall into the Guac Detention Facility: There is an existing arroyo that conveys flow to the Sacate Blanco Diversion Channel head, that could be used to bypass the diversion channel and convey flows to the planned Guac Detention Facility. With the incorporation of rundowns and channel improvements along the old arroyo, the need for the diversion channel is eliminated. However, the cost to construct a rundown into the Guac Basin and 2,300 feet of channel improvements, would be significant.

Sacate Blanco Outfall into the Amole Arroyo: Under existing conditions, the outfall for the Sacate Blanco Diversion Channel is the Amole Arroyo. This system is undersized for existing conditions runoff and would be grossly undersized for developed conditions without the South Powerline Diversion. Impacts to the Sacate Blanco Diversion and the Amole Arroyo are reduced when the proposed South Powerline Diversion is constructed. With the South Powerline Diversion in place, the developed condition runoff in the Sacate Blanco Diversion reduces from 1070 cfs to 309 cfs at the head and from 2,380 cfs to 1,183 cfs at the Amole Arroyo confluence. The developed runoff will be "clean" water and erosive in the existing unlined channel. A channel upgrade consisting of soil cement or similar non-erosive lining is recommended. The impact on the Amole Arroyo below the confluence of including the flows from the Sacate Blanco Diversion is minimal (See Amole Arroyo Section). With only minor channel upgrade required within the existing AMAFCA ROW to mitigate channel inadequacy, this alternative has been chosen as the proposed DMP solution.

AHYMO Analysis: The Developed Conditions AHYMO model was modified to represent the proposed South Powerline Channel. Sub-basins in the Sacate Blanco that are tributary to the South Powerline Channel have been removed from the Sacate Blanco model and added to the South Powerline Channel AHYMO model. Developed conditions drainage divides within the Basin are assumed to be the same as Existing Conditions. Minor realignment of divides, conveyance paths, etc. will accompany development.

2. PROPOSED MANAGEMENT PLAN

The proposed Drainage Management Plan is schematically shown on Figure III-8. The hydrologic results for the Sacate Blanco Basin with the proposed plan in place are contained in Table III-5.

a. Sacate Blanco Diversion Channel Project SB1

Stabilize the channel to convey the "clean" water runoff to the convergence with the Amole Arroyo. See proposed channel section on Figure III-8.

Priority - Low - Development driven.

b. South Sacate Blanco Arroyo Project SB2

Conveys the runoff generated in the Sacate Blanco Basin to the diversion channel. This arroyo, shown on Figure III-8, is one main conveyance system of the basin. Since this arroyo is required to convey flows to the diversion, a flow path for the runoff must be maintained. This arroyo could be lined, placed in a storm drain, or otherwise stabilized, depending on future development. No recommendations are made about channel improvements as a result of this DMP. This DMP identifies the need for maintaining the existing facility as part of the Sacate Blanco Basin backbone conveyance system.

c. Sacate Blanco Avulsion Conveyance Project SB3

The existing drainage divide just upstream from the Diversion Channel is the result of an avulsion down an unimproved road. The DMP hydrology assumes this drainage divide remains. This conveyance is shown on Figure III-8. This conveyance could be street flow, storm drain or channel flow or a combination depending on future development. This DMP identifies the need for maintaining the existing facility as part of the Sacate Blanco Basin backbone conveyance system.

d. Avulsion Control

The South Powerline Diversion will cut off the sediment sources west of the powerline and allow local control of avulsions east of the powerline as development occurs. (See Sediment Reconnaissance Mapping in Volume II and Sediment Reconnaissance Report in Volume III for discussion of detailed avulsion potential.)

The avulsion plan:

- Construct the South Powerline Diversion prior to significant development within the Sacate Blanco, Rio Bravo or northern Borrega Basins.

- Design conveyance facilities through developed properties to accommodate the worst case combination of uncontrolled upstream avulsions.

- Control potential avulsions within the development in a stable manner to eliminate the avulsion potential.

e. Land Use Issues

Runoff Constraints: Due to the diversion by the South Powerline Channel facility and the proposed improvements to the Sacate Blanco Diversion to accommodate "clean water" runoff from the west, constraining runoff within the Sacate Blanco Basin is not proposed.

Priority - N/A

f. Crossing Structures

The Albuquerque Urban Area Long Range Major Street Plan (9/99) shows corridors for 98th and 118th Streets and Unser Blvd. in the Sacate Blanco Basin. (See Figure III-8.) The Unser crossing was assumed to be located downstream of the confluence of the Sacate Blanco Diversion and the Amole Arroyo. The estimated cost for that crossing structure is included in the Amole Arroyo estimate (AA-6). The 98th Street crosses both the Sacate Blanco Avulsion Conveyance (SB2). 118th Street crosses the South Sacate Blanco Arroyo Conveyance near the west end.

g. Budget

Budget Estimate: The estimated project budget for the proposed facilities is:

- Sacate Blanco Diversion Channel Improvements - $460,000
- South Sacate Blanco Arroyo Conveyance - $785,000
- Sacate Blanco Avulsion Conveyance - $628,000
- Crossing Structures -
  - Sacate Blanco Diversion Channel Improvements - no crossing
  - South Sacate Blanco Arroyo Conveyance - $1,003,200
  - Sacate Blanco Avulsion Conveyance - $591,360

