Conditional Letter of Map Revision (CLOMR)
Technical Data Notebook
For

Bullard Wash; Maricopa County, Arizona
Sections 2.371 through Section 6.320
(approximately Lower Buckeye Road to Thomas Road)

Prepared for:

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SECTION 1: INTRODUCTION

The purpose of this study is to document the results of an evaluation of Bullard Wash in Maricopa County, Arizona between Sections 2.371 (just south of Lower Buckeye Road) and 6.320 (just south of Thomas Road) in support of a Conditional Letter of Map Revison (CLOMR). The basis for the CLOMR is two-fold:

- *Revised hydrology* based on changes in the upstream watershed
- *Proposed levee and channel construction* for a segment starting at Van Buren Road and extending upstream approximately 1200 feet.

This study was prepared by JE Fuller/Hydrology & Geomorphology, Inc. (JEF) under contract to Pinnacle Engineering, Inc. The project manager for JEF was John M. Wallace, P.E.. The project manager for Pinnacle Engineering was Wade Cooke, P.E. Pinnacle Engineering prepared the Bullard Wash Channel Improvement Plans under contract to Marwest Enterprises, L.L.C.

This report was prepared using the format, forms and instructions outlined in References 1 and 2 by the Arizona Department of Water Resources (ADWR) and the Federal Emergency Management Agency (FEMA), respectively (see Appendix A: References).

The study reach for the CLOMR is located in Township 2 North, Range 1 West, Section 32 and Township 1 North, Range 1 West, Sections 5, 8, 17 and 20, Gila and Salt River Baseline and Meridian. The proposed levee and channel improvements are located entirely within Township 1 North, Range 1 West, Section 5. Figure 1.1 shows the study reach and improvement reach locations.

The methodology used for the hydrologic analysis for the CLOMR was the U.S. Army Corps of Engineers HEC-1 model. The model was developed utilizing existing modeling prepared by the Flood Control District of Maricopa County (FCDMC) and modified by JEF to reflect recent watershed modifications. The resulting HEC-1 model has been adopted by the FCDMC for use on future CLOMR submittals within the watershed (see correspondence in Appendices B and D of this report).

The methodology used for the hydraulic analysis for the CLOMR was the U.S. Army Corps of Engineers HEC-2 model. The analysis was performed by modifying the HEC-2 model used as the basis for the existing flood insurance study (FIS) to reflect the revised hydrology and the proposed levee/channelization improvements in Section 5 of T1N, R1W. The HEC-2 model revisions to reflect the proposed levee/channelization improvements were based on plans prepared by Pinnacle Engineering.

The results of the study provide a revised floodplain and floodway delineation for Bullard Wash for the study reach which reflects the revised hydrology and the proposed levee/channel improvements in Section 5 of T1N, R1W. In general the hydrologic revisions resulted in lower discharges, consequently resulting in a narrower floodplain

and floodway delineation. The proposed levee/channelization improvements in Section 5 of T1N, R1W result in a narrower floodplain and coincident floodway through this quarter mile reach.

SECTION 2: ADWR/FEMA FORMS

This section of the notebook documents the forms required by the Arizona Department of Water Resources (ADWR) and Federal Emergency Management Agency (FEMA) as a part of the CLOMR submittal. The forms provided for this submittal are contained in Appendix B of this report and include the following.

ADWR Study Documentation Abstract
FEMA MT-2, Form No. 1: Revision Requester and Community Official Form
FEMA MT-2, Form No. 3: Hydrology
FEMA MT-2, Form No. 4: Hydraulics
FEMA MT-2, Form No. 5: Mapping
FEMA MT-2, Form No. 6: Channelization
FEMA MT-2, Form No. 7: Bridge Culvert
FEMA MT-2, Form No. 8: Levee/Floodwall

SECTION 3: SURVEY AND MAPPING INFORMATION

The survey and mapping information used to prepare this report consist of:

- The original survey and mapping prepared by the WLB Group as a part of the existing FIS for Bullard Wash prepared in 1992. This work is documented in the existing FIS submittals and is not recreated herein.
- New survey work used in the development of the channel improvement plans for Bullard Wash associated with the Estrella Views Estates[1]. Sub-sections 3.1 and 3.2 document this new survey work.

3.1 Field Survey Information

New survey work was performed for the Estrella Views Estates project to provide a basis for development of the Bullard Wash Channel Improvement plans. The survey was performed by Peter Bellis, R.L.S., of Pinnacle Engineering. Survey field notes for the Estrella Views Estates/Bullard Wash Channel Improvement plans are contained in Appendix C of this report.

3.2 Mapping

The basis of the vertical control for the Estrella Views Estates/Bullard Wash Channel Improvement Plan survey was RM 214 on the existing FIS.

[1] Please note that at the time of the preparation of this report the name of the development was changed to "Mountain View Estates" and that the latter name appears on some documentation within this report.

SECTION 4: HYDROLOGY

The hydrology for this CLOMR represents a revision of the existing hydrologic model used as the basis for the existing FIS. The existing FIS hydrologic model was revised to reflect changes in the upstream watershed associated with the recently constructed Dysart Avenue Drain improvements. Those changes are documented in the Letter of Map Revision (LOMR) package recently submitted to FEMA by the Flood Control District of Maricopa County for Bullard Wash at Luke Air Force Base.

4.1 Method Description

The hydrology for the existing FIS and this CLOMR was based on the U.S. Army Corps. of Engineers HEC-1 model. The watershed map for the HEC-1 model is shown in Figure 4.1. Because the existing FIS HEC-1 model was used as the basis for the hydrologic model for the CLOMR, the reader is referred to the hydrology submittals for the existing FIS (Reference 3) for a detailed discussion of the development of that model.

4.2 Parameter Estimation

The reader is referred to the hydrology submittals for the existing FIS (Reference 3) for a detailed discussion of the parameter estimation for the original HEC-1 model. No revision of the parameters for the model were included as a part of this CLOMR.

4.3 Problems Encountered During the Study

No special problems were encountered associated with the revisions to the existing FIS HEC-1 model. No warning or error messages are present in the model output.

4.4 Calibration

No new calibration of the HEC-1 model was performed in connection with the revisions made as a part of this effort. The reader is referred to the hydrology submittals for the existing FIS (Refernce 3) for a detailed discussion of the parameter estimation for the original HEC-1 model.

4.5 Final Results

The table below provides a summary of the changes in discharges from the existing FIS HEC-1 model to the revised HEC-1 model.

HEC-2 section number	Location	HEC-1 CP number	Drainage Area (sq mi)	Existing discharge from FIS	Revised discharge for this CLOMR
1.893		CP 336	57.14	4899	3200
2.536	30' South of Lower Buckeye Road Alignment	CP 335	52.55	4906	3191
2.977		CP 334	52.20	4915	3194
3.167		1I 334	51.46	4432	2742
3.602	Yuma Road	CP 316	50.82	4438	2746
4.625	Van Buren Road	CP 298	50.80	4446	2754
5.430	Interstate-10				
5.460		CP 287	49.96	5319	3538
5.727	280' North of McDowell Road	CP 286	48.89	4662	3400

It should be noted that the original FIS HEC-1 model was run using the 1981 version of HEC-1 while the revised model for this CLOMR was prepared using the current version of HEC-1 (Version 4.0, September 1990). A portion of the revised HEC-1 model input/output showing the above concentration points is included in Appendix D of this report[1]. A 3.5" disk containing the revised HEC-1 models is contained in Appendix G of this report.

[1] The size of the output file precluded inclusion of a hard copy of the entire input/output.

SECTION 5: HYDRAULICS

5.1 Method Description

The hydraulic modeling for the proposed CLOMR was performed using the U.S. Army Corps of Engineers HEC-2 model which was used as the basis for the existing FIS. The model name of the existing FIS model is BULL_FIS.DAT. The model name of the revised HEC-2 model is BULL_CLM.DAT

The existing FIS HEC-2 model was revised to reflect the revised hydrology discussed in Section IV of this report. Also, the HEC-2 model was revised to reflect the proposed channel improvements planned as a part of the Estrella Views Estates project located immediately upstream of Van Buren Street.

The revised HEC-2 model starts at the downstream end of the Bullard Wash area mapped in detail on the existing Flood Insurance Rate Map (FIRM) panel no. 04013C2070, i.e., the point where Zone A ends and Zone AE begins. The existing water surface elevation at HEC-2 section 2.371 was used to start the revised HEC-2 model.

5.2 Work Study Maps

The results of the hydraulic modeling are documented on copies of the topographic maps used for the existing FIS, which were prepared by the WLB Group. The resulting maps are included in Appendix J of this report. These maps show the revised floodplain and floodway delineations resulting from the revised hydrology and proposed channel improvements planned as a part of the Estrella View Estates project. For comparison purposes, copies of the flooplain work maps from the existing FIS are also included in Appendix J.

5.3 Parameter Estimation

The reader is referred to the hydraulics submittals for the existing FIS (Reference 3) for a detailed discussion of the parameter estimation for the original HEC-2 model. No revision of the parameters for the model were included as a part of this CLOMR.

5.4 Cross-section Description

All cross-section locations are per the existing FIS (except as noted in Section 5.5 of this report). The reader is referred to the hydraulics submittals for the existing FIS (Reference 3) for a detailed discussion of the cross-section placement and orientation.

