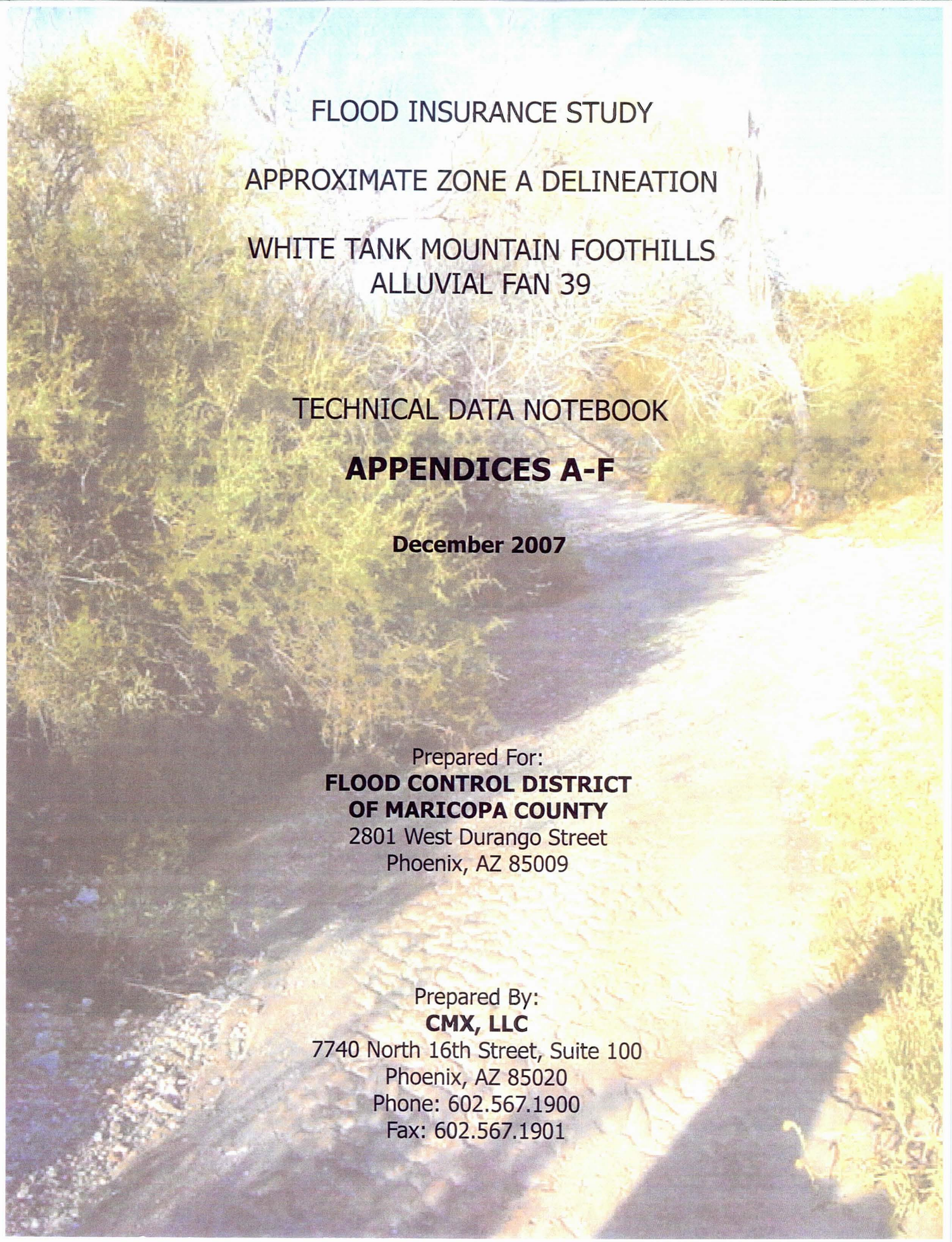
NOT FEMA APPROVED



FLOOD INSURANCE STUDY

APPROXIMATE ZONE A DELINEATION

WHITE TANK MOUNTAIN FOOTHILLS ALLUVIAL FAN 39

TECHNICAL DATA NOTEBOOK

APPENDICES A-F

December 2007

Prepared For:
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
2801 West Durango Street
Phoenix, AZ 85009

Prepared By:
CMX, LLC
7740 North 16th Street, Suite 100
Phoenix, AZ 85020
Phone: 602.567.1900
Fax: 602.567.1901

FLOOD INSURANCE STUDY

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Registered Professional Engineer (Civil)
CERTIFICATE NO.
35050
KEVIN C.
KAMMERZELL
Date Signed 12-31-07
ARIZONA, U.S.A.

December 2007
CMX Project No. 6359.63

APPENDIX A

REFERENCES

Alpha Engineering Group Inc. (January 7, 1994). *White Tank Wash Flood Insurance Study.* Prepared for the Flood Control District of Maricopa County. Submitted to FEMA. FCD90-64.

Ayres Associates (September 13, 2004). *Buckeye/Sun Valley ADMS Piedmont Landform Delineations (subtask 2.6.2).* Technical Memorandum FCD 2002C027 - T2.6.2. Prepared for the Flood Control District of Maricopa County.

Ayres Associates (October 13, 2004). *Buckeye/Sun Valley ADMS Sediment Yield Analysis (subtask 2.6.2).* Technical Memorandum FCD 2002C027 – T2.6.7. Prepared for the Flood Control District of Maricopa County.

Ayres Associates (November 24, 2004). *Buckeye/Sun Valley ADMS Existing Conditions Assessment of Primary Washes (subtask 2.6.4).* Technical Memorandum FCD 2002C027 – T2.6.4. Prepared for the Flood Control District of Maricopa County.

Ayres Associates (January 12, 2005). *Buckeye/Sun Valley ADMS Piedmont Landform Stability Assessment (subtask 2.6.3).* Technical Memorandum FCD 2002C027 – T2.6.3. Prepared for the Flood Control District of Maricopa County.

Camp, P D., (1986). Soil Survey of Aguila-Carefree Area, Parts of Maricopa and Pinal Counties, Arizona: *U.S. Soil Conservation Service Report*, 306 p., 53 maps, scale 1:24,000.

Federal Emergency Management Administration (February 2002). *Guidelines and Specifications for Flood Hazard Mapping Partners.* Available online: http://www.fema.gov/pdf/fhm/ft_afgd.pdf

Field, John J. and Phillip A. Pearthree (November 1991). Surficial Geology Around the White Tank Mountains, Central Arizona. *Open File Report 91-8.* Arizona Geological Survey.

Field, John J. and Phillip A. Pearthree (March 1992). Geologic Mapping of Flood Hazards in Arizona: An Example From the White Tank Mountains Area, Maricopa County. *Open File Report 91-10.* Arizona Geological Survey.

Flood Control District of Maricopa County (January 1, 1995). *Drainage Design Manual for Maricopa County, Arizona, Volume I, Hydrology.* Phoenix, AZ.

Flood Control District of Maricopa County (January 28, 1996). *Drainage Design Manual for Maricopa County, Arizona, Volume II, Hydraulics.* Phoenix, AZ.

Wood Patel & Associates, Inc. (December 2001). *Approximate Floodplain Delineation Study for White Tank Fan.* Prepared in association with JE Fuller Hydrology and Geomorphology, Inc. for the Flood Control District of Maricopa County.

Miller, J.F., R.H. Frederick, and R.J. Tracey (1973). *Precipitation Frequency Atlas of the Western United States. NOAA Atlas 2.* U.S. Department of Commerce, National Oceanic and Atmospheric Administration. Silver Spring, MD.

PBS&J (____, 2005). *Buckeye/Sun Valley Area Drainage Master Study.* Prepared for the Flood Control District of Maricopa County.

Soil Conservation Service (September 1977). *Soil Survey of Maricopa County, Arizona Central Part.* United States Department of Agriculture in cooperation with University of Arizona Agricultural Experiment Station

U.S. Army Corps of Engineers (1998). *HEC-1 Flood Hydrograph Package User's Manual.* Hydrologic Engineering Center, Davis, CA.

U.S. Bureau of Reclamation (1998). *PREFRE Program Users Manual.* Earth Sciences Division. Washington D.C.

U.S. Geological Survey (1992). Buckeye NW, AZ, NE, Digital Orthographic Quarter Quadrangle.

APPENDIX B

GENERAL DOCUMENTATION & CORRESPONDENCE

APPENDIX C

SURVEY FIELD NOTES

APPENDIX C.1

SUN VALLEY PARKWAY
ROADWAY & CULVERT AS-BUILT DOCUMENTATION

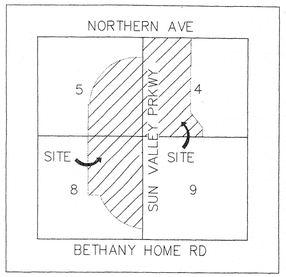
ALTA / ACSM LAND TITLE SURVEY
SUN VALLEY SOUTH

Prepared By: DEI Professional Services, L.L.C., April 2006

Provided only for the Reviewer's information, these as-builts were not employed for the study of Alluvial Fan 39

ALTA/ACSM LAND TITLE SURVEY
SUN VALLEY SOUTH

LOCATED IN THE WEST HALF OF SECTION 4 AND THE EAST HALF OF SECTIONS 5 AND 8, TOWNSHIP 2 NORTH, RANGE 4 WEST, OF THE GILA AND SALT RIVER BASE AND MERIDIAN, MARICOPA COUNTY, ARIZONA.



VICINITY MAP
NTS

NOTES

1. THIS SURVEY IS BASED ON STEWART TITLE INSURANCE COMPANY ORDER NO. 06100160 DATED JUNE 13, 2006 AT 5:00 P.M. 1ST AMENDED.

2. SCHEDULE B ITEMS 1–3 AND 27 ARE BEYOND THE REVIEW AND SCOPE OF THIS SURVEY.

3. THIS SURVEY CONTAINS OPTIONAL TABLE "A" ITEMS 1, 2, 3, 4, 5, 7(a), 8, 9, 10, 11, 13, 14, 15 AND 16.

4. THE SURVEYOR'S REVIEW OF DOCUMENTS REFERENCED IN THE TITLE REPORT AS SCHEDULE "B" ITEMS IS LIMITED TO THE SURVEYOR'S SCOPE–OF–SERVICES AS IDENTIFIED IN THE CERTIFICATION HEREON. ADDITIONALLY THE SURVEYOR'S SCOPE–OF–SERVICES IS LIMITED TO PROVIDING SERVICES IN A MANNER CONSISTENT WITH THE DEGREE OF CARE AND SKILL ORDINARILY EXERCISED BY MEMBERS OF THE SAME PROFESSION CURRENTLY PRACTICING UNDER SIMILAR CONDITIONS. SCHEDULE "B" ITEM DOCUMENTS MAY CONTAIN ENCUMBRANCES WHICH AFFECT THE SUBJECT PROPERTY WHICH THE SURVEYOR IS NOT QUALIFIED TO INTERPRET AND/OR ARE NOT WITHIN THE SURVEYOR'S SCOPE–OF–SERVICES. IT IS RECOMMENDED THAT INTERESTED AND AFFECTED PARTIES OBTAIN CONSULTATION WITH QUALIFIED LEGAL COUNSEL RELATIVE TO THE INTERPRETATION OF ALL SCHEDULE "B" DOCUMENTS REFERENCED IN THE TITLE REPORT.

5. VISIBLE SURFACE UTILITIES WITHIN SUBJECT PARCEL ARE SHOWN HEREON. NO RECORD MAPS FROM UTILITY OPERATING AGENCIES WERE REVIEWED. LOCATION OF UNDERGROUND UTILITIES ARE UNKNOWN.

6. PURSUANT TO TABLE "A", ITEM NUMBER 6, THE SURVEYOR HAS PRESENTED SETBACKS, HEIGHT AND BULK RESTRICTIONS OF RECORD AS IDENTIFIED IN THE TITLE REPORT REFERENCED IN THE CERTIFICATION HEREON, OR AS PROVIDED TO THE SURVEYOR BY THE LOCAL AGENCY OF JURISDICTION RELATIVE TO THE EXISTING OR PROPOSED USE IDENTIFIED HEREON AND TO THE BEST OF THE SURVEYORS KNOWLEDGE THE EXISTING (OR PROPOSED USE IDENTIFIED HEREON) MEETS THESE EXISTING REQUIREMENTS AND RESTRICTIONS. HOWEVER, OTHER RESTRICTIONS MAY APPLY. INTERESTED AND AFFECTED PARTIES SHOULD SEEK CONSULTATION FROM AN ATTORNEY OR DESIGN PROFESSIONAL QUALIFIED TO INTERPRET AND IDENTIFY SUCH OTHER BUILDING CODE OR ZONING RESTRICTIONS.

SCHEDULE "B" ITEMS

(4) PROPERTY IS SUBJECT TO EASEMENT FOR ELECTRICAL POWER TRANSMISSION LINE AND ACCESS AND MAINTENANCE ROAD AND RIGHTS INCIDENT THERETO, AS SET FORTH IN INSTRUMENT RECORDED IN DOCUMENT NO. 85–411065.(ITEM IS PLOTTED HEREON)

(5) PROPERTY IS SUBJECT TO EASEMENT FOR ELECTRICAL TRANSMISSION LINE AND ACCESS ROAD RIGHT–OF–WAY AND RIGHTS INCIDENT THERETO, AS SET FORTH IN INSTRUMENT RECORDED IN DOCUMENT NO. 85–411067. (DOCUMENT DOES NOT PROVIDE GEOMETRIC INFORMATION TO DETERMINE THE LOCATION OF THE 150' WIDE ELECTRIC EASEMENT. IT DOES INDICATE AN EASEMENT 50' IN WIDTH WHICH COVERS THE MAINTENANCE ROAD FOR THE ELECTRIC LINE WHICH LIES OUTSIDE OF THE ORIGINALLY APPROVED 150' WIDE EASEMENT (ITEM IS PLOTTED HEREON))

(6) PROPERTY IS SUBJECT TO EASEMENT FOR 230 KV TRANSMISSION LINE AND RIGHTS INCIDENT THERETO, AS SET FORTH IN INSTRUMENT RECORDED IN DOCUMENT NO. 85–411069. (ITEM IS PLOTTED HEREON)

(7) PROPERTY IS SUBJECT TO EASEMENT FOR ELECTRIC POWER TRANSMISSION LINE AND ACCESS AND MAINTENANCE AND RIGHTS INCIDENT THERETO, AS SET FORTH IN INSTRUMENT RECORDED IN DOCUMENT NO. 85–411077. (ITEM IS PLOTTED HEREON)

(8) PROPERTY IS SUBJECT TO RESERVATIONS CONTAINED IN THE PATENT FROM THE UNITED STATES OF AMERICA, RECORDED IN DOCUMENT 86–111064 READING AS FOLLOWS: EXCEPTING AND RESERVING TO THE UNITED STATES

1. RIGHTS–OF–WAY THEREON FOR DITCHES AND CANALS CONSTRUCTED BY THE AUTHORITY OF THE UNITED STATES ACT OF AUGUST 30, 1890, 26 STAT. 391; U.S.C. 945
2. A RIGHT–OF–WAY FOR ELECTRIC TRANSMISSION LNE AND ACCESS ROAD PURPOSES FOR WESTERN AREA POWER ADMINISTRATION AS TO SW1/4NW1/4, N1/2SW1/4, SE1/45W1/4, SW1/4SE1/4 OF SEC.3, LOTS 1, 2, SE12/4NE1/4 OF SEC. 4 UNDER SUBSECTION P, SECTION 4 OF THE ACT OF DECEMBER 5, 1924, 43 STAT. 704, 43 U.S.C. 417 (PHX–080582).
3. OIL AND GAS LEASES A–12763, A–12764, A12765, A–12766, A–12767, A–12768, A–12770, ! 12771, A–12773, A–12776, A–12778 AND A–12783 AND ANY AUTHORIZED EXTENSIONS THEREOF. (DOCUMENT CONTAINS NUMEROUS TYPOS)(THE ABOVE THREE ITEMS CONTAIN NO PLOTTABLE INFORMATION)

(9) PROPERTY IS SUBJECT TO TERMS AND CONDITIONS AS CONTAINED IN INSTRUMENT ENTITLED GRANT OF EASEMENTS, RECORDED IN DOCUMENT NO. 86–111065. (ITEM IS PLOTTED HEREON)

(10) PROPERTY IS SUBJECT TO TERMS AND CONDITIONS AS CONTAINED IN INSTRUMENT ENTITLED NON–EXCLUSIVE EASEMENT FOR ROADWAY AND UTILITIES, RECORDED IN DOCUMENT NO. 86–162438. (ITEM IS PLOTTED HEREON)

(11) PROPERTY IS SUBJECT TO TERMS AND CONDITIONS AS CONTAINED IN INSTRUMENT ENTITLED NON–EXCLUSIVE EASEMENT FOR ROADWAY AND UTILITIES, RECORDED IN DOCUMENT NO. 86–162439. (ITEM IS PLOTTED HEREON)

(12) PROPERTY IS SUBJECT TO TERMS AND CONDITIONS AS CONTAINED IN INSTRUMENT ENTITLED NON–EXCLUSIVE EASEMENT FOR ROADWAY AND UTILITIES, RECORDED IN DOCUMENT NO. 86–167406. (PLOTTED HEREON)

(13) PROPERTY IS SUBJECT TO TERMS AND CONDITIONS AS CONTAINED IN INSTRUMENT ENTITLED NON–EXCLUSIVE EASEMENT FOR ROADWAY AND UTILITIES, RECORDED IN DOCUMENT NO. 87–194081. (DOCUMENT CONTAINS GEOMETRIC ERRORS AND IS NOT PLOTTABLE)

(14) PROPERTY IS SUBJECT TO EASEMENT FOR HIGHWAY PURPOSES AND RIGHTS INCIDENT THERETO, AS SET FORTH IN INSTRUMENT RECORDED IN DOCUMENT NO. 87–104082. (CONTAINS NO PLOTTABLE INFORMATION)

(15) PROPERTY IS SUBJECT TO EASEMENT FOR SLOPE, DRAINAGE AND PONDING AND RIGHTS INCIDENT THERETO, AS SET FORTH IN INSTRUMENT RECORDED IN DOCUMENT NO. 87–194096. (GEOMETRIC DATA IS ILLEGIBLE, ITEM IS SHOWN APPROXIMATELY ONLY HEREON)

(16) PROPERTY IS SUBJECT TO EASEMENT FOR SLOPE, DRAINAGE AND PONDING AND RIGHTS INCIDENT THERETO, AS SET FORTH IN INSTRUMENT RECORDED IN DOCUMENT NO. 87–194097. (GEOMETRIC DATA IS ILLEGIBLE, ITEM IS SHOWN APPROXIMATELY ONLY HEREON)

(17) PROPERTY IS SUBJECT TO EASEMENT FOR SLOPE, DRAINAGE AND PONDING AND RIGHTS INCIDENT THERETO, AS SET FORTH IN INSTRUMENT RECORDED IN DOCUMENT NO. 87–194115. (GEOMETRIC DATA IS ILLEGIBLE, ITEM IS NOT PLOTTED)

(18) PROPERTY IS SUBJECT TO MATTERS CONTAINED IN THAT CERTAIN EXHIBIT RECORDED IN BOOK 309 OF MAPS, PAGE 12. (GEOMETRIC DATA IS ILLEGIBLE, ITEM IS NOT PLOTTED)

(19) INTENTIONALLY DELETED

SCHEDULE "B" ITEMS (CONTINUED)

(20) PROPERTY IS SUBJECT TO NOTICE OF RESOLUTION RECORDED IN DOCUMENT NO. 98–1121262. (NO PLOTTABLE INFORMATION)

(21) PROPERTY IS SUBJECT TO TERMS AND CONDITIONS AS CONTAINED IN INSTRUMENT ENTITLED REDEVELOPMENT AGREEMENT, RECORDED IN DOCUMENT NO. 2000–787997, THEREAFTER ORDINANCE NO. 85–00 RECORDED IN DOCUMENT NO. 2000817697,THEREAFTER ACKNOWLEDGMENT RECORDED IN DOCUMENT NO. 2003–1177934 AND IN DOCUMENT 2004–0026791. (ITEM IS BLANKET IN NATURE)

(22) PROPERTY IS SUBJECT TO TERMS AND CONDITIONS AS CONTAINED IN INSTRUMENT ENTITLED GRANT OF EASEMENTS, RECORDED IN DOCUMENT NO. 93–862386, THEREAFTER THE EFFECT OF AGREEMENT OF PARTIAL TERMINATION OF EASEMENT RECORDED IN DOCUMENT NO. 2004–1373681. (PLOTTED HEREON, POSSIBLE ABANDONMENT OF EASEMENT PER DOCUMENT NO. 2004–1373981)

(23) PROPERTY IS SUBJECT TO TERMS AND CONDITIONS AS CONTAINED IN INSTRUMENT ENTITLED WATER ALLOCATION AGREEMENT, RECORDED IN DOCUMENT NO. 2005–398964. (ITEM IS BLANKET IN NATURE)

(24) PROPERTY IS SUBJECT TO TERMS AND CONDITIONS AS CONTAINED IN INSTRUMENT ENTITLED WELL DEVELOPMENT AND SEPARATION AGREEMENT, RECORDED IN DOCUMENT NO. 2005–1421770 AND RERECORDED IN DOCUMENT NO. 20051532394 (ITEM APPEARS BLANKET IN NATURE)

(25) PROPERTY IS SUBJECT TO TERMS AND CONDITIONS AS CONTAINED IN INSTRUMENT ENTITLED RESTRICTIVE COVENANT REGARDING EXEMPT WELLS, RECORDED IN DOCUMENT NO. 2005–1421771 AND RERECORDED IN DOCUMENT NO. 20051532395 (ITEM APPEARS BLANKET IN NATURE)

(26) PROPERTY IS SUBJECT TO ORDINANCE NO. 19–06 RECORDED IN DOCUMENT NO. 2006–405890 (ITEM IS BLANKET IN NATURE)

(28) PROPERTY IS SUBJECT TO TERMS AND CONDITIONS AS CONTAINED IN INSTRUMENT ENTITLED MEMORANDUM OF AGREEMENT FOR THE LOCATION AND DEVELOPMENT OF FUTURE WELLS, RECORDED IN DOCUMENT NO. 2006–513033 M.C.R. (ITEM IS BLANKET IN NATURE)

(29) PROPERTY IS SUBJECT TO ALL MATTERS CONTAINED IN THAT CERTAIN RIGHT–OF–WAY MAP FOR SUNVALLEY PARKWAY AS DISCLOSED IN BOOK 33 OF ROAD MAPS, PAGE 4 M.C.R. (ITEM IS PLOTTED HEREON)

(30) PROPERTY IS SUBJECT TO THE FOLLOWING MATTER(S) DISCLOSED BY SURVEY OF SAID LAND BY DEI PROFESSIONAL SERVICES, L.L.C., JOB NO. 06032, DATED LAST REVISED JUNE 9, 2006:

a. OVERHEAD ELECTRICAL LINE RUNNING THROUGH A PORTION OF PARCEL NO. 1.

b. PIPES, BOX CULVERTS WITH BARRELS PARCELS 1 AND 2.

c. WIRE FENCES RUN THROUGH PARCELS 1 AND 2.
(ITEMS ARE PLOTTED HEREON)

LEGAL DESCRIPTION

PARCEL NO.1:

THAT PORTION OF THE WEST HALF OF SECTION 4, TOWNSHIP 2 NORTH, RANGE 4 WEST OF THE GILA AND SALT RIVER MERIDIAN, MARICOPA COUNTY, ARIZONA, BEING MORE PARTICULARLY DESCRIBED AS FOLLOWS:

BEGINNING AT A FOUND M.C.H.D. BRASS CAP IN A HANDHOLE ACCEPTED AS THE NORTHWEST CORNER OF SAID SECTION 4 FROM WHICH A FOUND IRON PIN WITH A G.L.O. BRASS CAP ACCEPTED AS THE NORTH QUARTER CORNER OF SAID SECTION BEARS NORTH 89 DEGREES 42 MINUTES 13 SECONDS WEST A DISTANCE OF 2643.26 FEET;

THENCE ALONG THE NORTH LINE OF THE NORTHWEST QUARTER, NORTH 89 DEGREES 42 MINUTES 13 SECONDS WEST A DISTANCE OF 2005.26 FEET;

THENCE PARALLEL WITH AND 638.00 FEET WEST OF THE NORTH–SOUTH MID–SECTION LINE, SOUTH 00 DEGREES 30 MINUTES 59 SECONDS WEST A DISTANCE OF 3066.14 FEET;

THENCE SOUTH 38 DEGREES 38 MINUTES 03 SECONDS EAST A DISTANCE OF 780.72 FEET;

THENCE PARALLEL WITH AND 145.10 FEET WEST OF THE NORTH–SOUTH MID–SECTION LINE, SOUTH 00 DEGREES 30 MINUTES 59 SECONDS WEST A DISTANCE OF 1613.74 FEET TO A POINT ON THE SOUTH LINE OF THE SOUTHWEST QUARTER;

THENCE ALONG SAID SOUTH LINE OF SAID SOUTHWEST QUARTER, SOUTH 89 DEGREES 49 MINUTES 30 SECONDS WEST A DISTANCE OF 2549.59 FEET TO THE SOUTHWEST CORNER OF SAID SECTION 4;

THENCE ALONG THE WEST LINE OF SAID SOUTHWEST QUARTER, NORTH 01 DEGREES 04 MINUTES 04 SECONDS EAST A DISTANCE OF 2655.46 FEET TO THE WEST QUARTER CORNER OF SAID SECTION 4;

THENCE ALONG THE WEST LINE OF THE NORTHWEST QUARTER, NORTH 01 DEGREES 04 MINUTES 17 SECONDS EAST A DISTANCE OF 2653.16 FEET TO THE NORTHWEST CORNER OF SAID SECTION 4 AND BEING THE POINT OF BEGINNING.

PARCEL NO.2:

THAT PORTION OF THE EAST HALF OF SECTION 5 AND THE EAST HALF OF SECTION 8, ALL IN TOWNSHIP 2 NORTH, RANGE 4 WEST OF THE GILA AND SALT RIVER MERIDIAN, MARICOPA COUNTY, ARIZONA, BEING MORE PARTICULARLY DESCRIBED AS FOLLOWS:

COMMENCING AT A FOUND BRASS CAP IN A HANDHOLE ACCEPTED AS THE NORTHEAST CORNER OF SAID SECTION 5 FROM WHICH A FOUND BRASS CAP IN A HANDHOLE ACCEPTED AS THE EAST QUARTER CORNER OF SAID SECTION BEARS SOUTH 01 DEGREE 04 MINUTES 17 SECONDS WEST A DISTANCE OF 2653.16 FEET;

THENCE ALONG THE EAST LINE OF THE NORTHEAST QUARTER OF SAID SECTION 5, SOUTH 01 DEGREE 04 MINUTES 17 SECONDS WEST A DISTANCE OF 819.56 FEET TO THE POINT OF BEGINNING;

THENCE CONTINUING ALONG SAID EAST LINE, SOUTH 01 DEGREES 04 MINUTES 17 SECONDS WEST A DISTANCE OF 1833.61 FEET TO THE EAST QUARTER CORNER OF SAID SECTION 5;

THENCE ALONG THE EAST LINE OF THE SOUTHEAST QUARTER OF SAID SECTION 5, SOUTH 01 DEGREES 04 MINUTES 04 SECONDS WEST A DISTANCE OF 2655.46 FEET TO THE SOUTHEAST CORNER OF SAID SECTION 5 AND BEING THE NORTHEAST CORNER OF SAID SECTION 8; THENCE ALONG THE EAST LINE OF THE NORTHEAST QUARTER OF SAID SECTION 8, SOUTH 00 DEGREES 13 MINUTES 09 SECONDS EAST A DISTANCE OF 2648.12 FEET TO THE EAST QUARTER CORNER OF SAID SECTION 8;

THENCE ALONG THE EAST LINE OF THE SOUTHEAST QUARTER OF SAID SECTION 8, SOUTH 00 DEGREES 10 MINUTES 59 SECONDS EAST A DISTANCE OF 1366.42 FEET;

THENCE SOUTH 00 DEGREES 48 MINUTES 59 SECONDS WEST A DISTANCE OF 249.88 FEET TO THE BEGINNING OF A CURVE CONCAVE NORTHEASTERLY, HAVING A RADIUS OF 2000.00 FEET;

THENCE NORTHWESTERLY ALONG SAID CURVE THROUGH A CENTRAL ANGLE OF 72 DEGREES 01 MINUTES 05 SECONDS AN ARC LENGTH OF 2513.90 FEET TO A POINT OF NON–TANGENCY BEING A POINT ON THE NORTH LINE OF THE SOUTHEAST QUARTER OF SAID SECTION 8;

THENCE ALONG SAID NORTH LINE, NORTH 89 DEGREES 45 MINUTES 10 SECONDS WEST A DISTANCE OF 502.53 FEET TO THE CENTER OF SAID SECTION 8;

LEGAL DESCRIPTION (CONTINUED)

THENCE ALONG THE WEST LINE OF THE NORTHEAST QUARTER OF SAID SECTION 8, NORTH 00 DEGREES 04 MINUTES 16 SECONDS EAST A DISTANCE OF 2646.01 FEET TO THE NORTH QUARTER CORNER OF SAID SECTION 8 AND BEING THE SOUTH QUARTER CORNER OF SAID SECTION 5;

THENCE NORTH 00 DEGREES 04 MINUTES 16 SECONDS EAST A DISTANCE OF 1474.03 FEET;

THENCE SOUTH 89 DEGREES 55 MINUTES 44 SECONDS EAST A DISTANCE OF 416.81 FEET;

THENCE NORTH 01 DEGREES 04 MINUTES 17 SECONDS EAST A DISTANCE OF 1048.05 FEET TO THE BEGINNING OF A CURVE, CONCAVE SOUTHEASTERLY, HAVING A RADIUS OF 2000.00 FEET;

THENCE NORTHEASTERLY ALONG SAID CURVE THROUGH A CENTRAL ANGLE OF 90 DEGREES 00 MINUTES 00 SECONDS AN ARC LENGTH OF 3141.59 FEET TO A POINT OF TANGENCY;

THENCE SOUTH 88 DEGREES 55 MINUTES 43 SECONDS EAST A DISTANCE OF 250.00 FEET TO A POINT ON THE EAST LINE OF THE NORTHEAST QUARTER OF SAID SECTION 5 AND BEING THE POINT OF BEGINNING.

BENCHMARK/TOPOGRAPHY NOTES

THE BENCHMARK FOR THE TOPOGRAPHIC SPOT ELEVATIONS SHOWN HEREON IS BASED ON NGS DATA. PID–AJ3842, DESIGNATION–4DH1, ELEVATION 1287.30 FEET (NAVD 88) DESCRIBED AS AN ALUMINUM CAP IN A 5 INCH PVC SLEEVE.

NOTE:

THE CONTOURS SHOWN HEREON WERE SUPPLIED BY THE CLIENT THE VERTICAL REFERENCE IS UNKNOWN. BASED ON THE BENCHMARK LISTED ABOVE AND DEI FIELD MEASUREMENTS THE CONTOUR ELEVATIONS ARE WITHIN 0.22 FEET OF THE FIELD MEASURED LOCATIONS.

SHEET INDEX

SHEET 2 – OVERALL BOUNDARY
SHEET 3 – SECTIONS 4 AND 5 SCHEDULE B DETAIL
SHEET 4 – SECTIONS 8 AND 9 SCHEDULE B DETAIL
SHEET 5 AND 6 – SUN VALLEY PARKWAY SCHEDULE B DETAIL
SHEETS 7–10 – ROADWAY DETAIL SHEETS
SHEET 11 – OVERALL BOUNDARY AND TOPOGRAPHIC CONTOURS

FLOOD ZONE:

ACCORDING TO THE FLOOD INSURANCE RATE MAP #04013C1545H, DATED SEPTEMBER 30, 2005 THIS PROPERTY IS LOCATED IN FLOOD ZONE "X": AREAS OF 0.2% ANNUAL CHANCE FLOOD; AREAS OF 1% ANNUAL CHANCE FLOOD WITH AVERAGE DEPTHS OF LESS THAT 1 FOOT OR WITH DRAINAGE AREAS LESS THAN 1 SQUARE MILE; AND AREAS PROTECTED BY LEVEES FROM 1% ANNUAL CHANCE FLOOD. ALSO PORTIONS OF PARCEL 2 ARE WITHIN FLOOD ZONE "AE": THE FLOODWAY IS THE CHANNEL OF A STREAM PLUS ANY ADJACENT FLOODPLAIN AREAS THAT MUST BE KEPT FREE OF ENCROACHMENT SO THAT THE 1% ANNUAL CHANCE FLOOD CAN BE CARRIED WITHOUT SUBSTANTIAL INCREASES IN FLOOD HEIGHTS. BASE FLOOD ELEVATIONS DETERMINED.

AREA

SUBJECT PARCEL 1 CONTAINS 11,709,800.589 SQ.FT. OR 268.820 ACRES GROSS

SUBJECT PARCEL 2 CONTAINS 19,140,909.786 SQ.FT. OR 439.415 ACRES GROSS

ZONING

SUBJECT PARCEL IS ZONED PC TOWN OF BUCKEYE ZONING ORDINANCE. ZONING DESIGNATION WAS OBTAINED FOR THE MARICOPA COUNTY ASSESSORS WEB SITE @ http://www.maricopa.gov/Assessor/GIS/map.html. FOR MORE DETAILED ZONING STIPULATIONS PLEASE REFER TO THE TOWN OF BUCKEYE ZONING ORDINANCE.

SURVEYORS CERTIFICATE

TO: SUN VALLEY ASSEMBLAGE, L.L.C., AN ARIZONA LIMITED LIABILITY COMPANY
STEWART TITLE INSURANCE COMPANY

THIS IS TO CERTIFY THAT THIS MAP OR PLAT AND THE SURVEY ON WHICH IT IS BASED WERE MADE IN ACCORDANCE WITH "MINIMUM STANDARD DETAIL REQUIREMENTS FOR ALTA/ACSM LAND TITLE SURVEYS," JOINTLY ESTABLISHED AND ADOPTED BY ALTA AND NSPS IN 2005, AND INCLUDES ITEMS 1, 2, 3, 4, 5, 6, 7(a), 7(b), 7(c), 8, 9, 10, 11(a), 12, AND 13 OF TABLE A THERE OF. PURSUANT TO THE ACCURACY STANDARDS AS ADOPTED BY ALTA AND NSPS AND IN EFFECT ON THE DATE OF THIS CERTIFICATION, THE UNDERSIGNED FURTHER CERTIFIES THAT IN MY PROFESSIONAL OPINION, AS A LAND SURVEYOR REGISTERED IN THE STATE OF ARIZONA, THE RELATIVE POSITIONAL ACCURACY OF THIS SURVEY DOES NOT EXCEED THAT WHICH IS SPECIFIED THEREIN.

DALE A. MATTINGLY R.L.S.# 36888 DATE

Two working days before you dig CALL FOR THE BLUE STAKES 263-1100 Blue Stake Center CALL COLLECT

DEI Professional Services, LLC
6225 N. 24th St., Ste. 200
Phoenix, A.Z. 85016
Phone: (602)954-0038
Fax: (602)944-8605

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ALTA/ACSM LAND TITLE SURVEY
SUN VALLEY SOUTH
BUCKEYE, ARIZONA

REVISIONS
1 TEXT SCALE 6/9/06 SHEETS 2, 3 AND 4
2 UPDATED TITLE REPORT 7/05/06
3 ADDED SHEET 5 AND 6 7/17/06

DATE:	4/20/06
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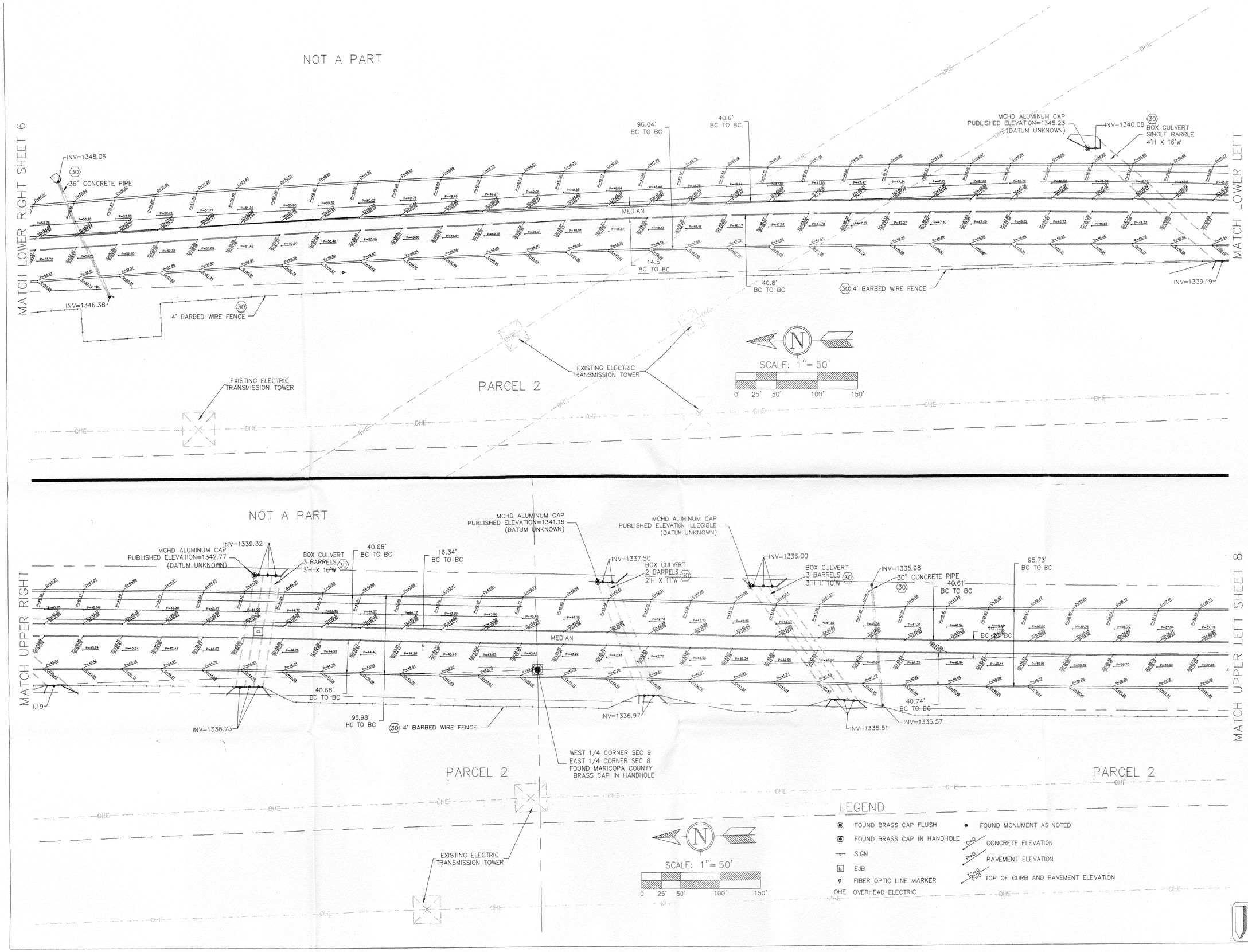
ALTA/ACSM SURVEY



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ALTA/ACSM LAND TITLE SURVEY
SUN VALLEY SOUTH
BUCKEYE, ARIZONA

REVISIONS
- 1 TEXT SCALE 6/9/06 SHEETS 2, 3 AND 4
- 2 UPDATED TITLE REPORT 7/05/06
- 3 ADDED SHEET 5 AND 6 7/17/06

DATE:	4/20/06
PROJ. NO:	06032
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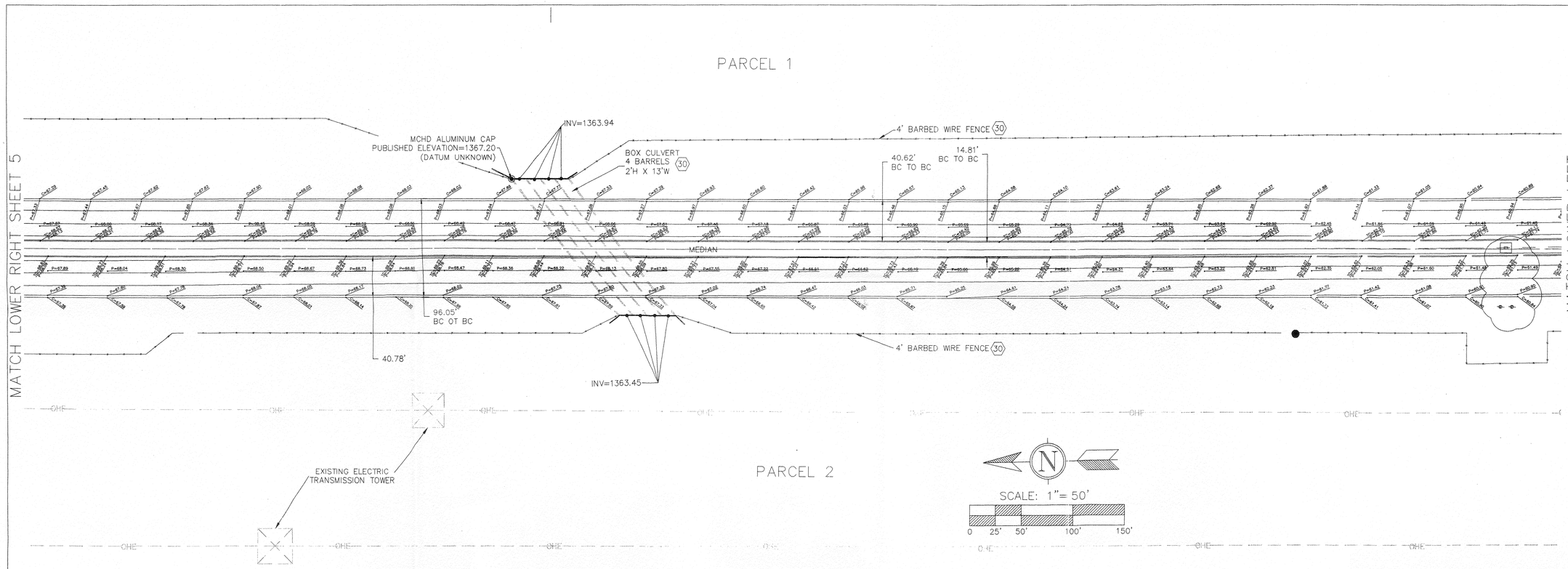

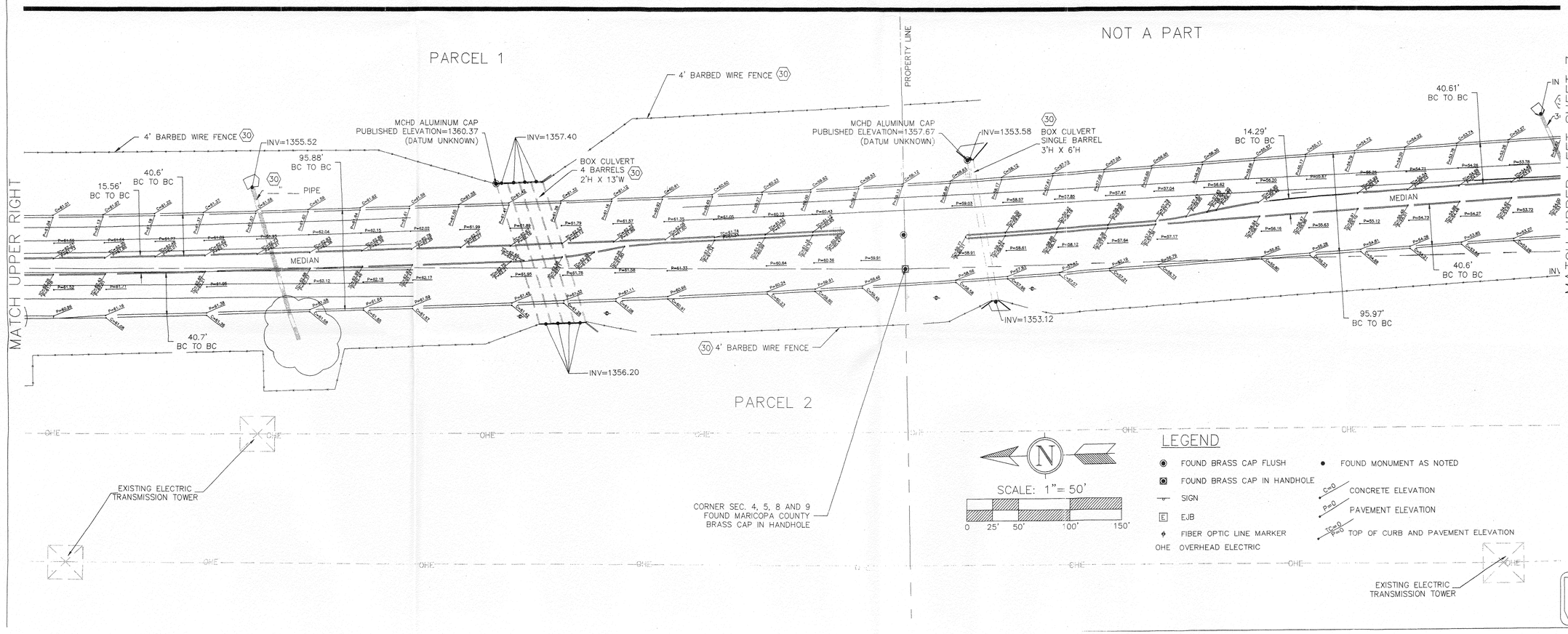

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3 ADDED SHEET 5 AND 6 7/17/06