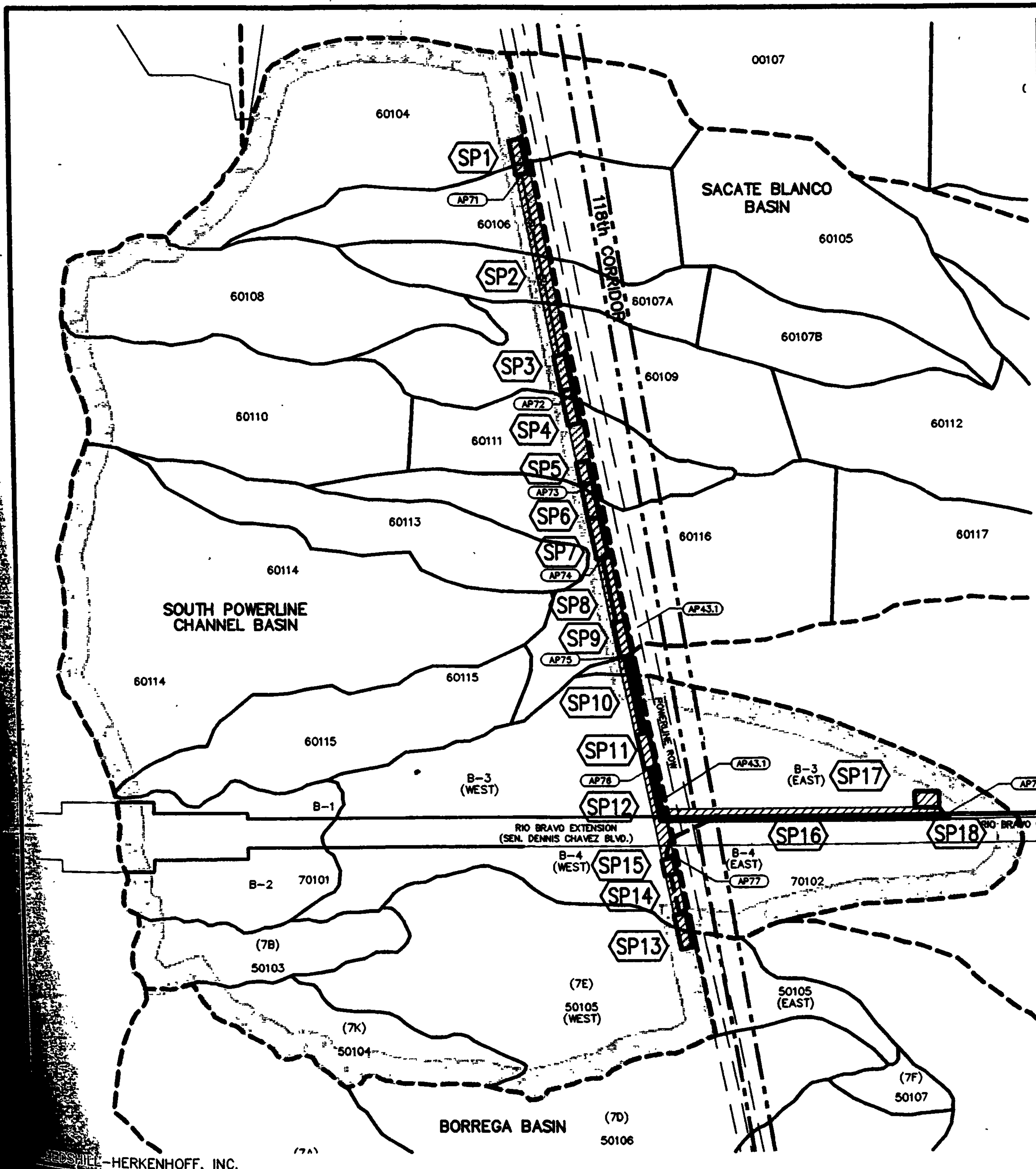
Timing: Conveyance improvements along the Sacate Blanco Diversion are required when development occurs.

TABLE III-5
HYDROLOGIC SUMMARY
SACATE BLANCO BASIN

AP NO.	MAP NO.	DESCRIPTION	VARIABLE	EXISTING FACILITIES			PROPOSED DMP FACILITIES	
				EXISTING	DEVEX	EXISTING CAPACITY	DMP	FUTURE CAPACITY
61	7	SACATE BLANCO DIVERSION AT HEAD	Q (cfs)	492	1070	853	369	853
			Tvol (AF)	16.9	50.1	(1660 cfs	19	
			Runoff (in)	0.53	1.58	bank full)	1.86	
			cfs/ac	1.29	2.81		3.03	
62	7	SACATE BLANCO BASIN AT ENTRANCE TO AMOLE ARROYO	Q (cfs)	901	2380	853	1183	1190
			Tvol (AF)	43.4	131	(1660 cfs	73.2	
			Runoff (in)	0.53	1.61	bank full)	1.83	
			cfs/ac	0.92	2.43		2.47	