5.5 Modeling Considerations

No revisions were made to the basic modeling effort reflected in the existing FIS model except where the proposed channel improvements planned as a part of the Estrella View Estates project were added to the model.

The plans for the proposed Bullard Wash Channel improvements associated with the Estrella Views Estates project are included in Appendix I of this report. The proposed improvements include the following components:

- Placement of a 12 celled, 10' x 4' reinforced concrete box culvert (RCBC) at the Van Buren Road crossing. It should be noted that the outer two cells, i.e., the most western and the most eastern, of the proposed RCBC are planned to be constructed as a 10'x 10' cell (western-most cell) and a 10'x 7' cell (eastern-most cell). The western-most cell is intended to serve as a future horse underpass. The invert of this cell will be located four feet below the invert of the interior cells and the soffit will be located two feet above the soffits of the interior cells. The eastern-most cell (10'x 7') has a depressed invert to allow for through flow of an existing irrigation ditch. The invert of this cell will be located three feet below the invert of the interior cells. To model the proposed culvert crossing, Section 4.625, located at Van Buren Street, was replaced with Sections 4.619 and 4.631, located at the upstream and downstream end of the proposed RCBC, respectively. The proposed RCBC was then modeled using the Special Culvert routine of HEC-2.

- Construction of approximately one-quarter mile of levee and channelization of the Bullard Wash upstream of the proposed RCBC described above. The proposed improvements include levees with four feet of freeboard within 100 feet of the proposed RCBC, three and one-half feet of freeboard at the upstream terminus, and three feet of freeboard elsewhere within the project. Details of the alignment, profile and cross-section of the proposed improvements are shown on the plan sheets included in Appendix I of this report. Specific engineering documentation required per FEMA MT-2, Form 8 (Levee/Floodwall) to address embankment protection, embankment and foundation stability, floodwall and foundation stability, settlement and interior drainage are contained in Appendix E of this report. To properly model the configuration of the proposed improvemens, additional cross-sections were added to the existing FIS HEC-2 model. The additional cross-sections are 4.754, 4.811, 4.833 and 4.855.

5.6 Floodway Modeling

Modeling of the revised floodway was based on optimization of equal conveyance reduction (encroachment method 5 of HEC-2 as described in Reference 4), then

modifying the resulting encroachments as needed to provide a reasonably smooth floodway delineation. The reader is referred to the hydraulics submittals for the existing FIS (Reference 3) for a detailed discussion of the floodway modeling approach used in the existing FIS HEC-2 model.

It should be noted that the proposed channel improvements associated with the Estrella Views Estates project encroach into the existing floodway. For this reason, the sections within the proposed improvement reach (Sections 4.701 through 4.855) reflect revised bank stations.

5.7 Problems Encountered during the Study

No special problems were encountered during the study which are not otherwise discussed in other sections of this report.

5.8 Calibration

No new or additional calibration was done beyond that done for the existing FIS.

5.9 Final Results

The input/output for the revised HEC-2 modeling are contained in Appendix E of this report. The summary printout from the revised HEC-2 model is shown on the following pages for ease of reference

BULLARD WASH CLOMR

SUMMARY PRINTOUT

	SECNO	Q	CWSEL	SSTA	STCHL	STCHR	ENDST	DIFWSX	TOPWID	DEPTH	EIMIN	10*KS	VCH
	2.371	3200.00	943.66	9277.65	9975.00	10030.00	10779.24	.00	1501.59	4.26	939.40	2.44	1.66
	2.371	3200.00	943.61	9506.21	9975.00	10030.00	10072.29	.00	566.08	4.21	939.40	6.34	2.66
*	2.435	3200.00	943.77	9276.89	9985.00	10085.00	10714.22	.11	1437.33	3.87	939.90	7.86	2.88
*	2.435	3200.00	943.85	9668.89	9985.00	10085.00	10085.00	.24	416.11	3.95	939.90	23.00	4.95
*	2.536	3191.00	945.40	9868.70	9965.00	10060.00	10649.76	1.63	781.06	1.90	943.50	122.60	8.06
*	2.536	3191.00	945.79	9915.00	9965.00	10060.00	10138.00	1.94	223.00	2.29	943.50	132.35	9.57
*	2.680	3191.00	948.59	9603.54	9925.00	10050.00	10674.57	3.19	964.41	3.39	945.20	17.97	4.31
*	2.680	3191.00	949.54	9925.00	9925.00	10050.00	10124.37	3.74	199.37	4.34	945.20	19.03	5.28
*	2.771	3191.00	950.08	9655.17	9985.00	10020.00	10532.04	1.49	858.07	2.78	947.30	68.90	6.57
*	2.771	3191.00	951.03	9972.38	9985.00	10020.00	10182.43	1.49	210.05	3.73	947.30	72.12	8.68
*	2.883	3191.00	952.33	9622.85	9985.00	10015.00	10420.12	2.25	797.28	3.83	948.50	23.35	4.96
*	2.883	3191.00	953.34	9853.00	9985.00	10015.00	10130.00	2.31	277.00	4.84	948.50	19.63	5.52
	2.977	3194.00	953.68	9686.92	9980.00	10050.00	10408.32	1.36	721.40	3.78	949.90	42.72	6.71
	2.977	3194.00	954.41	9875.00	9980.00	10050.00	10050.00	1.07	175.00	4.51	949.90	36.91	7.05
	3.070	3194.00	955.62	9531.43	9945.00	10025.00	10569.93	1.94	1038.51	3.32	952.30	27.39	4.54
	3.070	3194.00	956.40	9846.10	9945.00	10025.00	10134.96	1.99	288.85	4.10	952.30	35.59	6.26
	3.167	2742.00	956.84	9575.14	9970.00	10020.00	10570.36	1.22	995.22	2.94	953.90	20.18	4.10
	3.167	2742.00	957.86	9788.00	9970.00	10020.00	10130.00	1.46	342.00	3.96	953.90	17.88	4.84
*	3.291	2742.00	959.18	9989.16	9970.00	10020.00	10822.67	2.33	813.11	1.98	957.20	80.89	4.52
*	3.291	2742.00	960.06	9982.98	9970.00	10020.00	10284.69	2.20	298.43	2.86	957.20	92.63	5.64
*	3.376	2742.00	961.21	9772.58	9985.00	10015.00	10795.34	2.03	977.10	2.91	958.30	28.57	2.93
*	3.376	2742.00	962.25	9985.00	9985.00	10015.00	10291.73	2.19	306.73	3.95	958.30	27.65	4.09

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	SECNO	Q	CWSEL	SSTA	STCHL	STCHR	ENDST	DIFWSX	TOPWID	DEPTH	EIMIN	10*KS	VCH
	3.491	2742.00	962.60	9628.08	9980.00	10020.00	10599.29	1.40	971.21	3.10	959.50	19.00	3.36
	3.491	2742.00	963.62	9911.46	9980.00	10020.00	10234.04	1.37	322.58	4.12	959.50	18.97	4.43
*	3.602	2746.00	964.10	9742.06	9880.00	10100.00	10454.53	1.49	712.46	2.20	961.90	40.57	3.95
	3.602	2746.00	964.92	9880.00	9880.00	10100.00	10100.00	1.31	220.00	3.02	961.90	31.07	4.20
	3.702	2746.00	966.18	9297.73	9955.00	10055.00	10395.05	2.08	851.16	2.78	963.40	37.70	4.20
	3.702	2746.00	966.86	9600.00	9955.00	10055.00	10075.00	1.94	239.56	3.46	963.40	47.12	5.52
	3.841	2746.00	968.67	9229.62	9955.00	10070.00	10338.92	2.49	881.56	3.57	965.10	29.14	3.09
	3.841	2746.00	969.70	9588.62	9955.00	10070.00	10070.00	2.84	262.19	4.60	965.10	28.66	4.02
	3.978	2746.00	970.71	9279.88	9930.00	10095.00	10376.45	2.04	1096.57	3.81	966.90	27.96	3.56
	3.978	2746.00	971.60	9700.00	9930.00	10095.00	10095.00	1.90	395.00	4.70	966.90	24.66	4.06
	4.101	2746.00	972.63	9450.68	9960.00	10080.00	10450.15	1.92	999.47	3.93	968.70	30.32	3.57
	4.101	2746.00	973.48	9852.45	9960.00	10080.00	10091.34	1.87	238.89	4.78	968.70	35.66	4.77
	4.237	2746.00	974.47	9500.62	9935.00	10075.00	10323.19	1.84	822.57	3.17	971.30	22.35	3.49
	4.237	2746.00	975.50	9869.05	9935.00	10075.00	10075.00	2.02	205.95	4.20	971.30	22.27	4.22
	4.356	2746.00	975.86	9538.80	9950.00	10070.00	10345.85	1.40	807.05	3.26	972.60	21.67	3.47
	4.356	2746.00	976.90	9852.44	9950.00	10070.00	10070.00	1.41	217.56	4.30	972.60	21.57	4.18
	4.496	2746.00	977.52	9692.35	9975.00	10130.00	10385.67	1.66	693.32	3.12	974.40	23.85	3.61