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APPENDIX C.2

SUN VALLEY PARKWAY CULVERT EVALUATION

SUN VALLEY PARKWAY CULVERT EVALUATION, APPENDIX C

Prepared By: Entellus

Provided only for the Reviewer's information, this culvert evaluation was not employed for the study of Alluvial Fan 39

Entellus™

Sun Valley Parkway Culvert Evaluation
Appendix C

N8	N9 Location	Stationing *	# of Barrels	Material	Approximate Culvert Size	Upstream Headcutting	Upstream Vegetation	Upstream Sedimentation	Upstream Comments	Downstream Headcutting	Downstream Vegetation	Downstream Sedimentation	Downstream Comments	Headcutting Problem **	Vegetation Problem **	Sedimentation Problem **	Rating ***	Rating Comments
990135	3.7 mi N/ McDowell Rd	206+70	1	RCBC	3x10	Some erosion along roadway channel	Some Vegetation in upstream wash	None	No major problems	None	Some vegetation at edge of riprap	None	No major problem	1	1	1	A	No major problem
14A	3.8 mi N/ McDowell Rd	209+30	1	RCP	4x4	Erosion at headwall and along riprap	Some Vegetation in upstream wash	None		Potential for downcut at pipe, nothing currently	Minimal	None	No current problem. Potential for downcutting at pipe	2	2	1	B	Possible downstream cutting
990136	4.2 mi N/ McDowell Rd	229+50	1	RCBC	3x8	Some erosion along roadway channel	None	None	Barbed wire across inlet	None	None	None	No major problem	1	1	1	A	No major problem
15A	4.3 mi N/ McDowell Rd	234+10	2	RCP	3x3	Severe erosion and downcutting: ~4-5ft in some places, riprap completely exposed	None	Minimal	Cutting and erosion is major problem. Looks like wash was diverted slightly from natural course and new route is being cut	Headwall entrenched, fence post completely exposed	None	None	Headwall an issue	4	1	1	D	Upstream riprap completely exposed, and downstream head wall an issue
7657	4.4 mi N/ McDowell Rd	244+40	3	RCBC	3x8	None	Minimal	None	No major problems	Downcutting occurs in downstream wash	Trees growing at outlet	None	Cutting could be potential problem	2	1	1	B	Cutting downstream potential issue
7658	4.5 mi N/ McDowell Rd	246+40	2	RCBC	3x10	Cutting along roadway channel and fence, some cutting (1-2 ft) near inlet, and some cutting in wash	Some	Sediment almost completely covers riprap (~1-2 ft)	Cutting and sediment deposition main issues	None	Tree growing at outlet, other minor vegetation	None	Not too bad	2	2	2	B	Sediment and cutting potential issues
7659	4.6 mi N/ McDowell Rd	251+00	3	RCBC	4x10	Cutting in wash and along fence (Fence posts exposed)	Minimal	Lots of sediment ~2 ft	Erosion and sediment major issues	Some erosion in wash	Heavy vegetation at outlet	Lots of sediment	sediment and vegetation issues downstream	2	2	2	B	Upstream cutting potential issue
990137	4.6 mi N/ McDowell Rd	254+60	1	RCBC	4x10	Erosion in wash, and at headwall due to uncemented river rock	Large Palo Verde tree in wash	Minor sediment at base of culvert	Tree appears to be forcing water to flow to smaller area, increasing velocity and erosion in wash and at headwall	None	Palo Verde tree at outlet, heavy vegetation	None		2	2	1	C	Erosion on wing wall, vegetation problems

* tioning at McDowell Rd. is 10+00
** 1-No Apparent Problem, 2-Minor Problem, 3-Significant Problem, 4-Serious Problem
*** a-Unlikely to Develop a Problem, b-Potential for Developing Problem, c-Evidence of Problem, d-Significant Problem

Entellus™

Sun Valley Parkway Culvert Evaluation
Appendix C

N8	N9 Location	Stationing *	# of Barrels	Material	Approximate Culvert Size	Upstream Headcutting	Upstream Vegetation	Upstream Sedimentation	Upstream Comments	Downstream Headcutting	Downstream Vegetation	Downstream Sedimentation	Downstream Comments	Headcutting Problem **	Vegetation Problem **	Sedimentation Problem **	Rating ***	Rating Comments
990138	5.0 mi N/ McDowell Rd	273+30	1	RCBC	3x6	Minor erosion on some riprap	Some vegetation	None	Only flow appears to be from roadway channel	None	Minimal	None	No major problem	2	1	1	A	No major issue
7660	5.1 mi N/ McDowell Rd	277+70	4	RCBC	4x10	None	Extremely vegetated w/ Palo Verde trees and bushes. Inlet almost inaccessible	Lots of sediment, 1 barrel almost completely blocked, others ~1.5-2 ft of sediment	Vegetation could potentially completely block inlets	None	Large Palo Verde trees and other vegetation at outlets	sediment in all barrels	No defined wash. Large Palo Verde's and vegetation could be an issue	1	2	2	B	vegetation potential problem
7661	5.3 mi N/ McDowell Rd	292+00	4	RCBC	3x10	Some cutting in wash	All barrels blocked by vegetation	riprap completely covered, ~2-2.5 ft of sediment	Culverts have become almost completely ineffective	Downcut and fill in wash	Some vegetation at outlet	About 1/3 full of sediment		1	2	2	B	Upstream vegetation potential issue
22A	5.5 mi N/ McDowell Rd	300+10	1	RCP	2x2	Some cutting in wash	None	Minimal	Minor erosion at riprap and cutting in wash only issues	None	None	None	No major problem	2	1	1	B	Possible minor erosion on upstream side
990139	5.6 mi N/ McDowell Rd	303+30	1	RCBC	4x10	some erosion on roadway channel	Minimal	None	Erosion on roadway channel only issue. River rock was placed next to riprap, and this edge is where erosion, and minor riprap breakage has occurred	None	Some vegetation in wash	None	No major problem	2	1	1	B	Erosion on roadway channel only issue
7662	6.1 mi N/ McDowell Rd	330+20	3	RCBC	3x10	Some cutting in wash, ~2-4 ft	Minor vegetation at riprap	Lots of sediment. riprap completely covered, barrels w/ ~1-2 ft sediment	Cutting and sediment deposition main issues	None	Bushes in poorly defined wash	Minimal	No sign of problems	2	1	2	B	Upstream cutting and sediment potential issues
7663	6.1 mi N/ McDowell Rd	333+40	6	RCBC	3x10	None	Some vegetation at edge of riprap	Lots of sediment. 4 barrels w/ ~2 ft of sediment, only 1 barrel relatively clean. riprap completely covered	Culverts have become almost completely ineffective	Downcutting at edge of riprap (~1ft)	Some vegetation at outlet	Minimal	Cutting could undermine riprap in future,	2	1	3	C	Heavy upstream sediment an issue

ationing at McDowell Rd. is 10+00
* 1-No Apparent Problem, 2-Minor Problem, 3-Significant Problem, 4-Serious Problem
*** a-Unlikely to Develop a Problem, b-Potential for Developing Problem, c-Evidence of Problem, d-Significant Problem

APPENDIX D

HYDROLOGIC ANALYSIS SUPPORTING DOCUMENTATION

FLOOD INSURANCE STUDY

APPROXIMATE ZONE A DELINEATION

WHITE TANK MOUNTAIN FOOTHILLS ALLUVIAL FAN 39

HYDROLOGY CALCULATION REPORT

Prepared For:
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
2801 West Durango Street
Phoenix, AZ 85009

Prepared by:
CMX, L.L.C.
7740 North 16th Street, Suite 100
Phoenix, AZ 85020
Phone: 602.567.1900
Fax: 602.567.1901

December 2007
CMX Project No. 63.59.63

APPROXIMATE ZONE A DELINEATION
FOR
WHITE TANK MOUNTAIN FOOTHILLS
ALLUVIAL FAN 39

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SECTION 4. REFERENCES 2

APPENDIX D.1 HEC-1 OUTPUT 100-YEAR, 6-HOUR & 24-HOUR STORM EVENTS

SECTION 1. PROJECT OVERVIEW

CMX was contracted with the Flood Control District of Maricopa County (FCDMC), Arizona to delineate the approximate Zone A 100-year floodplain for White Tank Mountains Alluvial Fan 39. The study area lies in western Maricopa county, near the town of Buckeye. Fan 39 has formed in the desert piedmont between the western slopes of the White Tank Mountains, and the base level discharge point, White Tanks Wash. Specifically, the study area falls within a part of Township 2 North, Range 4 West, Sections 1-9 and 18, as well as Township 2 North, Range 5 West, Sections 1, 12, 13, and 24. The vicinity map, Figure 1, illustrates where the study area falls within Maricopa County.

SECTION 2. METHODOLOGY

In accordance with the FCDMC contract, the Buckeye/ Sun Valley Area Master Drainage Study served as the source of the hydrologic information used for the Fan 39 approximate Zone A study. The peak 100-year, 24-hour flow at Fan 39's apex, as published in the Buckeye/ Sun Valley ADMS, was designated the flow rate upon which the approximate Zone A limits would be determined. The 100-year, 6-hour storm was also analyzed, but was found to produce a lower peak flow rate at Fan 39's apex. Figure 7 shows an overlay of the ADMS drainage area boundaries and concentration points on the approximate Zone A limits for Fan 39. Digital copies of the output produced by the 6-hour and 24-hour HEC-1 models may be found on CD at the back of this appendix.

The following information summarizes the hydrologic methodology utilized in the ADMS. Further explanation of the methodology may be found within the Buckeye/ Sun Valley ADMS final reports.

Hydrologic Method:	US Army Corps of Engineers' HEC-1 Flood Hydrograph Package, June 1998, Version 4.1
Hydrologic Model:	Buckeye/ Sun Valley ADMS – May 2005
Initial Loss Rates:	Green and Ampt
Unit Hydrograph Procedure:	FCDMC S-Graph
Channel Routing Method:	Normal Depth
Land Use Data:	FCDMC GIS Data
Soil Data:	SUDA SCS Soil Survey (1972 & 1981)

A summary of the flows published in the Buckeye/ Sun Valley ADMS that were utilized within this Zone A study are as follows:

The peak 100-year, 24-hour flow at Fan 39's apex, 3,030 cfs (concentration point F3R) was designated the base flowrate upon which the hydraulic limits would be analyzed.

In light of the geologic and geomorphic characteristics of the Zone A study area, different hydrologic and hydraulic study approaches were taken upstream and downstream of Sun Valley Parkway. Upstream of the Parkway the flow patterns are too dynamic and complex to model individually, therefore a geomorphic analysis technique was utilized.

Downstream of Sun Valley Parkway flow patterns become better defined as wash corridors become more incised. As a result, a hydraulic model that analyzes individual riverine corridors became appropriate. With this technique the capacity of observed incised flow corridors (defined by topography and aerial photography) within Holocene formations were used to approximate the flow for the historic capacity of each corridor. Cross sections cut through these surficial Holocene geology formations and overlying topography were employed for the normal depth flow calculations used to estimate the historic flow rate capacity of each wash corridor. The total combined flow rate estimated for all three of the primary wash corridors exceeded the apex flow rate above the parkway, suggesting a defendable capacity analysis had been achieved.

SECTION 3. HYDROLOGIC SUMMARY

The input parameters for the approximate Zone A hydrologic analysis are displayed in Table 2.

SECTION 4. REFERENCES

PBS&J (May, 2005). *Buckeye/Sun Valley Area Drainage Master Study.* Prepared for the Flood Control District of Maricopa County.

Table 8: Hydrologic Summary Table
(per Cross-Section)

PREPARED BY: CMX
DATE: December 13, 2007

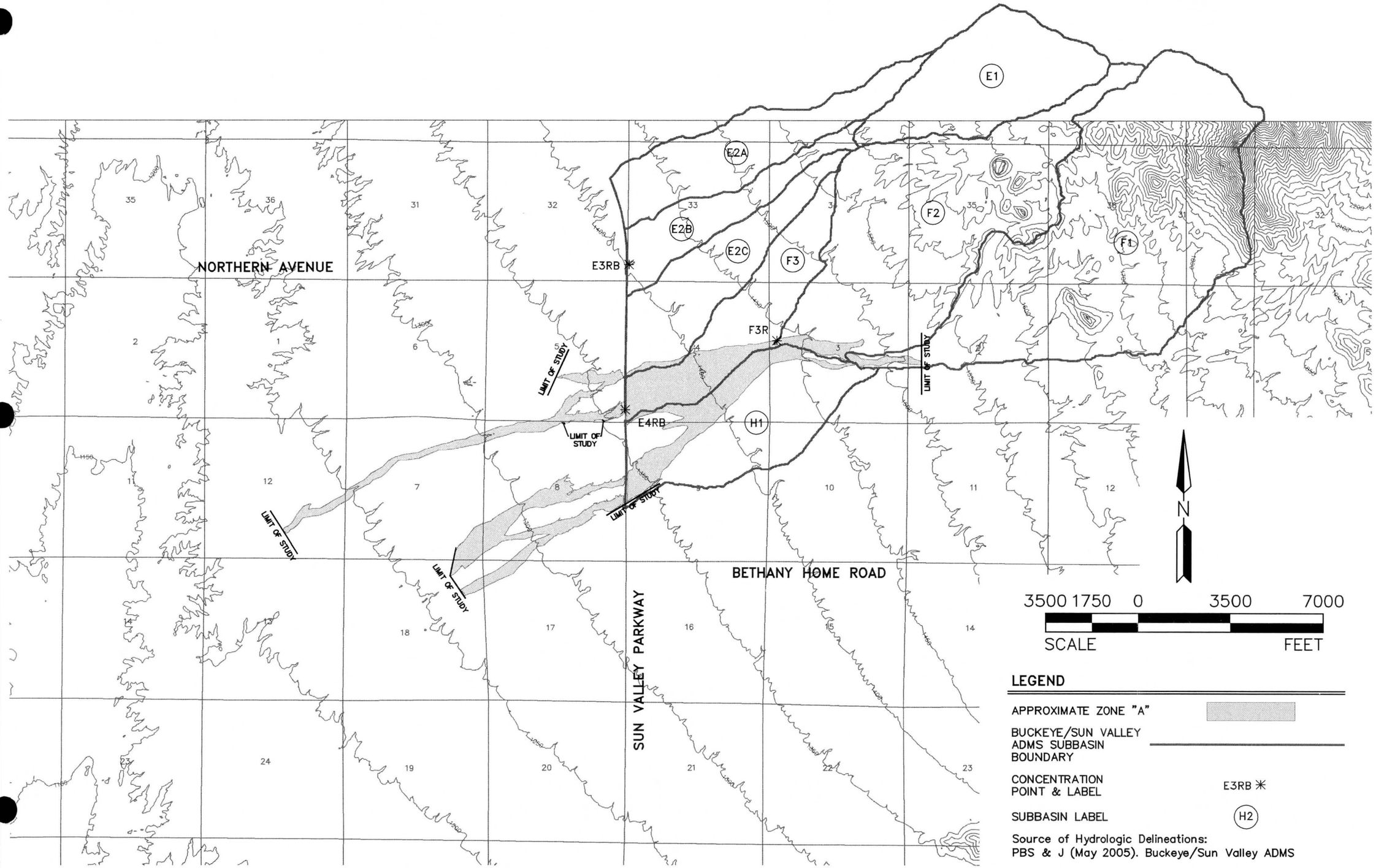
CMX

Sun Valley Parkway-
Transition from Alluvial Fan to Riverine Flow Condition (1)

HEC-RAS Reach	Upstream HEC-RAS Cross-Section	Downstream HEC-RAS Cross-Section	Upstream ADMS Concentration Point	Q_{100}	Percentage of Upstream Concentration Point's Peak Flow Conveyed in Reach
Northwest	1.09	1.09	F3R	500	17%
Northwest	1.08	1.01	F3R	250	8%
Northwest, South Branch	2.07	2.01	F3R	250	8%
Central West	3.19	3.09	F3R	1,000	33%
Central West	3.08	3.01	F3R	1,250	41%
Southwest, North Leg	4.14	4.03	F3R	850	28%
Southwest, North Leg	4.02	4.01	F3R	1,050	35%
Southwest, South Leg	5.14	5.05	F3R	850	28%
Southwest, South Leg	5.04	5.01	F3R	200	7%
Southwest, South Leg, South Branch	6.05	6.01	F3R	650	21%

Notes:

(1) - Peak flow values downstream of Sun Valley Parkway were determined by analzying the capacity of the holocene corridors downstream of the parkway.



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WHITE TANK MTN ALLUVIAL FAN 39
APPROXIMATE ZONE "A" DELINEATION STUDY
MARICOPA COUNTY, ARIZONA

FIG 7: HYDROLOGY EXHIBIT

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APPENDIX D.1

HEC-1 INPUT & OUTPUT FILES
100-YEAR, 6-HOUR &
100-YEAR, 24-HOUR STORM EVENT
(Digital Copy)

BUCKEYE/ SUN VALLEY AREA DRAINAGE MASTER STUDY

Prepared By: PBS & J, May 2005

APPENDIX E

HYDRAULIC ANALYSIS SUPPORTING DOCUMENTATION

FLOOD INSURANCE STUDY

APPROXIMATE ZONE A DELINEATION

WHITE TANK MOUNTAIN FOOTHILLS ALLUVIAL FAN 39

HYDRAULIC CALCULATION REPORT

Prepared For:
FLOOD CONTROL DISTRICT
OF MARICOPA COUNTY
2801 West Durango Street
Phoenix, AZ 85009

Prepared By:
CMX, L.L.C.
7740 North 16th Street, Suite 100
Phoenix, AZ 85020
Phone: 602.567.1900
Fax: 602.567.1901

December 2007
CMX Project No. 6359.63

APPROXIMATE ZONE A DELINEATION
FOR
WHITE TANK MOUNTAIN FOOTHILLS
ALLUVIAL FAN 39

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APPENDIX E.6 MANNING'S ROUGHNESS COEFFICIENT CALCULATION SHEETS & PHOTO DOCUMENTATION
APPENDIX E.7 FLOW SPLIT ANALYSIS

SECTION 1. PROJECT OVERVIEW

CMX was contracted by the Flood Control District of Maricopa County (FCDMC), Arizona to delineate the approximate Zone A 100-year floodplain for White Tank Mountains Alluvial Fan 39. The study area lies in western Maricopa County, near the town of Buckeye. Fan 39 has formed in the desert piedmont between the western slopes of the White Tank Mountains, and the base level discharge point, White Tanks Wash. Specifically, the study area falls within a part of Township 2 North, Range 4 West, Sections 1-9 and 18, as well as Township 2 North, Range 5 West, Sections 1, 12, 13, and 24. The vicinity map, Figure 1, illustrates where the study area falls within Maricopa County.

SECTION 2. METHODOLOGY

In general, hydraulic analyses were prepared where riverine flow regime could be defined by topography and supported by geomorphic record for each water course. The upper limits of Fan 39 were delineated by geomorphic methods to Sun Valley Parkway, which bisects the fan. Culverts exist at Sun Valley Parkway to convey storm flow to the downstream wash corridors. These culverts discharge flow into three independent wash corridors. The corridors, deemed *Northwest*, *Central West*, and *Southwest*, convey flows from the active portion of Fan 39 (located upstream of Sun Valley Parkway) to the distal limits of the fan formation, White Tanks Wash. Downstream of Sun Valley Parkway the Holocene deposits mark the location of primary flow corridors for the riverine systems (see Figure 4). Cross sections cut through these surficial Holocene geology formations and overlying topography were employed for the normal depth flow calculations used to estimate the historic flow rate capacity of each wash corridor. The total combined flow rate estimated for all three of the primary wash corridors, below Sun Valley Parkway, exceeded the apex flow rate above the parkway, suggesting a defendable capacity analysis had been achieved. Hydraulic calculations are included in Appendix E.

Water surface profile calculations were performed for this approximate Zone A study to estimate the normal flow depth and top width at identified cross-sections in the study area. The peak flow used was extracted from the ADMS HEC-1 model as indicated in the previous section. Weighted Manning's roughness coefficients were calculated to characterize each reach within Fan 39. HEC-RAS version 3.1.3 was used to produce the hydraulic model. Flow split locations were verified through field studies, photo documentation, and topographic interpretation and a hydraulic analysis of these flow splits was performed. The hydraulic grade line of each diverging corridor and parent stream were estimated at various discharge rates. Energy grade line elevations between the parent stream and diverging corridors were iteratively balanced until the approximate sum of flow discharged into each diverging corridor equaled the parent stream flow rate and parent stream energy grade elevation.

Downstream of Sun Valley Parkway cross-sections were cut at appropriate intervals along the aforementioned Northwest, Central West, and Southwest Reaches of Fan 39. Along with the flow rates determined by the Sun Valley Parkway culvert analysis, these cross-sections were used to create a HEC-RAS v. 3.1.3 hydraulic model. Through this HEC-RAS model, estimates of the water surface elevation and top flow width were determined at each cross-section (HEC-RAS output for the west reaches of Fan 39 is included in Sections E.1-E.6 of this appendix).

The downstream limits for this approximate Zone A delineation were established as the *tie-in* points with the effective Zone A for Alluvial Fan 6 for the Northwest Reach, and the effective Zone AE White Tanks Wash study for the Central West and Southwest Reaches.

SECTION 3. FLOW SPLIT ANALYSIS

Potential flow split locations were found by analyzing topographic, geologic and geomorphic maps, as well as aerial photos. In total, four split locations were investigated in field surveys for the western reaches of Fan 39. Field notes, site photos and aerial photos of these locations (*Northwest 1, Central West 1, Central West 2,* and *Southwest 1*) can be found in Appendix E.8. Hydraulic analysis for the four potential flow splits began by analyzing the capacity in the primary stream. In the case of the Central Reach, the primary stream was found to have more than adequate capacity to convey the estimated peak flow, Q_{100} = 1,000 cfs, in the vicinity of Central West Flow Splits 1 and 2 (See Section E.7). These results compliment the field surveys, during which no signs of significant breakouts were observed at either location. "Limit of Study" notes were added to the Annotated FIRM Panels (Figure 6) at each of these potential flow split locations to acknowledge that additional detailed analysis, which was outside the scope of this study, may be appropriate for these areas.

However, field visits and the hydraulic analysis did identify a lack of capacity in the vicinity of Northwest Flow Split 1 and Southwest Flow Split 1. HEC-RAS version 3.1.3 was employed to perform a flow split analysis by which the peak flow of each diverging corridor was determined.

Cross sections were cut adjacent to one another in the Northwest Reach, and the break-out corridor that diverges south, deemed the *Northwest Reach South Branch.* By iteratively dividing the 500 cfs peak flow contained in the upper corridor, and comparing the water surface elevation in the adjacent HEC-RAS cross-sections a balance was achieved. Specifically, balanced water surface elevations were found when 250 cfs was passed down both the Northwest Reach, and the Northwest Reach South Branch. This was the flow rate used to delineate each reach downstream of the flow split. Hydraulic analysis for these reaches is contained in Sections E.1 and E.2.

A similar hydraulic analysis was performed for the Southwest Flow Split 1 located at the divergence of Southwest, *South Leg Reach* and the *Southwest, South Leg, South Branch* Reach. This analysis determined that 200 cfs and 650 cfs would flow down each diverging corridor, respectively.

SECTION 4. MANNING'S ROUGHNESS COEFFICIENT DETERMINATION

Manning's roughness coefficients (n-values) were determined for each HEC-RAS cross-section based on the technique outlined in the *Estimating Manning's Roughness Coefficients for Stream Channels and Flood Plains in Maricopa County, Arizona* manual (USGS 1991). The data utilized for the determination of Manning's roughness coefficients was obtained through extensive field visits and aerial photography. Field notes and photographs are contained within Section E.6.

The Manning's roughness coefficient (Manning's n value) in open channels represents the resistance to flow as a function of a variety of a channel's physical characteristics. These characteristics include a channel's bed composition, irregularity, obstruction, and vegetation. A brief discussion of the process by which Manning's n values are determined is included in this section. For further discussion see Reference 1.

The composite n value for a channel is determined by evaluating the individual n value characteristics for that channel. These characteristics include the channel material n value (nb), the degree of irregularity of channel cross section (n1), relative effect of obstructions (n2), vegetation (n3), variations in channel cross section (n4), and degree of meandering (m).

Once evaluated, these channel characteristics are lumped to calculate a composite n value using the following equation:

$$n_{COMPOSITE} = (nb + n1 + n2 + n3 + n4) * m$$

The base n value reflects the type of bed material or surface roughness. This generally ranges from nb = 0.026 for coarse sand to nb = 0.07 for boulder material.

The degree of irregularity of channel cross section is evaluated by determining the degree of side slope erosion and surface irregularity. The degree of irregularity ranges from smooth (n1 = 0.000) to severe (n1 = 0.020).

Obstruction takes into account the occurrence and characteristics of obstructing objects within the channel. Stumps, exposed roots, isolated boulders and other like objects all constitute obstructions. The adjustment values associated with obstructions range from negligible (n2 = 0.000) to severe (n2 = 0.060).

The vegetation adjustment values take into consideration the type and amount of vegetation. Vegetation values range from small (n3 = 0.002) to very large (n3 = 0.100).

Variations in channel cross sections takes into account the variability in channel cross section size and shape along the length of the channel. Adjustment values range from (n4 = 0.000) for slight variability to (n4 = 0.015) for great variability.

The degree of meandering is the final channel characteristic that is evaluated. The range for meandering is from minor (m = 1.00) to severe (m = 1.30).

Manning's n adjustment values used in this approximate Zone A study were estimated using the following:

1. Extensive field reconnaissance at the Zone A study area.
2. Aerial photography.
3. The calculation technique outlined in reference 1.

The method of determining Manning's n values explained above has been applied to all cross sections contained in each reach of this study area. In an effort to remain conservative, especially in consideration of the interval between cross sections, the maximum n value calculated within each reach was selected as representative for the entire reach.

The input parameters for the approximate Zone A hydraulic analysis, including Manning's coefficients, are displayed in Table 9.

SECTION 5. REFERENCES

U.S. Geological Survey (April 1991). *Estimated Manning's Roughness Coefficients for Stream Channels and Flood Plains in Maricopa County, Arizona*

Table 9: Hydraulic Analysis Input Parameters

PREPARED BY: CMX

DATE: December 13, 2007

CMX

Sun Valley Parkway Culvert Crossings-
Transition from Alluvial Fan to Riverine Flow Condition [2]

HEC-RAS Reach	Upstream HEC-RAS Cross-Section ID	Downstream HEC-RAS Cross-Section ID	Thalweg	"n" Value			Upstream ADMS Concentration Point	Percentage of Upstream Concentration Point's Peak Flow Conveyed in Reach	Q100
				Left Bank	Main Channel	Right Bank			
Northwest	1.09	1.09	39L	0.050	0.045	0.050	F3R	17%	500
Northwest	1.08	1.01	39L	0.055	0.045	0.055	F3R	8%	250
"n" Values Chosen for Reach [1,3]				0.055	0.045	0.055			
Central West	3.19	3.14	39B	0.050	0.045	0.050	F3R	33%	1,000
Central West	3.13	3.12	39B	0.045	0.040	0.045	F3R	33%	1,000
Central West	3.11	3.08	39B	0.055	0.045	0.055	F3R	33%	1,000
Central West	3.07	3.03	39B	0.050	0.045	0.050	F3R	41%	1,250
Central West	3.02	3..01	39B	0.050	0.045	0.050	F3R	41%	1,250
"n" Values Chosen for Reach [1, 4]				0.055	0.045	0.055			
Southwest, South Leg	5.14	5.05	39G	0.050	0.040	0.050	F3R	28%	850
Southwest, South Leg	5.04	5.03	39G, 39M	0.050	0.040	0.050	F3R	7%	200
Southwest, South Leg	5.02	5.01	39M	0.055	0.045	0.055	F3R	7%	200
"n" Values Chosen for Reach [1]				0.055	0.045	0.055			

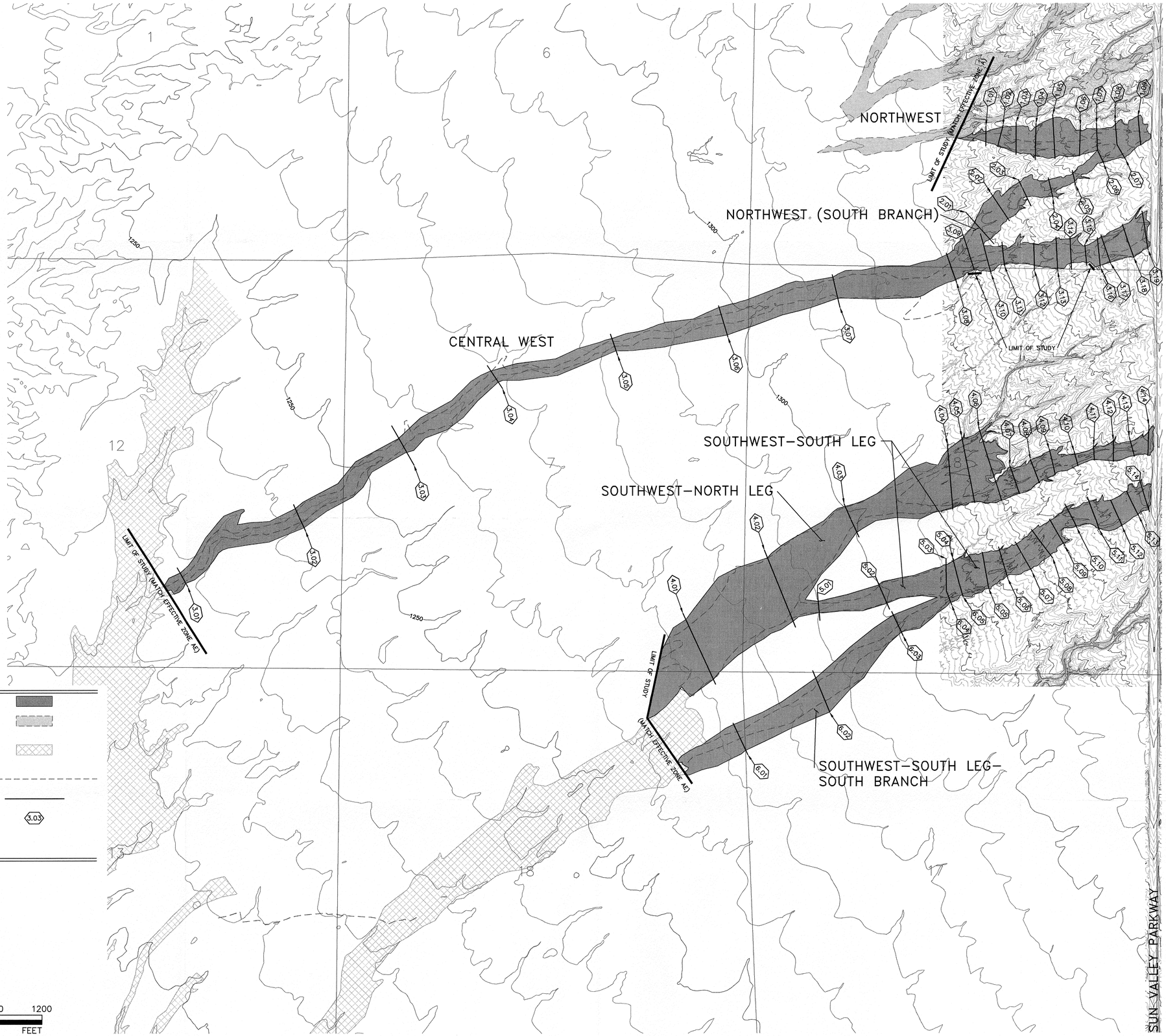
Notes:

(1) - To be conservative, the Manning's "n" values chosen for each reach represent the largest "n" values found within that reach.

(2) - Peak flow values downstream of Sun Valley Parkway were determined by analzying the capacity of the holocene corridors downstream of the parkway.

(3) - The Manning's values selected for the Northwest Reach were also used for the Northwest Reach *South Branch*.

(4) - The Manning's values selected for the Southwest, South Leg Reach were also used for the Southwest Reach *North Leg* and *South Leg, South Branch*.



LEGEND

- FAN 39 HYDRAULIC LIMITS
- EFFECTIVE FAN 6 ZONE A LIMITS
- WHITE TANKS WASH EFFECTIVE ZONE AE LIMITS
- LATE HOLOCENE DEPOSITS
- CROSS SECTION
- CROSS SECTION LABEL (3.03)

FAN 39–INDEX MAP

SCALE: N.T.S.

N

600 300 0 600 1200
SCALE FEET

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WHITE TANK MTN ALLUVIAL FAN 39

APPROXIMATE ZONE "A" DELINEATION STUDY
MARICOPA COUNTY

FIG 8: HYDRAULIC MAP

CMX PROJ: 6359.63	DATE: DEC. 2007
DESIGNED: AT	DRAWN: BC
REV.	

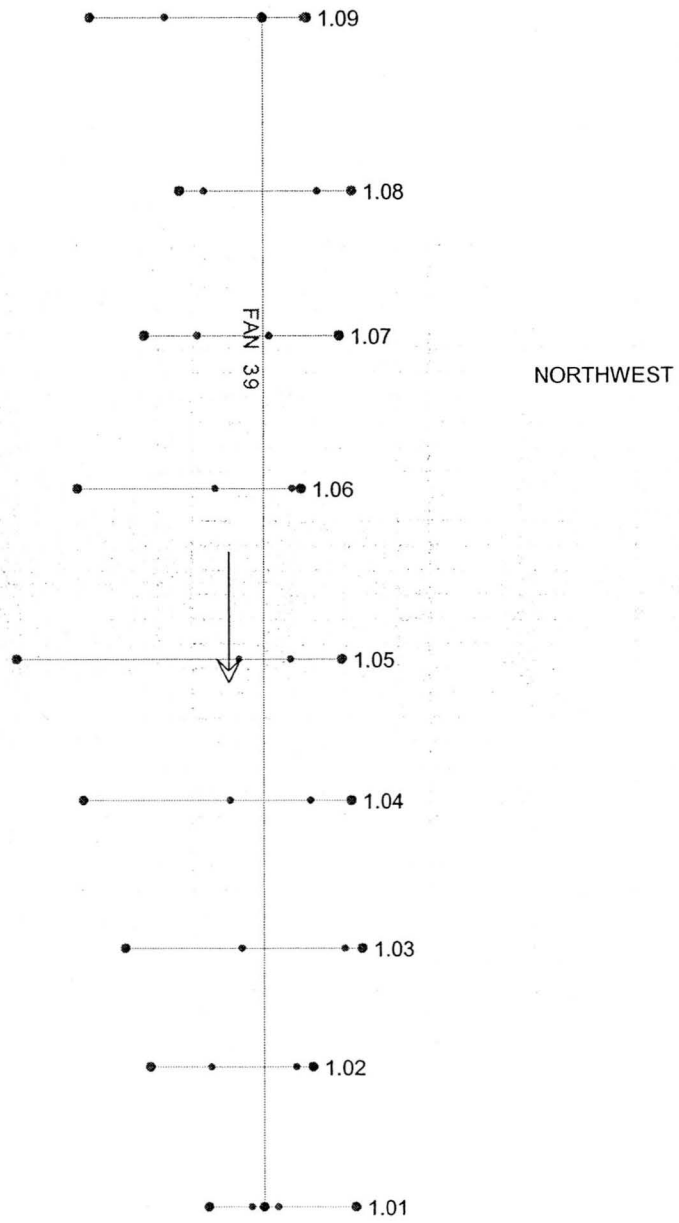
SCALE: 1"=600'
APPROVED: KCK

DWG. NO. 1
SHT. 1 OF 1

X:\6300\6359-63\Water Resources\VB-Exhibits\Drainage Report\TDH EXhibit-Update\FB-6359.63-Hydraulic-Ex.dwg 01-02-2008 - 9:02am

APPENDIX E.1

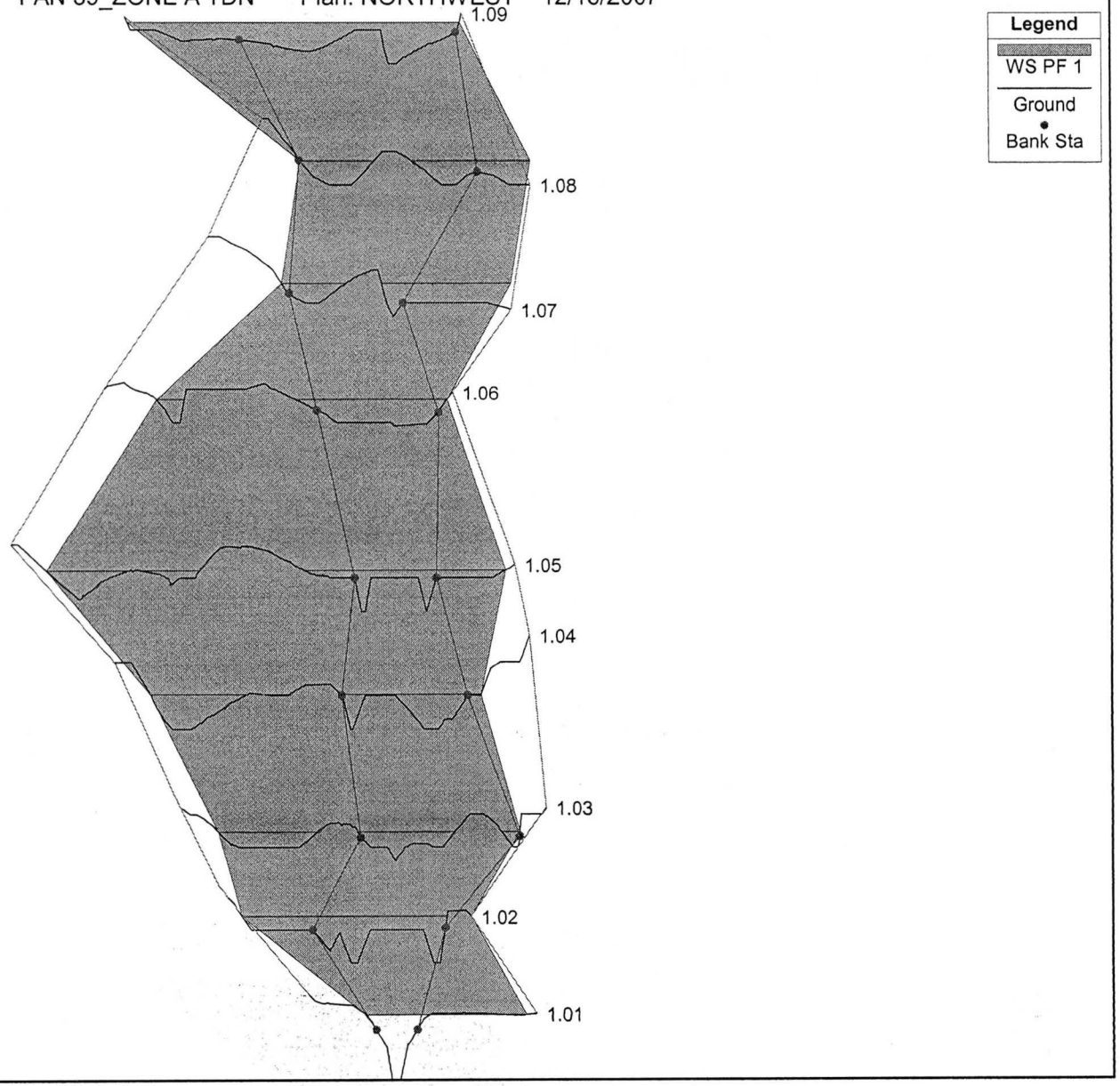
HEC-RAS OUTPUT
FOR
NORTHWEST REACH

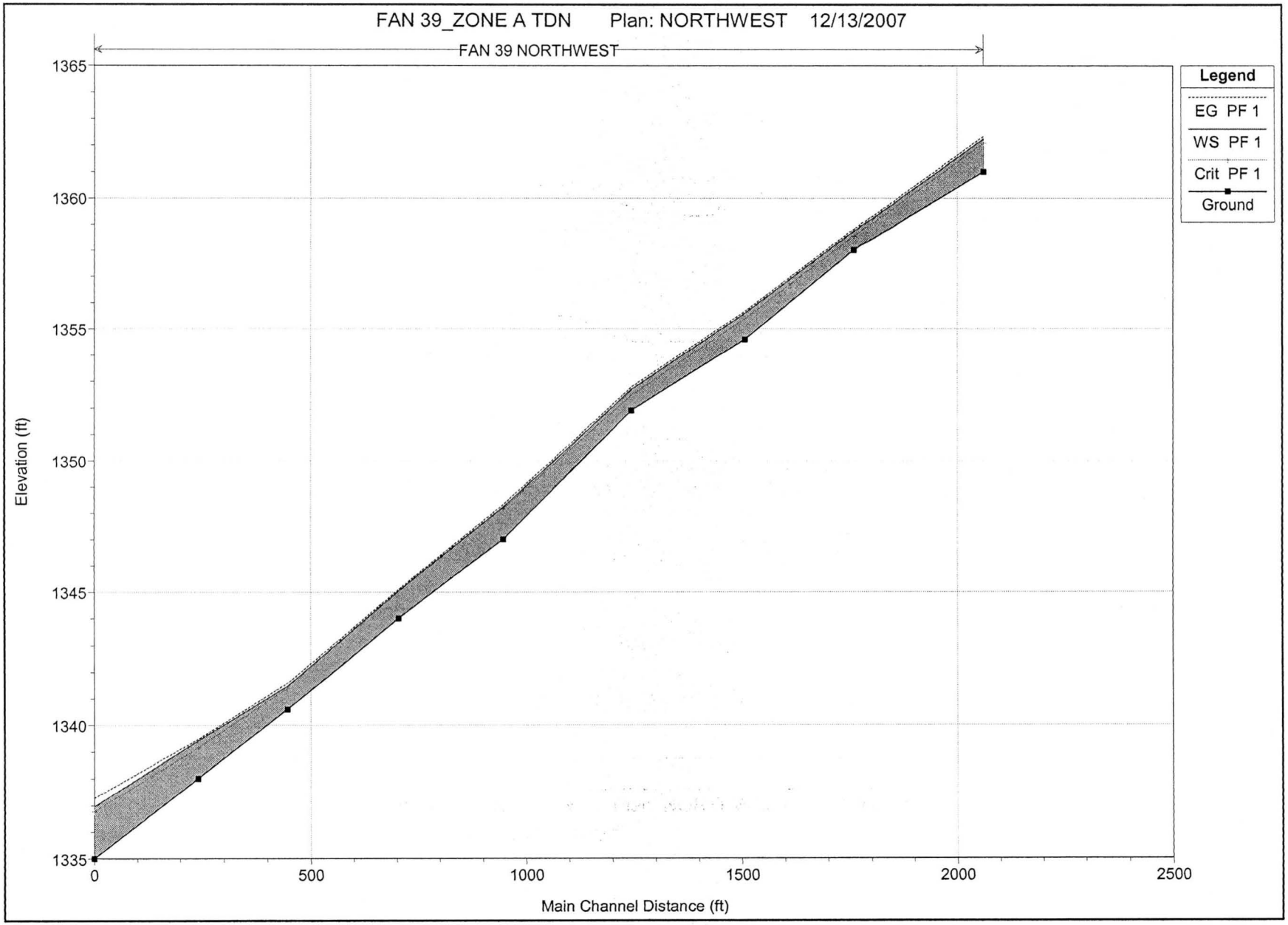

1.09
1.08
1.07
1.06
1.05
1.04
1.03
1.02
1.01
FAN 39
NORTHWEST

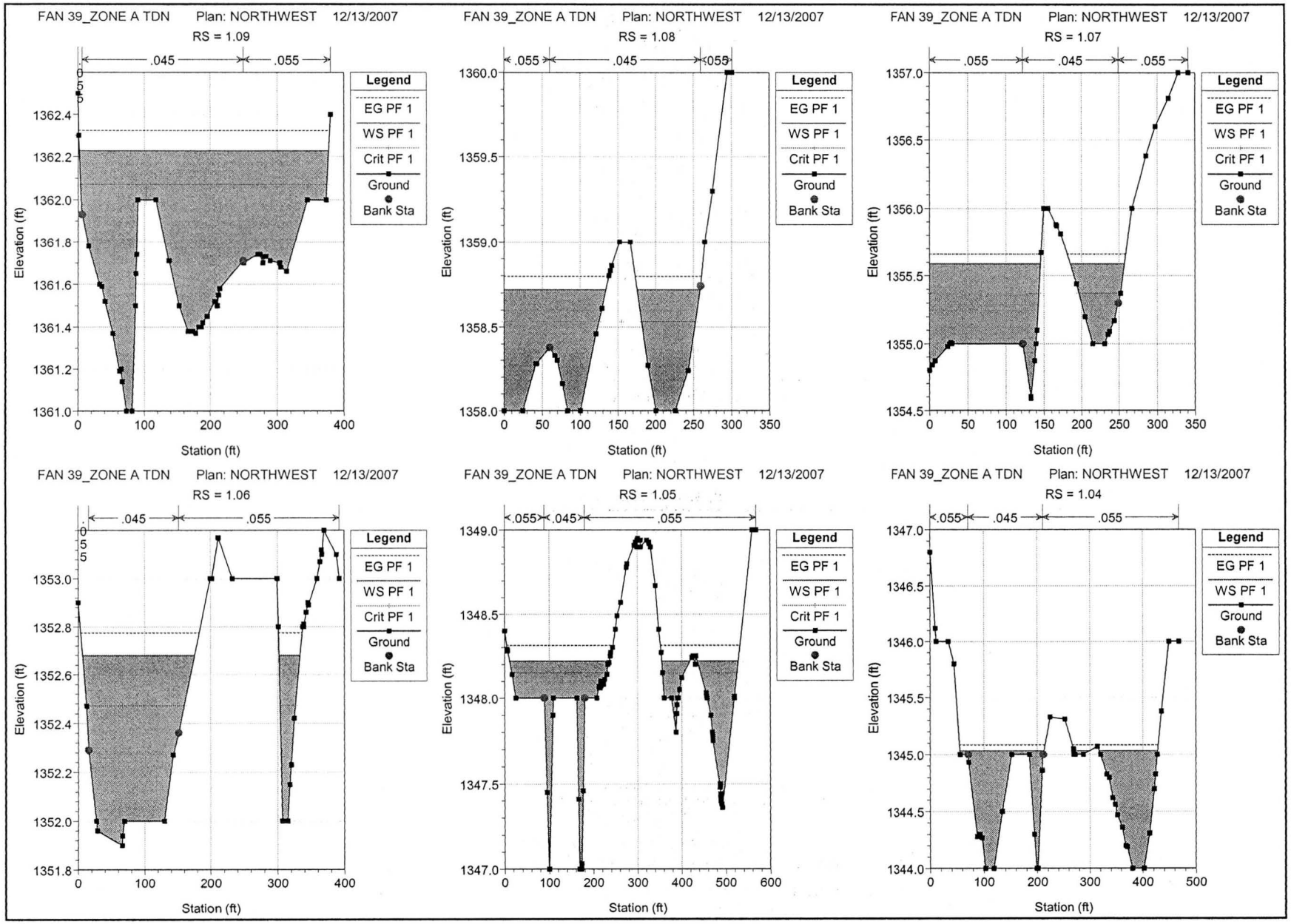
HEC-RAS Plan: NORTHWEST River: FAN 39 Reach: NORTHWEST Profile: PF 1