Notes/Legend

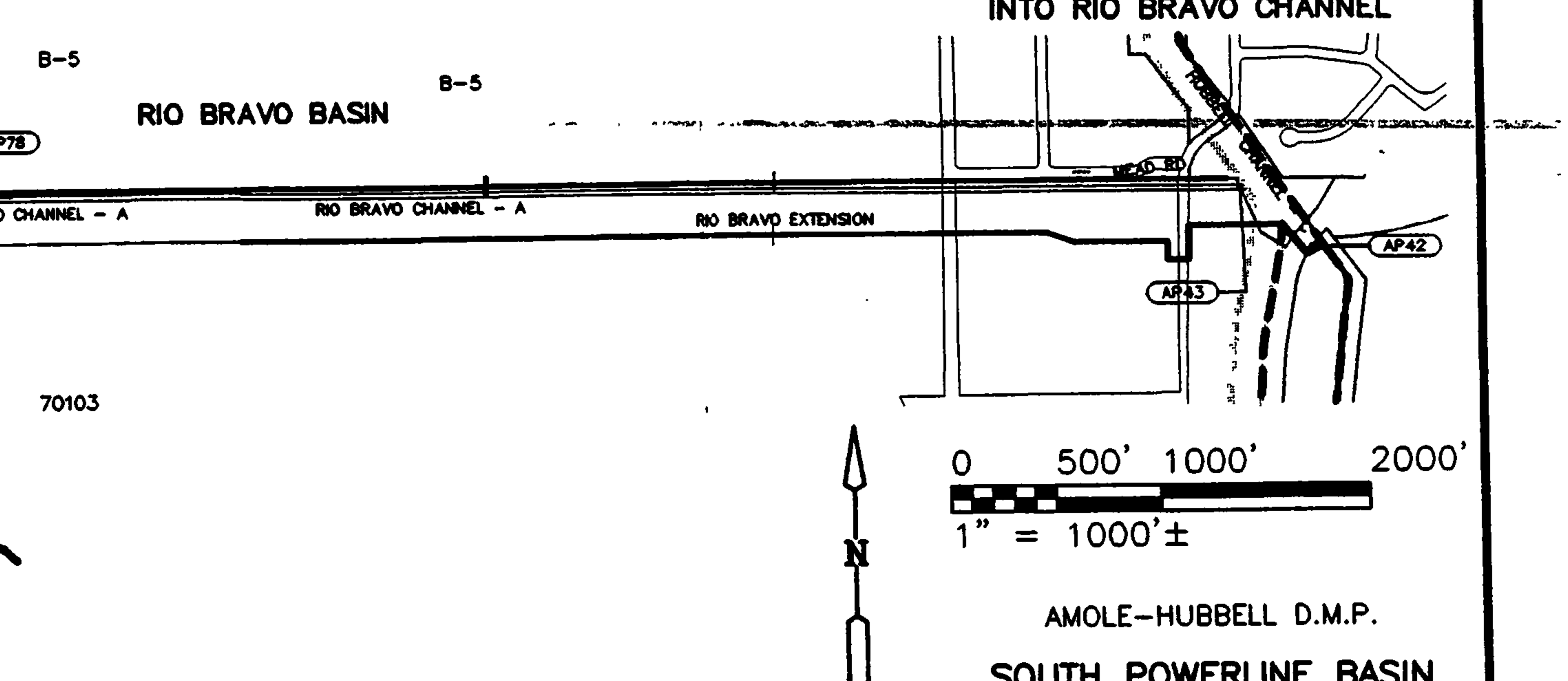
AP - Analysis Point - See Figures this report, maps in Volume II and detail hydrology in Volume III.
Q - Peak discharge rate
Tvol - Total runoff volume
Dvol - Maximum detained volume
Runoff - inches of runoff
cfs/ac - peak discharge rate per acre of contributing area.
Existing - Existing land use and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



SOUTH POWERLINE BASIN (SP)		EXISTING FACILITIES (DEVEX)		WITH DMP	
AP NO.	DESCRIPTION	VARIABLE	100 YR 24 HR.	VARIABLE	100 YR 24 HR.
71	POND 1 OUTFALL	Q cfs	N/A	Q cfs	21.2
		TVol AF	N/A	TVol AF	8.9
		DVol AF	N/A	DVol AF	5.9
72	POND 2 OUTFALL	Q cfs	N/A	Q cfs	118.8
		TVol AF	N/A	TVol AF	25.7
		DVol AF	N/A	DVol AF	8.6
73	POND 3 OUTFALL	Q cfs	N/A	Q cfs	167
		TVol AF	N/A	TVol AF	37.1
		DVol AF	N/A	DVol AF	6
74	POND 4 OUTFALL	Q cfs	N/A	Q cfs	174.7
		TVol AF	N/A	TVol AF	45.2
		DVol AF	N/A	DVol AF	6.3
75	POND 5 OUTFALL	Q cfs	N/A	Q cfs	356.4
		TVol AF	N/A	TVol AF	69.3
		DVol AF	N/A	DVol AF	9.7
76	POND 6 OUTFALL	Q cfs	N/A	Q cfs	351
		TVol AF	N/A	TVol AF	78.4
		DVol AF	N/A	DVol AF	9.6
77	PONDS 7 & 8 OUTFALL	Q cfs	N/A	Q cfs	56.4
		TVol AF	N/A	TVol AF	27.4
		DVol AF	N/A	DVol AF	19.10
78	SOUTH POWERLINE CHANNEL OUTFALL INTO RIO BRAVO CHANNEL	Q cfs	N/A	Q cfs	446.2
		TVol AF	N/A	TVol AF	114.9
		DVol AF	N/A	DVol AF	1.44

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



SOUTH POWERLINE BASIN MANAGEMENT PLAN

PROJECT SP1

SP1 POND 1–6 AF
SP2 24" STORM DRAIN.
SP3 POND 2–8.6 AF
SP4 EARTHEN 5' CHANNEL W/ GRADE CONTROL STRUCTURE.
SP5 POND 3–6 AF
SP6 EARTHEN 5' CHANNEL W/ GRADE CONTROL STRUCTURE.
SP7 POND 4–6.3 AF
SP8 EARTHEN 5' CHANNEL W/ GRADE CONTROL STRUCTURE.
SP9 POND 5–9.7 AF
SP10 EARTHEN 5' CHANNEL W/ GRADE CONTROL STRUCTURE.
SP11 POND 6–9.6 AF
SP12 66" STORM DRAIN
SP13 POND 7–10 AF
SP14 36" STORM DRAIN
SP15 POND 8–9.1 AF
SP16 60" STORM DRAIN
SP17 POND 9–5 AF
SP18 SOUTH POWERLINE DISCHARGE INTO RIO BRAVO CHANNEL

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SOUTH POWERLINE BASIN MANAGEMENT PLAN

FIGURE NO. III–7

BOHANNAN HUSTON / ...EDSILL–HERKENHOFF, INC.