	4.496	2746.00	978.53	9957.69	9975.00	10130.00	10131.68	1.63	173.99	4.13	974.40	23.92	4.43
	4.619	2754.00	979.15	9909.00	9909.00	10075.00	10075.00	1.63	166.00	3.15	976.00	34.46	5.32
	4.619	2754.00	979.86	9909.00	9909.00	10075.00	10075.00	1.33	166.00	3.86	976.00	17.83	4.33
	4.631	2754.00	980.09	9889.63	9873.00	10079.00	10061.91	.94	172.29	3.97	976.12	21.52	4.54
	4.631	2754.00	980.43	9887.94	9873.00	10079.00	10063.65	.57	175.71	4.31	976.12	16.11	4.13
	4.701	2754.00	980.86	9893.72	9881.50	10087.50	10075.28	.78	181.55	3.94	976.92	17.97	4.21
	4.701	2754.00	981.03	9893.06	9881.50	10087.50	10075.94	.60	182.88	4.11	976.92	15.61	4.03
	4.754	2754.00	981.38	9909.54	9897.00	10103.00	10090.46	.51	180.92	3.87	977.51	19.24	4.31
	4.754	2754.00	981.48	9909.12	9897.00	10103.00	10090.88	.45	181.76	3.97	977.51	17.56	4.18
	4.811	2754.00	981.96	9909.62	9897.00	10103.00	10090.38	.58	180.76	3.85	978.11	19.58	4.33
	4.811	2754.00	982.01	9909.38	9897.00	10103.00	10090.62	.53	181.24	3.90	978.11	18.58	4.26
*	4.833	2754.00	982.28	9871.23	9858.50	10141.50	10128.77	.32	257.54	3.93	978.35	8.29	2.91
*	4.833	2754.00	982.32	9871.04	9858.50	10141.50	10128.96	.31	257.93	3.97	978.35	7.97	2.87
*	4.855	2754.00	982.43	9688.90	9680.00	10175.00	10175.00	.15	486.10	3.86	978.57	3.24	1.70
*	4.855	2754.00	982.47	9688.81	9680.00	10175.00	10175.00	.15	486.19	3.90	978.57	3.14	1.68
*	4.858	2754.00	982.39	9688.41	9705.00	10290.00	10341.72	-.04	653.31	2.39	980.00	25.93	2.72
*	4.858	2754.00	982.28	9850.00	9705.00	10290.00	10150.00	-.19	300.00	2.28	980.00	65.48	4.68

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	SECNO	Q	CWSEL	SSTA	STCHL	STCHR	ENDST	DIFWSX	TOPWID	DEPTH	ELMIN	10*KS	VCH
	5.009	2754.00	984.73	9664.64	9935.00	10100.00	10332.94	2.34	668.30	2.83	981.90	33.54	3.68
*	5.009	2754.00	985.68	9875.00	9935.00	10100.00	10105.00	3.40	230.00	3.78	981.90	28.69	4.31
	5.153	2754.00	987.23	9543.26	9945.00	10090.00	10308.40	2.51	765.14	2.93	984.30	31.84	3.70
	5.153	2754.00	988.09	9865.00	9945.00	10090.00	10090.00	2.41	225.00	3.79	984.30	35.61	4.76
*	5.282	2754.00	988.68	9325.76	9945.00	10055.00	10352.76	1.45	1027.00	3.18	985.50	13.78	2.76
*	5.282	2754.00	989.72	9760.21	9945.00	10055.00	10055.00	1.63	294.79	4.22	985.50	13.68	3.31
*	5.430	2754.00	990.44	9913.90	9899.90	10100.10	10086.10	1.76	172.21	2.44	988.00	81.60	6.77
*	5.430	2754.00	991.13	9912.44	9899.90	10100.10	10087.56	1.41	175.13	3.13	988.00	35.11	5.22
*	5.460	3538.00	991.00	9912.71	9899.90	10100.10	10087.29	.56	174.57	3.00	988.00	66.93	7.01
*	5.460	3538.00	992.00	9910.62	9899.90	10100.10	10089.38	.87	178.77	4.00	988.00	25.47	5.19
*	5.563	3538.00	992.61	9351.44	9850.00	10100.00	10736.61	1.62	1385.17	4.11	988.50	5.08	2.02
*	5.563	3538.00	993.11	9850.00	9850.00	10100.00	10232.23	1.11	382.23	4.61	988.50	7.58	2.65
*	5.727	3400.00	993.54	9375.48	9935.00	10135.00	10467.87	.92	933.58	2.54	991.00	108.14	5.65
*	5.727	3400.00	994.30	9935.00	9935.00	10135.00	10135.00	1.19	200.00	3.30	991.00	81.45	5.92
*	5.840	3400.00	996.30	9353.27	9970.00	10170.00	10715.70	2.77	1293.68	2.90	993.40	21.83	3.01
*	5.840	3400.00	997.15	9953.68	9970.00	10170.00	10240.40	2.85	286.73	3.75	993.40	25.22	3.88
	5.960	3400.00	998.09	9735.32	9960.00	10150.00	10948.05	1.79	1212.73	2.19	995.90	39.62	3.21
	5.960	3400.00	999.10	9960.00	9960.00	10150.00	10274.06	1.95	314.06	3.20	995.90	39.85	4.24
	6.086	3400.00	1000.79	9475.24	9900.00	10100.00	10827.24	2.70	1352.00	2.49	998.30	40.60	3.39
	6.086	3400.00	1001.79	9900.00	9900.00	10100.00	10206.32	2.70	306.32	3.49	998.30	41.25	4.42
*	6.217	3400.00	1002.61	9445.53	9900.00	10100.00	10837.22	1.82	1391.69	2.51	1000.10	17.16	2.46
*	6.217	3400.00	1003.66	9850.00	9900.00	10100.00	10270.00	1.86	420.00	3.56	1000.10	15.88	3.01
	6.320	3400.00	1003.60	9582.92	9900.00	10100.00	10928.09	.99	1345.17	2.70	1000.90	19.52	2.67
	6.320	3400.00	1004.60	9900.00	9900.00	10100.00	10279.29	.94	379.29	3.70	1000.90	19.99	3.35

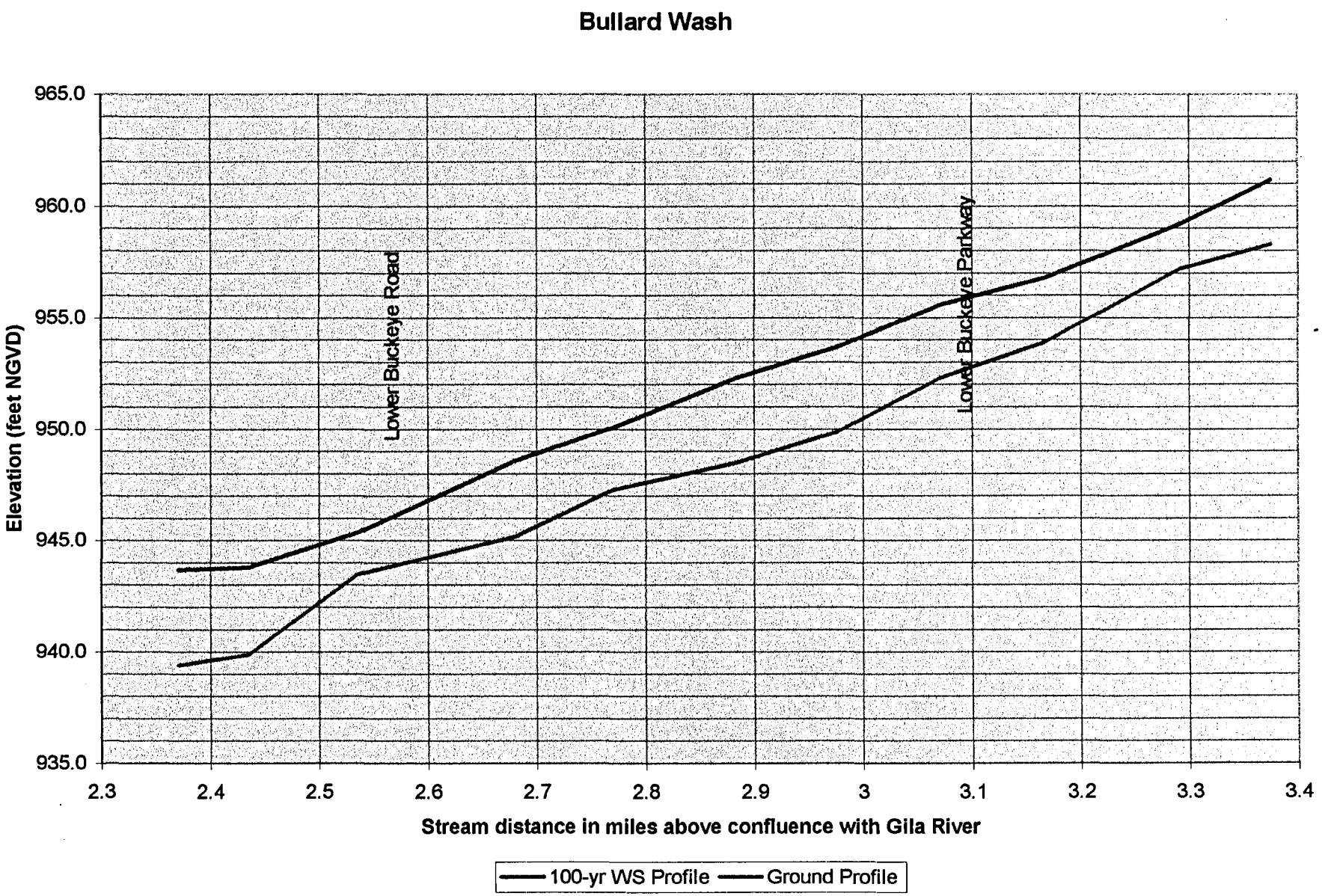
SECTION 6: EROSION AND SEDIMENT TRANSPORT