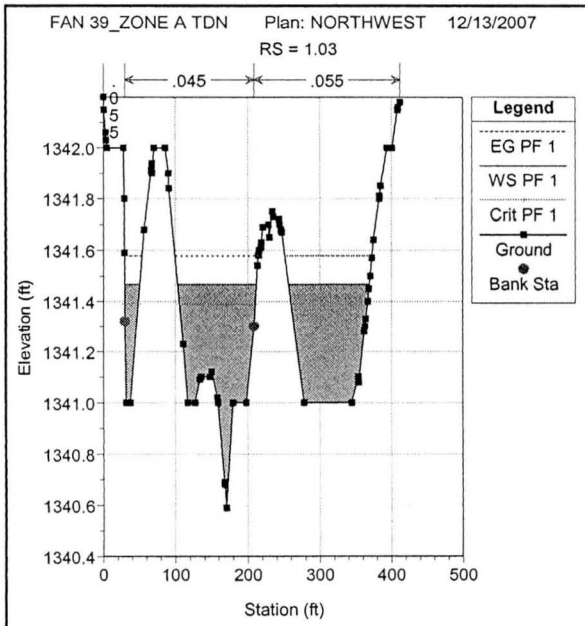
Reach	River Sta	Profile	Q Total	W.S. Elev	Crit W.S.	Vel Chnl	Top Width	Froude # Chl	Left Sta Eff	Rght Sta Eff
			(cfs)	(ft)	(ft)	(ft/s)	(ft)		(ft)	(ft)
NORTHWEST	1.09	PF 1	500.00	1362.23	1362.07	2.64	374.62	0.58	1.97	376.59
NORTHWEST	1.08	PF 1	250.00	1358.72	1358.53	2.31	217.61	0.58	0.00	258.88
NORTHWEST	1.07	PF 1	250.00	1355.59	1355.37	2.20	217.98	0.56	0.00	257.33
NORTHWEST	1.06	PF 1	250.00	1352.68	1352.47	2.54	200.56	0.55	6.32	333.09
NORTHWEST	1.05	PF 1	250.00	1348.22	1348.15	2.99	383.96	0.78	10.73	527.69
NORTHWEST	1.04	PF 1	250.00	1345.03		1.87	297.15	0.47	54.89	427.41
NORTHWEST	1.03	PF 1	250.00	1341.47	1341.39	2.91	242.66	0.80	29.75	369.16
NORTHWEST	1.02	PF 1	250.00	1339.41	1339.15	2.03	229.91	0.42	0.00	257.15
NORTHWEST	1.01	PF 1	250.00	1336.97	1336.77	4.52	97.08	0.73	11.53	193.04

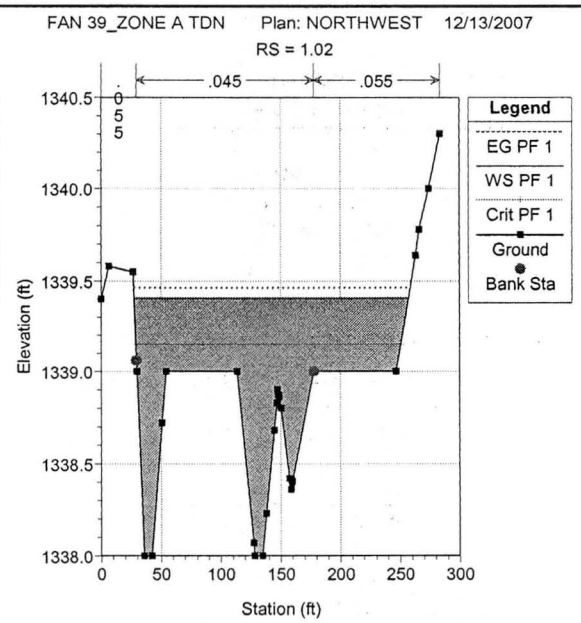
FAN 39_ZONE A TDN Plan: NORTHWEST 12/13/2007

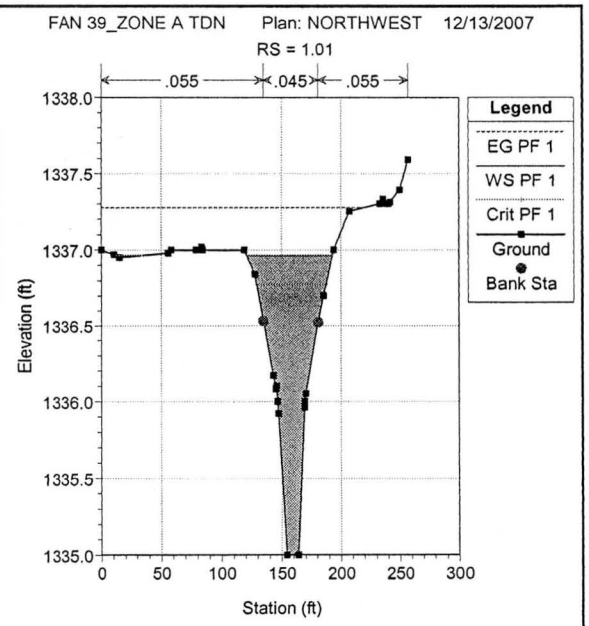



FAN 39_ZONE A TDN Plan: NORTHWEST 12/13/2007
FAN 39 NORTHWEST
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Elevation (ft)
1365
1360
1355
1350
1345
1340
1335
0
500
1000
1500
2000
2500
Main Channel Distance (ft)


FAN 39_ZONE A TDN Plan: NORTHWEST 12/13/2007
RS = 1.09
.045
.055
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
FAN 39_ZONE A TDN Plan: NORTHWEST 12/13/2007
RS = 1.08
.055
.045
.055
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
FAN 39_ZONE A TDN Plan: NORTHWEST 12/13/2007
RS = 1.07
.055
.045
.055
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
FAN 39_ZONE A TDN Plan: NORTHWEST 12/13/2007
RS = 1.06
.045
.055
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
FAN 39_ZONE A TDN Plan: NORTHWEST 12/13/2007
RS = 1.05
.055
.045
.055
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
FAN 39_ZONE A TDN Plan: NORTHWEST 12/13/2007
RS = 1.04
.055
.045
.055
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)

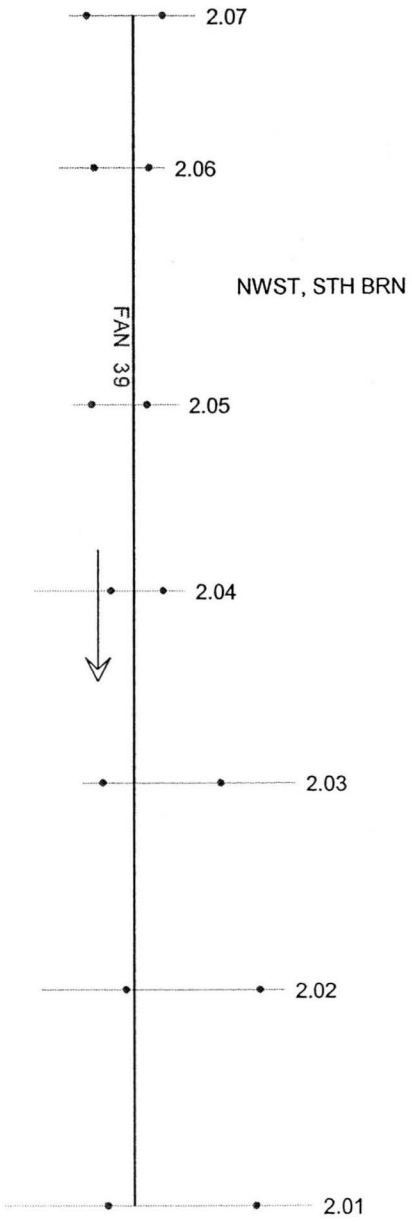

FAN 39_ZONE A TDN Plan: NORTHWEST 12/13/2007
RS = 1.03
.045
.055
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)


FAN 39_ZONE A TDN Plan: NORTHWEST 12/13/2007
RS = 1.02
.045
.055
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)


FAN 39_ZONE A TDN Plan: NORTHWEST 12/13/2007
RS = 1.01
.055
.045
.055
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)

APPENDIX E.2

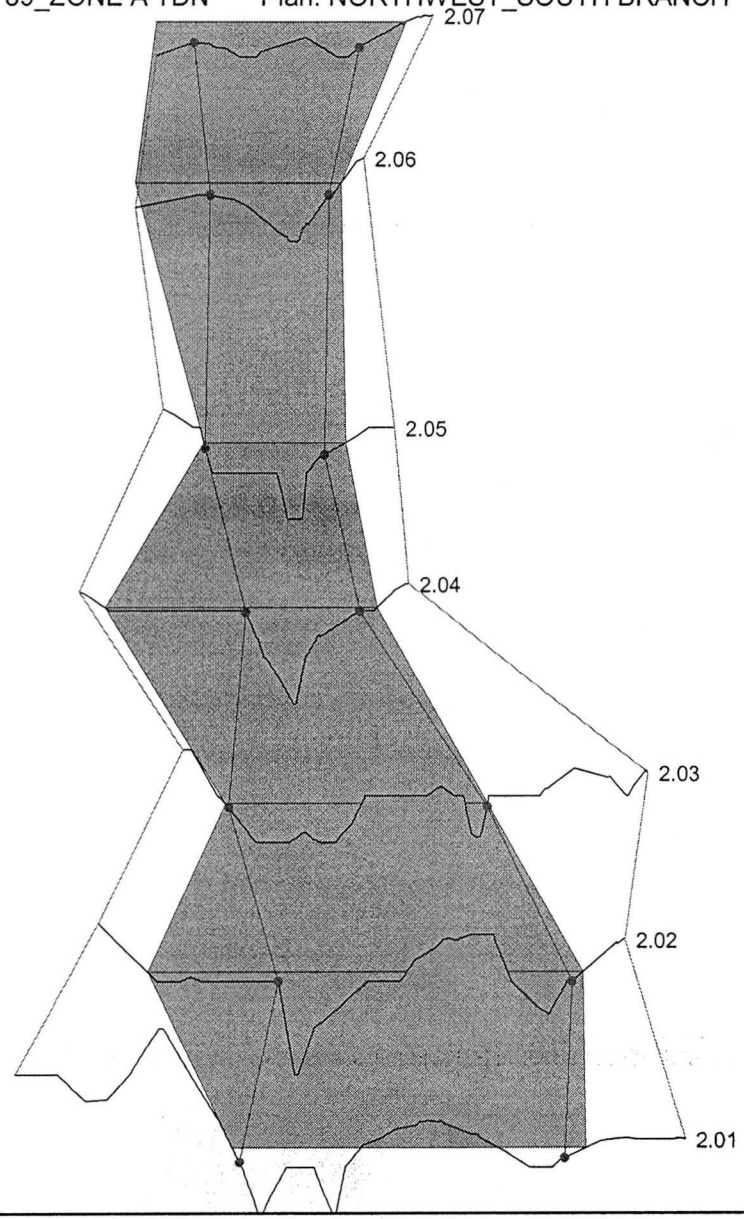
HEC-RAS OUTPUT
FOR
NORTHWEST REACH, SOUTH BRANCH


2.07
2.06
NWST, STH BRN
FAN 39
2.05
2.04
2.03
2.02
2.01

HEC-RAS Plan: NW_SOUTH BRN River: FAN 39 Reach: NWST, STH BRN Profile: PF 1

Reach	River Sta	Profile	Q Total	W.S. Elev	Crit W.S.	Vel Chnl	Top Width	Froude # Chl	Left Sta Eff	Rght Sta Eff
			(cfs)	(ft)	(ft)	(ft/s)	(ft)		(ft)	(ft)
NWST, STH BRN	2.07	PF 1	250.00	1358.76	1358.58	2.49	205.06	0.57	22.23	227.29
NWST, STH BRN	2.06	PF 1	250.00	1355.26	1355.15	3.11	169.54	0.66	18.44	187.98
NWST, STH BRN	2.05	PF 1	250.00	1349.67	1349.44	3.16	116.22	0.62	39.56	155.78
NWST, STH BRN	2.04	PF 1	250.00	1346.07	1345.71	3.01	223.56	0.57	25.34	248.90
NWST, STH BRN	2.03	PF 1	250.00	1341.84	1341.68	3.09	129.91	0.68	131.14	345.67
NWST, STH BRN	2.02	PF 1	250.00	1338.21	1337.81	2.15	274.27	0.45	34.33	391.09
NWST, STH BRN	2.01	PF 1	250.00	1334.42	1334.25	2.80	176.58	0.65	81.79	370.84

FAN 39_ZONE A TDN Plan: NORTHWEST_SOUTH BRANCH 12/13/2007

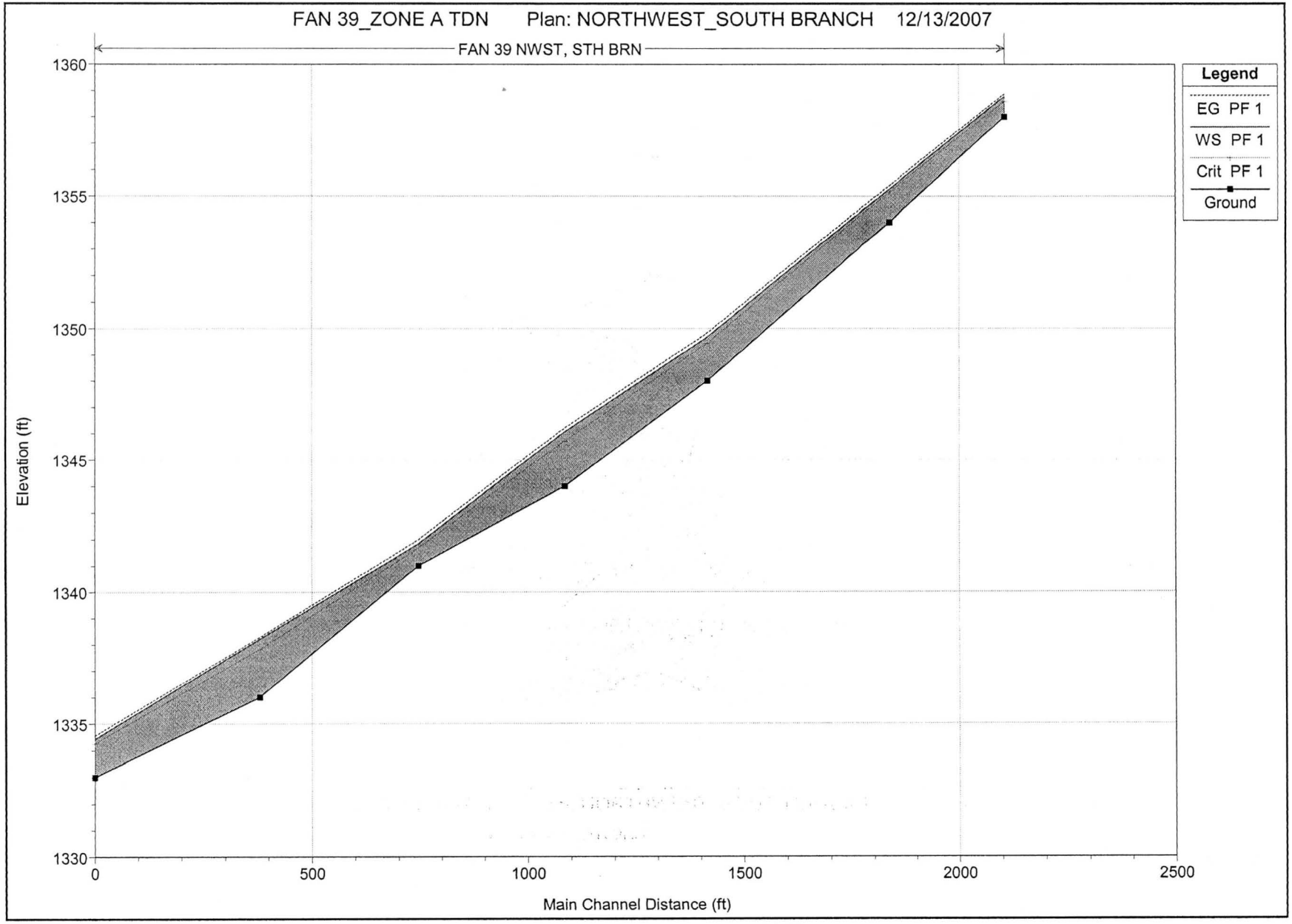


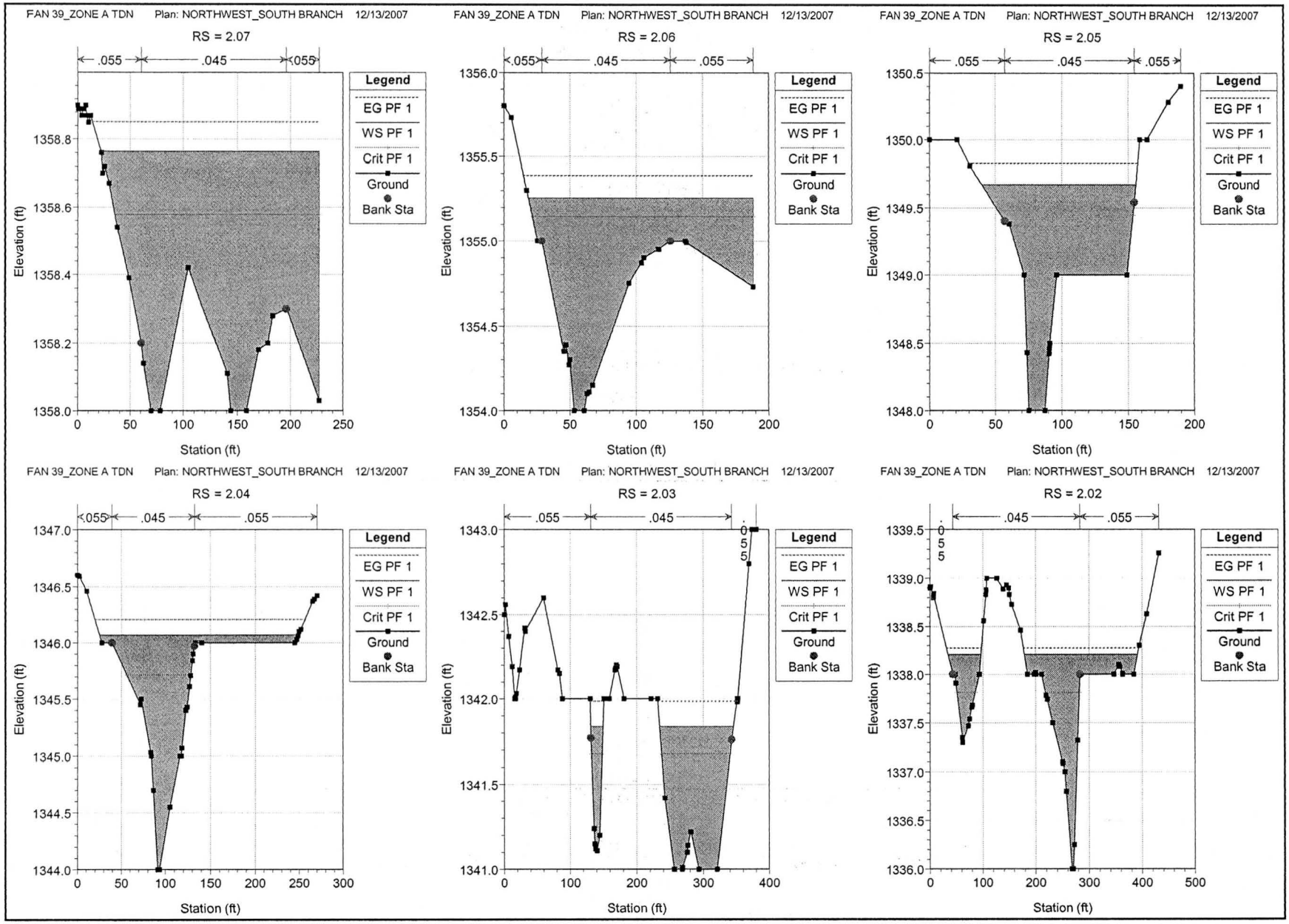
Legend

WS PF 1

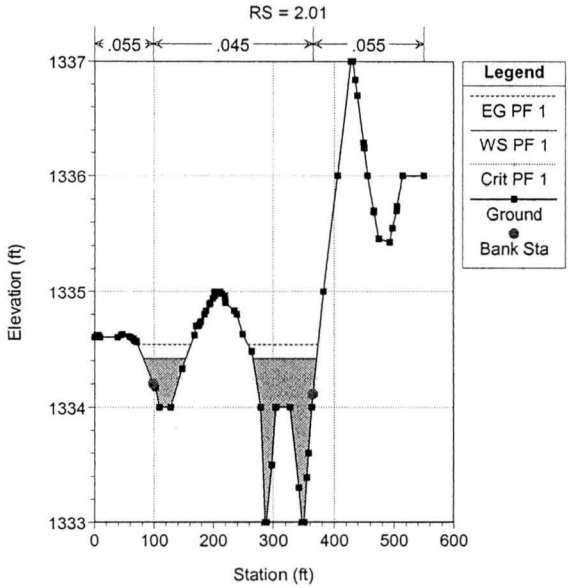
Ground

Bank Sta


FAN 39_ZONE A TDN Plan: NORTHWEST_SOUTH BRANCH 12/13/2007
FAN 39 NWST, STH BRN
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Elevation (ft)
1360
1355
1350
1345
1340
1335
1330
0
500
1000
1500
2000
2500
Main Channel Distance (ft)

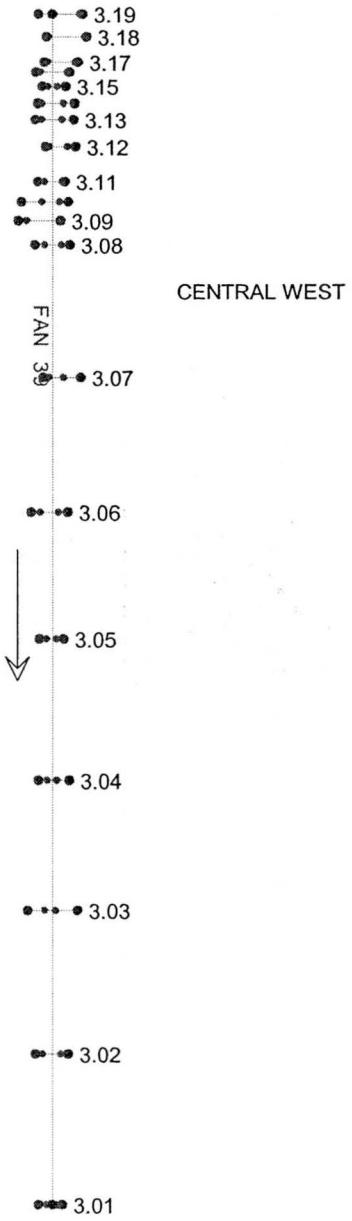

FAN 39_ZONE A TDN Plan: NORTHWEST_SOUTH BRANCH 12/13/2007
RS = 2.07
.055 .045 .055
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
FAN 39_ZONE A TDN Plan: NORTHWEST_SOUTH BRANCH 12/13/2007
RS = 2.06
.055 .045 .055
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
FAN 39_ZONE A TDN Plan: NORTHWEST_SOUTH BRANCH 12/13/2007
RS = 2.05
.055 .045 .055
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
FAN 39_ZONE A TDN Plan: NORTHWEST_SOUTH BRANCH 12/13/2007
RS = 2.04
.055 .045 .055
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
FAN 39_ZONE A TDN Plan: NORTHWEST_SOUTH BRANCH 12/13/2007
RS = 2.03
.055 .045 .055
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
FAN 39_ZONE A TDN Plan: NORTHWEST_SOUTH BRANCH 12/13/2007
RS = 2.02
.055 .045 .055
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)

FAN 39_ZONE A TDN Plan: NORTHWEST_SOUTH BRANCH 12/13/2007



APPENDIX E.3

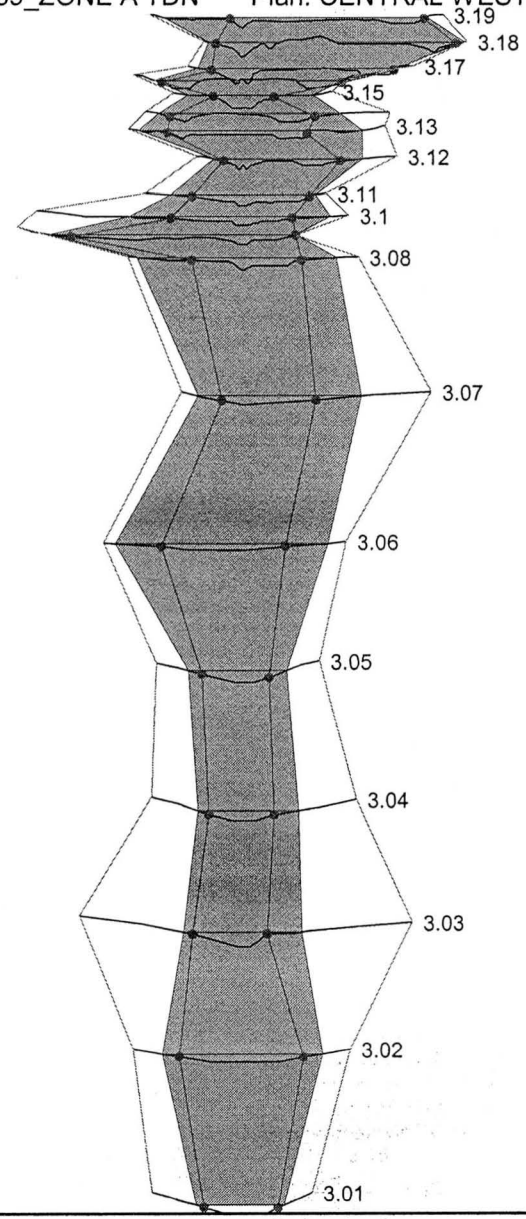
HEC-RAS OUTPUT
FOR
CENTRAL WEST REACH

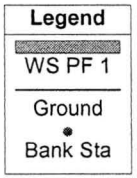

3.19
3.18
3.17
3.15
3.13
3.12
3.11
3.09
3.08
CENTRAL WEST
FAN 39
3.07
3.06
3.05
3.04
3.03
3.02
3.01

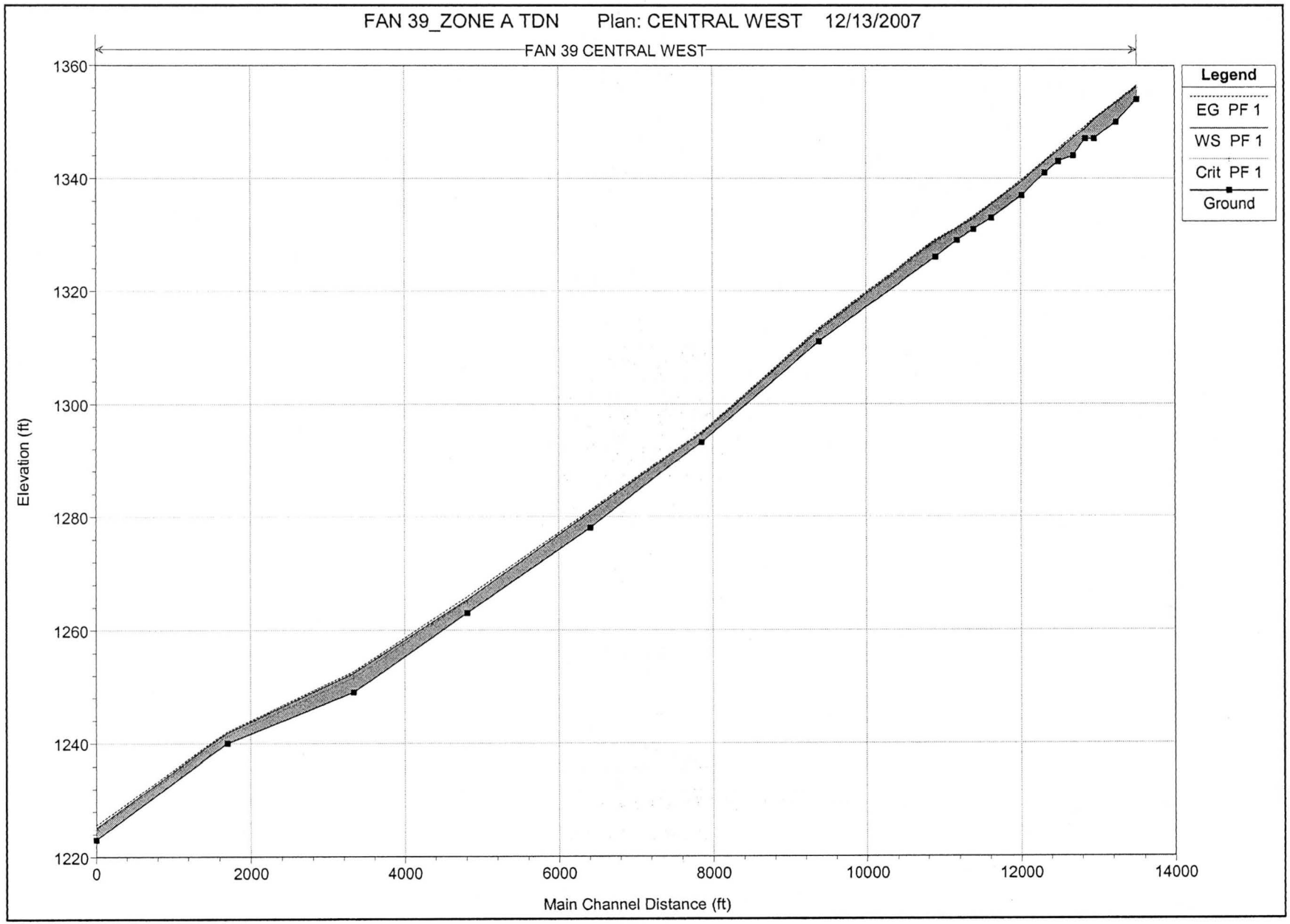
HEC-RAS Plan: CENTRAL WEST River: FAN 39 Reach: CENTRAL WEST Profile: PF 1

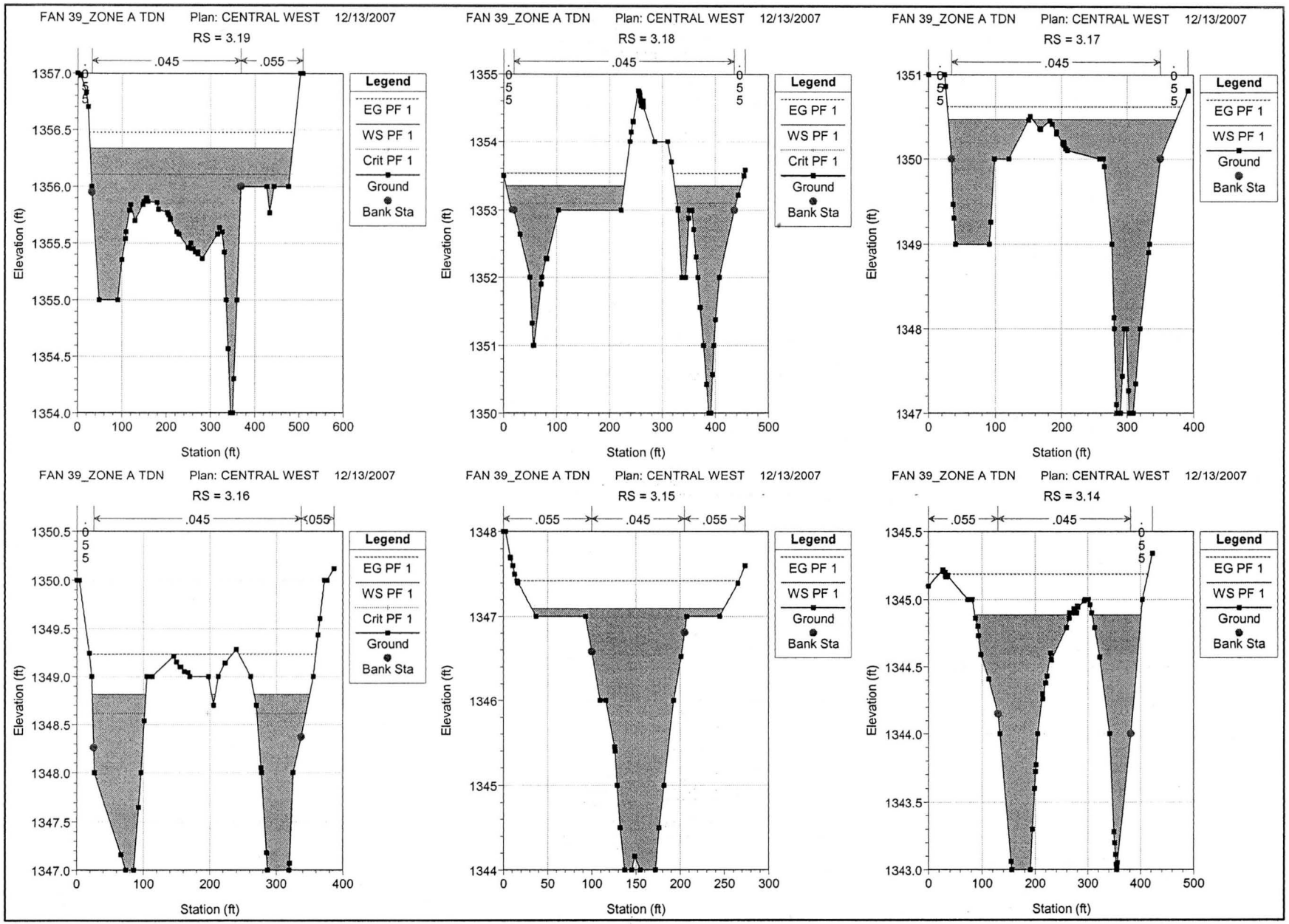
Reach	River Sta	Profile	Q Total	W.S. Elev	Crit W.S.	Vel Chnl	Top Width	Froude # Chl	Left Sta Eff	Rght Sta Eff
			(cfs)	(ft)	(ft)	(ft/s)	(ft)		(ft)	(ft)
CENTRAL WEST	3.19	PF 1	1000.00	1356.33	1356.11	3.13	457.77	0.58	27.55	485.32
CENTRAL WEST	3.18	PF 1	1000.00	1353.36	1353.10	3.41	348.25	0.63	4.25	448.09
CENTRAL WEST	3.17	PF 1	1000.00	1350.47		3.12	339.03	0.54	29.60	373.97
CENTRAL WEST	3.16	PF 1	1000.00	1348.82	1348.62	5.17	169.79	0.82	22.97	350.07
CENTRAL WEST	3.15	PF 1	1000.00	1347.09		4.64	217.06	0.57	32.46	249.51
CENTRAL WEST	3.14	PF 1	1000.00	1344.88		4.52	270.87	0.79	86.51	401.01
CENTRAL WEST	3.13	PF 1	1000.00	1342.94	1342.54	3.28	355.89	0.53	39.38	428.26
CENTRAL WEST	3.12	PF 1	1000.00	1339.44		4.53	257.62	0.77	60.17	317.79
CENTRAL WEST	3.11	PF 1	1000.00	1335.41		3.48	250.16	0.52	18.67	269.99
CENTRAL WEST	3.1	PF 1	1000.00	1332.98	1332.85	4.22	350.18	0.72	31.29	381.47
CENTRAL WEST	3.09	PF 1	1000.00	1331.15	1330.74	2.56	428.41	0.45	0.00	428.41
CENTRAL WEST	3.08	PF 1	1250.00	1328.84	1328.53	4.17	346.64	0.61	38.33	384.97
CENTRAL WEST	3.07	PF 1	1250.00	1313.00	1312.71	4.59	282.29	0.66	121.52	403.82
CENTRAL WEST	3.06	PF 1	1250.00	1294.71	1294.51	4.38	370.07	0.69	30.75	400.82
CENTRAL WEST	3.05	PF 1	1250.00	1280.77		4.72	170.82	0.57	55.71	226.53
CENTRAL WEST	3.04	PF 1	1250.00	1265.34	1265.07	5.69	174.44	0.73	99.25	273.70
CENTRAL WEST	3.03	PF 1	1250.00	1252.43	1251.61	4.40	204.97	0.53	191.13	396.10
CENTRAL WEST	3.02	PF 1	1250.00	1241.83	1241.28	3.65	277.92	0.51	47.61	325.53
CENTRAL WEST	3.01	PF 1	1250.00	1225.05	1224.81	5.73	152.29	0.78	47.88	200.17

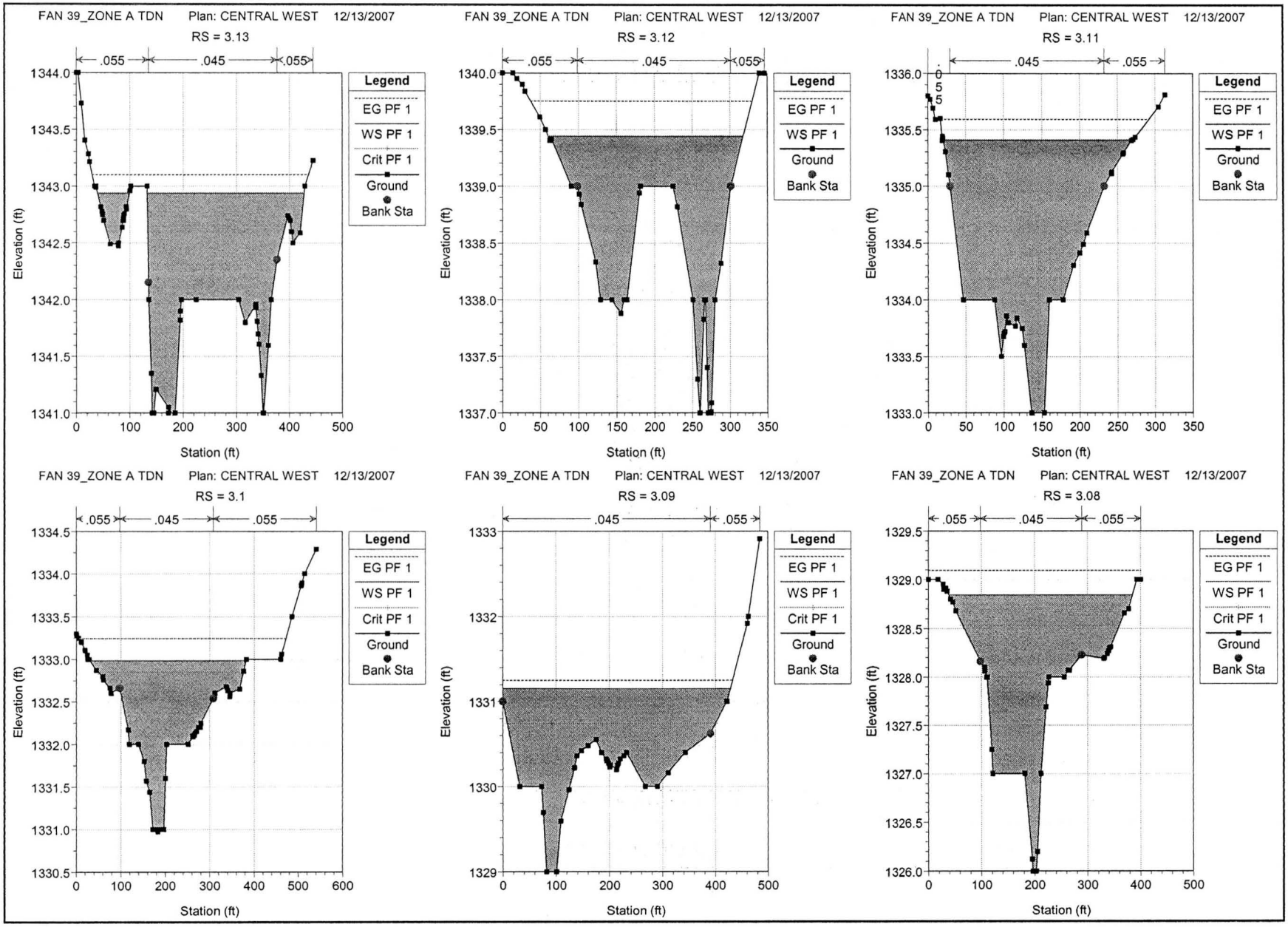
FAN 39_ZONE A TDN Plan: CENTRAL WEST 12/13/2007

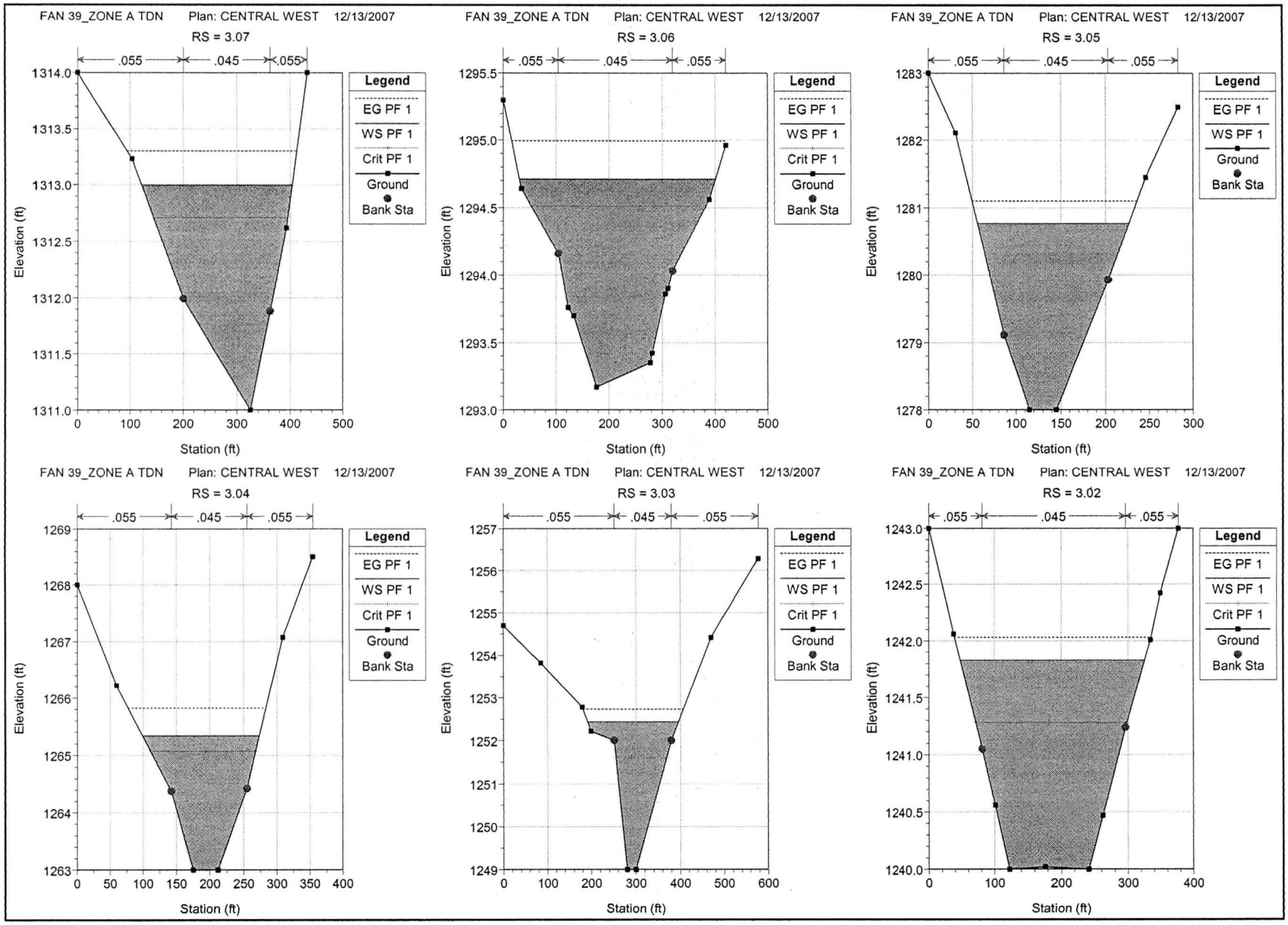





FAN 39_ZONE A TDN Plan: CENTRAL WEST 12/13/2007
FAN 39 CENTRAL WEST
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Elevation (ft)
1360
1340
1320
1300
1280
1260
1240
1220
0
2000
4000
6000
8000
10000
12000
14000
Main Channel Distance (ft)