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E. SOUTH POWERLINE CHANNEL BASIN

1. EVALUATION

a. Situation

Location: South Powerline Channel is a proposed DMP solution facility that will divert flows from the Sacate Blanco Basin, Rio Bravo Basin, and Borrega Basin, to the Rio Bravo Channel and ultimately Hubbell Lake. The drainage area from these basins begins at the top of the Ceja Mesa from the southern Amole Arroyo basin boundary, then south to sub-basin 50103 of the Borrega Basin. These basins drain west to east where the east boundary of the South Powerline Basin is the existing PNM and Plains Electric powerline easements. The South Powerline Channel outfall is the Rio Bravo Channel. The South Powerline Channel drainage area is shown on Figure III-7. (Also see aerial mapping with contours in Volume II.)

Stability: The South Powerline Channel drainage area characteristics are similar to the existing Powerline Channel Basin with a steep slope escarpment area. The escarpment is an erosive area that generates large volumes of sediment. Sediment is transported downstream resulting in incised arroyos. The transported sediment deposits in areas along the drainage ways creating alluvial fans and the development of avulsion points. With the high degree of sediment transport and alluvial fan and avulsion development, the conveyance systems are unstable.

PNM and Plains Electric Powerline Easements: Similar to the existing Powerline Diversion Channel, the PNM and Plains Electric powerlines extend to the south across the DMP watershed (see Figure III-7). PNM and Plains Electric have a 100-foot wide easement each and they are parallel to each other for a total easement width of 200 feet.

Rio Bravo Channel: Bernalillo County is extending Rio Bravo Boulevard from Coors to Paseo del Vulcan. A trapezoidal channel along the north side is planned as part of that roadway extension. The channel will be lined to sustain supercritical flows.

b. Problem Description

The drainage area between the powerlines and the Ceja Mesa is steep and consists of highly erodible soils. As a result, multiple avulsion points and unstable arroyos make up the conveyance system for runoff from the mesa. Each arroyo and avulsion point would have to be dealt with on a case by case basis to develop a stable conveyance system to various outfall points along the Amole Hubbell detention and channel system. The resulting product in the future could be a series of concrete lined channels, naturalistic channels, grade control structures, etc. These facilities would be expensive and may require significant maintenance.

c. Existing Facility Data

Other than natural arroyos, no constructed drainage facilities exist within the South Powerline Channel drainage area. However, there are the PNM and Plains Electric powerlines and easements.

d. Existing Right-of-Way

As a result of a bulk land transfer, AMAFCA was dedicated a series of easements for the existing arroyos (see ROW mapping in Volume II). Where feasible, the proposed sediment ponds will be placed in these easements, however, additional easements or ROW will be required.

e. Developed Conditions Data

The Southwest Area Plan proposes a 500-foot wide easement along the Ceja Mesa escarpment. Additionally, slopes greater than 9 percent are proposed to remain undeveloped. Therefore, sediment from the escarpment areas will continue to be generated in fully developed conditions from these open space areas. Currently, the South Powerline drainage area is undeveloped. When the area is fully developed, and according to current regulations, the runoff in the arroyos will be increased. The additional runoff will include "clean water", thereby causing an increase in sediment generated and conveyed downstream.

Several minor avulsions exist in arroyos downstream of the powerline where the arroyo bed slope reduces to the point that the arroyo can no longer carry the suspended sediment load. When the sediment drops out of suspension; meanders, avulsions, alluvial fans and braided streams are created. A major avulsion exists where the Rio Bravo and Borrega basin boundaries meet just west of the powerline (see Volume II, Sediment Reconnaissance, sheets SR-6 and SR-8). This avulsion is listed as an "active avulsion" in that the flow could be conveyed into either basin during any given rainfall event.

Rio Bravo Boulevard is designed to extend from Coors Boulevard to Paseo del Vulcan. This project is being lead by Bernalillo County Public Works Department. A channel along the north side of the extension is incorporated. The channel is steep and concrete lined. The intent of this DMP is to use the channel as the outfall for the South Powerline Channel. The flow rate entering the channel from the diversion is less than the Rio Bravo Channel design flow rate at that location.

The Rio Bravo drainage system was modeled in the Final Drainage Report for the Rio Bravo West Extension, in July 1993 (RD-22).

f. Criteria

The criteria is to provide a drainage management plan which:

- ✦ Provides a stable conveyance system that has the capacity to convey the 100 year event and meets the City of Albuquerque Design Process Manual requirements. A stable conveyance system in this situation is one which captures the runoff and sediment from the escarpment, removes the majority of sediment, and conveys the remaining flow to the Rio Bravo Channel. The stable system will control the Rio Bravo/Borrega basin major avulsion and greatly reduce the runoff and sediment to other potential avulsions east of the powerlines.

g. Alternative Evaluation

Essentially, there are two global alternatives to reducing sediment loadings generated by the escarpment, and controlling the avulsions and conveyance systems.