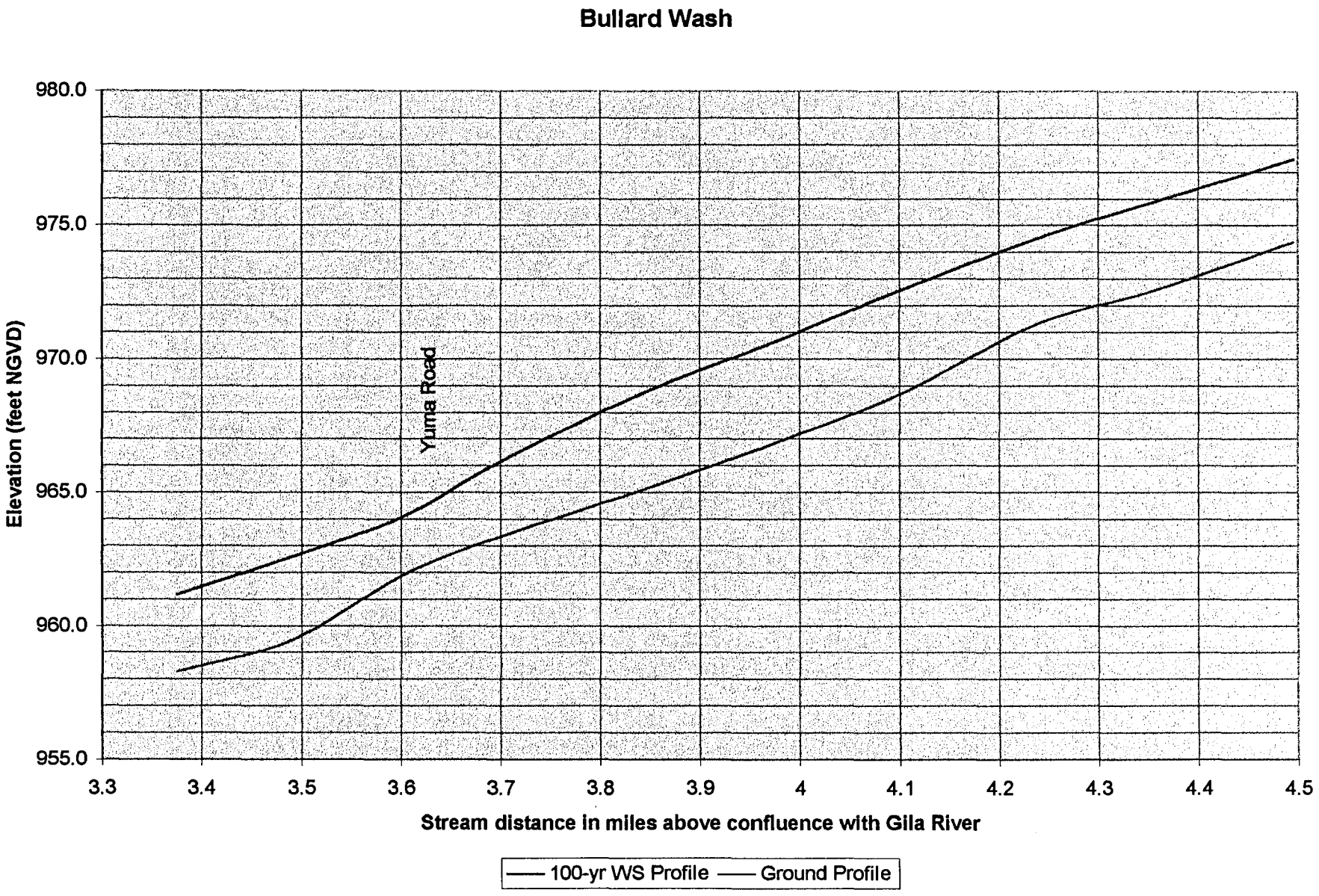
The Bullard Wash is a small, poorly defined, watercourse which flows through agricultural land in the Town of Goodyear, located west of Phoenix. The erosion and sediment transport characteristics of the watercourse are discussed in greater detail in Reference 3. Flow is generally of a very high width-to-depth ratio with a relatively low associated sediment transport capacity. The design of the proposed Bullard Wash Improvements at Estrella Views Estates will maintain the relatively high width-to-depth ratio of the watercourse. For this reason, no significant changes in the erosion and sediment transport characteristics of the wash are expected in connection with this CLOMR. Documentation associated with minor erosion potential within the improved reach is contained in Appendix E of this report.