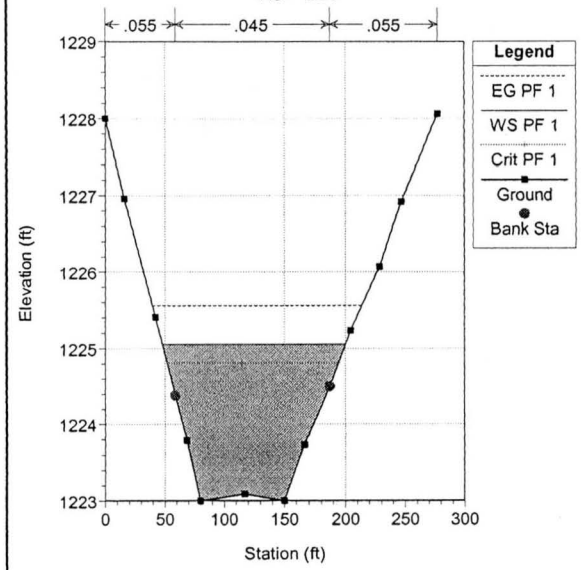

FAN 39_ZONE A TDN Plan: CENTRAL WEST 12/13/2007
RS = 3.19
.045
.055
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
FAN 39_ZONE A TDN Plan: CENTRAL WEST 12/13/2007
RS = 3.18
.045
.055
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
FAN 39_ZONE A TDN Plan: CENTRAL WEST 12/13/2007
RS = 3.17
.045
.055
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
FAN 39_ZONE A TDN Plan: CENTRAL WEST 12/13/2007
RS = 3.16
.045
.055
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
FAN 39_ZONE A TDN Plan: CENTRAL WEST 12/13/2007
RS = 3.15
.055
.045
.055
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
FAN 39_ZONE A TDN Plan: CENTRAL WEST 12/13/2007
RS = 3.14
.055
.045
.055
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)


FAN 39_ZONE A TDN Plan: CENTRAL WEST 12/13/2007
RS = 3.13
.055 .045 .055
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
FAN 39_ZONE A TDN Plan: CENTRAL WEST 12/13/2007
RS = 3.12
.055 .045 .055
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
FAN 39_ZONE A TDN Plan: CENTRAL WEST 12/13/2007
RS = 3.11
.045 .055
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
FAN 39_ZONE A TDN Plan: CENTRAL WEST 12/13/2007
RS = 3.1
.055 .045 .055
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
FAN 39_ZONE A TDN Plan: CENTRAL WEST 12/13/2007
RS = 3.09
.045 .055
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
FAN 39_ZONE A TDN Plan: CENTRAL WEST 12/13/2007
RS = 3.08
.055 .045 .055
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)


FAN 39_ZONE A TDN Plan: CENTRAL WEST 12/13/2007
RS = 3.07
.055 .045 .055
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
FAN 39_ZONE A TDN Plan: CENTRAL WEST 12/13/2007
RS = 3.06
.055 .045 .055
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
FAN 39_ZONE A TDN Plan: CENTRAL WEST 12/13/2007
RS = 3.05
.055 .045 .055
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
FAN 39_ZONE A TDN Plan: CENTRAL WEST 12/13/2007
RS = 3.04
.055 .045 .055
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
FAN 39_ZONE A TDN Plan: CENTRAL WEST 12/13/2007
RS = 3.03
.055 .045 .055
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
FAN 39_ZONE A TDN Plan: CENTRAL WEST 12/13/2007
RS = 3.02
.055 .045 .055
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta

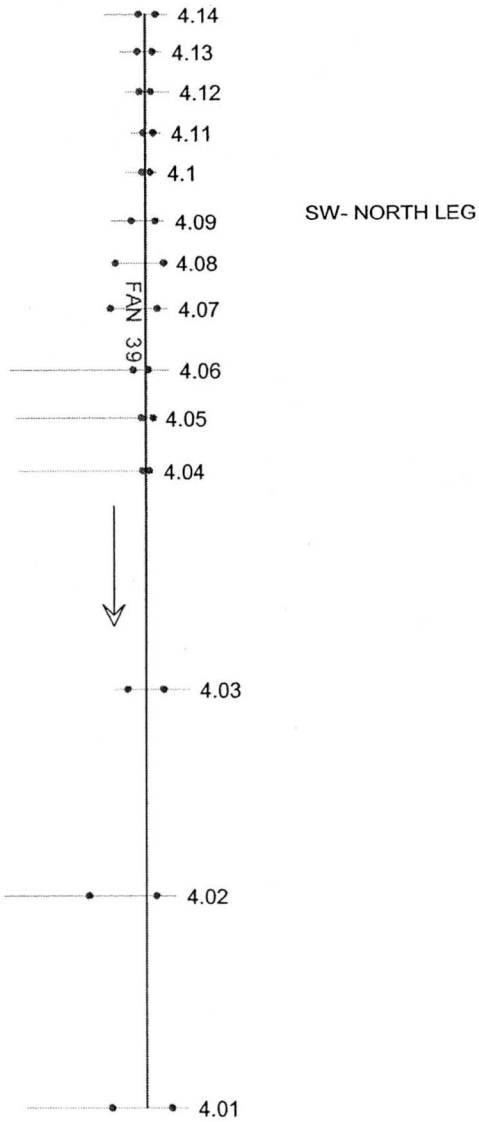
FAN 39_ZONE A TDN Plan: CENTRAL WEST 12/13/2007

RS = 3.01



APPENDIX E.4

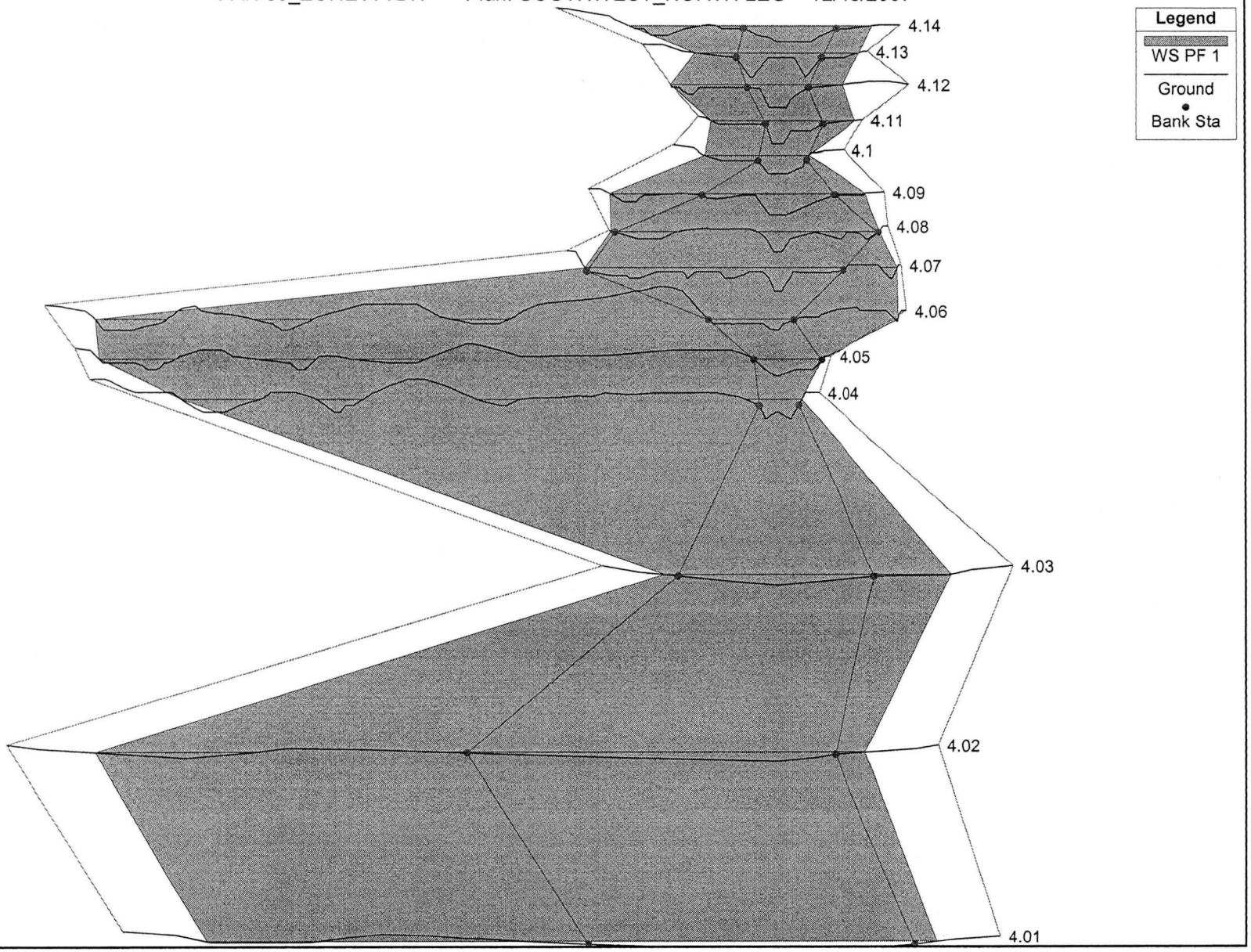
HEC-RAS OUTPUT
FOR
SOUTHWEST REACH, NORTH LEG

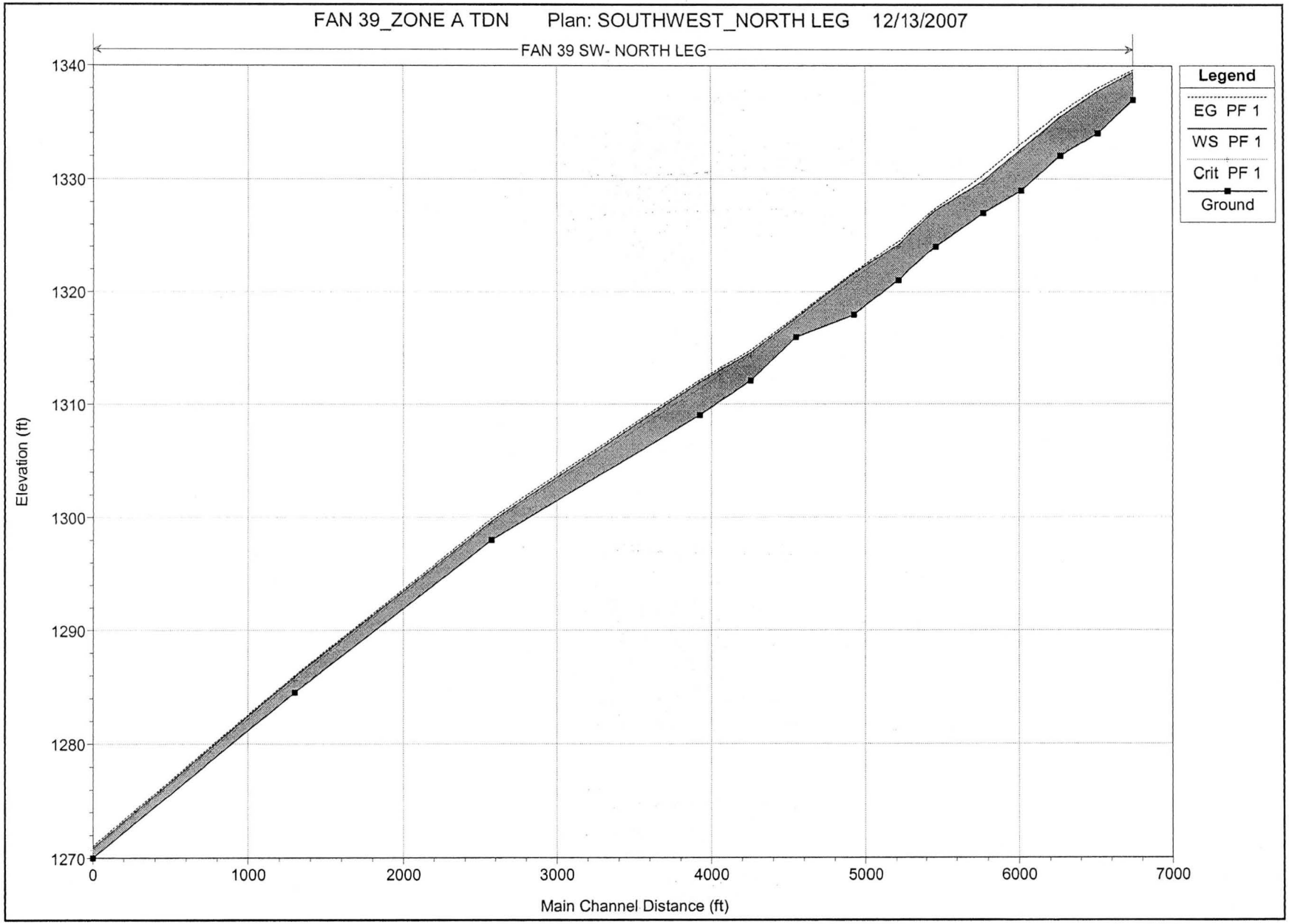

4.14
4.13
4.12
4.11
4.1
4.09
4.08
4.07
FAN 39
4.06
4.05
4.04
4.03
4.02
4.01
SW- NORTH LEG

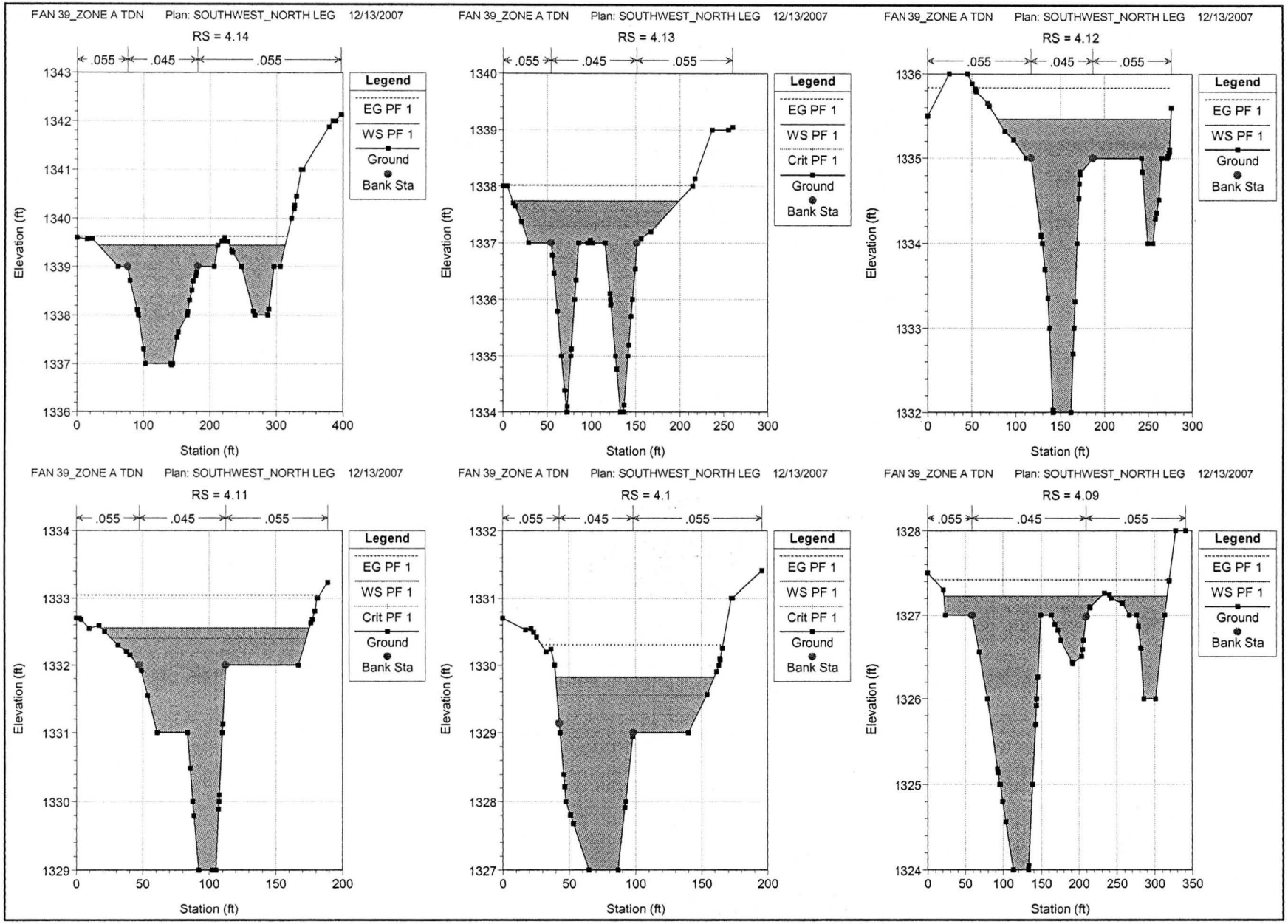
HEC-RAS Plan: SOUTHWEST_NO River: FAN 39 Reach: SW- NORTH LEG Profile: PF 1

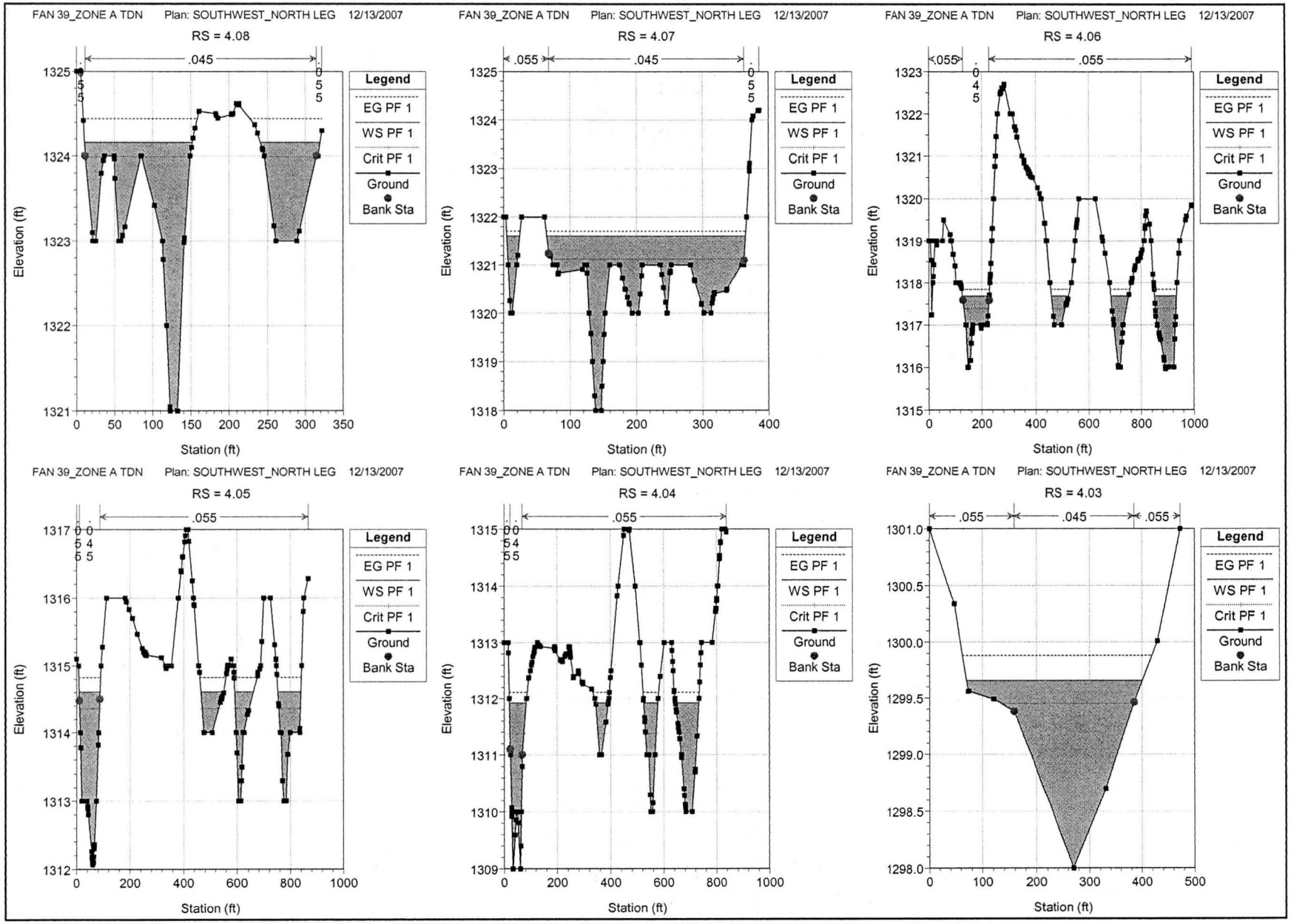
Reach	River Sta	Profile	Q Total	W.S. Elev	Crit W.S.	Vel Chnl	Top Width	Froude # Chl	Left Sta Eff	Rght Sta Eff
			(cfs)	(ft)	(ft)	(ft/s)	(ft)		(ft)	(ft)
SW- NORTH LEG	4.14	PF 1	850.00	1339.44		3.74	265.53	0.49	31.68	313.37
SW- NORTH LEG	4.13	PF 1	850.00	1337.74	1337.30	4.39	189.00	0.57	10.34	199.34
SW- NORTH LEG	4.12	PF 1	850.00	1335.47		5.20	196.40	0.65	78.96	275.36
SW- NORTH LEG	4.11	PF 1	850.00	1332.56	1332.40	5.85	157.74	0.72	9.47	175.28
SW- NORTH LEG	4.1	PF 1	850.00	1329.82	1329.55	5.87	119.60	0.68	39.92	159.52
SW- NORTH LEG	4.09	PF 1	850.00	1327.23		3.68	283.46	0.55	21.80	316.66
SW- NORTH LEG	4.08	PF 1	850.00	1324.16	1323.99	4.27	221.22	0.78	10.36	319.70
SW- NORTH LEG	4.07	PF 1	850.00	1321.61	1321.13	2.59	319.30	0.44	4.63	364.78
SW- NORTH LEG	4.06	PF 1	850.00	1317.69	1317.39	3.27	322.07	0.65	9.72	932.94
SW- NORTH LEG	4.05	PF 1	850.00	1314.61	1314.36	4.41	321.25	0.61	10.38	840.23
SW- NORTH LEG	4.04	PF 1	850.00	1311.92	1311.37	4.35	252.61	0.52	19.45	731.80
SW- NORTH LEG	4.03	PF 1	850.00	1299.66	1299.45	3.82	330.70	0.68	70.37	401.08
SW- NORTH LEG	4.02	PF 1	1050.00	1285.88	1285.60	2.72	663.10	0.53	84.27	969.49
SW- NORTH LEG	4.01	PF 1	1050.00	1270.86	1270.70	3.44	595.70	0.68	71.58	911.38

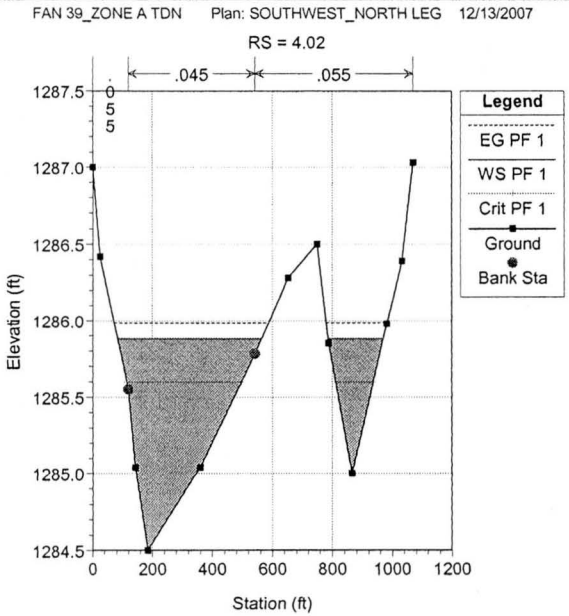
FAN 39_ZONE A TDN Plan: SOUTHWEST_NORTH LEG 12/13/2007

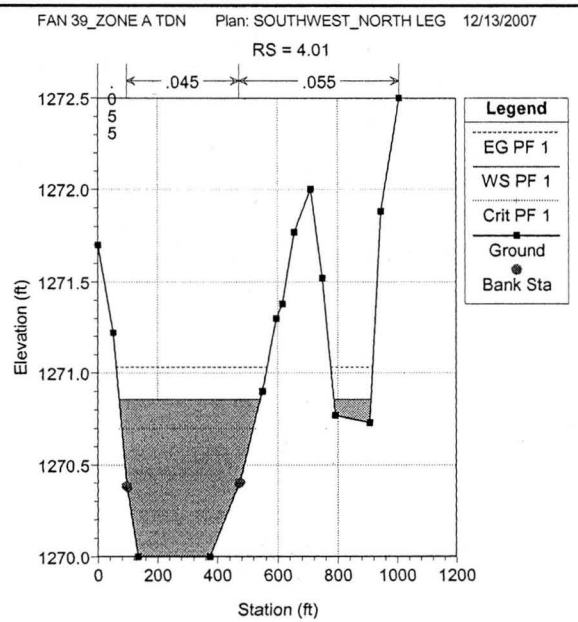



FAN 39_ZONE A TDN Plan: SOUTHWEST_NORTH LEG 12/13/2007
FAN 39 SW- NORTH LEG
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Elevation (ft)
1340
1330
1320
1310
1300
1290
1280
1270
0
1000
2000
3000
4000
5000
6000
7000
Main Channel Distance (ft)


FAN 39_ZONE A TDN Plan: SOUTHWEST_NORTH LEG 12/13/2007
RS = 4.14
.055 .045 .055
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
FAN 39_ZONE A TDN Plan: SOUTHWEST_NORTH LEG 12/13/2007
RS = 4.13
.055 .045 .055
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
FAN 39_ZONE A TDN Plan: SOUTHWEST_NORTH LEG 12/13/2007
RS = 4.12
.055 .045 .055
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
FAN 39_ZONE A TDN Plan: SOUTHWEST_NORTH LEG 12/13/2007
RS = 4.11
.055 .045 .055
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
FAN 39_ZONE A TDN Plan: SOUTHWEST_NORTH LEG 12/13/2007
RS = 4.1
.055 .045 .055
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
FAN 39_ZONE A TDN Plan: SOUTHWEST_NORTH LEG 12/13/2007
RS = 4.09
.055 .045 .055
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)

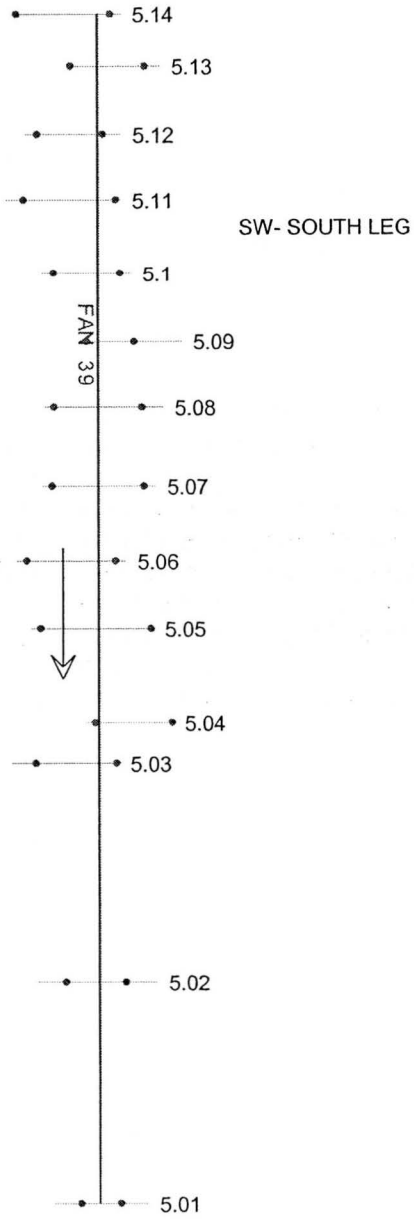

FAN 39_ZONE A TDN Plan: SOUTHWEST_NORTH LEG 12/13/2007
RS = 4.08
.045
.055
.055
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
FAN 39_ZONE A TDN Plan: SOUTHWEST_NORTH LEG 12/13/2007
RS = 4.07
.055
.045
.055
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
FAN 39_ZONE A TDN Plan: SOUTHWEST_NORTH LEG 12/13/2007
RS = 4.06
.055
.045
.055
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
FAN 39_ZONE A TDN Plan: SOUTHWEST_NORTH LEG 12/13/2007
RS = 4.05
.055
.055
.045
.055
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
FAN 39_ZONE A TDN Plan: SOUTHWEST_NORTH LEG 12/13/2007
RS = 4.04
.055
.055
.045
.055
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
FAN 39_ZONE A TDN Plan: SOUTHWEST_NORTH LEG 12/13/2007
RS = 4.03
.055
.045
.055
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)


FAN 39_ZONE A TDN Plan: SOUTHWEST_NORTH LEG 12/13/2007
RS = 4.02
.045
.055
.055
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
1287.5
1287.0
1286.5
1286.0
1285.5
1285.0
1284.5
0
200
400
600
800
1000
1200


FAN 39_ZONE A TDN Plan: SOUTHWEST_NORTH LEG 12/13/2007
RS = 4.01
.045
.055
.055
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
1272.5
1272.0
1271.5
1271.0
1270.5
1270.0
0
200
400
600
800
1000
1200

APPENDIX E.5

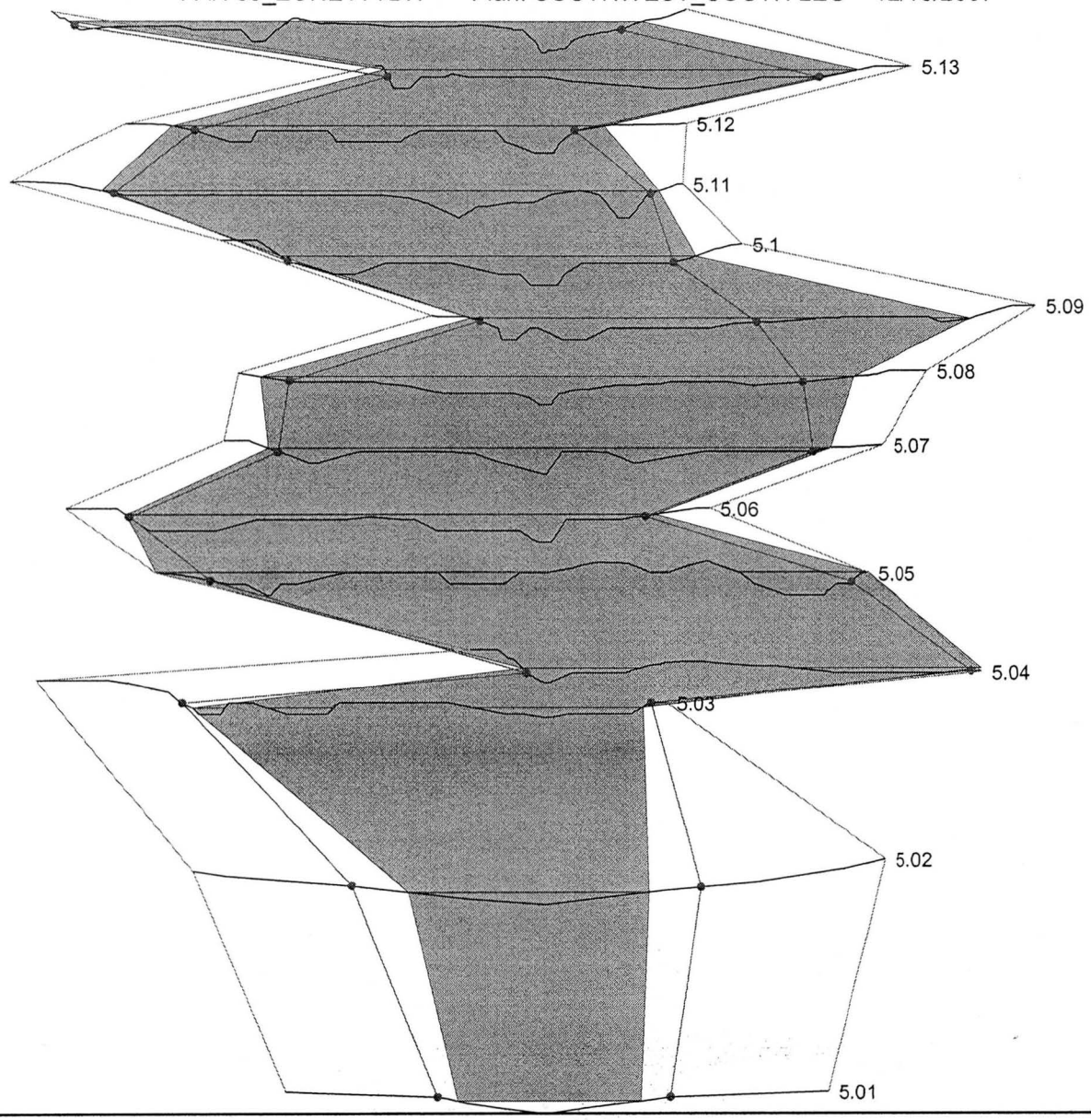
HEC-RAS OUTPUT
FOR
SOUTHWEST REACH, SOUTH LEG


5.14
5.13
5.12
5.11
SW- SOUTH LEG
5.1
FAN 39
5.09
5.08
5.07
5.06
5.05
5.04
5.03
5.02
5.01

HEC-RAS Plan: SW_SOUTH LEG River: FAN 39 Reach: SW- SOUTH LEG Profile: PF 1

Reach	River Sta	Profile	Q Total	W.S. Elev	Crit W.S.	Vel Chnl	Top Width	Froude # Chl	Left Sta Eff	Rght Sta Eff
			(cfs)	(ft)	(ft)	(ft/s)	(ft)		(ft)	(ft)
SW- SOUTH LEG	5.14	PF 1	850.00	1336.71	1336.52	3.32	366.12	0.69	29.75	410.92
SW- SOUTH LEG	5.13	PF 1	850.00	1334.66	1334.28	2.86	316.33	0.50	35.30	351.64
SW- SOUTH LEG	5.12	PF 1	850.00	1332.42		3.28	288.26	0.57	54.89	343.15
SW- SOUTH LEG	5.11	PF 1	850.00	1329.38	1329.19	3.30	366.63	0.68	15.89	386.30
SW- SOUTH LEG	5.1	PF 1	850.00	1326.62		2.93	277.10	0.49	30.83	307.93
SW- SOUTH LEG	5.09	PF 1	850.00	1323.88	1323.70	4.29	257.00	0.74	43.10	376.13
SW- SOUTH LEG	5.08	PF 1	850.00	1321.49		2.62	395.62	0.48	48.93	444.55
SW- SOUTH LEG	5.07	PF 1	850.00	1318.33	1318.19	3.38	374.67	0.71	34.68	409.35
SW- SOUTH LEG	5.06	PF 1	850.00	1315.47	1315.05	2.62	351.98	0.47	36.31	388.29
SW- SOUTH LEG	5.05	PF 1	850.00	1313.06	1312.63	3.22	362.33	0.63	0.00	473.64
SW- SOUTH LEG	5.04	PF 1	200.00	1308.41	1308.29	2.36	202.27	0.63	0.00	305.97
SW- SOUTH LEG	5.03	PF 1	200.00	1306.60	1306.37	2.07	182.11	0.50	15.47	316.18
SW- SOUTH LEG	5.02	PF 1	200.00	1299.10	1298.81	2.14	159.66	0.49	156.97	316.63
SW- SOUTH LEG	5.01	PF 1	200.00	1289.63	1289.45	2.82	121.98	0.65	124.68	246.66

FAN 39_ZONE A TDN Plan: SOUTHWEST_SOUTH LEG 12/13/2007

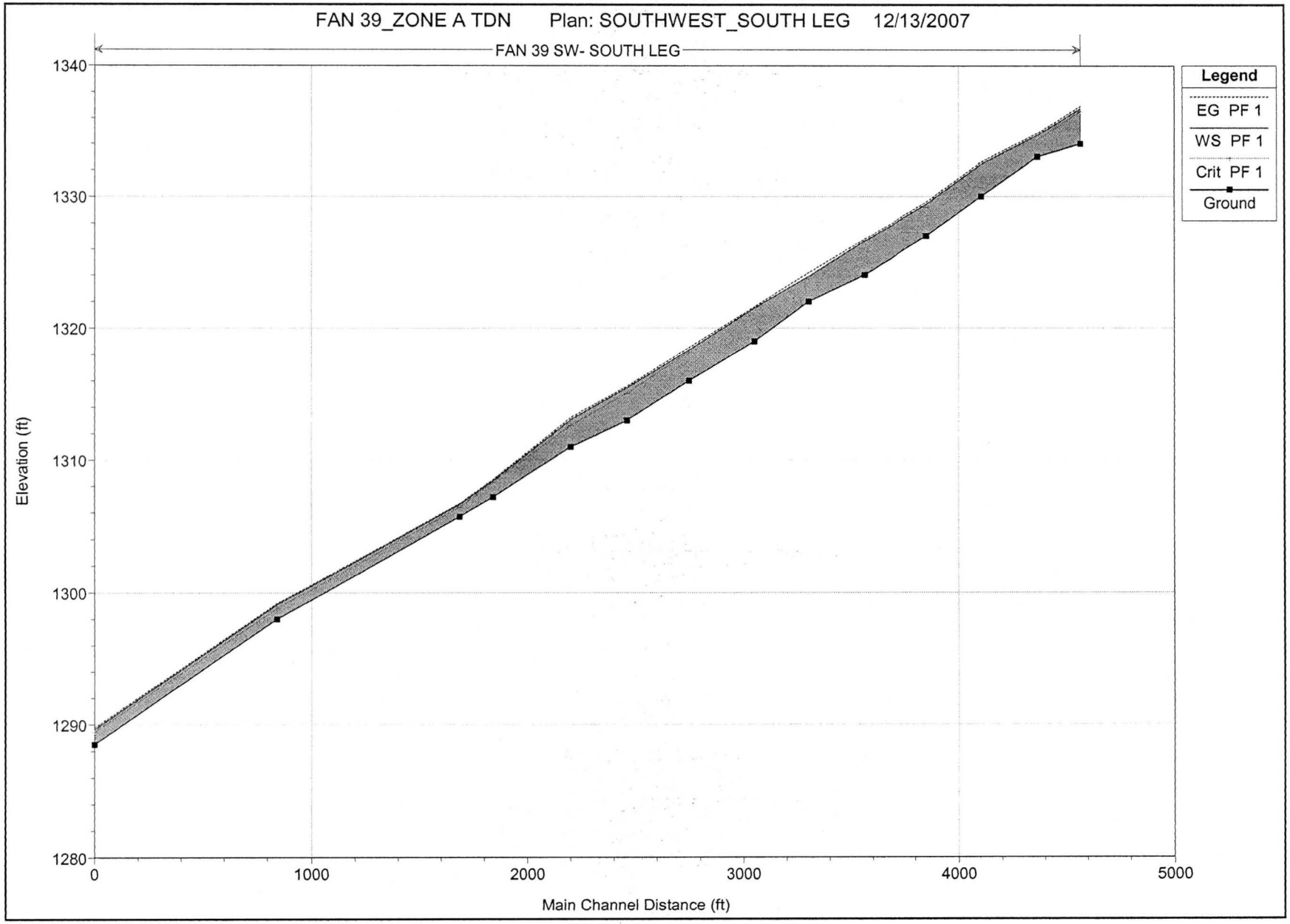


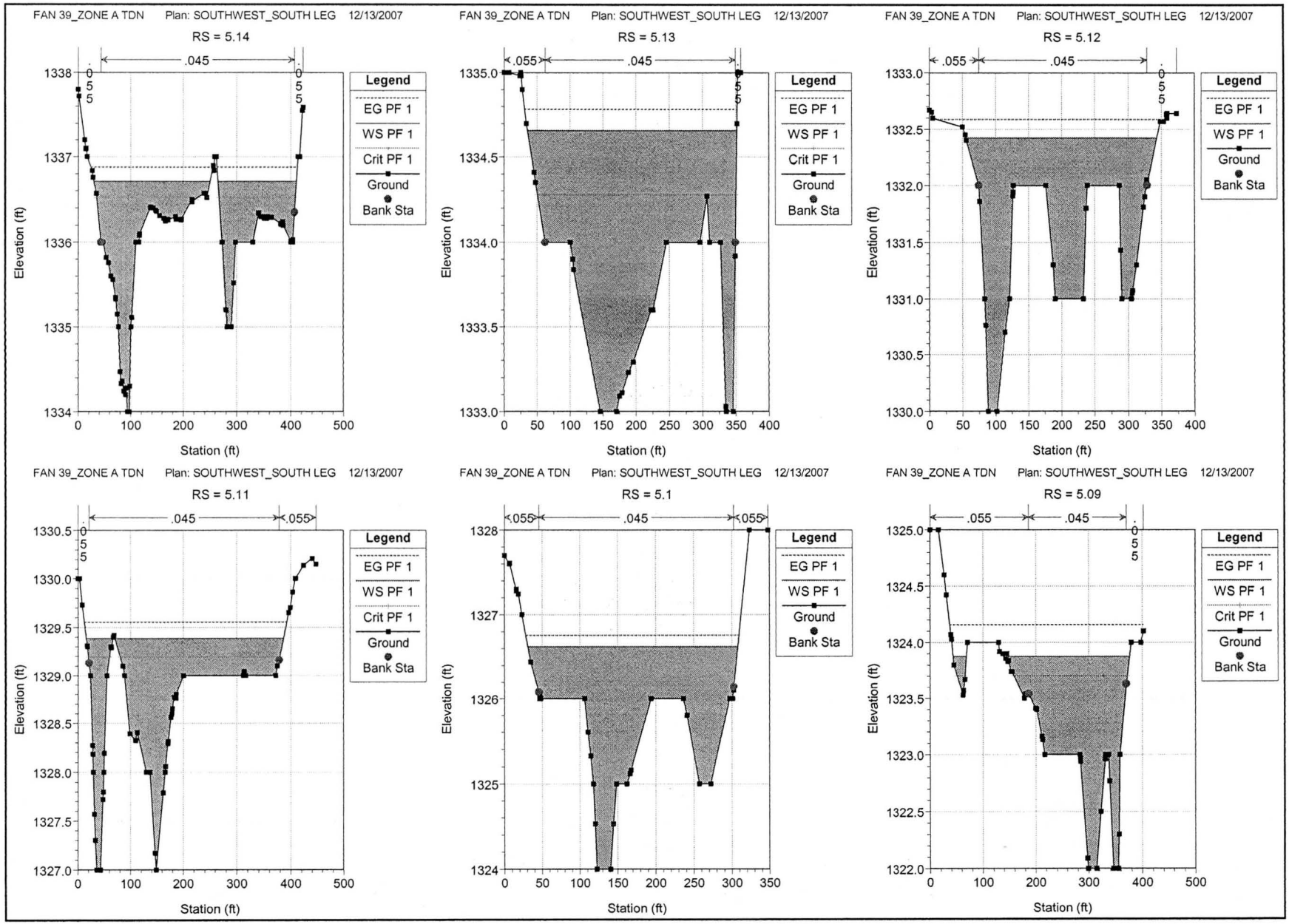
Legend

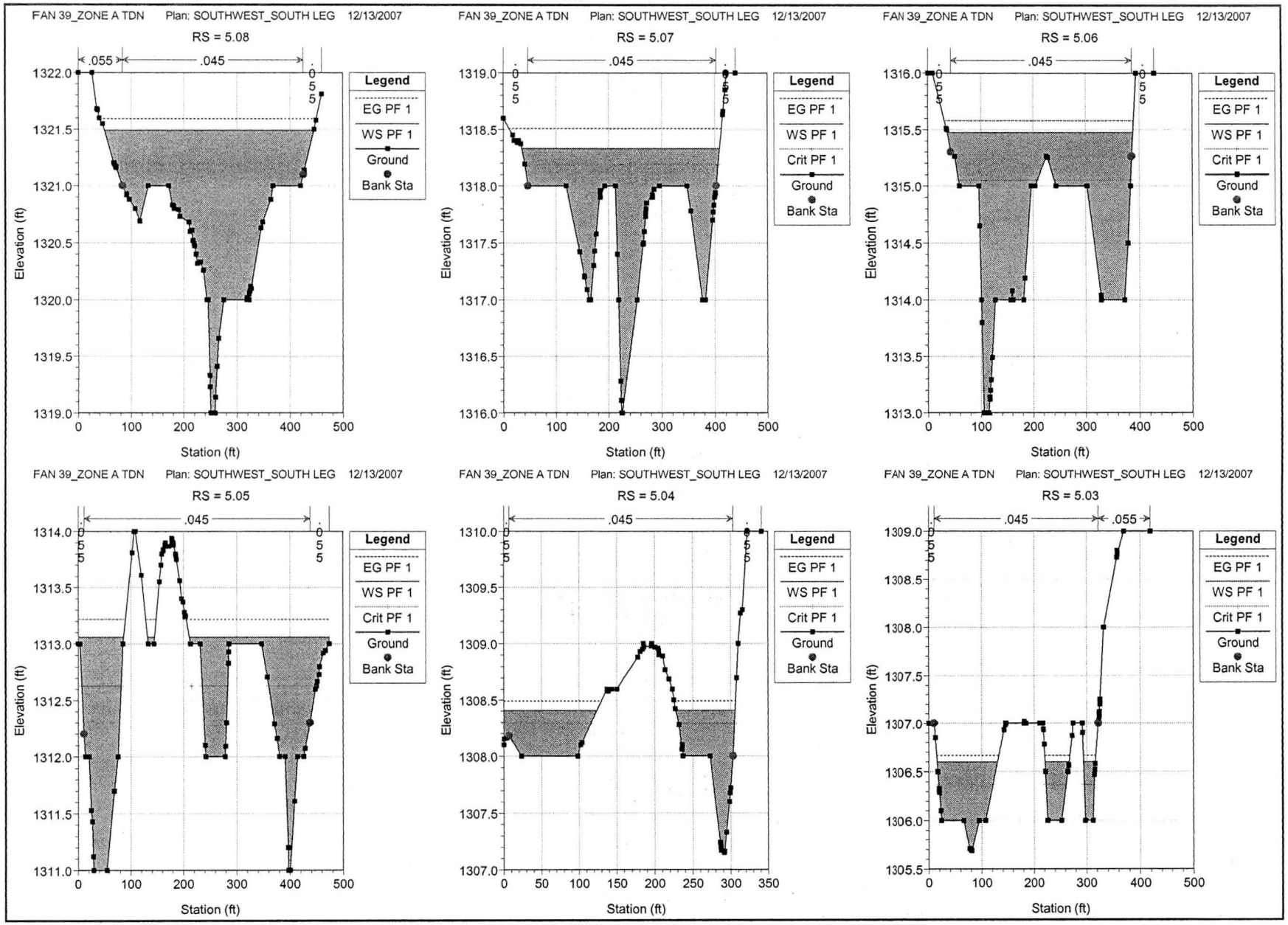
WS PF 1

Ground

Bank Sta

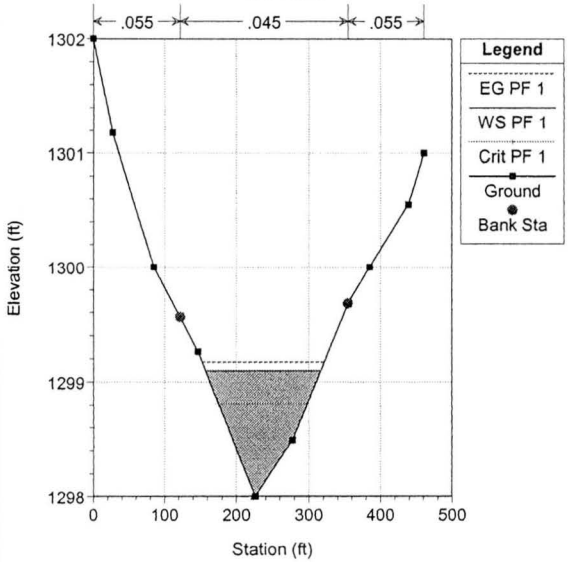

FAN 39_ZONE A TDN Plan: SOUTHWEST_SOUTH LEG 12/13/2007
FAN 39 SW- SOUTH LEG
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Elevation (ft)
1340
1330
1320
1310
1300
1290
1280
0
1000
2000
3000
4000
5000
Main Channel Distance (ft)