Individual Conveyance Systems: The first alternative is to provide improvements in each conveyance system such as channel lining, grade control structures, sedimentation ponds, and/or prudent limits. Due to the number of conveyance systems required, this alternative would be costly and maintenance intensive. Each conveyance system would follow existing arroyo alignments from the escarpment to their respective outfalls along the Amole/Hubbell system. This type of system is not considered prudent and has not been investigated further.

Diversion and Detention Facility: The second alternative is to capture the sediment and runoff and have a single conveyance system to convey the flow to the Amole/Hubbell system. As a result, the existing powerline easements have been chosen as the point of collection and the Rio Bravo channel as the point of discharge. The Rio Bravo channel is a facility that will have the capacity to convey the flow from the South Powerline Diversion to the Amole/Hubbell system. The total diversion system has been labeled the South Powerline Channel. This regional DMP facility consists of eight interconnected ponds with an additional pond located at the Rio Bravo Channel head. Results from this alternatives analysis are incorporated into the DMP solution and are presented in Table III-4.

Landform Design Issues: The South Powerline channel is a candidate for Landform Treatment similar to that discussed in the Powerline Basin section.

AHYMO Analysis: The Rio Bravo drainage system was modeled in the Final Drainage Report for the Rio Bravo West Extension, in July 1993 (RD-22). The Rio Bravo DMP AHYMO model has been modified to represent the South Powerline Basin with the in-line basins. Idealized conceptual basins have been inserted into the model to represent the proposed management plan. A more detailed AHYMO analysis will be required once specific detention pond and conveyance system parameters are established during design of these facilities.

2. PROPOSED MANAGEMENT PLAN

The proposed management plan is schematically shown on Figure III-7. The hydrologic and hydraulic results for the South Powerline Diversion Channel are contained in Table III-4.

The proposed improvements are:

a. South Powerline Channel/Detention Project SP-1

Sedimentation/Detention Basins: To capture the sediment generated from the escarpment, detention/sedimentation ponds with diversion berms are placed at existing arroyos along the powerline ROW. These locations cut off the sediment source from downstream alluvial fans and avulsions. The ponds are connected in series by conveyance systems. Detention/ sedimentation ponds will attenuate the peak runoff thereby reducing the size of conveyance systems required. This DMP facility has nine (9) ponds in the hydrologic model to achieve the required detention. Ponds one through six are located north of Rio Bravo and ponds seven and eight are located south of Rio Bravo. Pond nine is to detain the local runoff from subbasin B-3 east. A total of 71 AF of detention volume is required based on the analysis of this DMP. Sediment volume is inherent in the bulked volumes from the AHYMO analysis for fully developed conditions. A detailed hydrologic, hydraulic, sediment and runoff volume analysis will be required for design.

Priority - Low, (required by development)

South Powerline Channel Conveyance System: Each pond will be connected to the next by a conveyance system. Conveyance systems range from pipe to an open channel with a diversion berm. From pond one, a 24" pipe is modeled to convey the flow to pond two. Then, open channels are used between ponds two through six. The major avulsion located along the Rio Bravo/Borrega basin boundary is the location for ponds seven and eight. These two ponds will be used in capturing the flows at the avulsion. Since the two ponds are down gradient from the pond six outfall, flows from ponds seven and eight are collected and conveyed to a junction point with the pond six outfall. The combined flows are then piped to the Rio Bravo channel head for conveyance to the Amole/Hubbell system. Pond nine is modeled for the 80 acre local drainage area (Area B-3 East) at the Rio Bravo channel head. Pond nine is a local pond and to be constructed when needed by development.

Priority - Low, (required by development)

b. Land Use Issues

Runoff Constraints: Due to the capacity of the proposed South Powerline system to accommodate the runoff from the basin, constraining runoff from the South Powerline Basin is not proposed.

Priority - N/A

Southwest Area Plan: The Southwest Area Plan proposes an open space easement approximately 500-foot wide along the escarpment. Also, the Southwest Area Plan proposes a restriction on development of areas with slopes greater than 9 percent. These restrictions are intended to preserve the escarpment area and to reduce the impacts of development in the escarpment area. These restrictions are included in the DMP analysis.

Priority - N/A

PNM and Plains Electric Easements: The intent of this DMP is to construct a diversion channel with sediment and detention basins along the existing powerline easement. Coordination with PNM and Plains Electric to use part of the existing easement and additional ROW or easement are required. This location for the diversion works well, due to the existing powerline easement which forms a development boundary.

Priority - N/A

c. Crossing Structures

Local residential crossing structures are not considered in the cost estimate. Rio Bravo (Sen. Dennis Chavez Blvd.) and 118th Street Corridors cross the proposed South Powerline Channel, but were assumed to cross over pipe outfall structures and not open channels, so crossing structures are not considered in the cost estimate.

d. Budget

Budget Estimate: The estimated project cost of the planned drainage facilities are:

Detention/Sedimentation ponds - $ 950,000
Conveyance Systems - $ 220,000
Right-of-Way - $ 620,000 (Assumes purchase required.)
Crossing Structures - N/A

Timing: These facilities are not required today since the drainage area below the diversion is currently undeveloped. These facilities will become necessary as development, either to the west or to the east of the powerline, occurs.