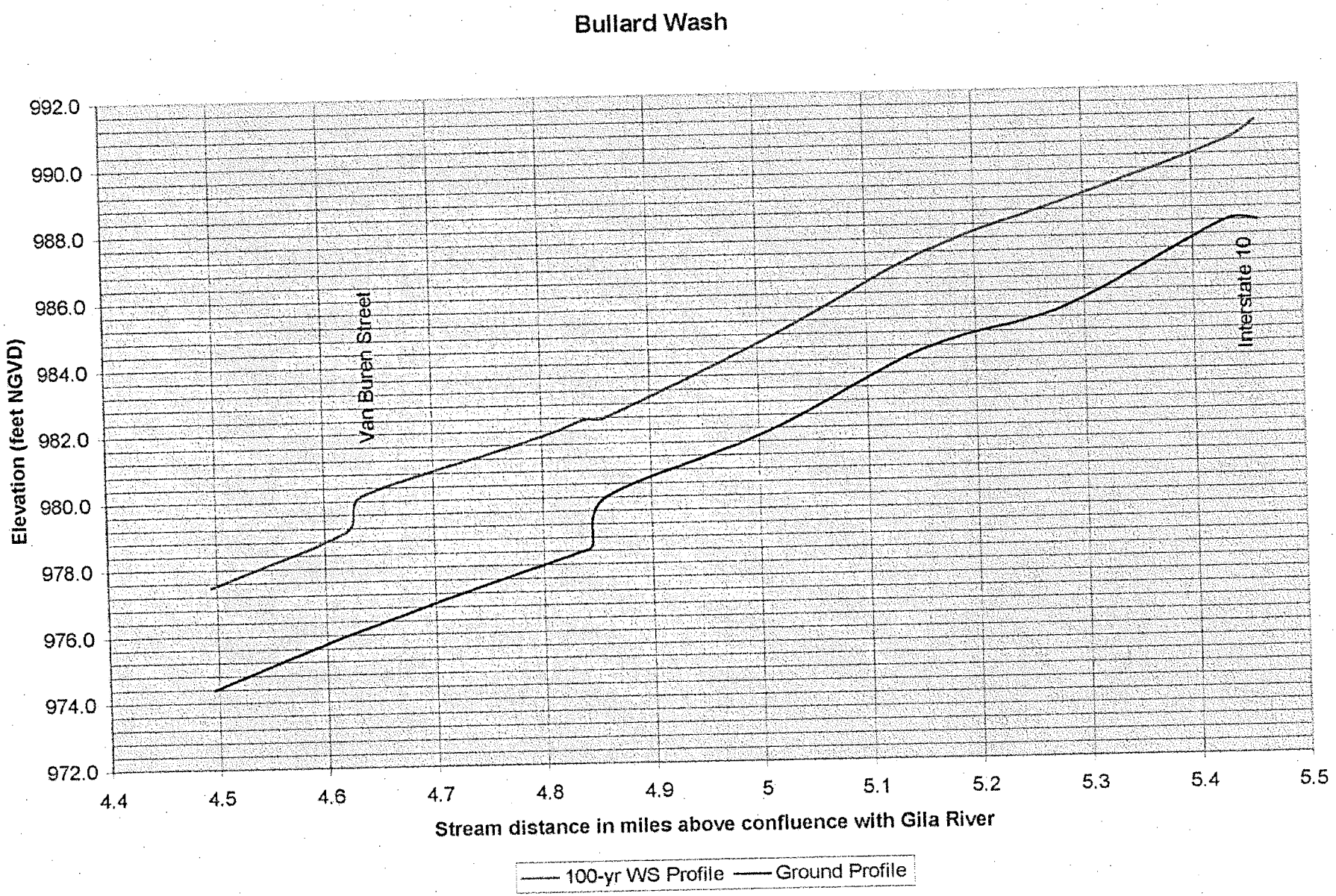
SECTION 7: DRAFT FIS REPORT DATA

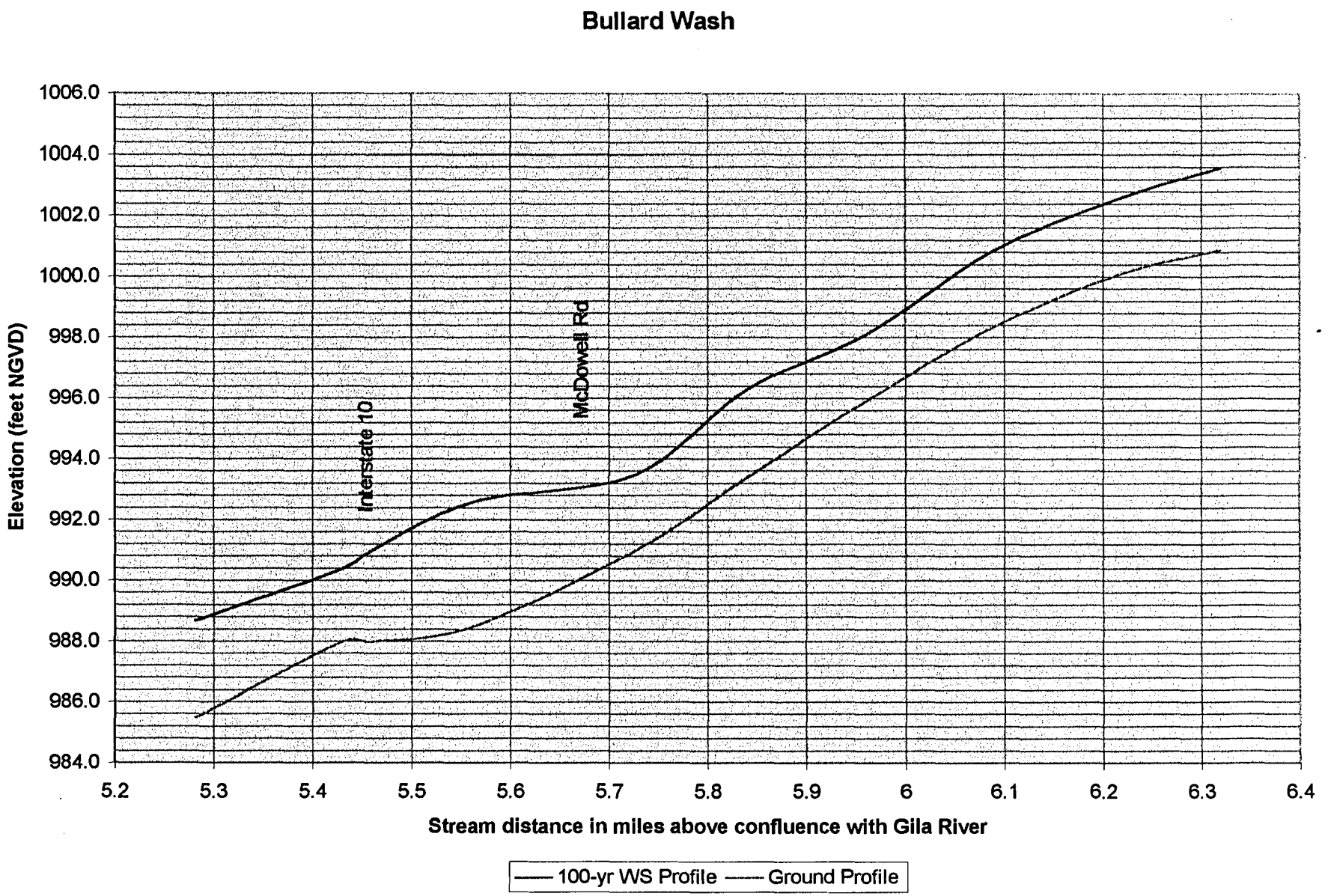
Draft floodway table data for the Bullard Wash CLOMR are shown below. Flood profiles are shown on the following pages.

Floodway Data Table						
	Floodway			Base Flood Water Surface Elevation		
Station	Width (feet)	Section Area (ft^2)	Mean Velocity (ft/s)	With Floodway	Without Floodway	Increase (ft)
2.371	566	1729	1.9	943.7	943.7	0.0
2.435	416	956	3.3	943.9	943.8	0.1
2.536	223	464	6.9	945.8	945.4	0.4
2.680	199	770	4.1	949.6	948.6	1.0
2.771	210	676	4.7	951.1	950.1	1.0
2.883	277	1023	3.1	953.3	952.3	1.0
2.977	175	585	5.5	954.4	953.7	0.7
3.070	289	816	3.9	956.4	955.6	0.8
3.167	342	991	2.8	957.8	956.8	1.0
3.291	302	699	3.9	960.1	959.2	0.9
3.376	307	1029	2.7	962.2	961.2	1.0
3.491	323	1090	2.5	963.6	962.6	1.0
3.602	220	653	4.2	964.9	964.1	0.8
3.702	475	675	4.1	966.9	966.2	0.7
3.841	481	856	3.2	969.7	968.7	1.0
3.978	395	885	3.1	971.6	970.7	0.9
4.101	239	739	3.7	973.5	972.6	0.9
4.237	206	755	3.6	975.5	974.5	1.0
4.356	218	818	3.4	976.9	975.9	1.0
4.496	174	656	4.2	978.5	977.5	1.0
4.619	166	636	4.3	979.8	979.1	0.7
4.631	176	667	4.1	980.4	980.1	0.3
4.701	183	684	4.0	981.1	980.9	0.2
4.754	182	659	4.2	981.5	981.4	0.1
4.811	181	647	4.3	982.1	982.0	0.1
4.833	258	960	2.9	982.3	982.3	0.0
4.855	486	1636	1.7	982.4	982.4	0.0
4.858	300	589	4.7	982.3	982.4	-0.1
5.009	230	734	3.8	985.7	984.7	1.0
5.153	225	687	4.0	988.1	987.2	0.9
5.282	295	1134	2.4	989.7	988.7	1.0
5.430	175	528	5.2	991.1	990.4	0.7
5.460	179	681	5.2	992.0	991.0	1.0
5.563	382	1576	2.2	993.1	992.6	0.5
5.727	200	574	5.9	994.3	993.5	0.8
5.840	287	994	3.4	997.1	996.3	0.8
5.960	314	933	3.6	999.1	998.1	1.0
6.086	306	888	3.8	1001.8	1000.8	1.0
6.217	420	1412	2.4	1003.6	1002.6	1.0
6.320	379	1240	2.7	1004.6	1003.6	1.0


Bullard Wash
965.0
960.0
955.0
950.0
945.0
940.0
935.0
Elevation (feet NGVD)
Lower Buckeye Road
Lower Buckeye Parkway
2.3
2.4
2.5
2.6
2.7
2.8
2.9
3
3.1
3.2
3.3
3.4
Stream distance in miles above confluence with Gila River
100-yr WS Profile
Ground Profile


Bullard Wash
980.0
975.0
970.0
965.0
960.0
955.0
Elevation (feet NGVD)
Yuma Road
3.3
3.4
3.5
3.6
3.7
3.8
3.9
4
4.1
4.2
4.3
4.4
4.5
Stream distance in miles above confluence with Gila River
100-yr WS Profile
Ground Profile


Bullard Wash
Elevation (feet NGVD)
992.0
990.0
988.0
986.0
984.0
982.0
980.0
978.0
976.0
974.0
972.0
4.4
4.5
4.6
4.7
4.8
4.9
5
5.1
5.2
5.3
5.4
5.5
Stream distance in miles above confluence with Gila River
Van Buren Street
Interstate 10
100-yr WS Profile
Ground Profile


Bullard Wash
1006.0
1004.0
1002.0
1000.0
998.0
996.0
994.0
992.0
990.0
988.0
986.0
984.0
Elevation (feet NGVD)
Interstate 10
McDowell Rd
5.2
5.3
5.4
5.5
5.6
5.7
5.8
5.9
6
6.1
6.2
6.3
6.4
Stream distance in miles above confluence with Gila River
100-yr WS Profile
Ground Profile

Appendix A: References

1. *Instructions for Organizing and Submitting Technical Documentation for Flood Studies*, Arizona Department of Water Resources, State Standard Attachment, SSA 1-97, November 1997

2. *Revisions to National Flood Insurance Program Maps*, Application/Certification Forms and Instructions for Conditional Letters of Map Revision, Letters of Map Revision and Physical Map Revisions, MT-2, FEMA Form 81-89 Series, June 1998

3. *White Tanks/Agua Fria Area Drainage Master Study*, Part A: Flood Study Technical Documentation Notebook (TDN), WLB Group, October 1992

4. *HEC-2 Water Surface Profiles Users Manual*, U.S. Army Corps of Engineers, September 1990.

APPENDIX B

ADWR/FEMA Forms & General Documentation and Correspondence

Study Documentation Abstract for FEMA Submittals	Initial Study		Restudy		CLOMR	X	LOMR		Other	

Section 2.1: Study Documentation Abstract for FEMA Submittals		
2.1.1	Date Study Accepted	
2.1.2	Study Contractor Contact(s) Address Phone Internal Reference Number	JE Fuller/Hydrology & Geomorphology John M. Wallace 2881 N. Silver Spur Drive Tucson, Arizona 85745 520-623-3112 Pinnacle Engineering/Bullard Wash CLOMR
2.1.3	FEMA Technical Review Contractor Contact(s) Address Phone Internal Reference Number	
2.1.4	FEMA Regional Reviewer Phone	
2.1.5	State Technical Reviewer Phone	
2.1.6	Local Technical Reviewer Phone	
2.1.7	Reach Description	Bullard Wash; Maricopa County, Arizona
2.1.8	USGS Quad Sheet(s) with original photo date & latest photo revision date	
2.1.9	Unique Conditions and Problems	
2.1.10	Coordination of Q's (Agency, Date, Comments)	Flood Control District of Maricopa County reviewed and approved HEC-1 model for CLOMR preparation.