FAN 39_ZONE A TDN Plan: SOUTHWEST_SOUTH LEG 12/13/2007
RS = 5.14
.045
.055
.055
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
FAN 39_ZONE A TDN Plan: SOUTHWEST_SOUTH LEG 12/13/2007
RS = 5.13
.055
.045
.055
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
FAN 39_ZONE A TDN Plan: SOUTHWEST_SOUTH LEG 12/13/2007
RS = 5.12
.055
.045
.055
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
FAN 39_ZONE A TDN Plan: SOUTHWEST_SOUTH LEG 12/13/2007
RS = 5.11
.045
.055
.055
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
FAN 39_ZONE A TDN Plan: SOUTHWEST_SOUTH LEG 12/13/2007
RS = 5.1
.055
.045
.055
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
FAN 39_ZONE A TDN Plan: SOUTHWEST_SOUTH LEG 12/13/2007
RS = 5.09
.055
.045
.055
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)


FAN 39_ZONE A TDN Plan: SOUTHWEST_SOUTH LEG 12/13/2007
RS = 5.08
.055
.045
.055
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
FAN 39_ZONE A TDN Plan: SOUTHWEST_SOUTH LEG 12/13/2007
RS = 5.07
.055
.045
.055
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
FAN 39_ZONE A TDN Plan: SOUTHWEST_SOUTH LEG 12/13/2007
RS = 5.06
.055
.045
.055
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
FAN 39_ZONE A TDN Plan: SOUTHWEST_SOUTH LEG 12/13/2007
RS = 5.05
.055
.045
.055
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
FAN 39_ZONE A TDN Plan: SOUTHWEST_SOUTH LEG 12/13/2007
RS = 5.04
.055
.045
.055
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
FAN 39_ZONE A TDN Plan: SOUTHWEST_SOUTH LEG 12/13/2007
RS = 5.03
.055
.045
.055
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)

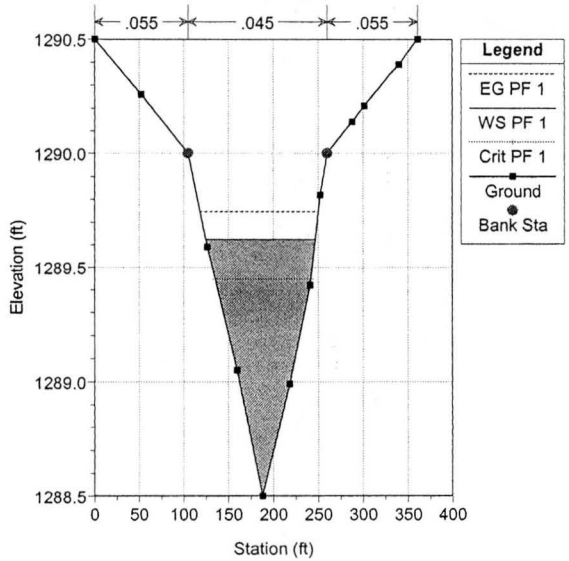
FAN 39_ZONE A TDN Plan: SOUTHWEST_SOUTH LEG 12/13/2007

RS = 5.02



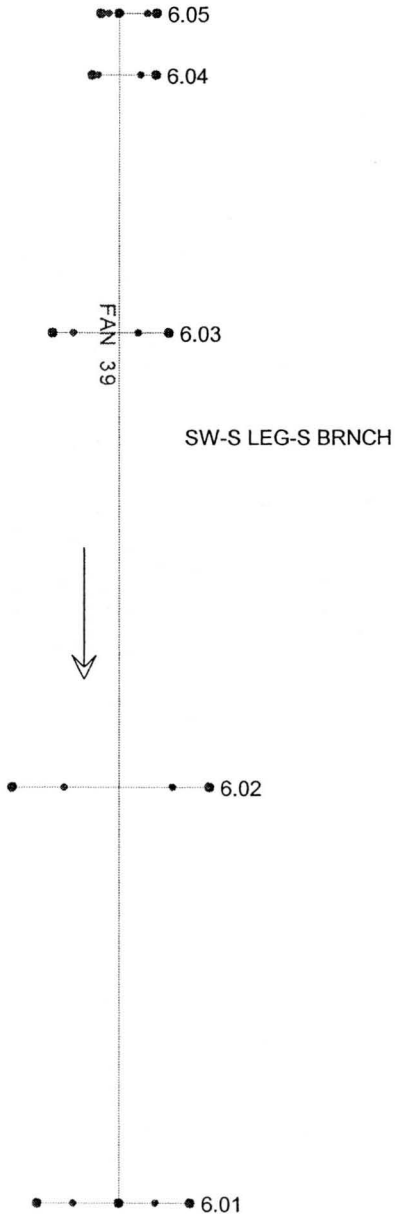
FAN 39_ZONE A TDN Plan: SOUTHWEST_SOUTH LEG 12/13/2007

RS = 5.01



APPENDIX E.6

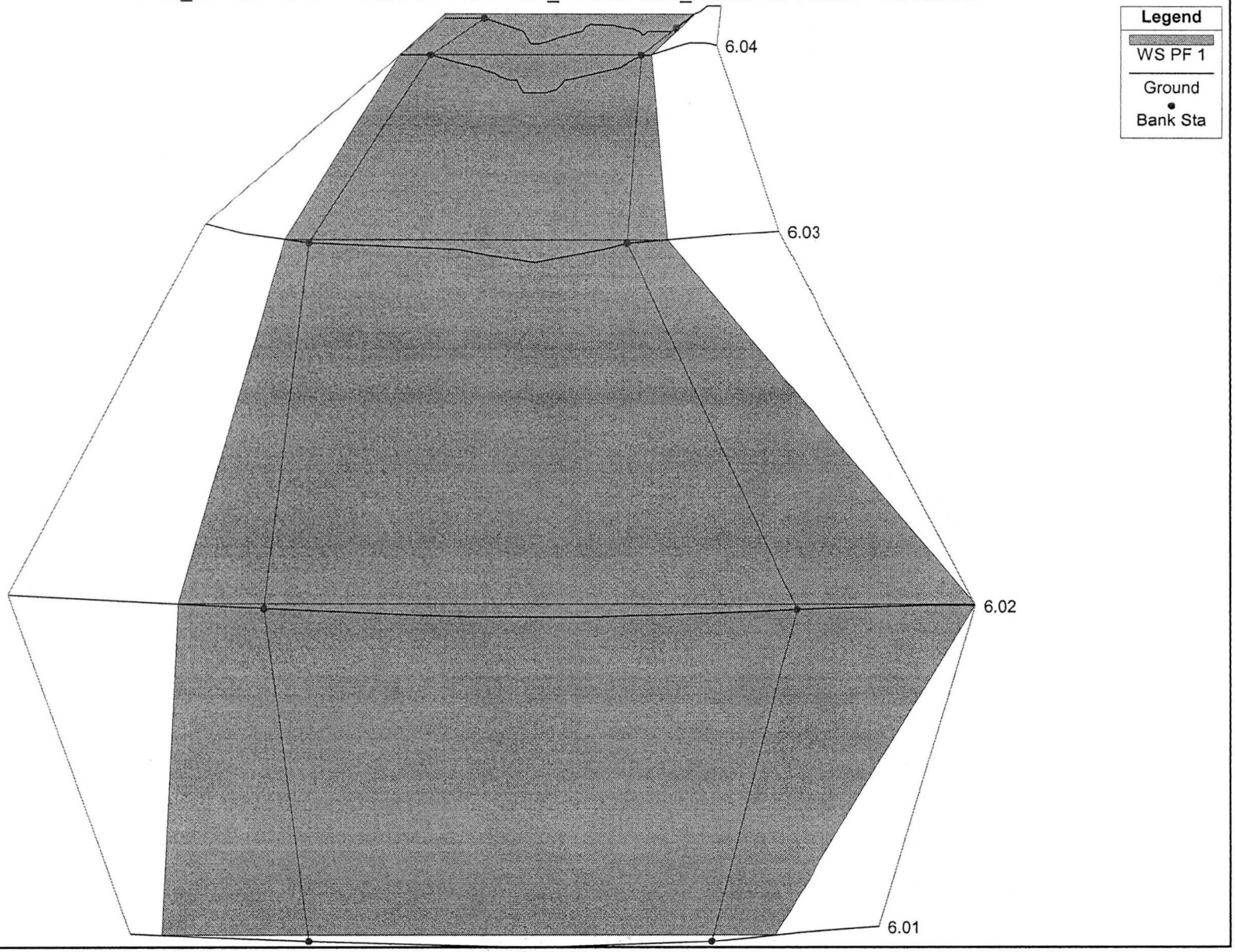
HEC-RAS OUTPUT
FOR
SOUTHWEST REACH, SOUTH LEG, SOUTH BRANCH

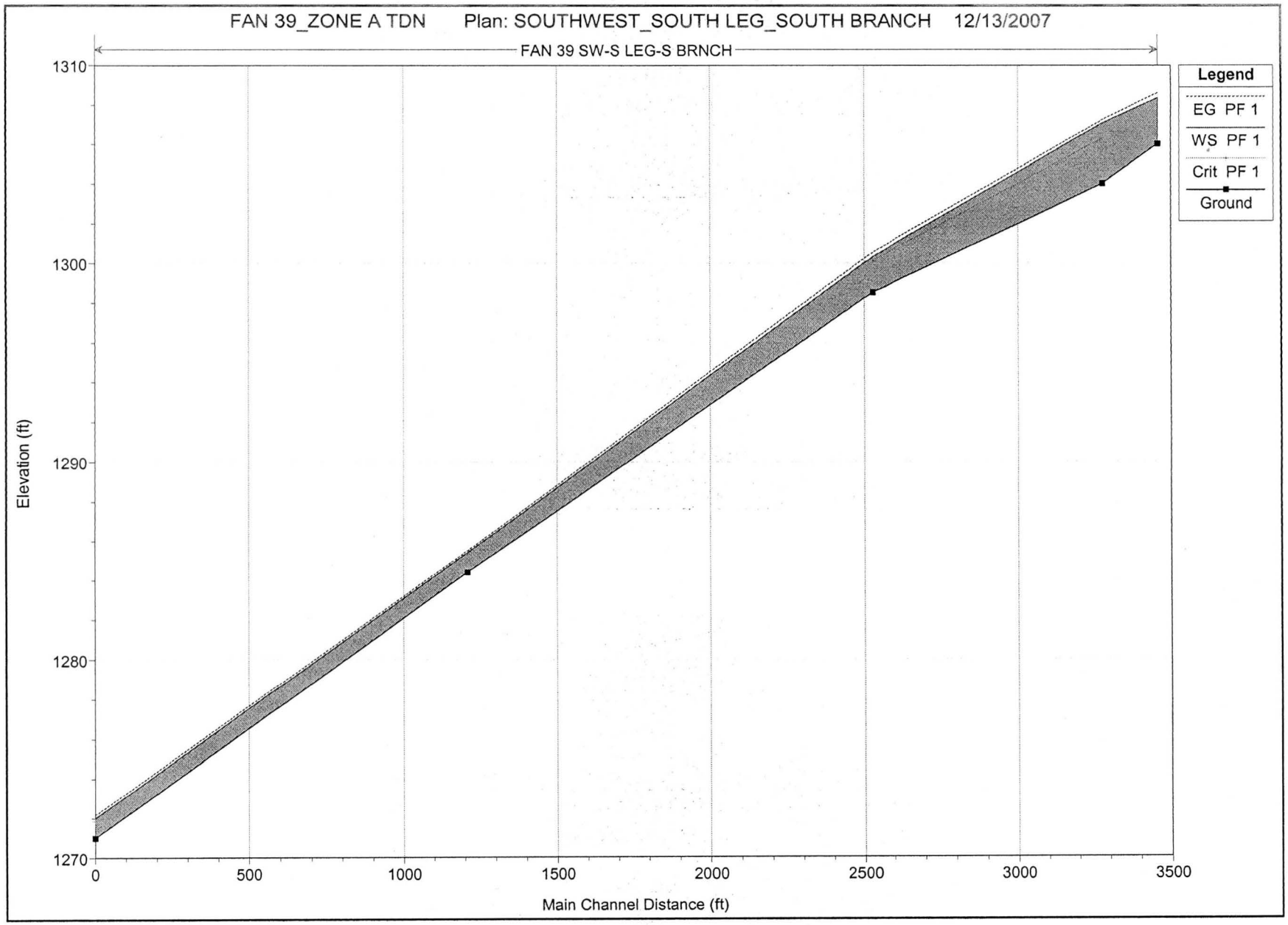

6.05
6.04
6.03
FAN 39
SW-S LEG-S BRNCH
6.02
6.01

HEC-RAS Plan: SOUTHWEST_SO River: FAN 39 Reach: SW-S LEG-S BRNCH Profile: PF 1

Reach	River Sta	Profile	Q Total	W.S. Elev	Crit W.S.	Vel Chnl	Top Width	Froude # Chl	Left Sta Eff	Rght Sta Eff
			(cfs)	(ft)	(ft)	(ft/s)	(ft)		(ft)	(ft)
SW-S LEG-S BRNCH	6.05	PF 1	650.00	1308.36		4.12	148.66	0.63	15.31	163.97
SW-S LEG-S BRNCH	6.04	PF 1	650.00	1307.06	1306.28	3.33	149.54	0.47	38.49	188.02
SW-S LEG-S BRNCH	6.03	PF 1	650.00	1300.29	1300.12	3.86	228.43	0.73	66.11	294.54
SW-S LEG-S BRNCH	6.02	PF 1	650.00	1285.39		2.56	474.42	0.51	0.00	474.42
SW-S LEG-S BRNCH	6.01	PF 1	650.00	1272.00	1271.86	3.35	364.18	0.68	62.35	426.53

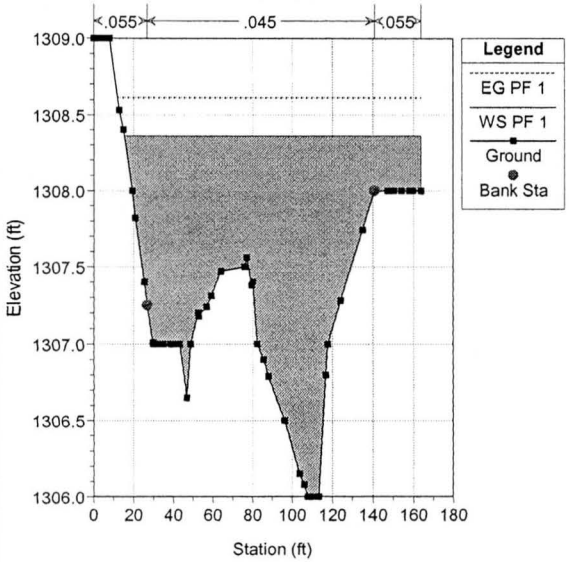
FAN 39_ZONE A TDN Plan: SOUTHWEST_SOUTH LEG_SOUTH BRANCH 12/13/2007




FAN 39_ZONE A TDN Plan: SOUTHWEST_SOUTH LEG_SOUTH BRANCH 12/13/2007
FAN 39 SW-S LEG-S BRNCH
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Elevation (ft)
1310
1300
1290
1280
1270
0
500
1000
1500
2000
2500
3000
3500
Main Channel Distance (ft)

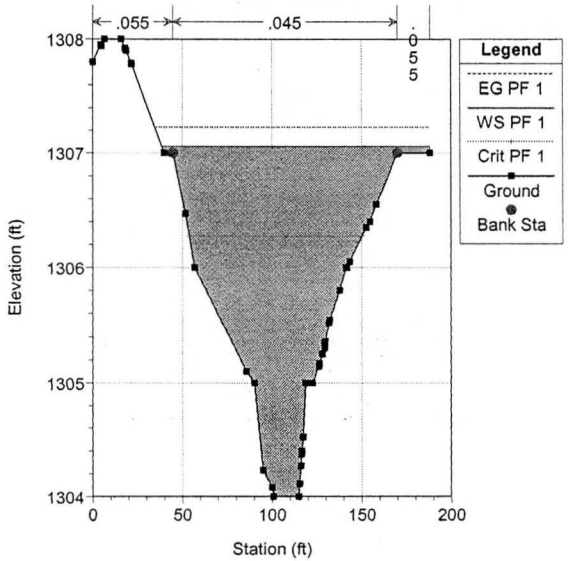
FAN 39_ZONE A TDN Plan: SOUTHWEST_SOUTH LEG_SOUTH BRANCH 12/13/2007

RS = 6.05



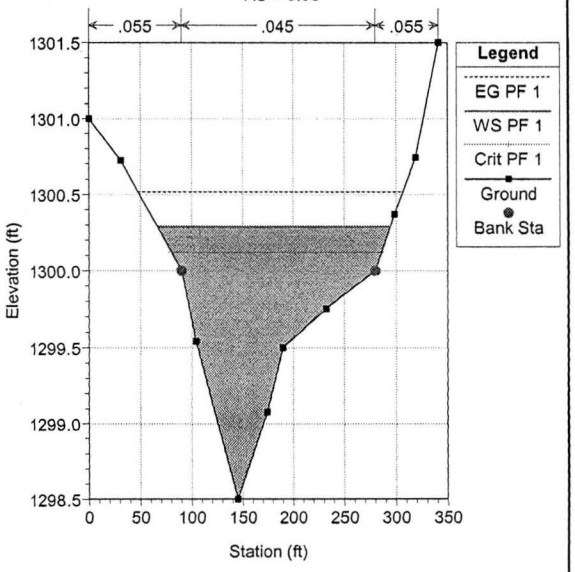
FAN 39_ZONE A TDN Plan: SOUTHWEST_SOUTH LEG_SOUTH BRANCH 12/13/2007

RS = 6.04



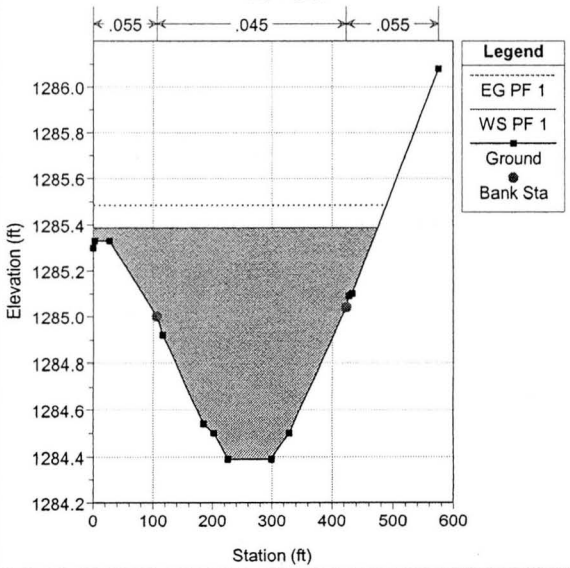
FAN 39_ZONE A TDN Plan: SOUTHWEST_SOUTH LEG_SOUTH BRANCH 12/13/2007

RS = 6.03



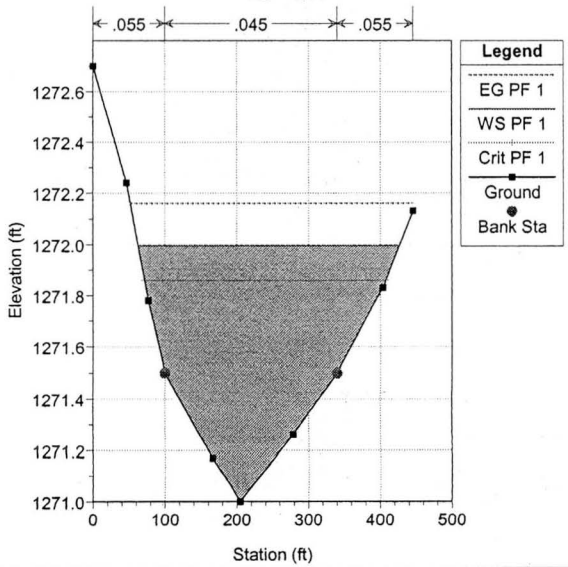
FAN 39_ZONE A TDN Plan: SOUTHWEST_SOUTH LEG_SOUTH BRANCH 12/13/2007

RS = 6.02



FAN 39_ZONE A TDN Plan: SOUTHWEST_SOUTH LEG_SOUTH BRANCH 12/13/2007

RS = 6.01



APPENDIX E.7

MANNING'S ROUGHNESS COEFFICIENT CALCULATION SHEETS & PHOTO DOCUMENTATIN

NORTHWEST REACH

Manning's (n) Evaluation

Project: White Tank Mountain Fan 39 Zone A Study
CMX Job No: 6359.63
prepared by: YLX

Thalweg: 39L
HEC-RAS Reach: Northwest
HEC-RAS Cross-Section I.D.: 1.09-1.09

Channel Conditions		Manning's n Adjustment		Left Overbank	Channel	Right Overbank
Channel Material	Course Sand	nb	0.026-0.035			
	Gravel		0.028-0.035		0.030	
	Cobble		0.030-0.050	0.030		0.030
	Boulder		0.040-0.070			
Degree of Irregularity	Smooth	n1	0.000			
	Minor		0.001-0.005	0.001	0.001	0.001
	Moderate		0.006-0.010			
	Severe		0.011-0.020			
Effects of Obstruction	Neglegible	n2	0.000-0.004	0.003		0.003
	Minor		0.005-0.015		0.005	
	Appreciable		0.020-0.030			
	Severe		0.040-0.060			
Vegetation	Small	n3	0.002-0.010		0.004	
	Medium		0.010-0.025	0.015		0.015
	Large		0.025-0.050			
	Very Large		0.050-0.100			
Variations in Channel Cross Section	Gradual	n4	0.000			
	Occationally Alt.		0.001-0.005	0.001	0.005	0.001
	Frequently Alt.		0.010-0.015			
Degree of Meandering	Minor	m	1.00	1.000	1.000	1.000
	Appreciable		1.15			
	Severe		1.30			
n=(nb+n1+n2+n3+n4)m				0.050	0.045	0.050

Reference: Estimated Manning's Roughness Coefficeints for Stream Channels and Flood Plains in Maricopa County, Arizona (by U.S.G.S., 1991)

Manning's (n) Evaluation

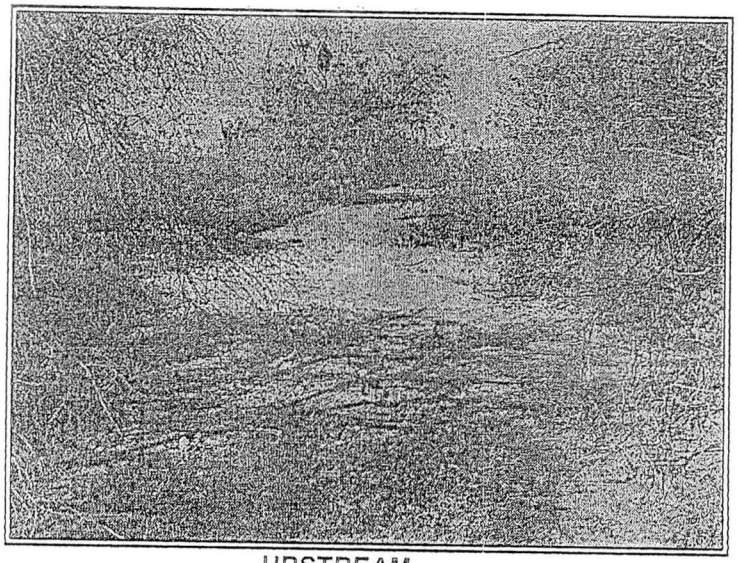
Project: White Tank Mountain Fan 39 Zone A Study
CMX Job No: 6359.63
prepared by: YLX

Thalweg: 39L
HEC-RAS Reach: Northwest
HEC-RAS Cross-Section I.D.: 1.08-1.01

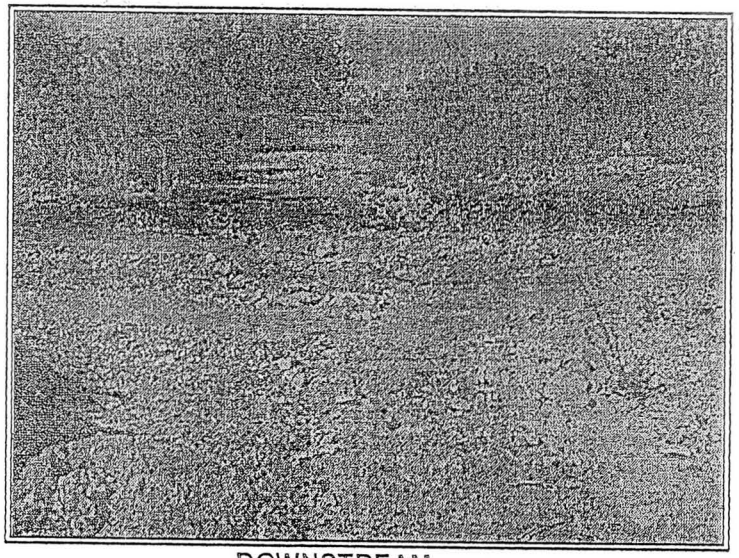
Channel Conditions		Manning's n Adjustment		Left Overbank	Channel	Right Overbank
Channel Material	Course Sand	nb	0.026-0.035			
	Gravel		0.028-0.035			
	Cobble		0.030-0.050	0.030	0.030	0.030
	Boulder		0.040-0.070			
Degree of Irregularity	Smooth	n1	0.000	0.000		0.000
	Minor		0.001-0.005		0.003	
	Moderate		0.006-0.010			
	Severe		0.011-0.020			
Effects of Obstruction	Neglegible	n2	0.000-0.004			
	Minor		0.005-0.015	0.005	0.005	0.005
	Appreciable		0.020-0.030			
	Severe		0.040-0.060			
Vegetation	Small	n3	0.002-0.010		0.002	
	Medium		0.010-0.025	0.015		0.015
	Large		0.025-0.050			
	Very Large		0.050-0.100			
Variations in Channel Cross Section	Gradual	n4	0.000	0.005		0.005
	Occationally Alt.		0.001-0.005		0.005	
	Frequently Alt.		0.010-0.015			
Degree of Meandering	Minor	m	1.00	1.000	1.000	1.000
	Appreciable		1.15			
	Severe		1.30			
n=(nb+n1+n2+n3+n4)m				0.055	0.045	0.055

Reference: Estimated Manning's Roughness Coefficeints for Stream Channels and Flood Plains in Maricopa County, Arizona (by U.S.G.S., 1991)

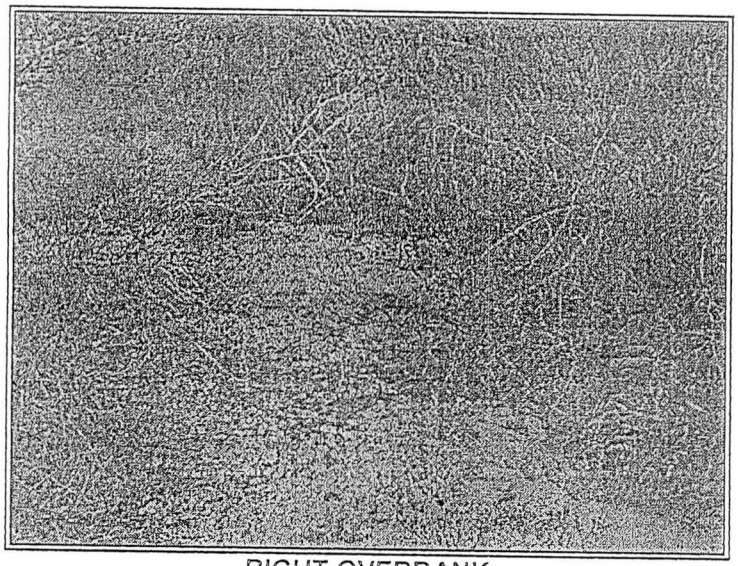
REACH: NORTHWEST



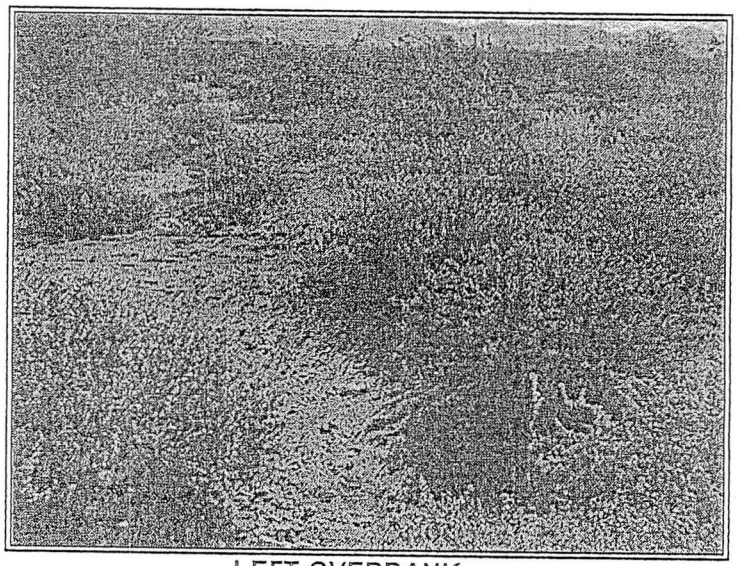
UPSTREAM



DOWNSTREAM



RIGHT OVERBANK



LEFT OVERBANK

THALWEG 39L

CENTRAL WEST REACH

Manning's (n) Evaluation

Project:	White Tank Mountain Fan 39 Zone A Study
CMX Job No:	6359.63
prepared by:	YLX
Thalweg:	39B
HEC-RAS Reach:	Central West
HEC-RAS Cross-Section I.D.:	3.19-3.14

Channel Conditions		Manning's n Adjustment		Left Overbank	Channel	Right Overbank
Channel Material	Course Sand	nb	0.026-0.035			
	Gravel		0.028-0.035			
	Cobble		0.030-0.050	0.030	0.030	0.030
	Boulder		0.040-0.070			
Degree of Irregularity	Smooth	n1	0.000			
	Minor		0.001-0.005	0.003	0.005	0.003
	Moderate		0.006-0.010			
	Severe		0.011-0.020			
Effects of Obstruction	Neglegible	n2	0.000-0.004	0.000	0.002	0.000
	Minor		0.005-0.015			
	Appreciable		0.020-0.030			
	Severe		0.040-0.060			
Vegetation	Small	n3	0.002-0.010		0.005	
	Medium		0.010-0.025	0.015		0.015
	Large		0.025-0.050			
	Very Large		0.050-0.100			
Variations in Channel Cross Section	Gradual	n4	0.000			
	Occationally Alt.		0.001-0.005	0.002	0.003	0.002
	Frequently Alt.		0.010-0.015			
Degree of Meandering	Minor	m	1.00	1.000	1.000	1.000
	Appreciable		1.15			
	Severe		1.30			
n=(nb+n1+n2+n3+n4)m				0.050	0.045	0.050

Reference: Estimated Manning's Roughness Coefficeints for Stream Channels and Flood Plains in Maricopa County, Arizona (by U.S.G.S., 1991)

Manning's (n) Evaluation

Project:	White Tank Mountain Fan 39 Zone A Study
CMX Job No:	6359.63
prepared by:	YLX
Thalweg:	39B
HEC-RAS Reach:	Central West
HEC-RAS Cross-Section I.D.:	3.13-3.12

Channel Conditions		Manning's n Adjustment		Left Overbank	Channel	Right Overbank
Channel Material	Course Sand	nb	0.026-0.035		0.028	
	Gravel		0.028-0.035	0.028		0.028
	Cobble		0.030-0.050			
	Boulder		0.040-0.070			
Degree of Irregularity	Smooth	n1	0.000			
	Minor		0.001-0.005	0.002	0.002	0.002
	Moderate		0.006-0.010			
	Severe		0.011-0.020			
Effects of Obstruction	Neglegible	n2	0.000-0.004	0.003	0.002	0.003
	Minor		0.005-0.015			
	Appreciable		0.020-0.030			
	Severe		0.040-0.060			
Vegetation	Small	n3	0.002-0.010		0.005	
	Medium		0.010-0.025	0.010		0.010
	Large		0.025-0.050			
	Very Large		0.050-0.100			
Variations in Channel Cross Section	Gradual	n4	0.000			
	Occationally Alt.		0.001-0.005	0.002	0.003	0.002
	Frequently Alt.		0.010-0.015			
Degree of Meandering	Minor	m	1.00	1.000	1.000	1.000
	Appreciable		1.15			
	Severe		1.30			
n=(nb+n1+n2+n3+n4)m				0.045	0.040	0.045

Reference: Estimated Manning's Roughness Coefficeints for Stream Channels and Flood Plains in Maricopa County, Arizona (by U.S.G.S., 1991)

Manning's (n) Evaluation

Project: White Tank Mountain Fan 39 Zone A Study
CMX Job No: 6359.63
prepared by: YLX

Thalweg: 39B
HEC-RAS Reach: Central West
HEC-RAS Cross-Section I.D.: 3.11-3.08

Channel Conditions		Manning's n Adjustment		Left Overbank	Channel	Right Overbank
Channel Material	Course Sand	nb	0.026-0.035			
	Gravel		0.028-0.035		0.030	
	Cobble		0.030-0.050	0.030		0.030
	Boulder		0.040-0.070			
Degree of Irregularity	Smooth	n1	0.000			
	Minor		0.001-0.005	0.001	0.001	0.001
	Moderate		0.006-0.010			
	Severe		0.011-0.020			
Effects of Obstruction	Neglegible	n2	0.000-0.004		0.004	
	Minor		0.005-0.015	0.009		0.009
	Appreciable		0.020-0.030			
	Severe		0.040-0.060			
Vegetation	Small	n3	0.002-0.010		0.005	
	Medium		0.010-0.025	0.010		0.010
	Large		0.025-0.050			
	Very Large		0.050-0.100			
Variations in Channel Cross Section	Gradual	n4	0.000			
	Occationally Alt.		0.001-0.005	0.005	0.005	0.005
	Frequently Alt.		0.010-0.015			
Degree of Meandering	Minor	m	1.00	1.000	1.000	1.000
	Appreciable		1.15			
	Severe		1.30			
n=(nb+n1+n2+n3+n4)m				0.055	0.045	0.055

Reference: Estimated Manning's Roughness Coefficeints for Stream Channels and Flood Plains in Maricopa County, Arizona (by U.S.G.S., 1991)

Manning's (n) Evaluation

Project: White Tank Mountain Fan 39 Zone A Study
CMX Job No: 6359.63
prepared by: YLX

Thalweg: 39B
HEC-RAS Reach: Central West
HEC-RAS Cross-Section I.D.: 3.07-3.03

Channel Conditions		Manning's n Adjustment		Left Overbank	Channel	Right Overbank
Channel Material	Course Sand	nb	0.026-0.035			
	Gravel		0.028-0.035			
	Cobble		0.030-0.050	0.030	0.030	0.030
	Boulder		0.040-0.070			
Degree of Irregularity	Smooth	n1	0.000			
	Minor		0.001-0.005	0.001	0.001	0.001
	Moderate		0.006-0.010			
	Severe		0.011-0.020			
Effects of Obstruction	Neglegible	n2	0.000-0.004	0.004	0.004	0.004
	Minor		0.005-0.015			
	Appreciable		0.020-0.030			
	Severe		0.040-0.060			
Vegetation	Small	n3	0.002-0.010		0.005	
	Medium		0.010-0.025	0.010		0.010
	Large		0.025-0.050			
	Very Large		0.050-0.100			
Variations in Channel Cross Section	Gradual	n4	0.000			
	Occationally Alt.		0.001-0.005	0.005	0.005	0.005
	Frequently Alt.		0.010-0.015			
Degree of Meandering	Minor	m	1.00	1.000	1.000	1.000
	Appreciable		1.15			
	Severe		1.30			
n=(nb+n1+n2+n3+n4)m				0.050	0.045	0.050

Reference: Estimated Manning's Roughness Coefficeints for Stream Channels and Flood Plains in Maricopa County, Arizona (by U.S.G.S., 1991)

Manning's (n) Evaluation

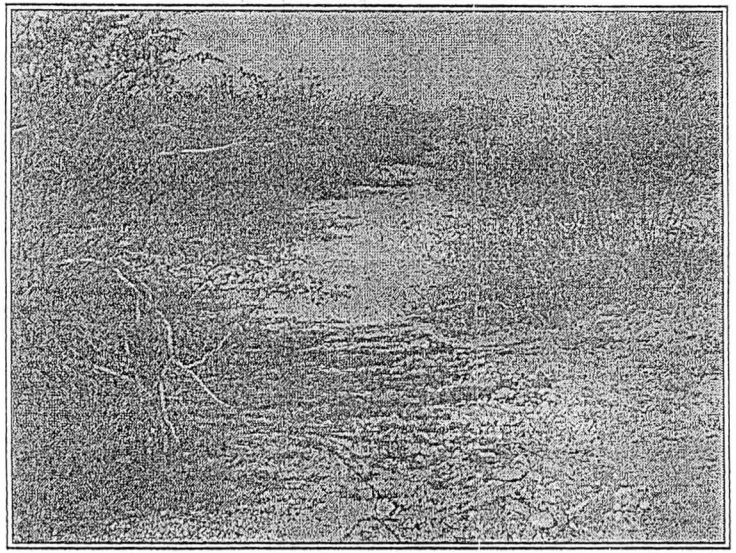
Project: White Tank Mountain Fan 39 Zone A Study
CMX Job No: 6359.63
prepared by: YLX

Thalweg: 39B
HEC-RAS Reach: Central West
HEC-RAS Cross-Section I.D.: 3.02-3.01

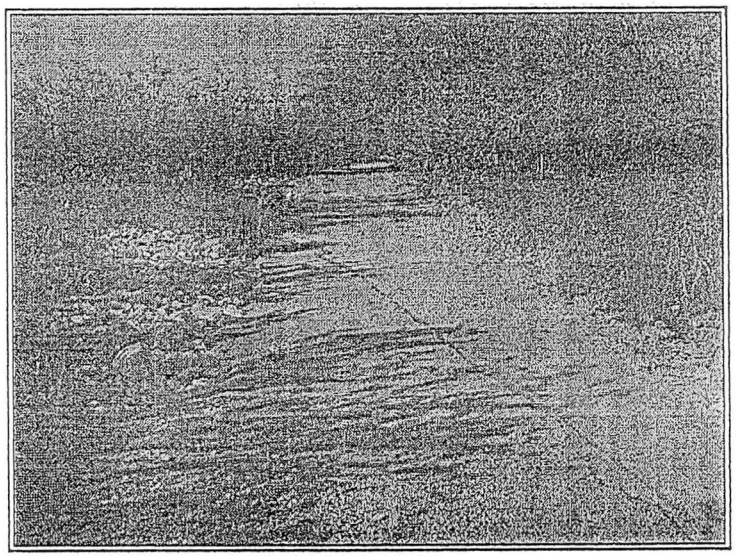
Channel Conditions		Manning's n Adjustment		Left Overbank	Channel	Right Overbank
Channel Material	Course Sand	nb	0.026-0.035			
	Gravel		0.028-0.035			
	Cobble		0.030-0.050	0.030	0.030	0.030
	Boulder		0.040-0.070			
Degree of Irregularity	Smooth	n1	0.000			
	Minor		0.001-0.005	0.001	0.001	0.001
	Moderate		0.006-0.010			
	Severe		0.011-0.020			
Effects of Obstruction	Neglegible	n2	0.000-0.004	0.004	0.004	0.004
	Minor		0.005-0.015			
	Appreciable		0.020-0.030			
	Severe		0.040-0.060			
Vegetation	Small	n3	0.002-0.010		0.005	
	Medium		0.010-0.025	0.010		0.010
	Large		0.025-0.050			
	Very Large		0.050-0.100			
Variations in Channel Cross Section	Gradual	n4	0.000			
	Occationally Alt.		0.001-0.005	0.005	0.005	0.005
	Frequently Alt.		0.010-0.015			
Degree of Meandering	Minor	m	1.00	1.000	1.000	1.000
	Appreciable		1.15			
	Severe		1.30			
n=(nb+n1+n2+n3+n4)m				0.050	0.045	0.050

Reference: Estimated Manning's Roughness Coefficeints for Stream Channels and Flood Plains in Maricopa County, Arizona (by U.S.G.S., 1991)

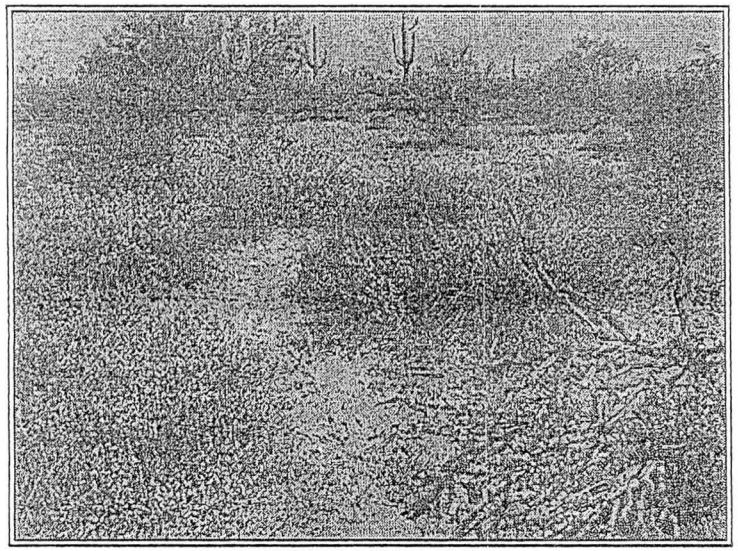
REACH: CENTRAL WEST



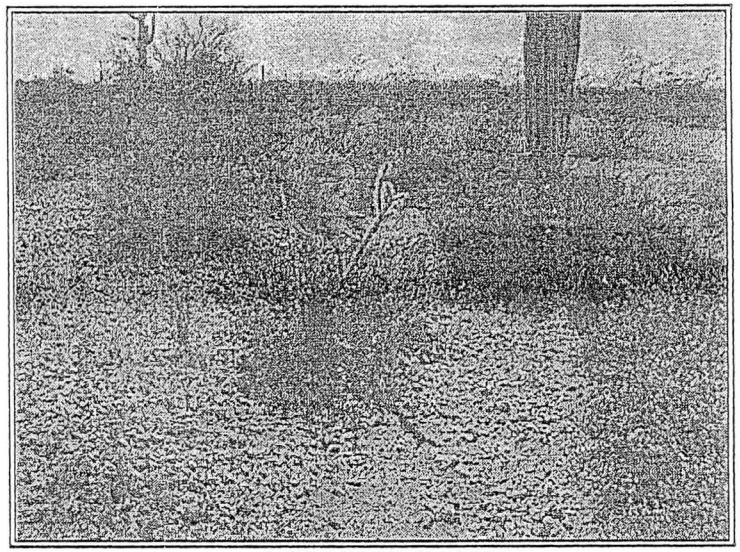
UPSTREAM



DOWNSTREAM



RIGHT OVERBANK



LEFT OVERBANK

THALWEG 39B

SOUTHWEST REACH

Manning's (n) Evaluation

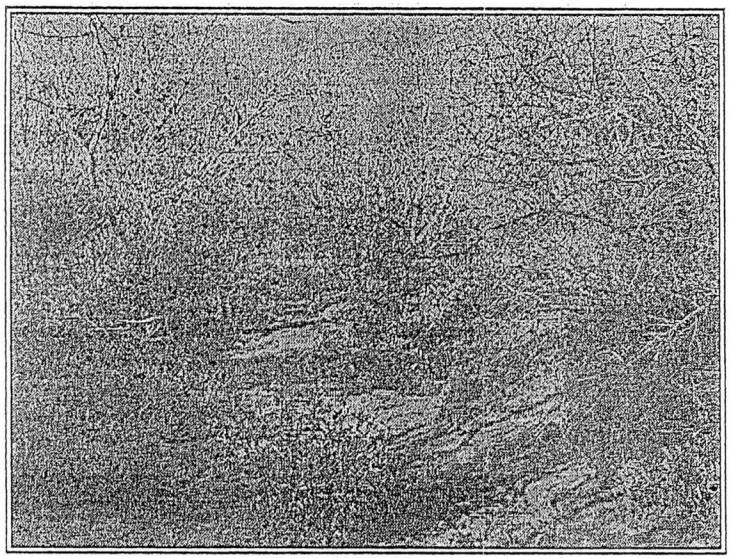
Project: White Tank Mountain Fan 39 Zone A Study
CMX Job No: 6359.63
prepared by: YLX