Right-of-Way: AMAFCA may consider acquiring Right-of-Way for these planned facilities in the near future if economically feasible. The Right-of-Way would be used to supplement agreements that can be reached with proposed development or with PNM and Plains Electric for the use of their existing easement.

TABLE III-4
HYDROLOGIC SUMMARY
SOUTH POWERLINE CHANNEL BASIN

AP NO.	MAP NO	DESCRIPTION	VARIABLE	EXISTING FACILITIES			PROPOSED DMP FACILITIES	
				EXISTING	DEVEX	EXISTING CAPACITY	DMP	FUTURE CAPACITY
71	2	POND 1 OUTFALL	Q (cfs)	N/A	N/A	N/A	21.20	21.2
			Tvol (AF)				8.90	8.9
			Dvol (AF)				5.90	5.9
			Runoff (in)				1.42	
			cfs/ac				0.28	
72	3	POND 2 OUTFALL	Q (cfs)	N/A	N/A	N/A	118.80	118.8
			Tvol (AF)				25.70	25.7
			Dvol (AF)				8.60	8.6
			Runoff (in)				1.46	
			cfs/ac				0.56	
73	3	POND 3 OUTFALL	Q (cfs)	N/A	N/A	N/A	167.00	167.1
			Tvol (AF)				37.10	37.1
			Dvol (AF)				6.00	6.0
			Runoff (in)				1.47	
			cfs/ac				0.55	
74	3	POND 4 OUTFALL	Q (cfs)	N/A	N/A	N/A	174.70	174.7
			Tvol (AF)				45.20	45.2
			Dvol (AF)				6.30	6.3
			Runoff (in)				1.49	
			cfs/ac				0.48	
75	3	POND 5 OUTFALL	Q (cfs)	N/A	N/A	N/A	356.40	356.4
			Tvol (AF)				69.30	69.3
			Dvol (AF)				9.70	9.7
			Runoff (in)				1.47	
			cfs/ac				0.63	
76	3	POND 6 OUTFALL	Q (cfs)	N/A	N/A	N/A	351.00	351.0
			Tvol (AF)				78.40	78.4
			Dvol (AF)				9.60	9.6
			Runoff (in)				1.45	
			cfs/ac				0.54	
77	5	PONDS 7&8 OUTFALL	Q (cfs)	N/A	N/A	N/A	56.40	56.4
			Tvol (AF)				27.40	27.4
			Dvol (AF)				19.10	19.0
			Runoff (in)				1.43	
			cfs/ac				0.25	
78	5	SOUTH POWERLINE CHANNEL OUTFALL INTO RIO BRAVO CHANNEL	Q (cfs)	N/A	N/A	N/A	446.20	446.2
			Tvol (AF)				114.90	114.9
			Runoff (in)				1.44	
			cfs/ac				0.47	

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.

SACATE BLANCO BASIN (SB)		EXISTING FACILITIES (DEVEX)		WITH DMP	
AP NO.	DESCRIPTION	VARIABLE	100 YR 24 HR.	VARIABLE	100 YR 24 HR.
61	SB DIVERSION @ HEAD	Q cfs	1070	Q cfs	369
		TVol AF	50.1	TVol AF	19.0
62	SB @ AMOLE ARROYO	Q cfs	2380	Q cfs	1183
		TVol AF	131	TVol AF	73.2