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

Public reporting burden for this form is estimated to average 2.13 hours per response. The burden estimate includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the needed data, and completing and reviewing the form. Send comments regarding the accuracy of the burden estimate and any suggestions for reducing this burden to: Information Collections Management, Federal Emergency Management Agency, 500 C Street, S.W., Washington DC 20472; and to the Office of Management and Budget, Paperwork Reduction Project (3067-0148), Washington, DC 20503.

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

1. REQUESTED RESPONSE FROM FEMA

This request is for a:

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

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

☐ Other Describe:

2. OVERVIEW

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

☒ Physical Change ☐ Improved Methodology/Data ☒ Floodway Revision

☐ Other Describe:

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

2. Flooding Source: Bullard Wash, Town of Goodyear, Maricopa County, Arizona

3. Project Name/Identifier: Bullard Wash,

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

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

Community No.	Community Name	State	Map No.	Panel No.	Effective Date
Ex: 480301	Katy, City	TX	480301	0005D	02/08/83
480287	Harris County	TX	48201C	0220G	09/28/90
040046	Town of Goodyear	AZ	04013C	2060E	09/30/95

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

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

PLEASE REFER TO THE INSTRUCTIONS FOR THE APPROPRIATE MAILING ADDRESS

4. ENCROACHMENT INFORMATION

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

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

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

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

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

5. MAINTENANCE RESPONSIBILITY

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

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

6. REVIEW FEE

The review fee for the appropriate request category has been included. ☒ Yes Fee amount: $3,300

OR

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

Please see Instructions for Fee Amounts

7. SIGNATURE

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

John M. Wallace
Signature of Revision Requester

John M. Wallace, P.E., Vice President
Printed Name and Title of Revision Requester

JE Fuller/Hydrology & Geomorphology, Inc.
Company Name

Telephone No.: 520-623-3112 Date: 9/30/1998

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

Signature of Community Official

Printed Name and Title of Community Official

Community Name

Telephone No.: Date:

CERTIFICATION BY REGISTERED PROFESSIONAL ENGINEER AND/OR LAND SURVEYOR

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

John M. Wallace
Signature

John M. Wallace, P.E., Vice President
Printed Name and Title of Revision Requester

Registr No. 22922 Expires (Date) 12/31/98 State AZ

Type of License/Expertise: Civil Engineer

Check which forms have been included with this request

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

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

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

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

Note: Fill out one form for each flooding source studied

Community Name: Town of Goodyear, Maricopa County, Arizona

Flooding Source: Bullard Wash, Town of Goodyear, Maricopa County, Arizona

Project Name/Identifier: Bullard Wash Revised Hydrology and Estrella Views Estates Improvement Project

1. REASON FOR NEW HYDROLOGIC ANALYSIS

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

☐ Alternative methodology ☐ Proposed Conditions (CLOMR) ☐ Other

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

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

2. METHODOLOGY FOR NEW ANALYSIS

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

3. APPROVAL OF ANALYSIS

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

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

4. COMPARISON OF BASE FLOOD DISCHARGES

Location:	Drainage Area (SqMi)	FIS(cfs)	Revised (cfs)
280' North of McDowell Rd.	48.89	4662	3400
Van Buren Road	50.80	4446	2754
30' South of Buckeye Rd. Alignment	57.14	4906	3200

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

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

5. HISTORICAL FLOODING INFORMATION

dates, and source of information. ☐ Data Attached ☒ Data Not Available

PLEASE REFER TO THE INSTRUCTIONS FOR THE APPROPRIATE MAILING ADDRESS

ATTACHMENT D: PRECIPITATION/RUNOFF MODEL

		FIS:		Revised:	
1.	Method or model used:	HEC-1		HEC-1	
	Version:	4.0			
	Date:	9/1990			
2.	Source of rainfall depth:	FCDMC			
3.	Source of rainfall distribution:	FCDMC			
4.	Rainfall duration:	24-hour			
5.	Areal adjustment to precipitation (%):	Varies			
6.	Maximum overland flow length	NA			
7.	Hydrograph development method:	Unit Hydrograph			
8.	Loss rate method:	Green-Ampt			
	Source of soils information:	FCMCD			
	Source of land use information:	FCMCD			
9.	Channel routing method:	Normal Depth			
10.	Reservoir routing:	☒ Yes	☐ No	☒ Yes	☐ No
11.	Baseflow considerations: **If Yes, explain below how baseflow was determined:**	☐ Yes	☒ No	☐ Yes	☒ No
12.	Snowmelt considerations:	☐ Yes	☒ No	☐ Yes	☒ No
13.	Model calibration: **If Yes, explain below how calibration was performed**	☐ Yes	☒ No	☐ Yes	☒ No
14.	Future land use condition: **If Yes, explain why below**	☐ Yes	☒ No	☐ Yes	☒ No

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

Information and Maps provided? ☐ Yes ☒ No *

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

* Output of portion of HEC-1 model is contained in Appendix D.
Disk with HEC-1 model is contained in Appendix G
Watershed map is contained in Appendix H.
See Reference 3 for all other information

FLOOD CONTROL DISTRICT
of
Maricopa County

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

BOARD OF DIRECTORS
Jan Brewer
Fulton Brock
Andrew Kunasek
Don Stapley
Mary Rose Garrido Wilcox

September 25, 1998

Mr. John Wallace
2881 North Silver Spur Drive
Tucson, Arizona 85745

Dear Mr. Wallace:

The HEC-1 model "bullab3.dat," developed by the Flood Control District of Maricopa County, will be submitted to FEMA for the Bullard Wash Channel LOMR package.

I am enclosing the drainage maps for White Tanks ADMS and Bullard Wash Channel hydrology.

If you have any questions, please call me at (602) 506-3293.

Sincerely,

Bing Zhao, Ph.D., P.E.
Civil Engineer

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

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

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

Note: Fill out one form for each flooding source studied

Community Name: Town of Goodyear

Flooding Source: Bullard Wash, Town of Goodyear, Maricopa County, Arizona

Project Name/Identifier: Bullard Wash Revised Hydrology and Estrella Views Estates Improvement Project

1. REACH TO BE REVISED

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

Downstream Limit: ~900 south of Lower Buckeye Road (extended) (HEC-2 section 2.371)

Upstream Limit: ~3400 north of McDowell Road (HEC-2 section 6.320)

2. MODELS SUBMITTED

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

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

1. Duplicate Effective Model ☒ **Natural** **File Name** Bull fis.dat ☒ **Floodway** **File Name** Bull fis.dat

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

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

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

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

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

4. Revised or Post-Project Conditions Model ☒ **Natural** **File Name** Bull clm.dat ☒ **Floodway** **File Name** Bull clm.dat

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

Floodway

PLEASE REFER TO THE INSTRUCTIONS FOR THE APPROPRIATE MAILING ADDRESS

3. STARTING WATER-SURFACE ELEVATIONS

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

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

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

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

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

☐ Floodway Surcharges Greater Than Maximum Allowed by Community/State

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

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

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

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

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

5. REVISED FIRM/FBFM AND FLOOD PROFILES

1. **Profile Transition**

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

Downstream End 2.371 within NA (feet) *Cross-Section #* Upstream End 6.320 within NA (feet) *Cross-Section #*

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

Downstream End 2.371 within NA (feet) *Cross-Section #* Upstream End 6.32 within NA (feet) *Cross-Section #*

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

Downstream End 2.371 within NA (feet) *Cross-Section #* Upstream End 6.32 within NA (feet) *Cross-Section #*

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

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

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

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

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

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

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

Floodway Data Table

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

Floodway Data Table Attached ☒ **Yes** ☐ **Not Required**

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

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

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

Note: Fill out one form for each flooding source studied

Community Name: Town of Goodyear

Flooding Source: Bullard Wash, Town of Goodyear, Maricopa County, Arizona

Project Name/Identifier: Bullard Wash Revised Hydrology and Estrella Views Estates Improvement Project

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

1. MAPPING CHANGES

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

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

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

2. What is the source and date of the updated topographic information (example: orthophoto maps, July 1985; filed survey, May 1979, beach profile, June 1987 etc.)? 1989 topographic mapping from original FIS used supplemented with new survey for the Estrella Views Estates, Bullard Wash improvements (located immediately north of Van Buren Street)

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

Effective FIS Scale 1"=400' Contour Interval 2'

Revision Request Scale same as FIS Contour Interval same as FIS

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

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

PLEASE REFER TO THE INSTRUCTIONS FOR THE APPROPRIATE MAILING ADDRESS

2. EARTH FILL PLACEMENT

1. The fill is: ☐ Existing ☐ Proposed NOT APPLICABLE

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

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

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

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

      If Yes, justify steeper slopes

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

      ☐ Yes ☐ No

      If No, describe erosion protection provided

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

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

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

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

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

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

   ☐ Yes ☐ No

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

FEDERAL EMERGENCY MANAGEMENT AGENCY **CHANNELIZATION FORM**	O.M.B. Burden No. 3067-0148 Expires April 30, 2001

PUBLIC BURDEN DISCLOSURE NOTICE

Public reporting burden for this form is estimated to average 1.75 hours per response. The burden estimate includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the needed data, and completing and reviewing the form. Send comments regarding the accuracy of the burden estimate and any suggestions for reducing this burden to: Information Collections Management, Federal Emergency Management Agency, 500 C Street, S.W., Washington, DC 20472; and to the Office of Management and Budget, Paperwork Reduction Project (3067-0148), Washington, DC 20503.