Thalweg: 39G
HEC-RAS Reach: Southwest
HEC-RAS Cross-Section I.D.: 5.14-5.05

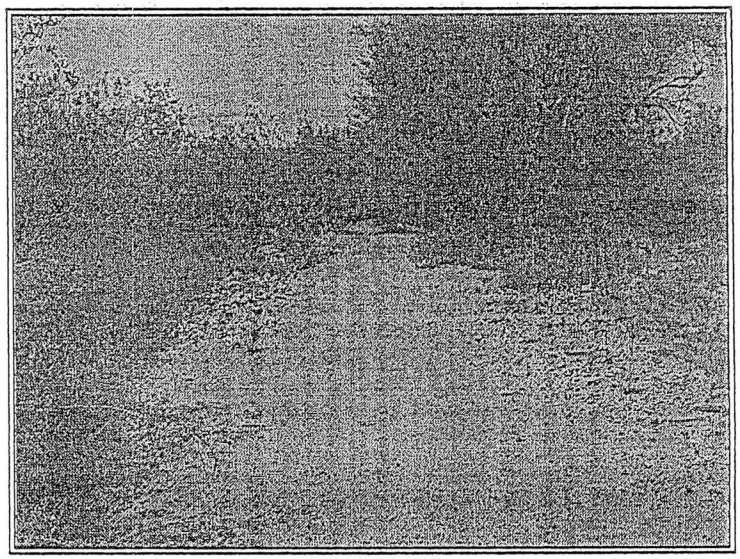
Channel Conditions		Manning's n Adjustment		Left Overbank	Channel	Right Overbank
Channel Material	Course Sand	nb	0.026-0.035			
	Gravel		0.028-0.035		0.030	
	Cobble		0.030-0.050	0.030		0.030
	Boulder		0.040-0.070			
Degree of Irregularity	Smooth	n1	0.000			
	Minor		0.001-0.005	0.003	0.003	0.003
	Moderate		0.006-0.010			
	Severe		0.011-0.020			
Effects of Obstruction	Neglegible	n2	0.000-0.004	0.004	0.004	0.004
	Minor		0.005-0.015			
	Appreciable		0.020-0.030			
	Severe		0.040-0.060			
Vegetation	Small	n3	0.002-0.010		0.002	
	Medium		0.010-0.025	0.010		0.010
	Large		0.025-0.050			
	Very Large		0.050-0.100			
Variations in Channel Cross Section	Gradual	n4	0.000			
	Occationally Alt.		0.001-0.005	0.003	0.001	0.003
	Frequently Alt.		0.010-0.015			
Degree of Meandering	Minor	m	1.00	1.000	1.000	1.000
	Appreciable		1.15			
	Severe		1.30			
n=(nb+n1+n2+n3+n4)m				0.050	0.040	0.050

Reference: Estimated Manning's Roughness Coefficeints for Stream Channels and Flood Plains in Maricopa County, Arizona (by U.S.G.S., 1991)

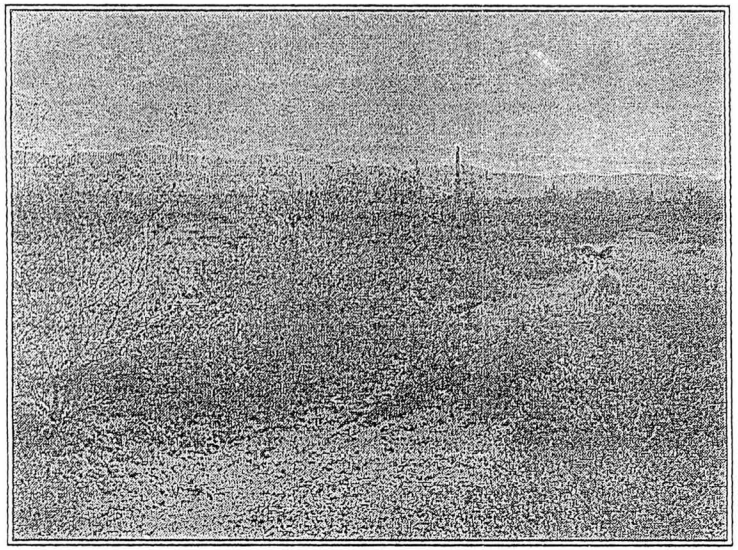
REACH: SOUTHWEST



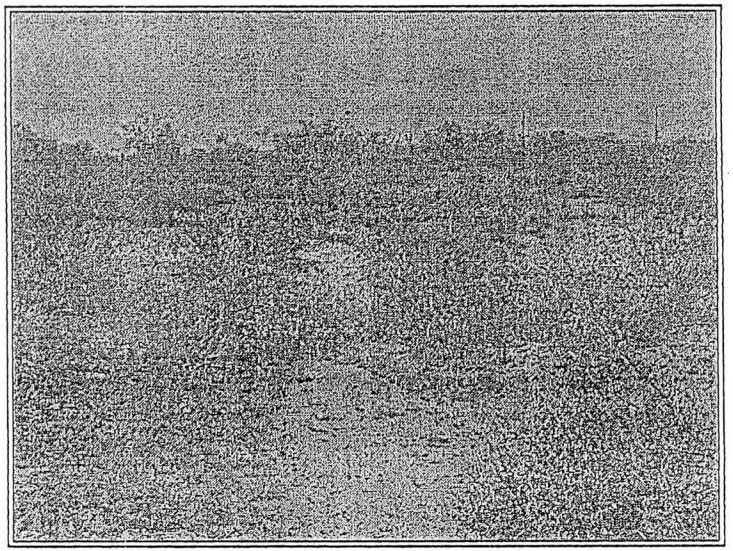
UPSTREAM



DOWNSTREAM



RIGHT OVERBANK



LEFT OVERBANK

THALWEG 39G

Manning's (n) Evaluation

Project:	White Tank Mountain Fan 39 Zone A Study
CMX Job No:	6359.63
prepared by:	YLX
Thalweg:	39G, 39M
HEC-RAS Reach:	Southwest
HEC-RAS Cross-Section I.D.:	5.04-5.03

Channel Conditions		Manning's n Adjustment		Left Overbank	Channel	Right Overbank
Channel Material	Course Sand	nb	0.026-0.035			
	Gravel		0.028-0.035	0.030	0.030	0.030
	Cobble		0.030-0.050			
	Boulder		0.040-0.070			
Degree of Irregularity	Smooth	n1	0.000			
	Minor		0.001-0.005	0.001	0.001	0.001
	Moderate		0.006-0.010			
	Severe		0.011-0.020			
Effects of Obstruction	Neglegible	n2	0.000-0.004	0.003		0.003
	Minor		0.005-0.015		0.005	
	Appreciable		0.020-0.030			
	Severe		0.040-0.060			
Vegetation	Small	n3	0.002-0.010		0.002	
	Medium		0.010-0.025	0.015		0.015
	Large		0.025-0.050			
	Very Large		0.050-0.100			
Variations in Channel Cross Section	Gradual	n4	0.000			
	Occationally Alt.		0.001-0.005	0.001	0.002	0.001
	Frequently Alt.		0.010-0.015			
Degree of Meandering	Minor	m	1.00	1.000	1.000	1.000
	Appreciable		1.15			
	Severe		1.30			
n=(nb+n1+n2+n3+n4)m				0.050	0.040	0.050

Reference: Estimated Manning's Roughness Coefficeints for Stream Channels and Flood Plains in Maricopa County, Arizona (by U.S.G.S., 1991)

Manning's (n) Evaluation

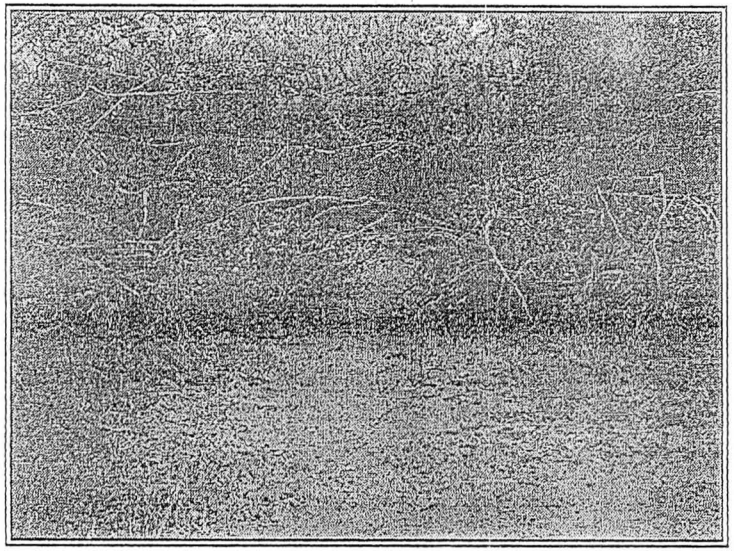
Project: White Tank Mountain Fan 39 Zone A Study
CMX Job No: 6359.63
prepared by: YLX

Thalweg: 39M
HEC-RAS Reach: Southwest
HEC-RAS Cross-Section I.D.: 5.02-5.01

Channel Conditions		Manning's n Adjustment		Left Overbank	Channel	Right Overbank
Channel Material	Course Sand	nb	0.026-0.035			
	Gravel		0.028-0.035	0.030	0.030	0.030
	Cobble		0.030-0.050			
	Boulder		0.040-0.070			
Degree of Irregularity	Smooth	n1	0.000			
	Minor		0.001-0.005	0.005		0.005
	Moderate		0.006-0.010		0.006	
	Severe		0.011-0.020			
Effects of Obstruction	Neglegible	n2	0.000-0.004			
	Minor		0.005-0.015	0.005	0.005	0.005
	Appreciable		0.020-0.030			
	Severe		0.040-0.060			
Vegetation	Small	n3	0.002-0.010		0.002	
	Medium		0.010-0.025	0.010		0.010
	Large		0.025-0.050			
	Very Large		0.050-0.100			
Variations in Channel Cross Section	Gradual	n4	0.000			
	Occationally Alt.		0.001-0.005	0.005	0.002	0.005
	Frequently Alt.		0.010-0.015			
Degree of Meandering	Minor	m	1.00	1.000	1.000	1.000
	Appreciable		1.15			
	Severe		1.30			
n=(nb+n1+n2+n3+n4)m				0.055	0.045	0.055

Reference: Estimated Manning's Roughness Coefficeints for Stream Channels and Flood Plains in Maricopa County, Arizona (by U.S.G.S., 1991)

REACH: SOUTHWEST



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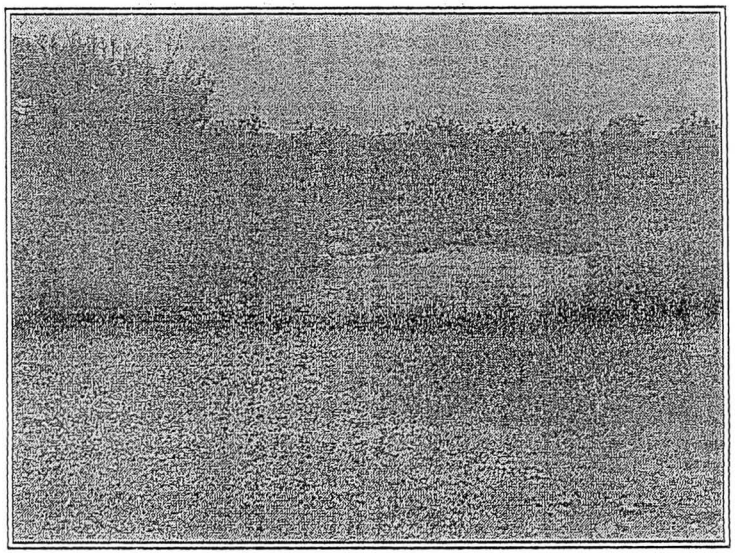

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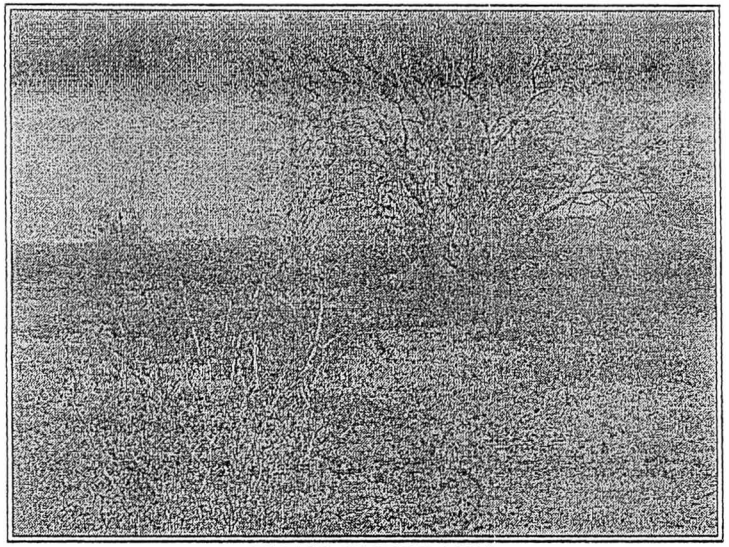

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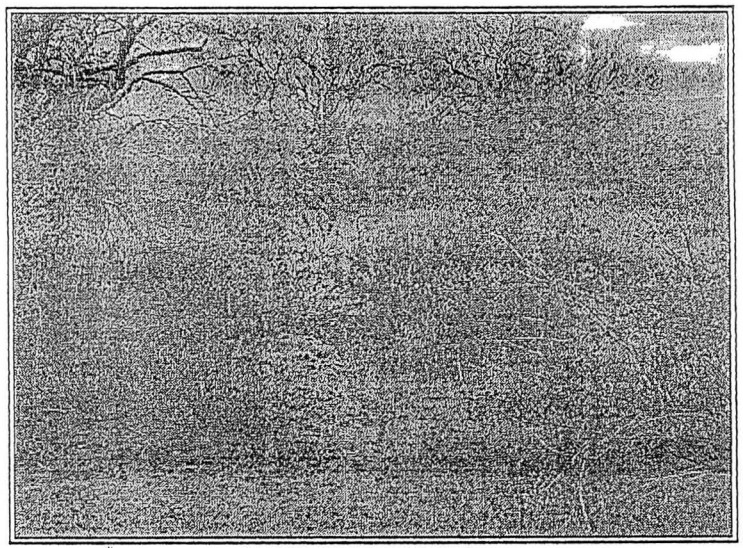

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THALWEG 39M

APPENDIX E.8

FLOW SPLIT ANALYSIS

CMX PROJ.	6359.63
DATE:	DEC. 2007
SCALE:	N.T.S.
DRAWN BY:	AMS
CHECKED BY:	AJT

WHITE TANK MOUNTAIN ALLUVIAL FAN 39

FLOOD CONTROL DISTRICT MARICOPA COUNTY
BUCKEYE, ARIZONA

FIG 10: FLOW SPLIT/CONFLUENCE LOCATION MAP

PHOENIX OFFICE
7740 N. 16TH ST. STE 100
PHOENIX, ARIZONA
PH (602) 567-1900
FAX (602) 567-1901
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CMX

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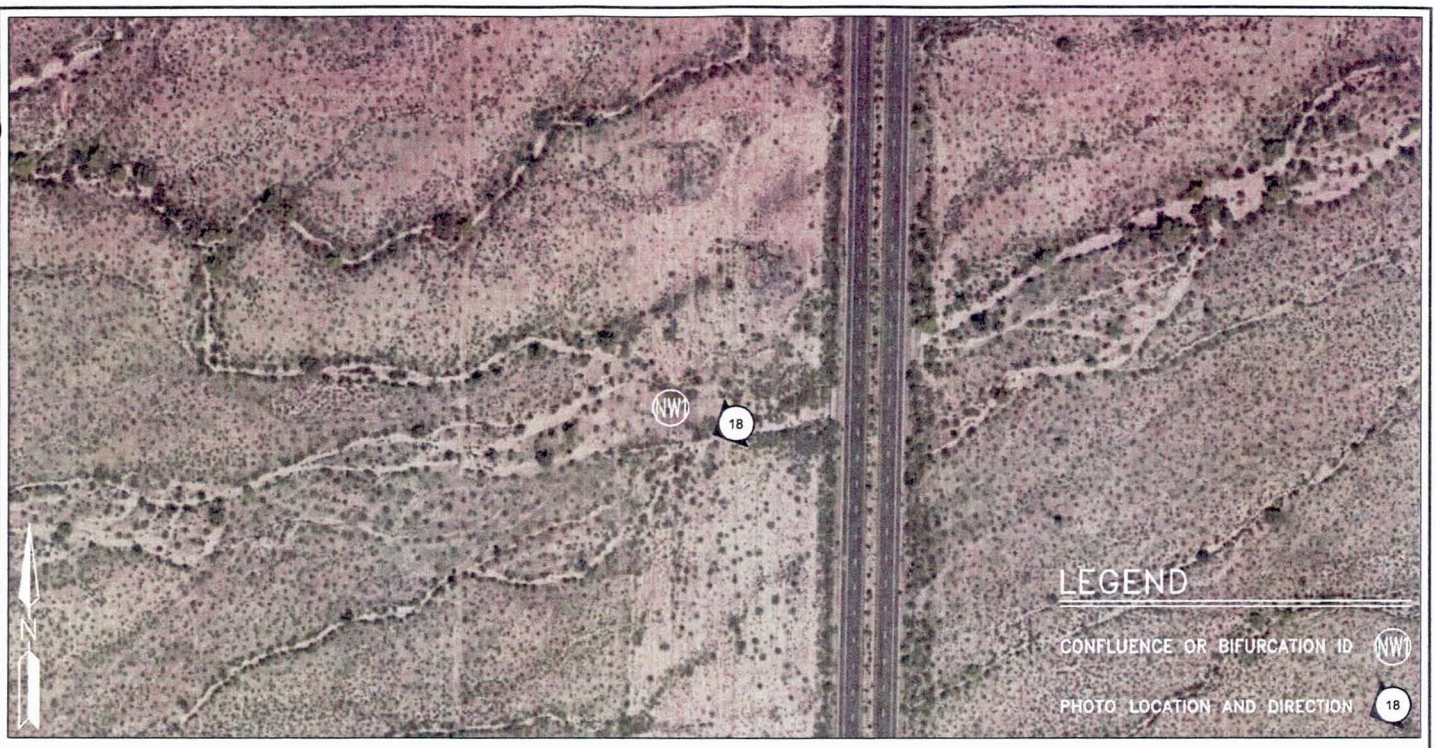

CMX PROJ. 6359.63	WHITE TANK MOUNTAIN ALLUVIAL FAN 39	PHOENIX OFFICE	
DATE: DEC. 2007	FLOOD CONTROL DISTRICT MARICOPA COUNTY	7740 N. 16TH ST. STE 100	
SCALE: N.T.S.	BUCKEYE, ARIZONA	PHOENIX, ARIZONA	
DRAWN BY: AMS		PH (602) 567-1900	
CHECKED BY: AJT	FIG 10: NORTHWEST FLOW SPLIT 1	FAX (602) 567-1901	
		www.cmxinc.com	CMX

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PROJECT FEN 29 APPROXIMATE ZONE A

SUBJECT JUNCTION / BIFURCATION SITE VISIT

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SHEET ____ OF ____ BY AT DATE 2/8/05

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7740 North 16th Street
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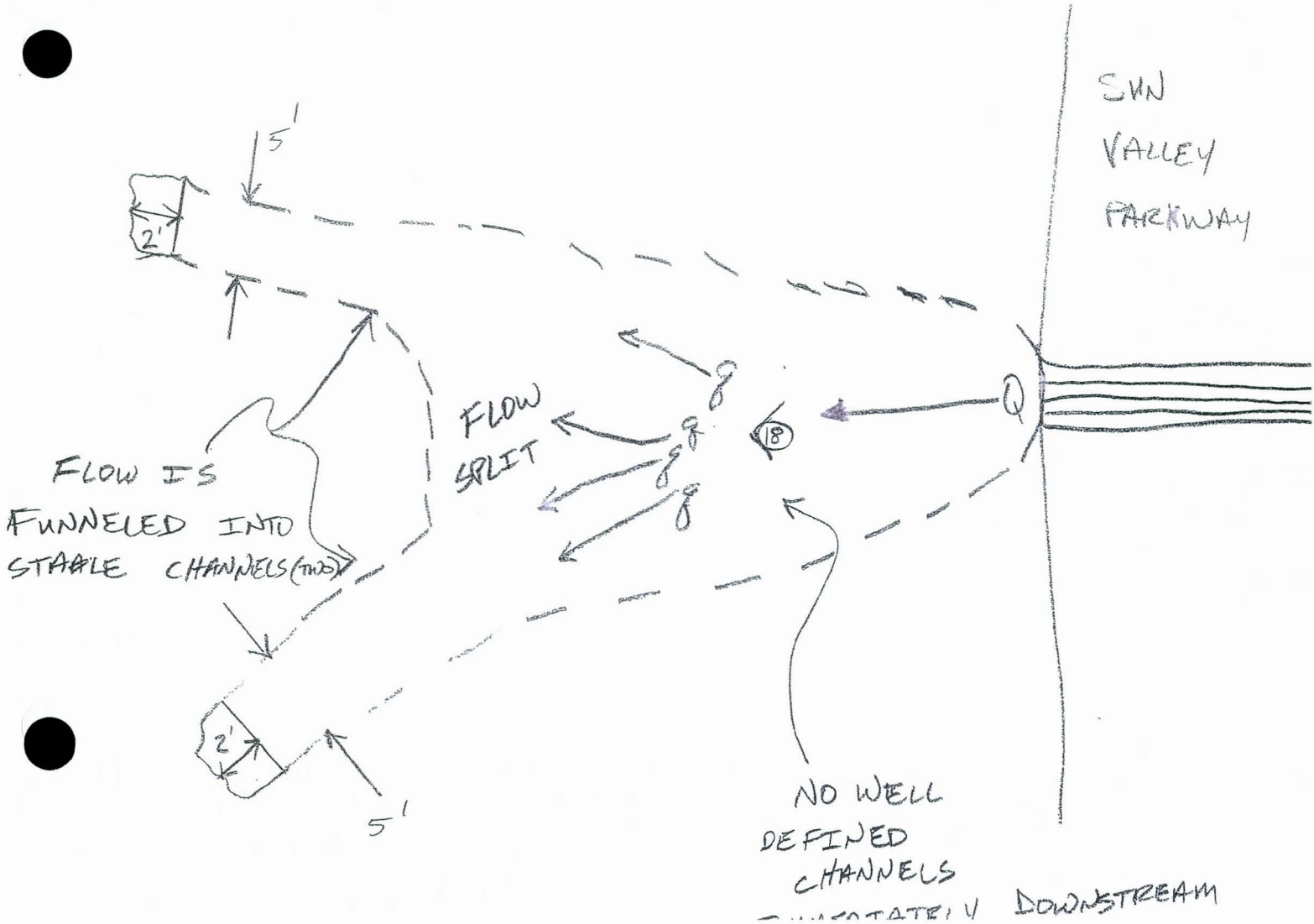
Phoenix, AZ 85020
p: 602.567.1900
f: 602.567.1901

NORTHWEST REACH — LOCATION # 1

↑ N
N.T.S.

BANK (APPROX.)
CHANNEL X-SECTION
⑧ PHOTO LOCATION



CMX PROJ. 6359.63	WHITE TANK MOUNTAIN ALLUVIAL FAN 39	PHOENIX OFFICE	
DATE: DEC. 2007	FLOOD CONTROL DISTRICT MARICOPA COUNTY	7740 N. 16TH ST. STE 100	
SCALE: N.T.S.	BUCKEYE, ARIZONA	PHOENIX, ARIZONA	
DRAWN BY: AMS		PH (602) 567-1900	
CHECKED BY: AJT	FIG 10: CENTRAL WEST FLOW SPLIT 1	FAX (602) 567-1901	
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PROJECT FLN 39 APPROXIMATE ZONE A

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SHEET ____ OF ____ BY AT DATE 2/8/05

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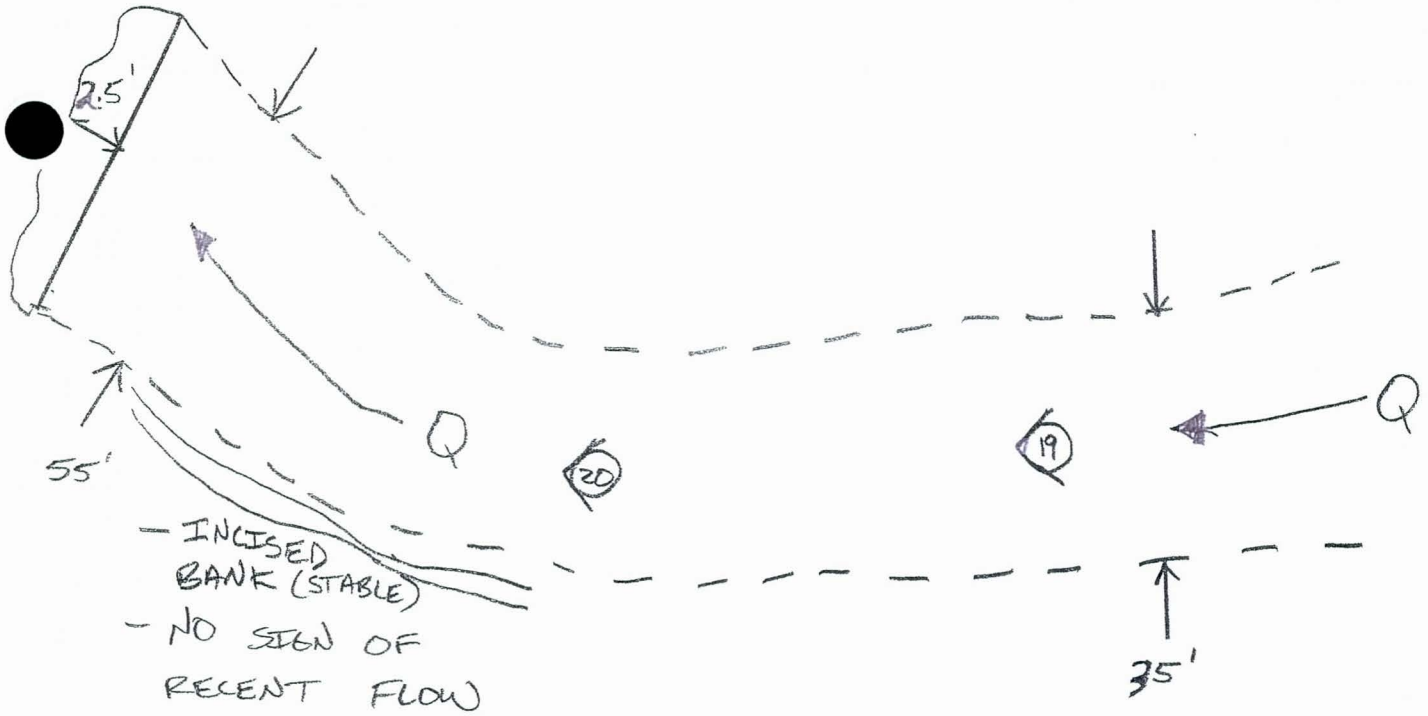
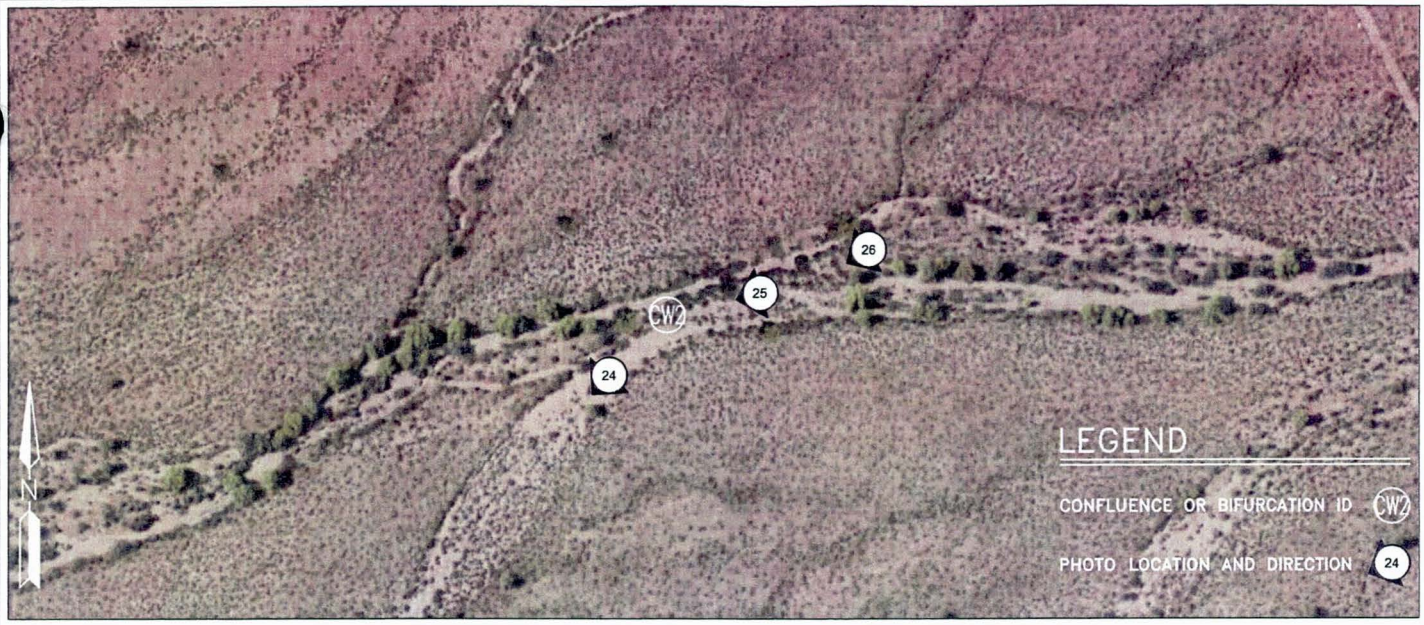
7740 North 16th Street
Suite 100
Phoenix, AZ 85020
p: 602.567.1900
f: 602.567.1901

CENTRAL WEST REACH — LOCATION # 1

↑ N
N.T.S.

BANK (APPROX.)
CHANNEL X-SECTION
(8) PHOTO LOCATION





CMX PROJ.	6359.63	WHITE TANK MOUNTAIN ALLUVIAL FAN 39	PHOENIX OFFICE
DATE:	DEC. 2007	FLOOD CONTROL DISTRICT MARICOPA COUNTY	7740 N. 16TH ST. STE 100
SCALE:	N.T.S.	BUCKEYE, ARIZONA	PHOENIX, ARIZONA
DRAWN BY:	AMS		PH (602) 567-1900
CHECKED BY:	AJT	FIG 10: CENTRAL WEST FLOW SPLIT 2	FAX (602) 567-1901
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PROJECT FAN 39 APPROXIMATE ZONE A

SUBJECT JUNCTION / BIFURCATION SITE VISIT

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SHEET ____ OF ____ BY AT DATE 2/8/05

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7740 North 16th Street
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Phoenix, AZ 85020
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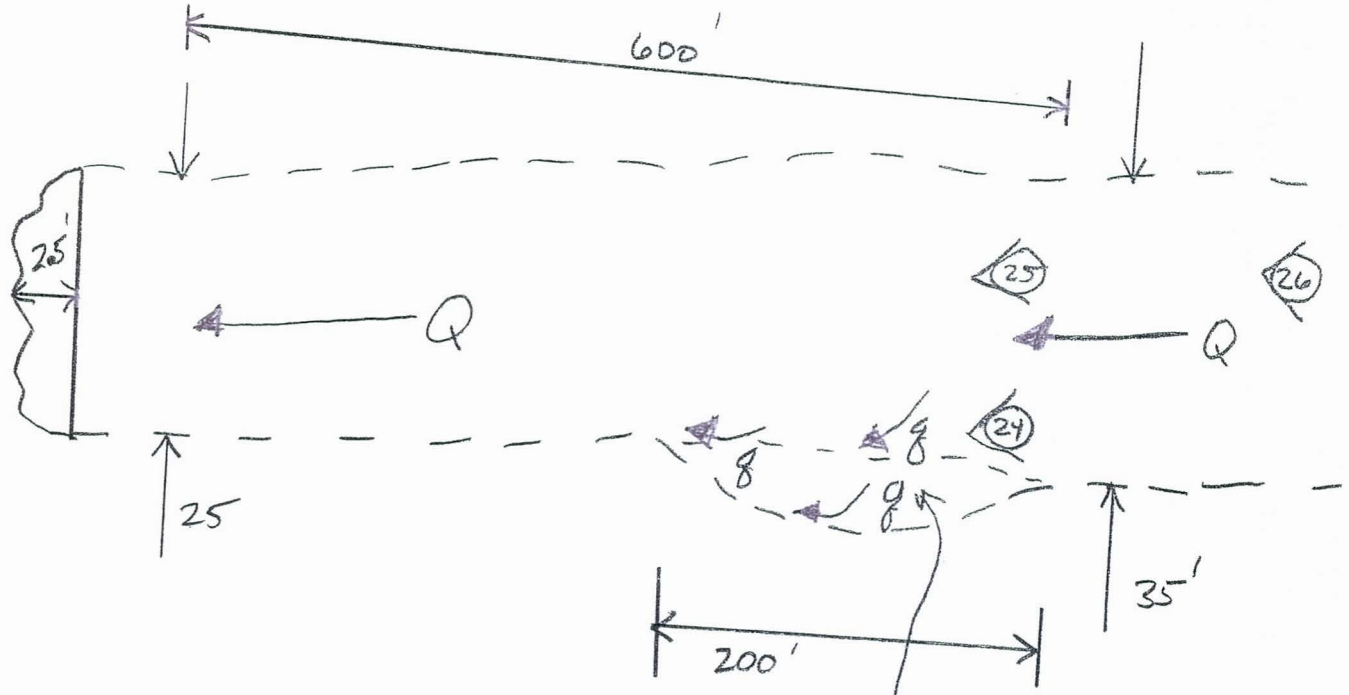
f: 602.567.1901

CENTRAL WEST REACH — LOCATION # 2

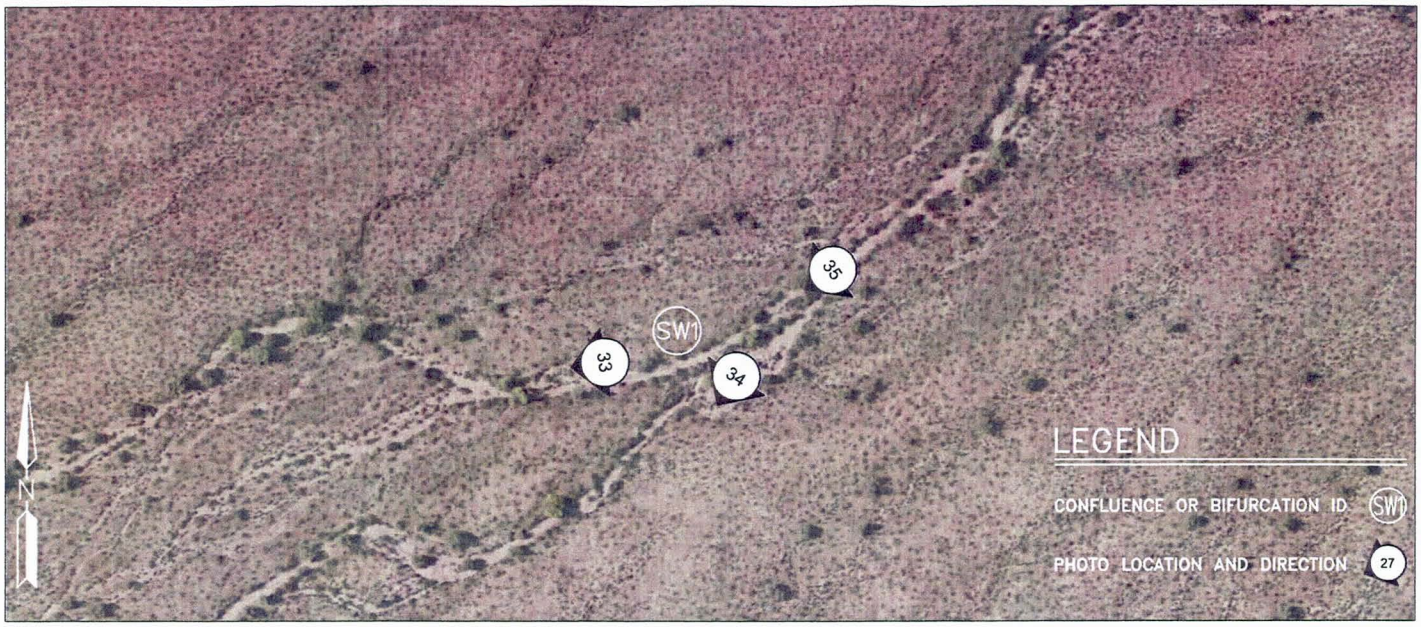
↑ N
N.T.S.

BANK (APPROX.)
CHANNEL X-SECTION
PHOTO LOCATION



— SOME EVIDENCE OF SHALLOW OVERBANK FLOW

— NO DEFINED CHANNELS



CMX PROJ.	6359.63	WHITE TANK MOUNTAIN ALLUVIAL FAN 39	PHOENIX OFFICE
DATE:	DEC. 2007	FLOOD CONTROL DISTRICT MARICOPA COUNTY	7740 N. 16TH ST. STE 100
SCALE:	N.T.S.	BUCKEYE, ARIZONA	PHOENIX, ARIZONA
DRAWN BY:	AMS		PH (602) 567-1900
CHECKED BY:	AJT	FIG 10: SOUTHWEST FLOW SPLIT 1	FAX (602) 567-1901
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APPENDIX F

EROSION AND SEDIMENT YIELD ANALYSIS SUPPORTING DOCUMENTATION

AYRES ASSOCIATES

TECHNICAL MEMORANDUM

To: Kathryn Gross, Valerie Swick – Flood Control District of Maricopa County, AZ

From: William J. Spitz, R.G., Anthony Alvarado, E.I., and Jim Schall, Ph.D., P.E.

Date: October 8, 2004

Re: **Technical Memorandum FCD 2002C027-T2.6.7**
Buckeye/Sun Valley ADMS Sediment Yield Analysis (Subtask 2.6.7)

The Buckeye/Sun Valley Area Drainage Master Study (ADMS) is being performed for the Flood Control District of Maricopa County (District) and the Town of Buckeye under Contract FCD. The purpose of the Buckeye/Sun Valley ADMS is to quantify the extent of drainage, flooding, and erosion problems, sources, and hazards in the Buckeye/Sun Valley area, and develop preliminary solutions to mitigate the identified concerns. Arizona Revised Statutes Title 48, Chapter 21, requires the Board of Directors to identify flood control problems and prepare plans that, when implemented, will eliminate or minimize flooding problems.

Task 2.6 represents the Geomorphic Evaluation and Landform Stability Assessment portion of the Scope of Work (SOW). The purpose of Task 2.6 is to provide a qualitative assessment of potential erosion and sedimentation hazards of primary washes, lateral and vertical stream instability, and piedmont landform stability within the drainage networks of Area 3 (Buckeye Structures) and Area 4 (North Sun Valley) of the Buckeye/Sun Valley ADMS watershed.

1. OBJECTIVE

This TM documents the methodology and results of the sediment yield analysis performed by Ayres Associates and is submitted in fulfillment of Subtask 2.6.7. The objective of Subtask 2.6.7 was to evaluate the 100-year storm event sediment yield for each of the three Buckeye Flood Retarding Structures (FRS). Included in this TM is supporting documentation for the analysis with examples of the various calculations used.

2. INTRODUCTION

A sediment yield analysis was performed on the Buckeye FRSs #1, #2, and #3 to determine the amount of sediment that could be deposited at the base of the structures and could potentially result in overtopping.

3. METHODS

3.1 Field Data Collection

Field reconnaissance was performed to locate and measure areas of deposition along the FRSs. Sediment samples (**Figure 3.1**) were taken at various locations and the depths of the deposition were estimated. In some places, the outline of the deposition zone was determined; otherwise, the deposition area was measured using the 2003 MrSID aerial photography of the location.

Figure 3.1. Bulk sediment sample taken at the downstream end of White Tanks Wash.

All Terrain Vehicles (ATVs) with utility racks were the main mode of transportation used in the field reconnaissance (**Figure 3.2**). The Trimble GeoXT, which is shown mounted on the ATV in **Figure 3.3**, is part of the Trimble GeoExplorer CE Series, a handheld Windows CE device with an integrated Trimble GPS receiver. The GPS system uses the Wide Area Augmentation System (WAAS), which was created by the Federal Aviation Administration (FAA) as a free-to-air differential correction service. With Windows CE, the device is capable of incorporating mobile Geographic Information System (GIS) field software. The Trimble GeoXT provides sub-meter GPS accuracy with the portability of a fully editable mobile GIS database. For this project, the software used was ESRI's ArcPad 6.0, which is the mobile form of ArcGIS with GPSCorrect.

Figure 3.2. All Terrain Vehicle used for field data collection.

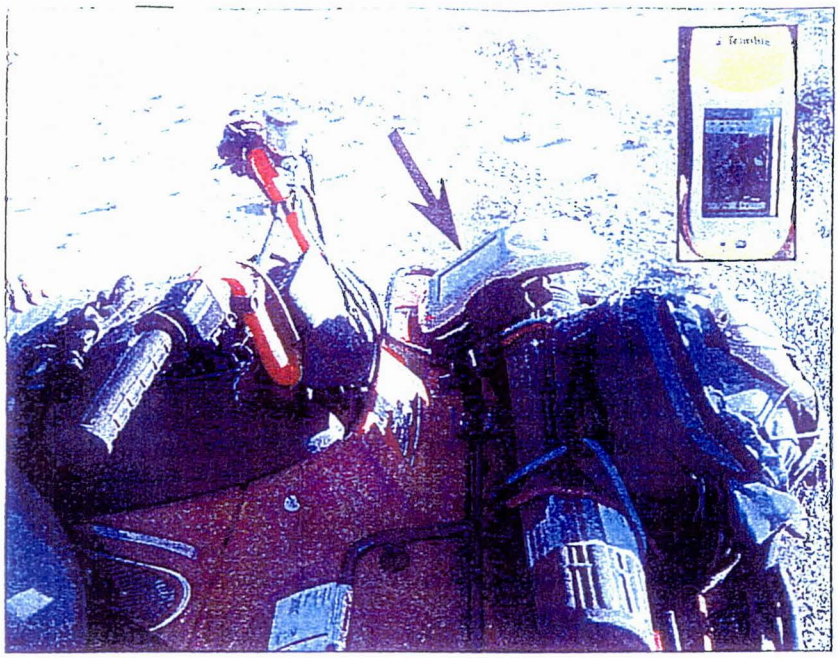

Figure 3.3. The Trimble GeoXT handheld GIS-based GPS unit (arrow) mounted on the ATV.

Using ArcPad with the georeferenced aerial orthophotography and the GPS Tracking Log, photos taken in the field were georeferenced and the sediment sample locations were accurately determined.

The portability of the Trimble GeoXT for use with the ATVs was accomplished using a GPS-mount placed on the front utility rack of the ATV. The mounted GPS was readily visible and allowed for easy tracking of the current location and navigation to a specific site.

3.2 Measurement of Sediment Deposition Volumes

The data collected in the field were used to estimate the volume of sediment deposition along each FRS. ArcGIS was the GIS software used for the sediment yield analysis. Ten-foot contour topography and 2003 MrSID orthophotography were obtained from the District and overlaid in ArcGIS. The topography and orthophotography were then utilized to guide the delineation and measurement of the actual deposition zones. The volume of sediment deposited along each FRS over the past 30 years was then calculated using the measured areas and field-estimated depths. **Table 3.1** presents the results as well as latitude and longitude locations of each major zone of deposition identified in the field or by using the orthophotography. If the average depth of deposition were unknown, a conservative estimated depth of 1 foot was used. **Figure 3.4** shows the FRS Area 3 drainage basins and sub-basins with the location of each deposition zone and the active alluvial fans in the area.

The largest volume of deposited sediment is found along FRS #1, which captures drainage from areas that include White Tank Wash and the major active alluvial fans at USGS Sites 36 through 39, as well as two lesser active fans identified in the field and described in Technical Memo 2.6.2. The largest contribution of sediment (at Deposition Zone #1) is from the active fan area of USGS Site 36 (White Tank Fan).