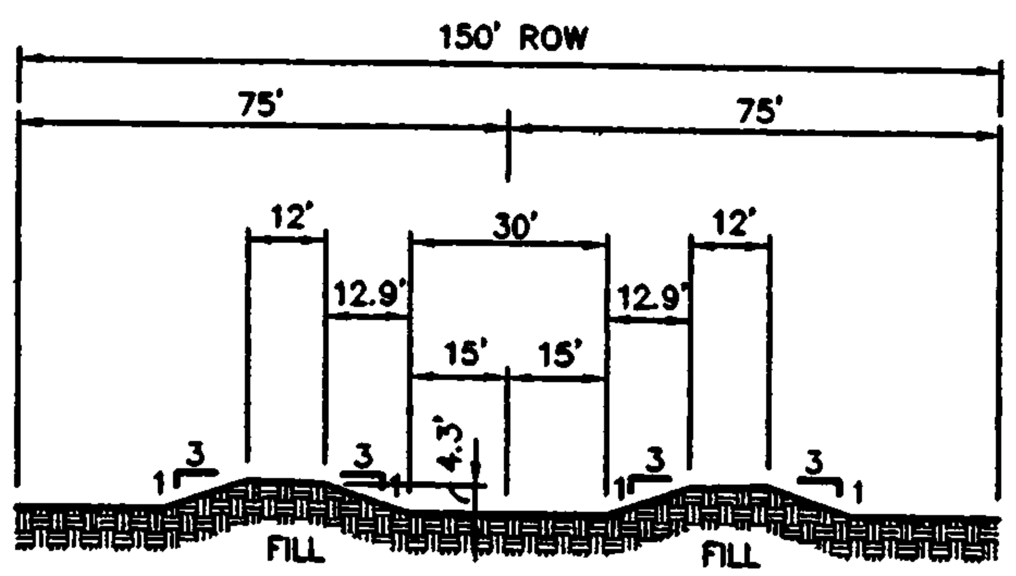
SACATE BLANCO BASIN MANAGEMENT PLAN

SB1 DIVERSION CHANNEL UPGRADE

SB2 SOUTH SACATE BLANCO ARROYO CONVEYANCE

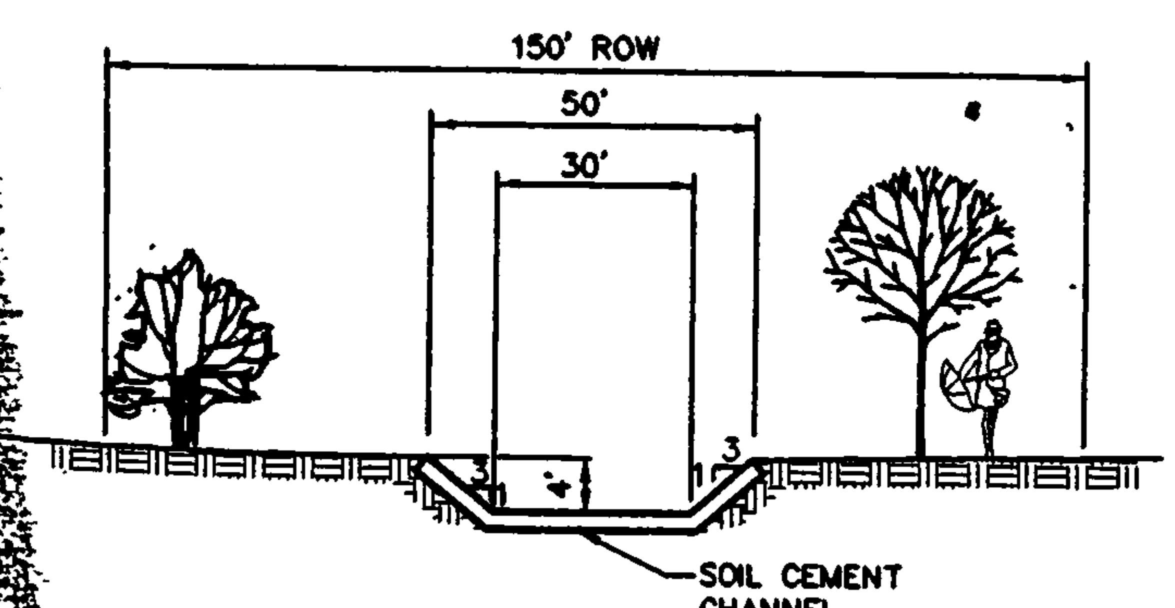
SB3 AVULSION CONVEYANCE

SB4 OPTIONAL DIRECT ENTRY TO GUAC BASIN



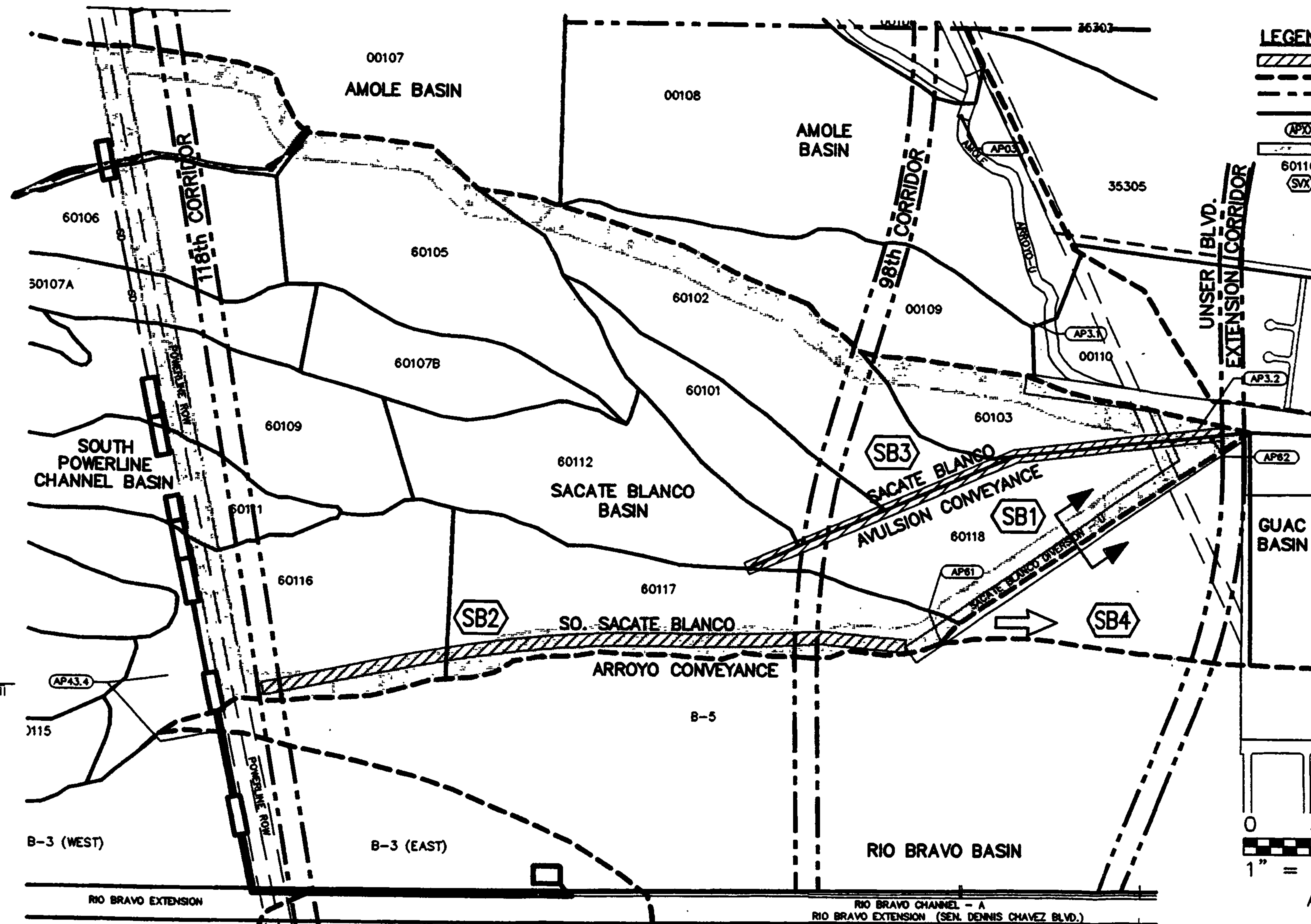
EXISTING SACATE BLANCO DIVERSION CHANNEL SECTION

SCALE: NO SCALE



PROPOSED SACATE BLANCO DIVERSION CHANNEL SECTION

SCALE: NO SCALE



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

0 500' 1000' 2000'

1" = 1000'±

AMOLE-HUBBELL D.M.P.

SACATE BLANCO BASIN MANAGEMENT PLAN

FIGURE NO. III-8

BOHANNAN?-HERKENHOFF, INC.

95043\95043_32\DWG\C\SB-BASIN dwg 3-11-99 KHK

EXHIBITS

EXHIBIT 1 - DEVELOPED CONDITIONS LAND TREATMENTS

EXHIBIT 2 - BASIN MAP OVERLAY: GIBSON BLVD CORRIDOR DMP VS. AMOLE-HUBBELL DMP

EXHIBIT 3 - DEVELOPED CONDITIONS BASIN MAP

EXHIBIT 1

DEVELOPED CONDITIONS LAND TREATMENT MAP

EXHIBIT 2

BASIN OVERLAY MAP:

GIBSON BOULEVARD CORRIDOR DMP

VS. AMOLE-HUBBELL DMP

EXHIBIT 3

DEVELOPED CONDITIONS BASIN MAP

Bohannan ▵ Huston Inc.
Courtyard I
7500 Jefferson St. NE
Albuquerque, NM
87109-4335
www.bhinc.com
voice: 505.823.1000
facsimile: 505.798.7988
toll free: 800.877.5332

Smith Engineering Company

A Full Service Engineering Company

To: COA Plaza del Sol

Attn: Brad Bingham, PE

Date: 9/27/2005 12:37

Project No: --------------------

Reference: Amole Arroyo DMP

We are sending you:

☒ Attached ☐ Under Separate Cover ☒ Delivered By Hand

The Following:

☒ Originals ☐ Prints ☐ Reproducibles

☐ Shop Drawings ☐ Reports ☐ Correspondence

☐ Other

Quantity	Description
1	Original copy of Amole DMP dated June 5, 2003

These are transmitted as indicated below:

☒ As Requested ☐ For Final Approval ☐ For Field Use

☐ For Your Information ☐ For Distribution ☐ Return Approved Copies