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

Community Name: Town of Goodyear

Flooding Source: Bullard Wash, Town of Goodyear, Maricopa County, Arizona

Project Name/Identifier: Bullard Wash Revised Hydrology and Estrella Views Estates Improvement Project

1. REACH TO BE REVISED

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

Downstream Limit: ~900 ft. downstream of Lower Buckeye Road alignment (end of Zone AE)

Upstream Limit: ~3300 ft. upstream of McDowell Road (end of Zone AE)

2. CHANNEL DESCRIPTION

Attach the following information about the channel (check box if information has been provided):

☒ Description of the inlet and outlet

☒ Description of the shape of the channel *(both cross sectional and planimetric configuration)* and its lining *(channel bottom and sides)*:

3. ACCESSORY STRUCTURES

The channelization includes:

- ☒ Levees *(Attach Levee/Floodwall System Analysis Form - Form 8)*
- ☒ Drop structures
- ☐ Superelevated sections
- ☒ Transitions in cross sectional geometry
- ☐ Debris basin/detention basin
- ☐ Energy dissipater
- ☐ Other (Describe):

4. DRAWING CHECKLIST

Attach the plans of the channelization certified by a registered professional engineer. The plan detail and information should include (check box if information has been provided):

☒ Channel alignment and locations of inlet, outlet, and accessory structures

☒ Channel lining

☒ Typical cross sections and profiles of channel banks and invert

SEE IMPROVEMENT PLANS IN APPENDIX I

5. HYDRAULIC CONSIDERATIONS

1. The channel was designed to carry 2754 (cfs) and/or the 100-year flood.

2. The design elevation in the channel based on:

   ☒ Subcritical flow

   ☐ Critical flow

   ☐ Supercritical flow

   ☐ Energy grade line

3. **If there is the potential for a hydraulic jump at the following locations, check the box(es) that apply and attach an explanation of how the hydraulic jump is controlled without affecting the stability of the channel.**

Inlet to channel?	☐ Yes
Outlet of channel?	☐ Yes
At Drop Structures?	☐ Yes
At Transitions?	☐ Yes
Other locations?	☐ Yes

Explanation Attached? ☐ **Yes** ☒ **No** ☐ **N/A**

6. SEDIMENT TRANSPORT CONSIDERATIONS

If there is any indication from historical records that sediment transport (including scour and deposition) can affect the 100-year (base flood) water-surface elevations; and/or based on the stream geomorphology, vegetative cover, development of the watershed and bank conditions, there is a potential for debris and sediment transport (including sewer and deposition) to affect the base flood water-surface elevations, then provide the following information **(Check the box if provided):**

☐ Estimated sediment load

☐ Method used to estimate sediment transport

☒ Method used to estimate scour and/or deposition

☐ Method used to revise hydraulic or hydrologic analysis (model) to account for sediment transport

FEDERAL EMERGENCY MANAGEMENT AGENCY **BRIDGE/CULVERT FORM**	O.M.B. Burden No. 3067-0148 Expires April 30, 2001

PUBLIC BURDEN DISCLOSURE NOTICE

Public reporting burden for this form is estimated to average 2 hours per response. The burden estimate includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the needed data, and completing and reviewing the form. Send comments regarding the accuracy of the burden estimate and any suggestions for reducing this burden to: Information Collections Management, Federal Emergency Management Agency, 500 C Street, S.W., Washington, DC 20472; and to the Office of Management and Budget, Paperwork Reduction Project (3067-0148), Washington, DC 20503.

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

Community Name: Town of Goodyear

Flooding Source: Bullard Wash, Town of Goodyear, Maricopa County, Arizona

Project Name/Identifier: Bullard Wash Revised Hydrology and Estrella Views Estates Improvement Project

1. IDENTIFIER

1. Name of structure (roadway, railroad, etc.): Van Buren Streeet Box Culvert

2. Location of bridge/culvert along flooding source (in terms of stream distance or cross-section identifier):

   River mile 4.619 (Section 4.619 in HEC-2 model)

3. This revision reflects (check one of the following):

   ☒ New bridge/culvert not modeled in the FIS

   ☐ Modified bridge/culvert previously modeled in the FIS

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

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

   HEC-2

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

   Justification attached ☐ **Yes** ☐ **No** ☒ **N/A**

PLEASE REFER TO THE INSTRUCTIONS FOR THE APPROPRIATE MAILING ADDRESS

2. DRAWING CHECKLIST

Attach plans of the structure(s) certified by a registered professional engineer. The plan detail and information should include the following (check the boxes if the information has been provided):

- ☒ Dimensions (height, width, span, radius, length)
- ☒ Shape (culverts only)
- ☒ Material
- ☒ Beveling or Rounding
- ☒ Wing Wall Angle
- ☒ Low Chord Elevations - Upstream and Downstream
- ☒ Top of Road Elevations - Upstream and Downstream
- ☒ Structure Invert Elevations - Upstream and Downstream
- ☒ Stream Invert Elevations - Upstream and Downstream
- ☒ Skew Angle
- ☒ Cross-Section Locations
- ☒ Distances Between Cross Sections
- ☒ Erosion Protection

SEE IMPROVEMENT PLANS IN APPENDIX I.

3. SEDIMENT TRANSPORT CONSIDERATIONS

If there is any indication from historical records that sediment transport (including scour and deposition) can affect the 100-year (base flood) water-surface elevations; and/or based on the stream geomorphology, vegetative cover, development of the watershed and bank conditions, there is a potential for debris and sediment transport (including sewer and deposition) to affect the base flood elevations, then provide the following information **(Check the box if provided):**

- ☐ Estimated sediment load
- ☐ Method used to estimate sediment transport
- ☐ Method used to estimate scour and/or deposition
- ☐ Method used to revise hydraulic or hydrologic analysis (model) to account for sediment transport

FEDERAL EMERGENCY MANAGEMENT AGENCY **LEVEE/FLOODWALL SYSTEM ANALYSES FORM**	O.M.B. Burden No. 3067-0148 Expires April 30, 2001

PUBLIC BURDEN DISCLOSURE NOTICE

Public reporting burden for this form is estimated to average 3.0 hours per response. The burden estimate includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the needed data, and completing and reviewing the form. Send comments regarding the accuracy of the burden estimate and any suggestions for reducing this burden to: Information Collections Management, Federal Emergency Management Agency, 500 C Street, S.W., Washington, DC 20472; and to the Office of Management and Budget, Paperwork Reduction Project (3067-0148), Washington, DC 20503.

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

Community Name: Town of Goodyear

Flooding Source: Bullard Wash, Town of Goodyear, Maricopa County, Arizona

Project Name/Identifier: Bullard Wash Revised Hydrology and Estrella Views Estates Improvement Project

1. REACH TO BE REVISED

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

Downstream Limit: ~900 ft. downstream of Lower Buckeye Road alignment (end of Zone AE)

Upstream Limit: ~3300 ft. upstream of McDowell Road (end of Zone AE)

2. LEVEE/FLOODWALL SYSTEM ELEMENTS

1. This Levee/Floodwall analysis is based on:

   ☐ upgrading of an existing levee/floodwall system
   ☒ a newly constructed levee/floodwall system
   ☐ reanalysis of an existing levee/floodwall system

2. Levee elements and locations are:

   ☒ earthen embankment, dike, berm, etc. Station _____ to
   ☐ structural floodwall Station _____ to
   ☐ other (describe): _____ Station _____ to

3. Structural Type:

   ☐ monolithic cast-in place reinforced concrete
   ☐ reinforced concrete masonry block
   ☐ sheet piling
   ☐ other (describe):

4. Has this levee/floodwall system been certified by a Federal agency to provide protection against the 1% annual chance (100-year) flood event? ☐ Yes ☒ No

   If Yes, by which agency?

   If Yes, complete only the interior drainage section on pages 7 and 8 of this form and the operation and maintenance section of Revision Requestor and Community Official Form.

PLEASE REFER TO THE INSTRUCTIONS FOR THE APPROPRIATE MAILING ADDRESS

2. LEVEE/FLOODWALL SYSTEM ELEMENTS (Cont'd)

5. Attach certified drawings containing the following information (indicate drawing sheet numbers):

   a. Plan of the levee embankment and floodwall structures. Sheet Numbers 2

   b. A profile of the levee/floodwall system showing the 100-year water-surface (base flood) elevation, levee and/or wall crest and foundation, and closure locations for the total levee system. Sheet Numbers 4 and 5

   c. A profile of the base flood elevation, closure opening outlet and inlet invert elevations, type and size of opening, and kind of closure device. Sheet Numbers 5 and 6

   d. A layout detail for the embankment protection measures. Sheet Numbers 3

   e. Location, layout, and size and shape of the levee embankment features, foundation treatment, floodwall structure, closure structures, and pump stations. Sheet Numbers 3

3. FREEBOARD

1. The minimum freeboard provided above the base flood elevation is:

   Riverine

   3.0 feet or more at the downstream end and throughout ☒ Yes ☐ No
   3.5 feet or more at the upstream end ☒ Yes ☐ No
   4.0 feet immediately upstream of all structures and constrictions ☒ Yes ☐ No

   Coastal

   1.0 foot above the height of the one percent wave for the 100-year stillwater surge elevation or maximum wave runup (whichever is greater). ☐ Yes ☐ No

   2.0 feet above 100-year stillwater surge elevation ☐ Yes ☐ No

Please note, occasionally exceptions are made to the minimum freeboard requirement. If an exception is requested, attach documentation addressing Part 65.10(b)(1)(ii) of the National Flood Insurance Program regulations.