Table 3.1. Major Depositional Zones along the Buckeye Flood Retarding Structures.							
#	Latitude	Longitude	FRS	Area (ft^2)	Average Depth (ft)	Volume (Ac-ft)	Total FRS Volume
1	33° 27' 24.07"	112° 44' 38.90"	1	462,168	1.8	19.1	44.6
2	33° 27' 09.13"	112° 43' 27.61"	1	67,577	2.8	4.3	
3	33° 26' 52.34"	112° 42' 13.36"	1	123,181	1.0	2.8	
4	33° 26' 19.52"	112° 39' 48.39"	1	11,688	2.0	0.5	
5	33° 26' 08.85"	112° 38' 52.28"	1	72,852	2.5	4.2	
6	33° 26' 02.85"	112° 38' 24.23"	1	11,456	1.0	0.3	
7	33° 26' 03.45"	112° 36' 27.09"	1	584,376	1.0	13.4	
8	33° 26' 25.95"	112° 35' 43.98"	2	24,080	1.0	0.6	2.7
9	33° 26' 24.04"	112° 34' 37.43"	2	11,358	1.5	0.4	
10	33° 26' 33.42"	112° 34' 18.61"	2	6,276	2.0	0.3	
11	33° 26' 34.75"	112° 34' 17.19"	2	21,032	2.8	1.4	
12	33° 26' 55.39"	112° 33' 17.48"	3	29,545	1.0	0.7	3.0
13	33° 27' 03.79"	112° 32' 48.39"	3	6,879	2.5	0.4	
14	33° 27' 02.17"	112° 32' 39.78"	3	10,773	2.0	0.5	
15	33° 27' 03.08"	112° 32' 37.44"	3	11,930	2.0	0.5	
16	33° 27' 36.36"	112° 31' 41.74"	3	9,265	3.0	0.6	
17	33° 28' 01.80"	112° 31' 31.98"	3	23,291	0.5	0.3	

3.3. Initial Comparison With the Original FRS Study

The only previous sediment yield study completed on the Buckeye FRSs was conducted on the area at the east edge of FRS #1 on sub-basin Q1 (**Figure 3.5**). This calculation was performed in 1974 by the Soil Conservation Service (SCS) using the Universal Soil Loss Equation (USLE) method. The study provides an estimated sediment yield of 0.015 Ac-ft per square-mile per year and a volume of deposition over 25 years equal to 6 Ac-ft (**Table 3.2**). This equals an average annual sediment storage in sub-basin Q1 of 0.09 Ac-ft/mi^2/yr.

Table 3.2. Comparison of 1974 and 2004 Estimated Volume Calculations at Sub-basin Q1.			
Study	Deposition Area (ft^2)	Volume (Ac-ft)	Sediment Storage (Ac-ft/mi^2/yr)
2004 Measured (Zone #7)	314,353*	7.2 (30 yrs)	0.09
1974 USLE Analysis	440,000	6.0 (25 yrs)	0.09
*The western part of Deposition Area #7 falls outside of the sub-basin Q1 and therefore was not included in the comparison.			

Deposition Zone #7, which was an area that was measured in the field in 2004, matches the outlet area for the SCS sub-basin Q1. Based on the field measurements of the area, the estimated deposition volume that occurred over the past 30 years is 7.2 Ac-ft, which produces an average annual sediment storage of 0.09 Ac-ft/mi^2/yr.

From the results of this comparison, it can be concluded that the 1974 analysis of this area was reasonable and that some of the same assumptions made in the SCS analysis can also be made in the current analysis.

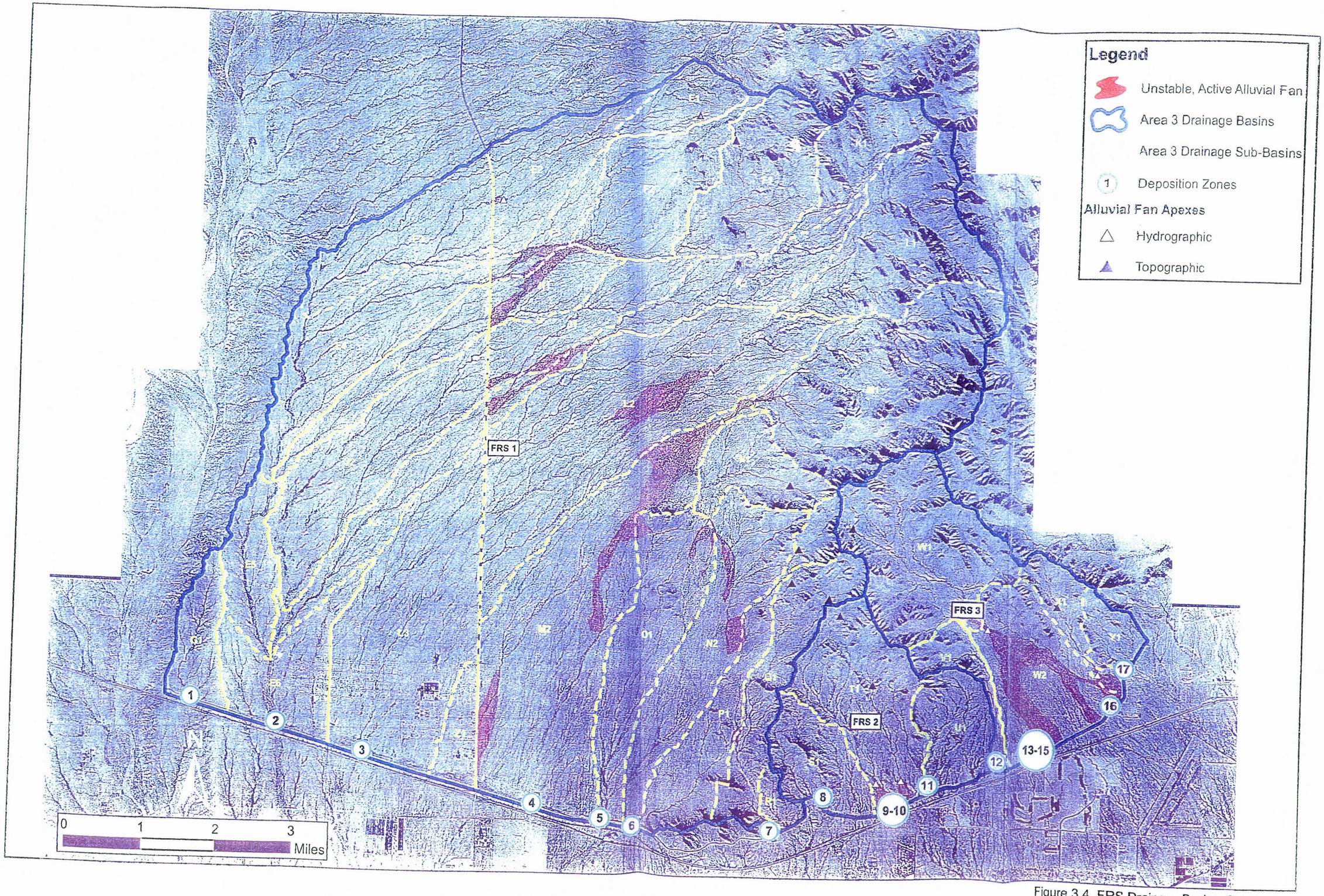

Figure 3.4. FRS Drainage Basins, Sub-basins, and Locations of Deposition Zones.

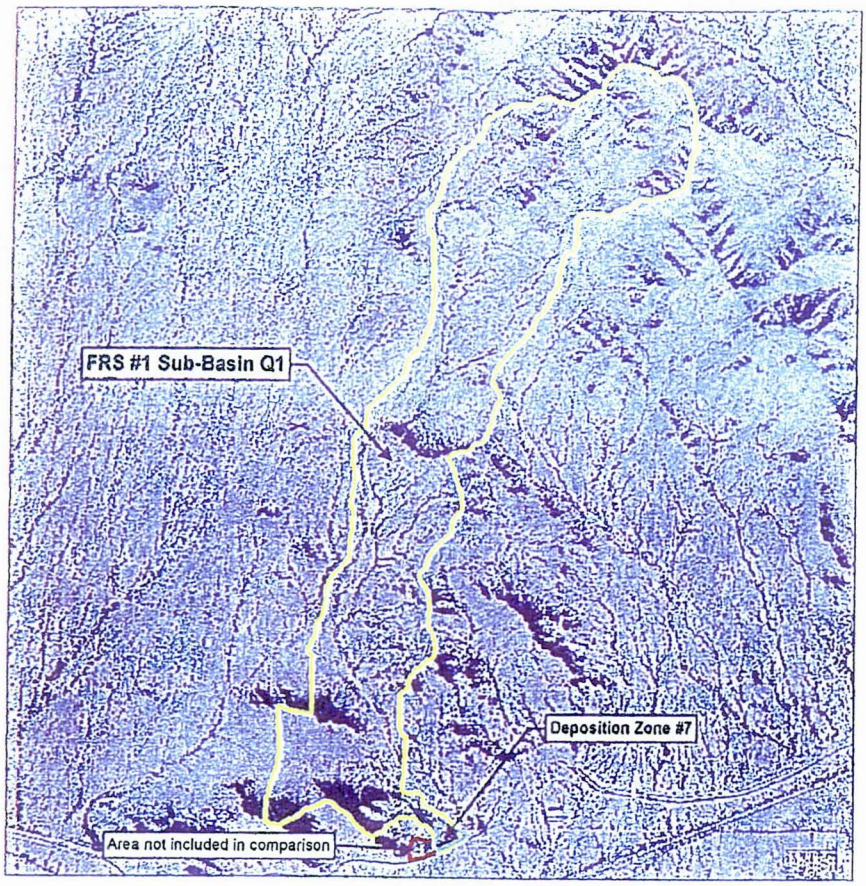

Figure 3.5. Deposition Zone #7 with sub-basin Q1 shown, as well as the portion of the area that was not included in the comparison.

3.4 Average Annual Sediment Yield Analysis Using RUSLE2

The current sediment yield calculations were conducted using the Revised Universal Soil Loss Equation (RUSLE). The computer program, RUSLE2, developed by the NRCS, was used to perform the analysis. RUSLE has the same form as the original USLE:

A = RKLSCP

where:

A	=	Average annual soil loss (not the sediment yield)
R	=	Rainfall erosivity
K	=	Soil Erodibility
LS	=	Slope length and steepness
C	=	Cover management factor
P	=	Support conservation practices

Initially, RUSLE2 was used to calculate the average annual soil loss. However, RUSLE2 can be used to estimate storm event soil loss by adjusting the rainfall erosivity factor (Kelsey 2002) The rainfall erosivity value was adjusted to account for the 100-year 24- and 6-hour events to provide an event-based soil loss (see Section 3.5).

3.4.1 Rainfall Erosivity

The R factor represents the rainfall erosivity of the climate at a particular location. The RUSLE2 climate database was utilized for the rainfall erosivity for the average annual analysis. In the USA climate database for Arizona, the erosivity for "Phoenix at point" was used. This rainfall erosivity value was 22.6.

3.4.2 Soil Erodibility

The K factor represents the base soil erodibility as determined using the soil erodibility nomograph. The K factor is an empirical measure of soil erodibility that is affected by intrinsic soil properties. Soils survey data of the area for RUSLE2 was acquired from the NRCS National RUSLE2 Database. The soil data for the drainage area of the three Buckeye FRSs is from two soil surveys: the southern part of the drainage area is from a soil survey of the central part of Maricopa County (Hartman 1977) and the northern part of the drainage area is from a soil survey of the Aguila-Carefree Area (Camp 1986). The soils mapping was also obtained in the form of a GIS shapefile, which provides the location and total area of each of the soil types. This GIS information was valuable in determining the slope and the total area of each soil type.

The resulting soil types are shown in **Tables 3.3, 3.4,** and **3.5**. For each soil description there were usually two or three soil types associated with it in the RUSLE2 database. For example, for the NRCS soil, Carrizo-Gunsight complex, 1 to 5 percent slopes, the user could select either "Carrizo gravelly sandy loam" or "Gunsight very gravelly sandy loam." For the purposes of this analysis, the soil type that gave the higher soil erodibility was used in the RUSLE2 calculation. In this example, "Gunsight very gravelly sandy loam" had a K value of 0.37 while "Carrizo gravelly sandy loam" has a K value of 0.32. Therefore, "Gunsight very gravelly sandy loam" was the soil type used to define K in calculating the soil loss for Carrizo-Gunsight complex.

3.4.3 Slope Length and Steepness

The LS factor jointly represents the effect of steepness, slope length, and shape (convex, concave, or uniform slopes) on sediment production. ArcGIS software was utilized to calculate the steepness or slope of each soil group using the NRCS soil survey GIS information. **Tables 3.6, 3.7,** and **3.8** provide the calculated slopes. Slope length was estimated using the calculated slopes. If the slope were 5 percent or less, the slope length input into RUSLE2 was 200 feet. If the slope were between 5 and 15 percent, the slope length input into RUSLE2 was 100. If the slope were greater than 15 percent, the slope length input into RUSLE2 was 30 feet (Tables 3.6, 3.7, and 3.8). These slope length estimates are based on the estimates made in the original 1974 sediment yield study. The shape was assumed to be a uniform up and down contouring over the course of the entire area. All three of these variables, the steepness or slope, the slope length, and the shape were input into RUSLE2 to calculate the LS factors shown in Tables 3.6, 3.7, and 3.8.

3.4.4. Cover Management Factor

The C factor, or cover management factor, is the ratio of soil loss from an area with specified vegetation and management to that from the fallow condition on which the factor K is evaluated. In the original 1974 study, a C factor of 0.3 for desert shrub was used. This was assumed to be reasonable and a C factor of 0.3 was used for the current analysis as well.

Table 3.3. Soil Groups and Erodibility Values for Buckeye FRS #1.		
NRCS Soil Description	RUSLE2 Soil Type	Soil Erodibility K
Antho sandy loams	Antho sandy loam 25%	0.28
Carrizo very gravelly sand	Carrizo very gravelly sand 100%	0.06
Carrizo-Gunsight complex, 1 to 5 % slopes	Gunsight very gravelly sandy loam 30%	0.43
Cheriono-Rock outcrop complex	Cherioni extremely stony loam 60%	0.74
Chuckawalla-Gunsight complex, 1 to 8 % slopes	Gunsight very gravelly loam 35%	0.57
Cipriano very gravelly loam	Cipriano very gravelly loam 100%	0.74
Coolidge-Laveen association	Coolidge sandy loam 40%	0.28
Denure-Momoli-Carrizo complex	Momoli gravelly sandy loam 30%	0.43
Ebon-Gunsight-Cipriano association, 3 to 25 % slopes	Gunsight very gravelly sandy loam 20%	0.43
Ebon-Pinamt complex, 20 to 40 % slopes	Ebon very gravelly loam 45%	0.32
Gachado-Lomitas-Rock outcrop complex, 7 to 55 % slopes	Gachado very gravelly loam 45%	0.43
Gilman-Antho association	Gilman loam 50%	0.37
Gunsight-Cipriano complex, 1 to 7 % slopes	Gunsight very gravelly sandy loam 45%	0.43
Gunsight-Pinal complex, 1 to 10 % slopes	Pinal gravelly loam 30%	0.37
Gunsight-Rillito complex, 0 to 10 % slopes	Gunsight gravelly loam 40%	0.37
Gunsight-Rillito complex, 1 to 25 % slopes	Gunsight very gravelly loam 40%	0.57
Gunsight-Rillito complex, low precipitation, 1 to 40 % slopes	Gunsight very gravelly loam 40%	0.57
Harqua-Gunsight complex, 0 to 5 % slopes	Gunsight gravelly loam 35%	0.37
Perryville-Rillito complex, 0 to 3 % slopes	Perryville loam 35%	0.37
Pinal gravelly loam	Pinal gravelly loam 100%	0.37
Pinamt-Tremant complex, 1 to 10 % slopes	Tremant gravelly loam 35%	0.74
Quilotosa-Vaiva-Rock outcrop complex, 20 to 65 % slopes	Quilotosa extremely gravelly sandy loam 50%	0.12
Rillito gravelly loam, 1 to 8 % slopes	Rillito gravelly loam 100%	0.37
Sal-Cipriano complex, 1 to 10 % slopes	Sal extremely gravelly loam 50%	0.37
Tremant gravelly loams, low precipitation	Tremant gravelly loam 35%	0.74

Table 3.4. Soil Groups and Erodibility Values for Buckeye FRS #2.		
NRCS Soil Description	RUSLE2 Soil Type	Soil Erodibility K
Antho sandy loams	Antho gravelly sandy loam 30%	0.28
Cheriono-Rock outcrop complex	Cherioni extremely stony loam 60%	0.74
Gunsight-Pinal complex, 1 to 10 % slopes	Pinal gravelly loam 30%	0.37
Gunsight-Rillito complex, 0 to 10 % slopes	Gunsight gravelly loam 40%	0.37
Gunsight-Rillito complex, 1 to 25 % slopes	Gunsight very gravelly loam 40%	0.57
Pinamt-Tremant complex, 1 to 10 % slopes	Tremant gravelly loam 35%	0.74
Quilotosa-Vaiva-Rock outcrop complex, 20 to 65 % slopes	Quilotosa extremely gravelly sandy loam 50%	0.12
Tremant-Rillito complex, 0 to 5 % slopes	Rillito gravelly loam 30%	0.37

Table 3.5. Soil Groups and Erodibility Values for Buckeye FRS #3.		
NRCS Soil Description	RUSLE2 Soil Type	Soil Erodibility K
Antho-Carrizo-Maripo complex	Antho gravelly sandy loam 30%	0.28
Denure-Momoli-Carrizo complex	Momoli gravelly sandy loam 30%	0.43
Gunsight-Rillito complex, 0 to 10 % slopes	Gunsight gravelly loam 40%	0.37
Harqua-Gunsight complex, 0 to 5 % slopes	Gunsight gravelly loam 35%	0.37
Pinamt-Tremant complex, 1 to 10 % slopes	Tremant gravelly loam 35%	0.74
Quilotosa-Vaiva-Rock outcrop complex, 20 to 65 % slopes	Quilotosa extremely gravelly sandy loam 50%	0.12
Rock outcrop-Cheriono complex	Cherioni extremely stony loam 60%	0.74

Table 3.6. Slope, Slope Length, and LS Factors for Buckeye FRS #1.			
NRCS Soil Description	Slope	Slope Length (ft)	LS Factor
Antho sandy loams	1.7%	200	0.24
Carrizo very gravelly sand	1.9%	200	0.28
Carrizo-Gunsight complex, 1 to 5 % slopes	2.5%	200	0.36
Cheriono-Rock outcrop complex	21.6%	30	2.00
Chuckawalla-Gunsight complex, 1 to 8 % slopes	2.6%	200	0.37
Cipriano very gravelly loam	11.4%	100	1.60
Coolidge-Laveen association	1.4%	200	0.20
Denure-Momoli-Carrizo complex	2.2%	200	0.31
Ebon-Gunsight-Cipriano association, 3 to 25 % slopes	7.7%	100	0.96
Ebon-Pinamt complex, 20 to 40 % slopes	12.1%	100	1.70
Gachado-Lomitas-Rock outcrop complex, 7 to 55 % slopes	22.5%	30	2.10
Gilman-Antho association	1.2%	200	0.17
Gunsight-Cipriano complex, 1 to 7 % slopes	4.7%	200	0.70
Gunsight-Pinal complex, 1 to 10 % slopes	5.7%	100	0.70
Gunsight-Rillito complex, 0 to 10 % slopes	1.9%	200	0.27
Gunsight-Rillito complex, 1 to 25 % slopes	4.0%	200	0.57
Gunsight-Rillito complex, low precipitation, 1 to 40 % slopes	1.5%	200	0.21
Harqua-Gunsight complex, 0 to 5 % slopes	2.2%	200	0.31
Perryville-Rillito complex, 0 to 3 % slopes	1.5%	200	0.21
Pinal gravelly loam	6.3%	100	0.78
Pinamt-Tremant complex, 1 to 10 % slopes	5.8%	100	0.72
Quilotosa-Vaiva-Rock outcrop complex, 20 to 65 % slopes	35.3%	30	3.20
Rillito gravelly loam, 1 to 8 % slopes	1.5%	200	0.22
Sal-Cipriano complex, 1 to 10 % slopes	3.4%	200	0.42
Tremant gravelly loams, low precipitation	1.4%	200	0.20

Table 3.7. Slope, Slope Length, and K Factors for Buckeye FRS #2.			
NRCS Soil Description	Slope (%)	Slope Length (ft)	LS Factor
Antho sandy loams	2.3%	200	0.28
Cheriono-Rock outcrop complex	24.1%	30	0.74
Gunsight-Pinal complex, 1 to 10 % slopes	6.1%	100	0.37
Gunsight-Rillito complex, 0 to 10 % slopes	2.4%	200	0.37
Gunsight-Rillito complex, 1 to 25 % slopes	8.8%	100	0.57
Pinamt-Tremant complex, 1 to 10 % slopes	7.4%	100	0.74
Quilotosa-Vaiva-Rock outcrop complex, 20 to 65 % slopes	36.2%	30	0.12
Tremant-Rillito complex, 0 to 5 % slopes	3.9%	200	0.37

Table 3.8. Slope, Slope Length, and K Factors for Buckeye FRS #3.			
NRCS Soil Description	Slope (%)	Slope Length (ft)	LS Factor
Antho-Carrizo-Maripo complex	2.8%	200	0.28
Denure-Momoli-Carrizo complex	4.1%	200	0.43
Gunsight-Rillito complex, 0 to 10 % slopes	2.3%	200	0.37
Harqua-Gunsight complex, 0 to 5 % slopes	1.9%	200	0.37
Pinamt-Tremant complex, 1 to 10 % slopes	7.4%	100	0.74
Quilotosa-Vaiva-Rock outcrop complex, 20 to 65 % slopes	37.3%	30	0.12
Rock outcrop-Cheriono complex	27.8%	30	0.74

3.4.5 Support Conservation Practices

Support conservation practices were not taken into account in this analysis; therefore, the P factor was assumed to be 1.0.

3.4.6 Average Annual Sediment Yield Results

The average annual sediment yield analysis was performed for each of the Buckeye FRSs (**Tables 3.9, 3.10, and 3.11**). An average annual soil loss was calculated in RUSLE2 for each soil group. Given these results and the GIS calculated total area of each soil group, an area weighted soil loss for each FRS drainage basin was computed (Table 4.1). Channel erosion was taken into account as being 20 percent of the total soil loss as assumed in the original 1974 study. The sediment delivery, or how much of the sediment loss actually is transported to the FRS, was assumed to be 70 percent. The trap efficiency, or how much of the sediment is deposited in the FRS as opposed to flowing to the Hassayampa River, was assumed to be 65 percent. These same assumptions were made in the original 1974 sediment yield analysis. Accounting for these factors provided a final resultant sediment storage value or an estimate of how much sediment would be deposited at each FRS.

The results indicate that the calculated sediment storage is 0.20 Ac-ft/mi^2/yr for FRS #1, 0.70 Ac-ft/mi^2/yr for FRS #2, and 0.40 Ac-ft/mi^2/yr for FRS #3. The calculated sediment storage of FRS #2 is higher than either of the calculated sediment storages for FRS #1 and #3 because of its high slope over a smaller area and also because it has a higher percentage of relict fan and mountain soil types. The calculated sediment storage of FRS #1 is lowest because of its lower average slope compared to the other two drainage areas.

These numbers appear reasonable when compared to other measured sediment yield data from the Southwest (**Table 3.12**) Table 3.12 presents actual data based on total sediment deposited over a certain period of time.

The results also appear reasonable when compared to computed sediment yield analysis data from previous Maricopa County studies (**Table 3.13**). Table 3.13 presents computed average annual sediment yield estimates from previous studies performed. The Maricopa County area previous studies have an arithmetic average of 0.65 Ac-ft/mi^2/yr, which can be viewed as an upper limit of most of the estimates (Fuller 2003). The calculated sediment storage of FRS #2 is higher than the previous study average most likely because of higher average slope over a relatively small area.

3.5 Single Event Sediment Yield Analysis

A single event sediment yield analysis was performed on the 100-year 6- and 24-hour events. Initially, the 100-year 6- and 24-hour event-based sediment yield analyses was performed using the same factor values as the average annual analysis in RUSLE2 with the exception of the R factor being adjusted to account for the events. However, this approach produced unreasonably low sediment loads so a different approach was taken. The second approach predicted a sediment load and deposition based on an assumption of the sediment concentration by volume given the flow characteristics that the flood would have. This approach led to a more reasonable prediction of the sediment deposition at the FRSs.

Table 3.16. FRS #1 100-Year 6-Hour Storm Sediment Yield RUSLE2 Results

Soil Description	Climate	Soil Classification used in RUSLE2	Area (Acre)	% of Total	Annual R Factor 22.6		R (100yr 6hr) 31.72			RUSLE2	100-Year 6-hr
					Slope (%)	Slope Length (ft)	Net LS Factor	Net C Factor	Net K Factor	Avg Annual Soil Loss (Tons/Ac/Yr)	Weighted-Average Soil Loss (Tons/Ac/Event)
Antho sandy loams	Arizona\Phoenix at point	1 ANTHO SANDY LOAMS\ANTHO sandy loam 25%	6985.35	14.36%	1.7%	200	0.24	0.30	0.28	0.4	0.083
Carrizo very gravelly sand	Arizona\Phoenix at point	14 CARRIZO VERY GRAVELLY SAND\CARRIZO very gravelly sand 100%	2473.06	5.10%	1.9%	200	0.28	0.30	0.06	0.1	0.007
Carrizo-Gunsight complex, 1 to 5 percent slopes	Arizona\Phoenix at point	15 CARRIZO-GUNSIGHT COMPLEX, 1 TO 5 PERCENT SLOPES\GUNSIGHT very gravelly sandy loam 30%	3454.05	7.12%	2.5%	200	0.36	0.30	0.43	0.9	0.094
Cheriono-Rock outcrop complex	Arizona\Phoenix at point	18 CHERIONI-ROCK OUTCROP COMPLEX, 5 TO 60 PERCENT SLOPES\CHERIONI extremely stony loam 60%	482.21	0.99%	21.6%	30	2.00	0.30	0.74	9.9	0.138
Chuckawalla-Gunsight complex, 1 to 8 percent slopes	Arizona\Phoenix at point	19 CHUCKAWALLA-GUNSIGHT COMPLEX, 1 TO 8 PERCENT SLOPES\GUNSIGHT very gravelly loam 35%	1454.62	3.00%	2.6%	200	0.37	0.30	0.57	1.3	0.055
Cipriano very gravelly loam	Arizona\Phoenix at point	21 CIPRIANO VERY GRAVELLY LOAM\CIPRIANO very gravelly loam 100%	260.70	0.54%	11.4%	100	1.60	0.30	0.74	7.5	0.057
Coolidge-Laveen association	Arizona\Phoenix at point	CV COOLIDGE-LAVEEN ASSOCIATION\COOLIDGE sandy loam 40%	721.22	1.49%	1.4%	200	0.20	0.30	0.28	0.3	0.007
Denure-Momoli-Carrizo complex	Arizona\Phoenix at point	29 DENURE-MOMOLI-CARRIZO COMPLEX\MOMOLI gravelly sandy loam 30%	2306.75	4.76%	2.2%	200	0.31	0.30	0.43	0.8	0.055
Ebon-Gunsight-Cipriano association, 3 to 25 percent slopes	Arizona\Phoenix at point	47 EBON-GUNSIGHT-CIPRIANO ASSOCIATION, 3 TO 25 PERCENT SLOPES\GUNSIGHT very gravelly sandy loam 20%	704.65	1.45%	7.7%	100	0.96	0.30	0.43	2.5	0.051
Ebon-Pinamt complex, 20 to 40 percent slopes	Arizona\Phoenix at point	49 EBON-PINAMT COMPLEX, 20 TO 40 PERCENT SLOPES\EBON very gravelly loam 45%	446.62	0.92%	12.1%	100	1.70	0.30	0.32	3.6	0.047
Gachado-Lomitas-Rock outcrop complex, 7 to 55 percent slopes	Arizona\Phoenix at point	52 GACHADO-LOMITAS-ROCK OUTCROP COMPLEX, 7 TO 55 PERCENT SLOPES\GACHADO very gravelly loam 45%	535.04	1.10%	22.5%	30	2.10	0.30	0.43	6.0	0.093
Gilman-Antho association	Arizona\Phoenix at point	GM GILMAN-ANTHO ASSOCIATION\GILMAN loam 50%	456.13	0.94%	1.2%	200	0.17	0.30	0.37	0.4	0.005
Gunsight-Cipriano complex, 1 to 7 percent slopes	Arizona\Phoenix at point	68 GUNSIGHT-CIPRIANO COMPLEX, 1 TO 7 PERCENT SLOPES\GUNSIGHT very gravelly sandy loam 45%	94.77	0.20%	4.7%	200	0.70	0.30	0.43	1.8	0.005
Gunsight-Pinal complex, 1 to 10 percent slopes	Arizona\Phoenix at point	GWD GUNSIGHT-PINAL COMPLEX, 1 TO 10 PERCENT SLOPES\PINAL gravelly loam 30%	585.35	1.21%	5.7%	100	0.70	0.30	0.37	1.6	0.027
Gunsight-Rillito complex, 0 to 10 percent slopes	Arizona\Phoenix at point	GYD GUNSIGHT-RILLITO COMPLEX, 0 TO 10 PERCENT SLOPES\GUNSIGHT gravelly loam 40%	1332.15	2.75%	1.9%	200	0.27	0.30	0.37	0.6	0.023
Gunsight-Rillito complex, 1 to 25 percent slopes	Arizona\Phoenix at point	70 GUNSIGHT-RILLITO COMPLEX, 1 TO 25 PERCENT SLOPES\GUNSIGHT very gravelly loam 40%	4194.56	8.65%	4.0%	200	0.57	0.30	0.57	2.0	0.243
Gunsight-Rillito complex, low precipitation, 1 to 40 percent slopes	Arizona\Phoenix at point	71 GUNSIGHT-RILLITO COMPLEX, LOW PRECIPITATION, 1 TO 40 PERCENT SLOPES\GUNSIGHT very gravelly loam 40%	378.99	0.78%	1.5%	200	0.21	0.30	0.57	0.7	0.008
Harqua-Gunsight complex, 0 to 5 percent slopes	Arizona\Phoenix at point	HLC HARQUA-GUNSIGHT COMPLEX, 0 TO 5 PERCENT SLOPES\GUNSIGHT gravelly loam 35%	61.37	0.13%	2.2%	200	0.31	0.30	0.37	0.7	0.001
Perryville-Rillito complex, 0 to 3 percent slopes	Arizona\Phoenix at point	PRB PERRYVILLE-RILLITO COMPLEX, 0 TO 3 PERCENT SLOPES\PERRYVILLE loam 35%	1038.32	2.14%	1.5%	200	0.21	0.30	0.37	0.5	0.014
Pinal gravelly loam	Arizona\Phoenix at point	PT PINAL GRAVELLY LOAM\PINAL gravelly loam 100%	38.09	0.08%	6.3%	100	0.78	0.30	0.37	1.8	0.002
Pinamt-Tremant complex, 1 to 10 percent slopes	Arizona\Phoenix at point	98 PINAMT-TREMANT COMPLEX, 1 TO 10 PERCENT SLOPES\TREMANT gravelly loam 35%	1952.98	4.03%	5.8%	100	0.72	0.30	0.74	3.2	0.181
Quilotosa-Vaiva-Rock outcrop complex, 20 to 65 percent slopes	Arizona\Phoenix at point	100 QUILOTOSA-VAIVA-ROCK OUTCROP COMPLEX, 20 TO 65 PERCENT SLOPES\QUILOTOSA extremely gravelly sandy loam 5	8411.65	17.35%	35.3%	30	3.20	0.30	0.12	2.4	0.584
Rillito gravelly loam, 1 to 8 percent slopes	Arizona\Phoenix at point	102 RILLITO GRAVELLY LOAM, 1 TO 8 PERCENT SLOPES\RILLITO gravelly loam 100%	7261.00	14.97%	1.5%	200	0.22	0.30	0.37	0.5	0.103
Sal-Cipriano complex, 1 to 10 percent slopes	Arizona\Phoenix at point	106 SAL-CIPRIANO COMPLEX, 1 TO 10 PERCENT SLOPES\SAL extremely gravelly loam 50%	1988.08	4.10%	3.4%	200	0.42	0.30	0.37	1.0	0.055
Tremant gravelly loams, low precipitation	Arizona\Phoenix at point	114 TREMANT GRAVELLY LOAMS, LOW PRECIPITATION\TREMANT gravelly loam 35%	129.93	0.27%	1.4%	200	0.20	0.30	0.74	0.9	0.003
		Total	48490.90	100.00%						Total (Tons/Acre)	1.94
										Total (Ac-ft/Sq-mi)	0.58
										Channel (20% of Total)	0.12
										Total Erosion	0.69
										Estimated 70% Delivery	0.48
										Estimated 65% Trap Efficiency	0.31
										Sediment Storage (Ac-ft/Sq-mi)	0.30

Table 3.17. FRS #2 100-Year 6-Hour Storm Sediment Yield RUSLE2 Results

Soil Description	Climate	Soil Classification used in RUSLE2	Area (Acre)	% of Total	Annual R Factor 22.6		R (100yr 6hr) 77.47			RUSLE2	100-Year 6-hr
					Slope (%)	Slope Length (ft)	Net LS Factor	Net C Factor	Net K Factor	Avg Annual Soil Loss (Tons/Ac/Yr)	Weighted-Average Soil Loss (Tons/Ac/Event)
Antho association	Arizona\Phoenix at point	AL ANTHO ASSOCIATION\ANTHO gravelly sandy loam 30%	76.89	2.06%	2.3%	200	0.33	0.30	0.28	0.56	0.040
Cheriono-Rock outcrop complex	Arizona\Phoenix at point	18 CHERIONI-ROCK OUTCROP COMPLEX, 5 TO 60 PERCENT SLOPES\CHERIONI extremely stony loam 60%	695.20	18.66%	24.1%	30	2.30	0.30	0.74	11	7.034
Gunsight-Pinal complex, 1 to 10 percent slopes	Arizona\Phoenix at point	GWD GUNSIGHT-PINAL COMPLEX, 1 TO 10 PERCENT SLOPES\PINAL gravelly loam 30%	524.60	14.08%	6.1%	100	0.75	0.30	0.37	1.7	0.820
Gunsight-Rillito complex, 0 to 10 percent slopes	Arizona\Phoenix at point	GYD GUNSIGHT-RILLITO COMPLEX, 0 TO 10 PERCENT SLOPES\GUNSIGHT gravelly loam 40%	96.47	2.59%	2.4%	200	0.34	0.30	0.37	0.76	0.067
Gunsight-Rillito complex, 1 to 25 percent slopes	Arizona\Phoenix at point	70 GUNSIGHT-RILLITO COMPLEX, 1 TO 25 PERCENT SLOPES\GUNSIGHT very gravelly loam 40%	103.75	2.78%	8.8%	100	1.40	0.30	0.57	4.9	0.468
Pinamt-Tremant complex, 1 to 10 percent slopes	Arizona\Phoenix at point	98 PINAMT-TREMANT COMPLEX, 1 TO 10 PERCENT SLOPES\TREMANT gravelly loam 35%	1103.25	29.61%	7.4%	100	0.92	0.30	0.74	4.2	4.262
Quilotosa-Vaiva-Rock outcrop complex, 20 to 65 percent slopes	Arizona\Phoenix at point	100 QUILOTOSA-VAIVA-ROCK OUTCROP COMPLEX, 20 TO 65 PERCENT SLOPES\QUILOTOSA extremely gravelly sandy loam 5	494.30	13.26%	36.2%	30	3.30	0.30	0.12	2.5	1.137
Tremant-Rillito complex, 0 to 5 percent slopes	Arizona\Phoenix at point	TSC TREMANT-RILLITO COMPLEX, 0 TO 5 PERCENT SLOPES\RILLITO gravelly loam 30%	558.66	14.99%	3.9%	200	0.56	0.30	0.37	1.3	0.868
		Total	3726.48	100.00%						Total (Tons/Acre)	14.50
										Total (Ac-ft/Sq-mi)	4.30
										Channel (20% of Total)	0.86
										Total Erosion	5.16
										Estimated 70% Delivery	3.61
										Estimated 65% Trap Efficiency	2.35
										Sediment Storage (Ac-ft/Sq-mi)	2.30

Table 3.18. FRS #3 100-Year 6-Hour Storm Sediment Yield RUSLE2 Results

Soil Description	Climate	Soil Classification used in RUSLE2	Area (Acre)	% of Total	Annual R Factor 22.6		R (100yr 6hr) 57.77			RUSLE2	100-Year 6-hr
					Slope (%)	Slope Length (ft)	Net LS Factor	Net C Factor	Net K Factor	Avg Annual Soil Loss (Tons/Ac/Yr)	Weighted-Average Soil Loss (Tons/Ac/Event)
Antho-Carrizo-Maripo complex	Arizona\Phoenix at point	3 ANTHO-CARRIZO-MARIPO COMPLEX\ANTHO sandy loam 35%	806.13	14.36%	2.8%	200	0.40	0.30	0.28	0.68	0.250
Denure-Momoli-Carrizo complex	Arizona\Phoenix at point	29 DENURE-MOMOLI-CARRIZO COMPLEX\MOMOLI gravelly sandy loam 30%	9.60	0.17%	4.1%	200	0.60	0.30	0.43	1.6	0.007
Gunsight-Rillito complex, 0 to 10 percent slopes	Arizona\Phoenix at point	GYD GUNSIGHT-RILLITO COMPLEX, 0 TO 10 PERCENT SLOPES\GUNSIGHT gravelly loam 40%	143.20	2.55%	2.3%	200	0.32	0.30	0.37	0.72	0.047
Harqua-Gunsight complex, 0 to 5 percent slopes	Arizona\Phoenix at point	HLC HARQUA-GUNSIGHT COMPLEX, 0 TO 5 PERCENT SLOPES\GUNSIGHT gravelly loam 35%	86.88	1.55%	1.9%	200	0.27	0.30	0.37	0.6	0.024
Pinamt-Tremant complex, 1 to 10 percent slopes	Arizona\Phoenix at point	98 PINAMT-TREMANT COMPLEX, 1 TO 10 PERCENT SLOPES\TREMANT gravelly loam 35%	1508.85	26.87%	7.4%	100	0.92	0.30	0.74	4.2	2.885
Quilotosa-Vaiva-Rock outcrop complex, 20 to 65 percent slopes	Arizona\Phoenix at point	100 QUILOTOSA-VAIVA-ROCK OUTCROP COMPLEX, 20 TO 65 PERCENT SLOPES\QUILOTOSA extremely gravelly sandy loam 5	2992.43	53.29%	37.3%	30	3.30	0.30	0.12	2.6	3.542
Rock outcrop-Cherioni complex	Arizona\Phoenix at point	18 CHERIONI-ROCK OUTCROP COMPLEX, 5 TO 60 PERCENT SLOPES\CHERIONI extremely stony loam 60%	13.54	0.24%	27.8%	30	2.60	0.30	0.74	13	0.080
		Total	5615.45	100.00%						Total (Tons/Acre)	6.83
										Total (Ac-ft/Sq-mi)	2.03
										Channel (20% of Total)	0.41
										Total Erosion	2.43
										Estimated 70% Delivery	1.70
										Estimated 65% Trap Efficiency	1.11
										Sediment Storage (Ac-ft/Sq-mi)	1.10

Table 3.12. Comparison of Sediment Yield Data from the Southwest.			
Watershed	Area (mi^2)	Period (years)	Sediment Yield ($Ac\text{-}ft/mi^2/yr$)
Buckeye Flood Retarding Structures			
FRS #1	75.8	-	0.20
FRS #2	5.8	-	0.70
FRS #3	8.8	-	0.40
New Mexico (Curtis 1976)			
Santa Cruz	93.1	27.4	0.27
Santa Cruz R #6	3.12	6.7	3.30
Santa Cruz R #3	1.16	7.0	9.10
Zia Pueblo	2.40	7.0	5.84
Tortugas Arroyo	20.54	9.7	0.69
Upper Rio Hondo	93.9	12.9	0.54
Oak Creek	9.41	6.0	3.32
Upper Gila Valley Region	0.33	8.7	1.54
Southeastern Arizona – Walnut Gulch Experimental Watershed (Renard 1972)			
Basin 201	0.17	-	0.33
Basin 214	0.58	-	0.31
Basin 223	0.17	-	0.38
Glendora, California (PSIAC 1974)			
Bell Canyon #4	0.06	39	0.88
Eagle, Colorado (PSIAC 1974)			
Boca Mountain	< 0.01	7	0.65

Table 3.13. Comparison of Sediment Yield Analysis Results in Maricopa County.		
Watershed	Area (mi^2)	Average Annual Sediment Yield ($Ac\text{-}ft/mi^2/yr$)
Buckeye Flood Retarding Structures		
FRS #1	75.8	0.20
FRS #2	5.8	0.70
FRS #3	8.8	0.40
Maricopa County Previous Studies		
Casandro Wash[1]	1.2	0.31
Rawhide Wash[1]	13.6	0.39
Phoenix Mountain Preserve (Tatum Wash)[2]	1.9	1.9
Shea Boulevard (Tatum Wash)[2]	2.2	2.1
Western Tributary (Cherokee Wash)[3]	0.1	2.16
Desert Park Tributary (Cherokee Wash)[3]	0.3	1.98
Desert Greenbelt Project, AZ[4]	8.6	0.10
Cave Creek, AZ[4]	121.0	0.31
Spookhill Dam, AZ[4]	16.4	0.15
Saddleback Dam, AZ[4]	30.0	0.08
Davis Tank, AZ[5]	0.2	0.96
Kennedy Tank, AZ[5]	1.0	0.27
Juniper Wash, AZ[5]	2.0	0.29
Alhambra Tank, AZ[5]	6.6	0.03
Black Hills Tank, AZ[5]	1.1	0.68
Black Hills Tank, AZ[6]	1.6	0.58
Mesquite Tank, AZ[5]	9.0	0.03
Tank 76, AZ[5]	1.2	0.21
Spook Hill ADMP[7]	3.0 - 14.0	0.13
North Peoria ADMP[8]	0.1 - 32.9	0.31
	Average	**0.65**

1. CH2M-Hill, 1994
2. JE Fuller, 1997
3. WEST Consulting, 1997
4. Hjalmarson, 1996
5. Peterson, 1962
6. Langbien, Hains and Culler, 1951
7. JE Fuller, 2000
8. JE Fuller, 2002

3.5.1 Approach Using RUSLE2 and Erosion Works

For the 100-year event analysis, a software package called Erosion Works (American Excelsior 2004) was chosen to calculate the rainfall erosivity. Erosion Works is a program that takes a given rainfall intensity hyetograph and provides the corresponding R value for an event-based soil loss analysis.

To determine the 100-year 24- and 6-hour hyetographs for each of the structures, the procedures in Volume I of the Drainage Design Manual for Maricopa County (Sabol et al. 2003) were followed. The 100-year 24- and 6-hour area averaged point rainfall depths for each structure were obtained from the Buckeye/Sun Valley Area Drainage Master Study Hydrology Report (PBS&J 2004). **Table 3.14** shows the values that were used. The depth-area reduction factor (Table 3.13) was determined next using Figures 2.1 and 2.2 in Volume I of the Drainage Design Manual (Sabol et al. 2003). The depth-area reduction factor was applied to the area-averaged point rainfall depths, which was then applied to the dimensionless distributions in Table 2.4 and 2.5 (after determining the appropriate pattern number for the 6-hour storm) of the Drainage Design Manual. **Figures 3.6** and **3.7** show the final rainfall intensity hyetographs used in determining the rainfall erosivity for each FRS for the 100-year 24- and 6-hour storms, respectively. With these hyetographs, the 100-year 24- and 6-hour event rainfall erosivity values were calculated (**Table 3.15**).

Table 3.14. Basin 100-Year Rainfall Depths and Area Reduction Factors.

Drainage Basin	Rainfall Depth (ft) (6-hr)	Depth-Area Reduction Factor (6-hr)	Rainfall Depth (ft) (24-hr)	Depth-Area Reduction Factor (24-hr)
FRS #1	3.23	0.82	4.16	0.86
FRS #2	3.28	0.96	4.13	0.91
FRS #3	3.26	0.94	4.14	0.88

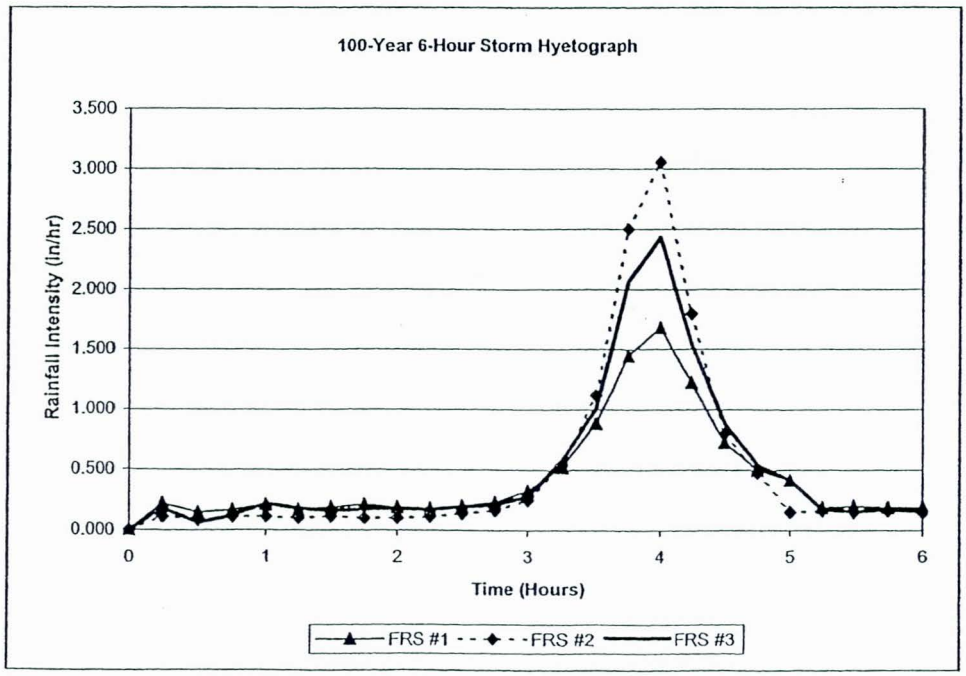

Figure 3.6. 100-Year 6-Hour Storm Hyetograph.