☐ For Review and Comment ☐ Returned For Correction ☐

Remarks:

Thanks Brad!!!

Submitted by,
Smith Engineering Company

Pat Conley

cc:

2201 San Pedro Drive., NE
Building 4, Suite 200
Albuquerque, NM 87110
patc@secnm.com
Telephone 505/884-0700 Fax 505/884-2376

Z:\Projects\2005 Projects\105614 Longford Village SW\Correspondence\transmittal to brad returning amole dmp 092705.doc

DRAINAGE AND TRANSPORTATION INFORMATION SHEET

(REV. 1/28/2003rd)

N-9/D4

PROJECT TITLE: Master Drainage Study, Gibson Corridor from 118th St to Amole Arroyo ZONE MAP/DRG. FILE #N-9/N-9
DRB #: ______ EPC#: ______ WORK ORDER#: ______

LEGAL DESCRIPTION: ______
CITY ADDRESS: ______

ENGINEERING FIRM: Bohannan Huston, Inc. — CONTACT: Scott Steffen
ADDRESS: 7500 Jefferson NE – Courtyard I — PHONE: (505) 823-1000
CITY, STATE: Albuquerque, NM — ZIP CODE: 87109

OWNER: Curb Inc. — CONTACT: Bo Johnson
ADDRESS: 6301 Indian School Rd, Suite 208 — PHONE: 899-9656
CITY, STATE: Albuquerque, NM — ZIP CODE: 87110

ARCHITECT: ______ — CONTACT: ______
ADDRESS: ______ — PHONE: ______
CITY, STATE: ______ — ZIP CODE: ______

SURVEYOR: ______ — CONTACT: ______
ADDRESS: ______ — PHONE: ______
CITY, STATE: ______ — ZIP CODE: ______

CONTRACTOR: ______ — CONTACT: ______
ADDRESS: ______ — PHONE: ______
CITY, STATE: ______ — 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
- ___ WORK ORDER APPROVAL
- X OTHER (SPECIFY) **Master Drainage Plan**

RECEIVED
MAY 09 2003
HYDROLOGY SECTION

WAS A PRE-DESIGN CONFERENCE ATTENDED:

- ___ YES
- ___ NO
- ___ COPY PROVIDED

DATE SUBMITTED: 5/8/03 BY: [signature] SCOTT J. STEFFEN

Requests for approvals of Site Development Plans and/or Subdivision Plats shall be accompanied by a drainage submittal. The particular nature , location and scope of 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.