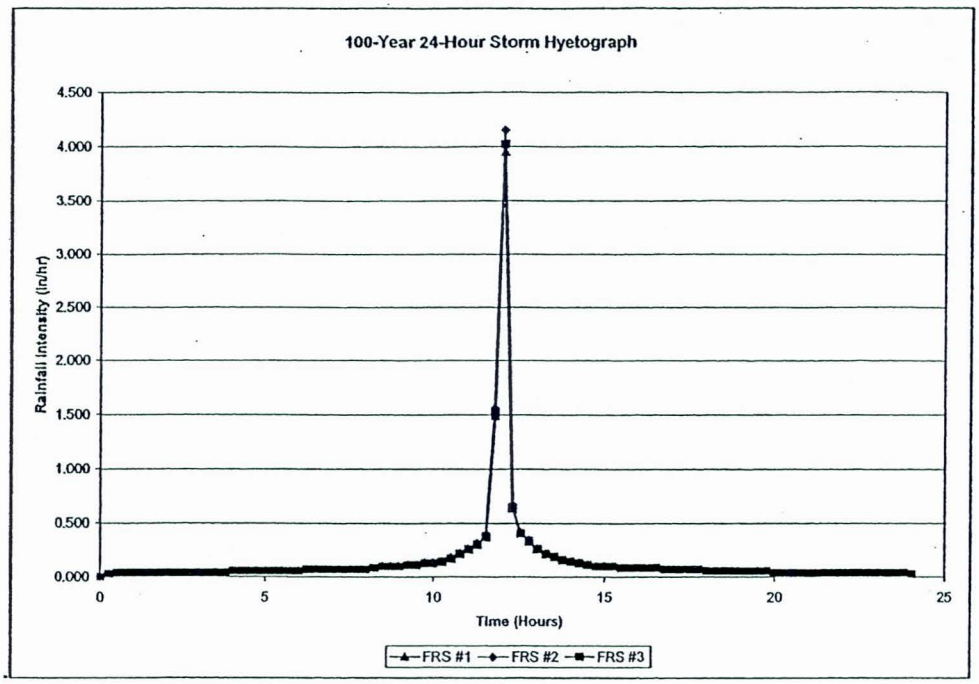

Figure 3.7. 100-Year 24-Hour Storm Hyetograph.

Table 3.15. Basin 100-Year Rainfall Erosivity Values.		
Drainage Basin	Rainfall Erosivity R (6-hour)	Rainfall Erosivity R (24-hour)
FRS #1	31.72	66.96
FRS #2	77.47	74.38
FRS #3	57.77	69.62

3.5.2 Results of RUSLE2 and Erosion Works Approach

The results for the 100-year 6-hour storm analysis are shown in **Tables 3.16, 3.17, and 3.18** with all RUSLE variables and values that were used. The calculated sediment storage for FRS #1 is 0.30 Ac-ft/mi^2 per event, for FRS #2 was 2.30 Ac-ft/mi^2 per event, for FRS #3 was 1.10 Ac-ft/mi^2 per event. The final results for the 100-year 24-hour storm analysis are shown in **Tables 3.19, 3.20, and 3.21**. The resulting sediment storage for FRS #1 was 0.70 Ac-ft/mi^2 per event, for FRS #2 was 2.30 Ac-ft/mi^2 per event, for FRS #3 was 1.30 Ac-ft/mi^2 per event.

Compared to the average annual results, the results for the 100-yr event were not significantly greater. To better evaluate these results the sediment concentration by volume was computed (**Tables 3.22 and 3.23**). In an arid region the average sediment concentration throughout a large event, such as the 100-year flood, would be expected to be quite high. Concentrations of 50,000 ppm or greater would not be unrealistic. However, many of the values in Tables 3.22 and 3.23 are considerably lower, suggesting that the single event application of the RUSLE may not be appropriate in an arid region. Therefore, an alternate approach to quantifying the single event sediment yield was adopted, as described in the following section.

Table 3.16. FRS #1 100-Year 6-Hour Storm Sediment Yield RUSLE2 Results

Soil Description	Climate	Soil Classification used in RUSLE2	Area (Acre)	% of Total	Slope (%)	Slope Length (ft)	Net LS Factor	Net C Factor	Net K Factor	Avg Annual Soil Loss (Tons/Ac/Yr)	Weighted-Average Soil Loss (Tons/Ac/Event)
					Annual R Factor	22.6	R (100yr 6hr)	31.72		RUSLE2	100-Year 6-hr
Antho sandy loams	Arizona\Phoenix at point	1 ANTHO SANDY LOAMS\ANTHO sandy loam 25%	6965.35	14.36%	1.7%	200	0.24	0.30	0.28	0.4	0.083
Carrizo very gravelly sand	Arizona\Phoenix at point	14 CARRIZO VERY GRAVELLY SAND\CARRIZO very gravelly sand 100%	2473.06	5.10%	1.9%	200	0.28	0.30	0.06	0.1	0.007
Carrizo-Gunsight complex, 1 to 5 percent slopes	Arizona\Phoenix at point	15 CARRIZO-GUNSIGHT COMPLEX, 1 TO 5 PERCENT SLOPES\GUNSIGHT very gravelly sandy loam 30%	3454.05	7.12%	2.5%	200	0.36	0.30	0.43	0.9	0.094
Cheriono-Rock outcrop complex	Arizona\Phoenix at point	18 CHERIONI-ROCK OUTCROP COMPLEX, 5 TO 60 PERCENT SLOPES\CHERIONI extremely stony loam 60%	482.21	0.99%	21.6%	30	2.00	0.30	0.74	9.9	0.138
Chuckawalla-Gunsight complex, 1 to 8 percent slopes	Arizona\Phoenix at point	19 CHUCKAWALLA-GUNSIGHT COMPLEX, 1 TO 8 PERCENT SLOPES\GUNSIGHT very gravelly loam 35%	1454.62	3.00%	2.6%	200	0.37	0.30	0.57	1.3	0.055
Cipriano very gravelly loam	Arizona\Phoenix at point	21 CIPRIANO VERY GRAVELLY LOAM\CIPRIANO very gravelly loam 100%	260.70	0.54%	11.4%	100	1.60	0.30	0.74	7.5	0.057
Coolidge-Laveen association	Arizona\Phoenix at point	CV COOLIDGE-LAVEEN ASSOCIATION\COOLIDGE sandy loam 40%	721.22	1.49%	1.4%	200	0.20	0.30	0.28	0.3	0.007
Denure-Momoli-Carrizo complex	Arizona\Phoenix at point	29 DENURE-MOMOLI-CARRIZO COMPLEX\MOMOLI gravelly sandy loam 30%	2306.75	4.76%	2.2%	200	0.31	0.30	0.43	0.8	0.055
Ebon-Gunsight-Cipriano association, 3 to 25 percent slopes	Arizona\Phoenix at point	47 EBON-GUNSIGHT-CIPRIANO ASSOCIATION, 3 TO 25 PERCENT SLOPES\GUNSIGHT very gravelly sandy loam 20%	704.65	1.45%	7.7%	100	0.96	0.30	0.43	2.5	0.051
Ebon-Pinamt complex, 20 to 40 percent slopes	Arizona\Phoenix at point	49 EBON-PINAMT COMPLEX, 20 TO 40 PERCENT SLOPES\EBON very gravelly loam 45%	446.62	0.92%	12.1%	100	1.70	0.30	0.32	3.6	0.047
Gachado-Lomitas-Rock outcrop complex, 7 to 55 percent slopes	Arizona\Phoenix at point	52 GACHADO-LOMITAS-ROCK OUTCROP COMPLEX, 7 TO 55 PERCENT SLOPES\GACHADO very gravelly loam 45%	535.04	1.10%	22.5%	30	2.10	0.30	0.43	6.0	0.093
Gilman-Antho association	Arizona\Phoenix at point	GM GILMAN-ANTHO ASSOCIATION\GILMAN loam 50%	456.13	0.94%	1.2%	200	0.17	0.30	0.37	0.4	0.005
Gunsight-Cipriano complex, 1 to 7 percent slopes	Arizona\Phoenix at point	68 GUNSIGHT-CIPRIANO COMPLEX, 1 TO 7 PERCENT SLOPES\GUNSIGHT very gravelly sandy loam 45%	94.77	0.20%	4.7%	200	0.70	0.30	0.43	1.8	0.005
Gunsight-Pinal complex, 1 to 10 percent slopes	Arizona\Phoenix at point	GWD GUNSIGHT-PINAL COMPLEX, 1 TO 10 PERCENT SLOPES\PINAL gravelly loam 30%	585.35	1.21%	5.7%	100	0.70	0.30	0.37	1.6	0.027
Gunsight-Rillito complex, 0 to 10 percent slopes	Arizona\Phoenix at point	GYD GUNSIGHT-RILLITO COMPLEX, 0 TO 10 PERCENT SLOPES\GUNSIGHT gravelly loam 40%	1332.15	2.75%	1.9%	200	0.27	0.30	0.37	0.6	0.023
Gunsight-Rillito complex, 1 to 25 percent slopes	Arizona\Phoenix at point	70 GUNSIGHT-RILLITO COMPLEX, 1 TO 25 PERCENT SLOPES\GUNSIGHT very gravelly loam 40%	4194.56	8.65%	4.0%	200	0.57	0.30	0.57	2.0	0.243
Gunsight-Rillito complex, low precipitation, 1 to 40 percent slopes	Arizona\Phoenix at point	71 GUNSIGHT-RILLITO COMPLEX, LOW PRECIPITATION, 1 TO 40 PERCENT SLOPES\GUNSIGHT very gravelly loam 40%	378.99	0.78%	1.5%	200	0.21	0.30	0.57	0.7	0.008
Harqua-Gunsight complex, 0 to 5 percent slopes	Arizona\Phoenix at point	HLC HARQUA-GUNSIGHT COMPLEX, 0 TO 5 PERCENT SLOPES\GUNSIGHT gravelly loam 35%	61.37	0.13%	2.2%	200	0.31	0.30	0.37	0.7	0.001
Perryville-Rillito complex, 0 to 3 percent slopes	Arizona\Phoenix at point	PRB PERRYVILLE-RILLITO COMPLEX, 0 TO 3 PERCENT SLOPES\PERRYVILLE loam 35%	1038.32	2.14%	1.5%	200	0.21	0.30	0.37	0.5	0.014
Pinal gravelly loam	Arizona\Phoenix at point	PT PINAL GRAVELLY LOAM\PINAL gravelly loam 100%	38.09	0.08%	6.3%	100	0.78	0.30	0.37	1.8	0.002
Pinamt-Tremant complex, 1 to 10 percent slopes	Arizona\Phoenix at point	98 PINAMT-TREMANT COMPLEX, 1 TO 10 PERCENT SLOPES\TREMANT gravelly loam 35%	1952.98	4.03%	5.8%	100	0.72	0.30	0.74	3.2	0.181
Quilotosa-Vaiva-Rock outcrop complex, 20 to 65 percent slopes	Arizona\Phoenix at point	100 QUILOTOSA-VAIVA-ROCK OUTCROP COMPLEX, 20 TO 65 PERCENT SLOPES\QUILOTOSA extremely gravelly sandy loam 5	8411.65	17.35%	35.3%	30	3.20	0.30	0.12	2.4	0.584
Rillito gravelly loam, 1 to 8 percent slopes	Arizona\Phoenix at point	102 RILLITO GRAVELLY LOAM, 1 TO 8 PERCENT SLOPES\RILLITO gravelly loam 100%	7261.00	14.97%	1.5%	200	0.22	0.30	0.37	0.5	0.103
Sal-Cipriano complex, 1 to 10 percent slopes	Arizona\Phoenix at point	106 SAL-CIPRIANO COMPLEX, 1 TO 10 PERCENT SLOPES\SAL extremely gravelly loam 50%	1988.08	4.10%	3.4%	200	0.42	0.30	0.37	1.0	0.055
Tremant gravelly loams, low precipitation	Arizona\Phoenix at point	114 TREMANT GRAVELLY LOAMS, LOW PRECIPITATION\TREMANT gravelly loam 35%	129.93	0.27%	1.4%	200	0.20	0.30	0.74	0.9	0.003
		Total	48490.90	100.00%						Total (Tons/Acre)	1.94
										Total (Ac-ft/Sq-mi)	0.58
										Channel (20% of Total)	0.12
										Total Erosion	0.69
										Estimated 70% Delivery	0.48
										Estimated 65% Trap Efficiency	0.31
										Sediment Storage (Ac-ft/Sq-mi)	0.30

Table 3.17. FRS #2 100-Year 6-Hour Storm Sediment Yield RUSLE2 Results

Soil Description	Climate	Soil Classification used in RUSLE2	Area (Acre)	% of Total	Slope (%)	Slope Length (ft)	Net LS Factor	Net C Factor	Net K Factor	Avg Annual Soil Loss (Tons/Ac/Yr)	Weighted-Average Soil Loss (Tons/Ac/Event)
					Annual R Factor	22.6	R (100yr 6hr)	77.47		RUSLE2	100-Year 6-hr
Antho association	Arizona\Phoenix at point	AL ANTHO ASSOCIATION\ANTHO gravelly sandy loam 30%	76.89	2.06%	2.3%	200	0.33	0.30	0.28	0.56	0.040
Cheriono-Rock outcrop complex	Arizona\Phoenix at point	18 CHERIONI-ROCK OUTCROP COMPLEX, 5 TO 60 PERCENT SLOPES\CHERIONI extremely stony loam 60%	695.20	18.66%	24.1%	30	2.30	0.30	0.74	11	7.034
Gunsight-Pinal complex, 1 to 10 percent slopes	Arizona\Phoenix at point	GWD GUNSIGHT-PINAL COMPLEX, 1 TO 10 PERCENT SLOPES\PINAL gravelly loam 30%	524.60	14.08%	6.1%	100	0.75	0.30	0.37	1.7	0.820
Gunsight-Rillito complex, 0 to 10 percent slopes	Arizona\Phoenix at point	GYD GUNSIGHT-RILLITO COMPLEX, 0 TO 10 PERCENT SLOPES\GUNSIGHT gravelly loam 40%	96.47	2.59%	2.4%	200	0.34	0.30	0.37	0.76	0.067
Gunsight-Rillito complex, 1 to 25 percent slopes	Arizona\Phoenix at point	70 GUNSIGHT-RILLITO COMPLEX, 1 TO 25 PERCENT SLOPES\GUNSIGHT very gravelly loam 40%	103.75	2.78%	8.8%	100	1.40	0.30	0.57	4.9	0.468
Pinamt-Tremant complex, 1 to 10 percent slopes	Arizona\Phoenix at point	98 PINAMT-TREMANT COMPLEX, 1 TO 10 PERCENT SLOPES\TREMANT gravelly loam 35%	1103.25	29.61%	7.4%	100	0.92	0.30	0.74	4.2	4.262
Quilotosa-Vaiva-Rock outcrop complex, 20 to 65 percent slopes	Arizona\Phoenix at point	100 QUILOTOSA-VAIVA-ROCK OUTCROP COMPLEX, 20 TO 65 PERCENT SLOPES\QUILOTOSA extremely gravelly sandy loam 5	494.30	13.26%	36.2%	30	3.30	0.30	0.12	2.5	1.137
Tremant-Rillito complex, 0 to 5 percent slopes	Arizona\Phoenix at point	TSC TREMANT-RILLITO COMPLEX, 0 TO 5 PERCENT SLOPES\RILLITO gravelly loam 30%	558.66	14.99%	3.9%	200	0.56	0.30	0.37	1.3	0.668
		Total	3726.48	100.00%						Total (Tons/Acre)	14.50
										Total (Ac-ft/Sq-mi)	4.30
										Channel (20% of Total)	0.86
										Total Erosion	5.16
										Estimated 70% Delivery	3.61
										Estimated 65% Trap Efficiency	2.35
										Sediment Storage (Ac-ft/Sq-mi)	2.30

Table 3.18. FRS #3 100-Year 6-Hour Storm Sediment Yield RUSLE2 Results

Soil Description	Climate	Soil Classification used in RUSLE2	Area (Acre)	% of Total	Slope (%)	Slope Length (ft)	Net LS Factor	Net C Factor	Net K Factor	Avg Annual Soil Loss (Tons/Ac/Yr)	Weighted-Average Soil Loss (Tons/Ac/Event)
					Annual R Factor	22.6	R (100yr 6hr)	57.77		RUSLE2	100-Year 6-hr
Antho-Carrizo-Maripo complex	Arizona\Phoenix at point	3 ANTHO-CARRIZO-MARIPO COMPLEX\ANTHO sandy loam 35%	806.13	14.36%	2.8%	200	0.40	0.30	0.28	0.69	0.250
Denure-Momoli-Carrizo complex	Arizona\Phoenix at point	29 DENURE-MOMOLI-CARRIZO COMPLEX\MOMOLI gravelly sandy loam 30%	9.60	0.17%	4.1%	200	0.60	0.30	0.43	1.6	0.007
Gunsight-Rillito complex, 0 to 10 percent slopes	Arizona\Phoenix at point	GYD GUNSIGHT-RILLITO COMPLEX, 0 TO 10 PERCENT SLOPES\GUNSIGHT gravelly loam 40%	143.20	2.55%	2.3%	200	0.32	0.30	0.37	0.72	0.047
Harqua-Gunsight complex, 0 to 5 percent slopes	Arizona\Phoenix at point	HLC HARQUA-GUNSIGHT COMPLEX, 0 TO 5 PERCENT SLOPES\GUNSIGHT gravelly loam 35%	86.88	1.55%	1.9%	200	0.27	0.30	0.37	0.6	0.024
Pinamt-Tremant complex, 1 to 10 percent slopes	Arizona\Phoenix at point	98 PINAMT-TREMANT COMPLEX, 1 TO 10 PERCENT SLOPES\TREMANT gravelly loam 35%	1508.85	26.87%	7.4%	100	0.92	0.30	0.74	4.2	2.885
Quilotosa-Vaiva-Rock outcrop complex, 20 to 65 percent slopes	Arizona\Phoenix at point	100 QUILOTOSA-VAIVA-ROCK OUTCROP COMPLEX, 20 TO 65 PERCENT SLOPES\QUILOTOSA extremely gravelly sandy loam 5	2992.43	53.29%	37.3%	30	3.30	0.30	0.12	2.6	3.542
Rock outcrop-Cherioni complex	Arizona\Phoenix at point	18 CHERIONI-ROCK OUTCROP COMPLEX, 5 TO 60 PERCENT SLOPES\CHERIONI extremely stony loam 60%	13.54	0.24%	27.8%	30	2.60	0.30	0.74	13	0.080
		Total	5615.45	100.00%						Total (Tons/Acre)	6.83
										Total (Ac-ft/Sq-mi)	2.03
										Channel (20% of Total)	0.41
										Total Erosion	2.43
										Estimated 70% Delivery	1.70
										Estimated 65% Trap Efficiency	1.11
										Sediment Storage (Ac-ft/Sq-mi)	1.10

Table 3.19. FRS #1 100-Year 24-Hour Storm Sediment Yield RUSLE2 Results

Annual R Factor 22.6 | R (100yr 24hr) 66.96

Soil Description	Climate	Soil Classification used in RUSLE2	Area (Acre)	% of Total	Slope (%)	Slope Length (ft)	Net LS Factor	Net C Factor	Net K Factor	RUSLE2 Avg Annual Soil Loss (Tons/Ac/Yr)	100-Year 24-hr Weighted-Average Soil Loss (Tons/Ac/Event)
Antho sandy loams	Arizona\Phoenix at point	1 ANTHO SANDY LOAMS\ANTHO sandy loam 25%	6965.35	14.36%	1.7%	200	0.24	0.30	0.28	0.4	0.174
Carrizo very gravelly sand	Arizona\Phoenix at point	14 CARRIZO VERY GRAVELLY SAND\CARRIZO very gravelly sand 100%	2473.06	5.10%	1.9%	200	0.28	0.30	0.06	0.1	0.015
Carrizo-Gunsight complex, 1 to 5 percent slopes	Arizona\Phoenix at point	15 CARRIZO-GUNSIGHT COMPLEX, 1 TO 5 PERCENT SLOPES\GUNSIGHT very gravelly sandy loam 30%	3454.05	7.12%	2.5%	200	0.36	0.30	0.43	0.9	0.198
Cheriono-Rock outcrop complex	Arizona\Phoenix at point	18 CHERIONI-ROCK OUTCROP COMPLEX, 5 TO 60 PERCENT SLOPES\CHERIONI extremely stony loam 60%	482.21	0.99%	21.6%	30	2.00	0.30	0.74	9.9	0.292
Chuckawalla-Gunsight complex, 1 to 8 percent slopes	Arizona\Phoenix at point	19 CHUCKAWALLA-GUNSIGHT COMPLEX, 1 TO 8 PERCENT SLOPES\GUNSIGHT very gravelly loam 35%	1454.62	3.00%	2.6%	200	0.37	0.30	0.57	1.3	0.116
Cipriano very gravelly loam	Arizona\Phoenix at point	21 CIPRIANO VERY GRAVELLY LOAM\CIPRIANO very gravelly loam 100%	260.70	0.54%	11.4%	100	1.60	0.30	0.74	7.5	0.119
Coolidge-Laveen association	Arizona\Phoenix at point	CV COOLIDGE-LAVEEN ASSOCIATION\COOLIDGE sandy loam 40%	721.22	1.49%	1.4%	200	0.20	0.30	0.28	0.3	0.015
Denure-Momoli-Carrizo complex	Arizona\Phoenix at point	29 DENURE-MOMOLI-CARRIZO COMPLEX\MOMOLI gravelly sandy loam 30%	2306.75	4.76%	2.2%	200	0.31	0.30	0.43	0.8	0.116
Ebon-Gunsight-Cipriano association, 3 to 25 percent slopes	Arizona\Phoenix at point	47 EBON-GUNSIGHT-CIPRIANO ASSOCIATION, 3 TO 25 PERCENT SLOPES\GUNSIGHT very gravelly sandy loam 20%	704.65	1.45%	7.7%	100	0.96	0.30	0.43	2.5	0.108
Ebon-Pinamt complex, 20 to 40 percent slopes	Arizona\Phoenix at point	49 EBON-PINAMT COMPLEX, 20 TO 40 PERCENT SLOPES\EBON very gravelly loam 45%	446.62	0.92%	12.1%	100	1.70	0.30	0.32	3.6	0.098
Gachado-Lomitas-Rock outcrop complex, 7 to 55 percent slopes	Arizona\Phoenix at point	52 GACHADO-LOMITAS-ROCK OUTCROP COMPLEX, 7 TO 55 PERCENT SLOPES\GACHADO very gravelly loam 45%	535.04	1.10%	22.5%	30	2.10	0.30	0.43	6.0	0.196
Gilman-Antho association	Arizona\Phoenix at point	GM GILMAN-ANTHO ASSOCIATION\GILMAN loam 50%	456.13	0.94%	1.2%	200	0.17	0.30	0.37	0.4	0.011
Gunsight-Cipriano complex, 1 to 7 percent slopes	Arizona\Phoenix at point	68 GUNSIGHT-CIPRIANO COMPLEX, 1 TO 7 PERCENT SLOPES\GUNSIGHT very gravelly sandy loam 45%	94.77	0.20%	4.7%	200	0.70	0.30	0.43	1.8	0.010
Gunsight-Pinal complex, 1 to 10 percent slopes	Arizona\Phoenix at point	GWD GUNSIGHT-PINAL COMPLEX, 1 TO 10 PERCENT SLOPES\PINAL gravelly loam 30%	585.35	1.21%	5.7%	100	0.70	0.30	0.37	1.6	0.057
Gunsight-Rillito complex, 0 to 10 percent slopes	Arizona\Phoenix at point	GYD GUNSIGHT-RILLITO COMPLEX, 0 TO 10 PERCENT SLOPES\GUNSIGHT gravelly loam 40%	1332.15	2.75%	1.9%	200	0.27	0.30	0.37	0.6	0.049
Gunsight-Rillito complex, 1 to 25 percent slopes	Arizona\Phoenix at point	70 GUNSIGHT-RILLITO COMPLEX, 1 TO 25 PERCENT SLOPES\GUNSIGHT very gravelly loam 40%	4194.56	8.65%	4.0%	200	0.57	0.30	0.57	2.0	0.513
Gunsight-Rillito complex, low precipitation, 1 to 40 percent slopes	Arizona\Phoenix at point	71 GUNSIGHT-RILLITO COMPLEX, LOW PRECIPITATION, 1 TO 40 PERCENT SLOPES\GUNSIGHT very gravelly loam 40%	378.99	0.78%	1.5%	200	0.21	0.30	0.57	0.7	0.017
Harqua-Gunsight complex, 0 to 5 percent slopes	Arizona\Phoenix at point	HLC HARQUA-GUNSIGHT COMPLEX, 0 TO 5 PERCENT SLOPES\GUNSIGHT gravelly loam 35%	61.37	0.13%	2.2%	200	0.31	0.30	0.37	0.7	0.003
Perryville-Rillito complex, 0 to 3 percent slopes	Arizona\Phoenix at point	PRB PERRYVILLE-RILLITO COMPLEX, 0 TO 3 PERCENT SLOPES\PERRYVILLE loam 35%	1038.32	2.14%	1.5%	200	0.21	0.30	0.37	0.5	0.030
Pinal gravelly loam	Arizona\Phoenix at point	PT PINAL GRAVELLY LOAM\PINAL gravelly loam 100%	38.09	0.08%	6.3%	100	0.78	0.30	0.37	1.8	0.004
Pinamt-Tremant complex, 1 to 10 percent slopes	Arizona\Phoenix at point	98 PINAMT-TREMANT COMPLEX, 1 TO 10 PERCENT SLOPES\TREMANT gravelly loam 35%	1952.98	4.03%	5.8%	100	0.72	0.30	0.74	3.2	0.382
Quilotosa-Vaiva-Rock outcrop complex, 20 to 65 percent slopes	Arizona\Phoenix at point	100 QUILOTOSA-VAIVA-ROCK OUTCROP COMPLEX, 20 TO 65 PERCENT SLOPES\QUILOTOSA extremely gravelly sandy loam 5	8411.65	17.35%	35.3%	30	3.20	0.30	0.12	2.4	1.234
Rillito gravelly loam, 1 to 8 percent slopes	Arizona\Phoenix at point	102 RILLITO GRAVELLY LOAM, 1 TO 8 PERCENT SLOPES\RILLITO gravelly loam 100%	7261.00	14.97%	1.5%	200	0.22	0.30	0.37	0.5	0.217
Sal-Cipriano complex, 1 to 10 percent slopes	Arizona\Phoenix at point	106 SAL-CIPRIANO COMPLEX, 1 TO 10 PERCENT SLOPES\SAL extremely gravelly loam 50%	1988.08	4.10%	3.4%	200	0.42	0.30	0.37	1.0	0.115
Tremant gravelly loams, low precipitation	Arizona\Phoenix at point	114 TREMANT GRAVELLY LOAMS, LOW PRECIPITATION\TREMANT gravelly loam 35%	129.93	0.27%	1.4%	200	0.20	0.30	0.74	0.9	0.007
		Total	48490.90	100.00%						Total Soil Loss (Tons/Acre)	4.10
										Total Soil Loss (Ac-ft/Sq-mi)	1.22
										Channel Erosion (20% of Total)	0.24
										Total Erosion (Ac-ft/Sq-mi)	1.46
										Estimated 70% Delivery	1.02
										Estimated 65% Trap Efficiency	0.66
										Sediment Storage (Ac-ft/Sq-mi)	0.70

Table 3.20. FRS #2 100-Year 24-Hour Storm Sediment Yield RUSLE2 Results

Annual R Factor 22.6 | R (100yr 24hr) 74.38

Soil Description	Climate	Soil Classification used in RUSLE2	Area (Acre)	% of Total	Slope (%)	Slope Length (ft)	Net LS Factor	Net C Factor	Net K Factor	RUSLE2 Avg Annual Soil Loss (Tons/Ac/Yr)	100-Year 24-hr Weighted-Average Soil Loss (Tons/Ac/Event)
Antho association	Arizona\Phoenix at point	AL ANTHO ASSOCIATION\ANTHO gravelly sandy loam 30%	76.89	2.06%	2.3%	200	0.33	0.30	0.28	0.56	0.038
Cheriono-Rock outcrop complex	Arizona\Phoenix at point	18 CHERIONI-ROCK OUTCROP COMPLEX, 5 TO 60 PERCENT SLOPES\CHERIONI extremely stony loam 60%	695.20	18.66%	24.1%	30	2.30	0.30	0.74	11	6.754
Gunsight-Pinal complex, 1 to 10 percent slopes	Arizona\Phoenix at point	GWD GUNSIGHT-PINAL COMPLEX, 1 TO 10 PERCENT SLOPES\PINAL gravelly loam 30%	524.60	14.08%	6.1%	100	0.75	0.30	0.37	1.7	0.788
Gunsight-Rillito complex, 0 to 10 percent slopes	Arizona\Phoenix at point	GYD GUNSIGHT-RILLITO COMPLEX, 0 TO 10 PERCENT SLOPES\GUNSIGHT gravelly loam 40%	96.47	2.59%	2.4%	200	0.34	0.30	0.37	0.76	0.065
Gunsight-Rillito complex, 1 to 25 percent slopes	Arizona\Phoenix at point	70 GUNSIGHT-RILLITO COMPLEX, 1 TO 25 PERCENT SLOPES\GUNSIGHT very gravelly loam 40%	103.75	2.78%	8.8%	100	1.40	0.30	0.57	4.9	0.449
Pinamt-Tremant complex, 1 to 10 percent slopes	Arizona\Phoenix at point	98 PINAMT-TREMANT COMPLEX, 1 TO 10 PERCENT SLOPES\TREMANT gravelly loam 35%	1103.25	29.61%	7.4%	100	0.92	0.30	0.74	4.2	4.092
Quilotosa-Vaiva-Rock outcrop complex, 20 to 65 percent slopes	Arizona\Phoenix at point	100 QUILOTOSA-VAIVA-ROCK OUTCROP COMPLEX, 20 TO 65 PERCENT SLOPES\QUILOTOSA extremely gravelly sandy loam 5	494.30	13.26%	36.2%	30	3.30	0.30	0.12	2.5	1.091
Tremant-Rillito complex, 0 to 5 percent slopes	Arizona\Phoenix at point	TSC TREMANT-RILLITO COMPLEX, 0 TO 5 PERCENT SLOPES\RILLITO gravelly loam 30%	558.66	14.99%	3.9%	200	0.56	0.30	0.37	1.3	0.641
		Total	3726.48	100.00%						Total Soil Loss (Tons/Acre)	13.92
										Total Soil Loss (Ac-ft/Sq-mi)	4.13
										Channel Erosion (20% of Total)	0.83
										Total Erosion (Ac-ft/Sq-mi)	4.96
										Estimated 70% Delivery	3.47
										Estimated 65% Trap Efficiency	2.26
										Sediment Storage (Ac-ft/Sq-mi)	2.30

Table 3.21. FRS #3 100-Year 24-Hour Storm Sediment Yield RUSLE2 Results

Annual R Factor 22.6 | R (100yr 24hr) 69.62

Soil Description	Climate	Soil Classification used in RUSLE2	Area (Acre)	% of Total	Slope (%)	Slope Length (ft)	Net LS Factor	Net C Factor	Net K Factor	RUSLE2 Avg Annual Soil Loss (Tons/Ac/Yr)	100-Year 24-hr Weighted-Average Soil Loss (Tons/Ac/Event)
Antho-Carrizo-Maripo complex	Arizona\Phoenix at point	3 ANTHO-CARRIZO-MARIPO COMPLEX\ANTHO sandy loam 35%	808.13	14.36%	2.8%	200	0.40	0.30	0.28	0.68	0.301
Denure-Momoli-Carrizo complex	Arizona\Phoenix at point	29 DENURE-MOMOLI-CARRIZO COMPLEX\MOMOLI gravelly sandy loam 30%	9.60	0.17%	4.1%	200	0.60	0.30	0.43	1.6	0.008
Gunsight-Rillito complex, 0 to 10 percent slopes	Arizona\Phoenix at point	GYD GUNSIGHT-RILLITO COMPLEX, 0 TO 10 PERCENT SLOPES\GUNSIGHT gravelly loam 40%	143.20	2.55%	2.3%	200	0.32	0.30	0.37	0.72	0.057
Harqua-Gunsight complex, 0 to 5 percent slopes	Arizona\Phoenix at point	HLC HARQUA-GUNSIGHT COMPLEX, 0 TO 5 PERCENT SLOPES\GUNSIGHT gravelly loam 35%	86.88	1.55%	1.9%	200	0.27	0.30	0.37	0.6	0.029
Pinamt-Tremant complex, 1 to 10 percent slopes	Arizona\Phoenix at point	98 PINAMT-TREMANT COMPLEX, 1 TO 10 PERCENT SLOPES\TREMANT gravelly loam 35%	1508.85	26.87%	7.4%	100	0.92	0.30	0.74	4.2	3.476
Quilotosa-Vaiva-Rock outcrop complex, 20 to 65 percent slopes	Arizona\Phoenix at point	100 QUILOTOSA-VAIVA-ROCK OUTCROP COMPLEX, 20 TO 65 PERCENT SLOPES\QUILOTOSA extremely gravelly sandy loam 5	2992.43	53.29%	37.3%	30	3.30	0.30	0.12	2.6	4.268
Rock outcrop-Cherioni complex	Arizona\Phoenix at point	18 CHERIONI-ROCK OUTCROP COMPLEX, 5 TO 60 PERCENT SLOPES\CHERIONI extremely stony loam 60%	13.54	0.24%	27.8%	30	2.60	0.30	0.74	13	0.097
		Total	5615.45	100.00%						Total Soil Loss (Tons/Acre)	8.24
										Total Soil Loss (Ac-ft/Sq-mi)	2.44
										Channel Erosion (20% of Total)	0.49
										Total Erosion (Ac-ft/Sq-mi)	2.93
										Estimated 70% Delivery	2.05
										Estimated 65% Trap Efficiency	1.33
										Sediment Storage (Ac-ft/Sq-mi)	1.30

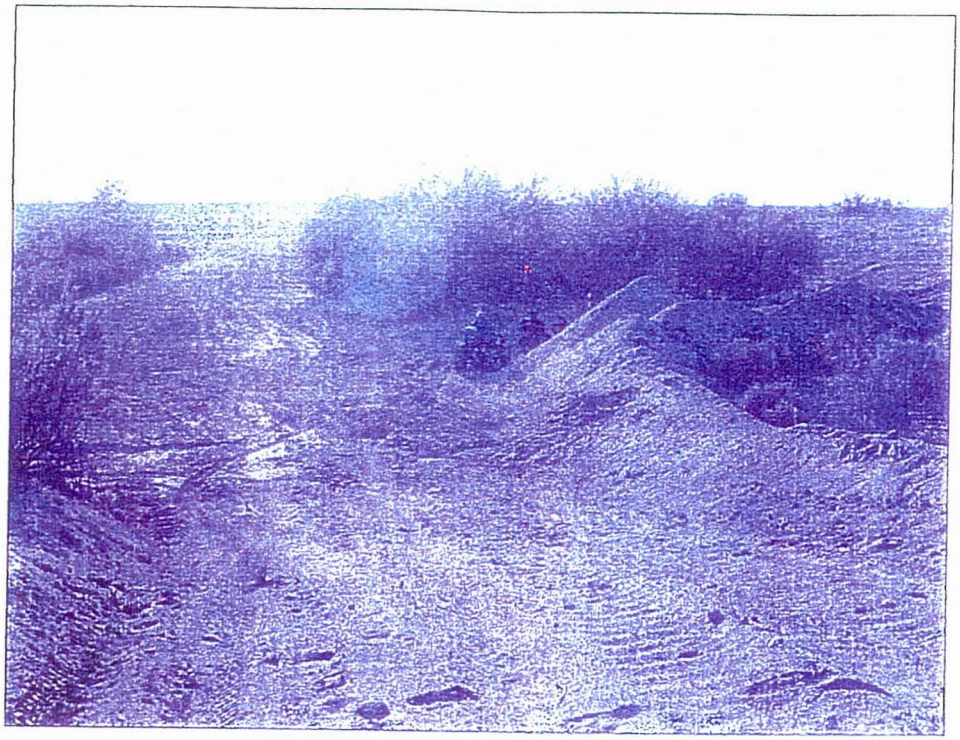

Figure 4.1. View looking downstream at Deposition Zone #5.

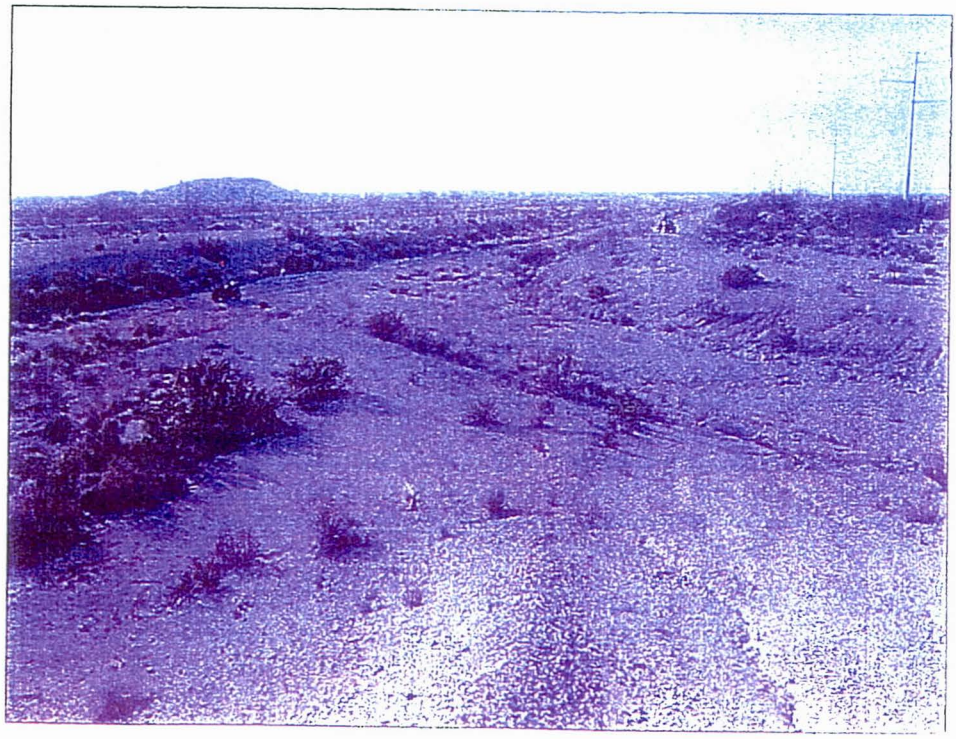

Figure 4.2. View looking across and downstream at Deposition Zone #6.

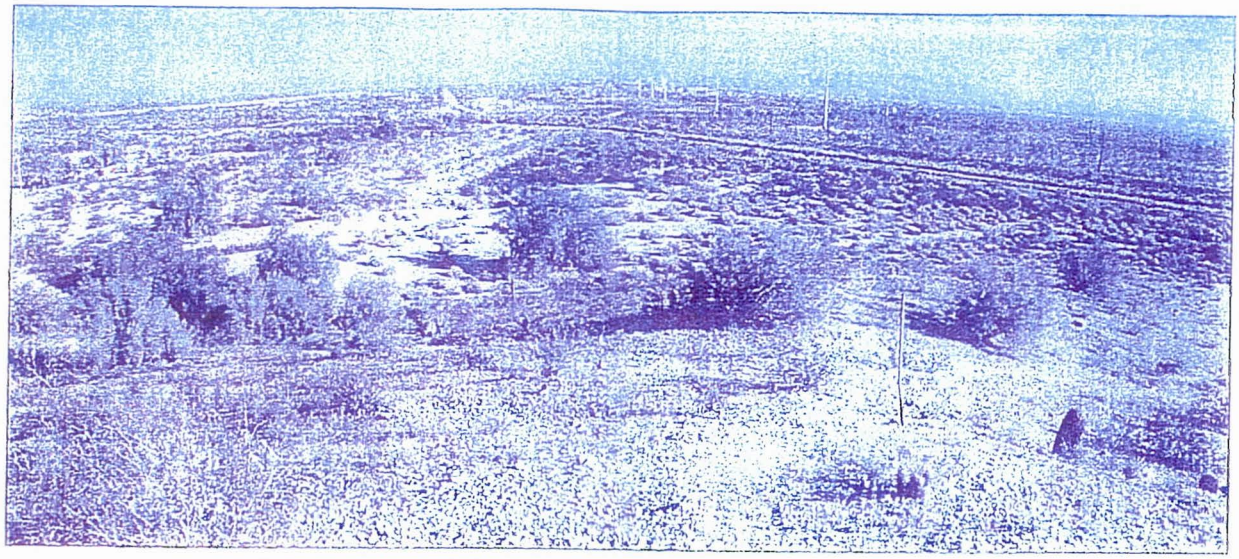

Figure 4.3. View southeast from a hill overlooking the fan at BSV Site 9 (Deposition Zone 7).

5. REFERENCES

American Excelsior, 2004. Erosion Works. (http://www.erosionworks.com/index.php).

Camp, P.D., 1986. Soil Survey of Aguila-Carefree Area, Parts of Maricopa and Pinal Counties, Arizona, USDA Soil Conservation Service, 306 pp.

Curtis, Jr., N.M., 1976. Erosion and Sediment Yield in New Mexico, In: Proceedings of the Third Federal Inter-Agency Sedimentation Conference, Denver, CO.

CH2M Hill, 1994. Casandro Wash Dam, Report Prepared for Flood Control District of Maricopa County, AZ.

CH2M Hill, 1994. Rawhide Wash Detention Basin, Report Prepared for Flood Control District of Maricopa County, AZ.

Hartman, G.W., 1977. Soil Survey of Maricopa County, Arizona, Central Part, USDA Soil Conservation Service, 117 pp.

Hjalmarson, H.W., 1996. City of Scottsdale Desert Greenbelt Project, Review of Sediment Yield. Report prepared for George V. Sabol Consulting Engineers, Inc.

Hjalmarson, H.W., 1998. Upper Cave Creek/Apache Wash Watercourse Master Plan, Report Prepared for Flood Control District of Maricopa County, AZ.

JE Fuller Hydrology & Geomorphology, Inc. (Fuller), 1997. Tatum Wash Sedimentation Study, Report Prepared for Flood Control District of Maricopa County, AZ.

JE Fuller Hydrology & Geomorphology, Inc. (Fuller), 2000. Spook Hill Area Drainage Master Plan: Update Sedimentation Analysis, Report Prepared for Wood/Patel Associates and the Flood Control District of Maricopa County, AZ.

JE Fuller Hydrology & Geomorphology, Inc. (Fuller), 2002. North Peoria Area Drainage Master Plan: Sedimentation Engineering and Geomorphic Evaluation, Report Prepared for Stantec Consulting and the Flood Control District of Maricopa County, AZ.

JE Fuller Hydrology & Geomorphology, Inc. (Fuller), 2003. Adobe Dam/Desert Hills Area Drainage Master Plan: Sedimentation Engineering and Geomorphic Evaluation, Draft Report Prepared for Flood Control District of Maricopa County, AZ.

Kelsey, K. L., 2002. Use of the Revised Universal Soil Loss Equation (RUSLE) to Predict Event Soil Loss, Thesis - College of Natural Resources, University of Wisconsin, Stevens Point, WI.

Resource Consultants & Engineers, Inc., (RCE), 1994. Sediment and Erosion Design Guide Prepared for Albuquerque Metropolitan Arroyo Flood Control Authority, NM.

Pacific Southwest Inter-Agency Committee, 1974. Erosion and Sediment Yield Methods, Report of the Water Management Subcommittee, USDA Soil Conservation Service, 47 pp.

PBS&J, 2004. Area 3 Technical Data Notebook, Volume I: Hydrology Report, Buckeye/Sun Valley Area Drainage Master Study, Draft Report Prepared for Flood Control District of Maricopa County, AZ, Contract FCD 2002C027.

Renard, K.G., 1972. Sediment Problems in the Arid and Semiarid Southwest, Soil Conservation Society of America, Proceedings 27th Annual Meeting, Portland, OR, pp. 225-232.

Sabol, G.V., Rumann, J.M., Khalili, D., Waters, S.D., Lehman, T., Gerlach, R.M., Motamedi, A.M., and Loomis, T.R., Revised 2003. Drainage Design Manual for Maricopa County, Volume I - Hydrology, Flood Control District of Maricopa County, AZ.

United States Department of Agriculture – Agriculture Research Service National Sedimentation Laboratory, 2004. Revised Universal Soil Los Equation Project. (http://www.sedlab.olemiss.edu/rusle/overview.html)

United States Department of Agriculture – Agriculture Research Service National Soil Erosion Research Laboratory, 2004. Official NRCS RUSLE2 Database, Purdue University, West Lafayette, IN. (http://fargo.nserl.purdue.edu/rusle2_dataweb/RUSLE2_Index.htm)

WEST Consulting (WEST), June 1997. Cherokee Wash Hydrologic, Hydraulic, and Sedimentation Study, Report Prepared for Flood Control District of Maricopa County, AZ.