If No is answered to any of the above, please attach an explanation.

2. Is there an indication from historical records that ice-jamming can effect the base flood elevation? ☐ Yes ☒ No
   If Yes, provide ice-jam analysis profile and evidence that the minimum freeboard discussed above still exists.

3. Tabulate the elevations at critical locations (tabulate values at each levee crest grade change, and where sediment may accumulate such as along bends in the channel.)

Station	Location	100-year Water Surface Elevation	Levee Crest	Freeboard (ft.)
22+76	Upper end	982.43	985.93	3.5
17+40	midway	981.38	984.48	3.1
10+40	Lower end	980.09	984.10	4.01

(Extend table on an added sheet as needed and reference)

4. SEDIMENT TRANSPORT CONSIDERATIONS

If there is any indication from historical records that sediment transport (including scour and deposition) can affect the 100-year water-surface (base flood) elevations; and/or based on the stream geomorphology, vegetative cover, development of the watershed and bank conditions, there is a potential for debris and sediment transport (including sewer and deposition) to affect the base flood elevations, then provide the following information:

- ☐ Estimated sediment load
- ☐ Method used to estimate sediment transport
- ☒ Method used to estimate scour and/or deposition
- ☐ Method used to revise hydraulic or hydrologic analysis (model) to account for sediment transport

5. CLOSURES

1. Openings through the levee system:

☒ exist ☐ do not exist

If openings exist, list all closures:

Channel Station	Left or Right Bank	Opening Type	Highest Elevation for Opening Invert	Type of Closure Device
approx 11+00	west bank	18" RGRCP	978.02 (outlet)	Neenah R-5050-SF18
approx 11+00	east bank	36" RGRCP	977.00 (outlet)	Neenah R-5050-SF36

(Extend table on an added sheet as needed and reference)

Note:
Geotechnical and geologic data

In addition to the required detail analysis reports, data obtained during field and laboratory investigations and used in the design analysis for the following levee system features should be submitted in a tabulated summary form. (Reference U.S. Army Corps of Engineers EM-1110-2-1906 Form 2086).

6. EMBANKMENT PROTECTION

1. The maximum levee slope landside is: 4:1
2. The maximum levee slope floodside is: 4:1
3. The range of 100-year (base) riverine flood velocities along the levee? 2.9 (min.) to 4.5 (max.)
4. Embankment material is protected by (describe the kind): rip rap along outside of bends and at transitions
5. Riprap Design Parameters: (Include references) ☒ Velocity ☐ Tractive stress

Reach	Sideslope	Flow Depth	Velocity	Curve or Straight	Stone Riprap			Depth of Toedown
					D_{100}	D_{50}	Thickness	
Sta 10+40 to 12+91	4:1	3.9 ft	4.3 ft/s	curve	1.0'	0.5'	1.0'	NA
Sta 12+91 to 14+39	4:1	3.9 ft	4.3 ft/s	straight	NA	NA	NA	NA
Sta 14+39 to 17+34	4:1	3.9 ft	4.3 ft/s	curve	1.0'	0.5'	1.0'	NA
Sta 17+34 to 20+50	4:1	3.9 ft	4.3 ft/s	straight	NA	NA	NA	NA
Sta 20+50 to 22+76	4:1	3.9 ft	4.3 ft/s	entrance transition	1.0'	0.5'	1.0'	NA
Sta to								

(Extend table on an added sheet as needed and reference)

6. Is a bedding/filter analysis and design attached? ☐ Yes ☒ No

7. Describe the analysis used for other kinds of protection used (include copies of the design analysis):

Embankment protection design memorandum is included in Technical Documentation Notebook report

Note: Attach engineering analysis to support construction plans.

7. EMBANKMENT AND FOUNDATION STABILITY

1. Identify locations and describe the basis for selection of critical location for analysis:

   ☒ Overall height: Sta ALL, height 7 ft.

   ☒ Limiting foundation soil strength:

   Sta ALL, depth 1.5 feet to

   strength Ø = 30 degrees, c = 1000 psf

   slope: SS = 4 (h) to 1 (v)

   (Repeat as needed on an added sheet for additional locations)

2. Specify the embankment stability analysis methodology used (e.g., circular arc, sliding block, infinite slope, etc.): Slope stability calculations were neglected due to the embankment slope being a 4:1 (horizontal to vertical)

3. Summary of stability analysis results:

Case	Loading Conditions	Critical Safety Factor	Criteria (Min.)
I	End of construction	>3	1.3
II	Sudden drawdown	>3	1.0
III	Critical flood stage	>3	1.4
IV	Steady seepage at flood stage	>3	1.4
VI	Earthquake (Case I)	>3	1.0

(Reference: U.S. Army Corps of Engineers (USACE) EM-1110-2-1913 Table 6-1)

4. Was a seepage analysis for the embankment performed? ☐ Yes ☒ No

   If Yes, describe methodology used:

5. Was a seepage analysis for the foundation performed: ☐ Yes ☒ No

6. Were uplift pressures at the embankment landside toe checked? ☐ Yes ☒ No

7. Were seepage exit gradients checked for piping potential? ☐ Yes ☒ No

8. The duration of 100-year (base) flood hydrograph against the embankment is 6 Hrs.

Note: Attach engineering analysis to support construction plans.

8. FLOODWALL AND FOUNDATION STABILITY

1. Describe analysis submittal based on Code:

   ☐ UBC (1988) or ☒ Other (specify):

2. Stability analysis submitted provides for:

   ☒ Overturning ☒ Sliding; If not, explain:

3. Loading included in the analyses were:

   ☒ Lateral earth @ P_A = 45 psf; P_P = 150 psf

   ☐ Surcharge-Slope @ _____, ☐ surface _____ psf

   ☐ Wind @ P_w = _____ psf

   ☐ Seepage (Uplift); _____ ☐ Earthquake @ P_{eq} = _____ %g

   ☐ 100-year significant wave height _____ ft.

   ☐ 100-year significant wave period _____ sec.

4. Summary of Stability Analysis Results: Factors of Safety. Itemize for each range in site layout dimension and loading condition limitation for each respective reach.

Loading Condition	Criteria (Min)		Sta	To	Sta	To
	Overturn	Sliding	Overturn	Sliding	Overturn	Sliding
Dead & Wind	1.5	1.5	2.81	3.06		
	1.5	1.5				
	1.5	1.5				
	1.3	1.3				

(Ref: FEMA 114 Sept 1986; USACE EM 1110-2-2502)

(Note: Extend table on an added sheet as needed and reference)

5. Foundation bearing strength for each soil type:

Bearing Pressure	Sustained Load (psf)	Short Term Load (psf)
Computed design maximum	1489	
Maximum allowable	1500	

6. Foundation scour protection ☒ is, ☐ is not provided. Describe if provided:

   Rock rip-rap (see plan set)

Note: Attach engineering analysis to support construction plans.

9. SETTLEMENT

1. Has anticipated potential settlement been determined and incorporated into the specified construction elevations to maintain the established freeboard margin? ☒ Yes ☐ No

2. The computed range of settlement is _____ ft. to .083 ft.

3. Settlement of the levee crest is determined to be primarily from:

   ☒ Foundation consolidation
   ☒ Embankment compression
   ☐ Other (describe):

4. Differential settlement of floodwalls

   ☒ has ☐ has not been accommodated in the structural design and construction.

Note: Attach engineering analysis to support construction plans.

10. INTERIOR DRAINAGE

1. Specify size of each interior watershed

   Draining to pressure conduit: NA

   Draining to ponding area: 23 acres behind west levee, 21 acres behind east levee

2. Relationships Established

Ponding elevation vs. storage	☒ Yes	☐ No
Ponding elevation vs. gravity flow	☐ Yes	☐ No
Differential head vs. gravity flow	☐ Yes	☐ No

3. The river flow duration curve is enclosed ☐ Yes ☒ No

4. Specify the discharge capacity of the head pressure conduit: no capacity assumed for concurrent flow conditions

5. Which Flooding Conditions Were Analyzed?

• Gravity flow (Interior Watershed)	☐ Yes	☒ No
• Common storm (River Watershed)	☒ Yes	☐ No
• Historical ponding probability	☐ Yes	☒ No
• Coastal wave overtopping	☐ Yes	☒ No

   If No, explain why not: ponding based on concurrent flow (i.e., joint probabiiity) was assumed to be worst case

6. Interior drainage has been analyzed based on joint probability of interior and exterior flooding and the capacities of pumping and outlet facilities to provide the established level of flood protection. ☒ Yes ☐ No

   If No, explain why not:

7. The rate of seepage through the levee system for the 100-year (base) flood is 3.28 x 10-7 cfs

10. INTERIOR DRAINAGE (Cont'd)

8. The length of levee system used to drive this seepage rate in item 7: _____ ft.

9. Will a pumping plant(s) be used for interior drainage? ☐ Yes ☒ No

If Yes, include the number of pumping plants:
For each pumping plant, list:

	Plant #1	Plant #2
The number of pumps		
The ponding storage capacity		
The maximum pumping rate		
The maximum pumping head		
The pumping starting elevation		
The pumping stopping elevation		
Is the discharge facility protected?		
Is there a flood warning plan?		
How much time is available between warning and flooding?		

Will the operations be automatic? ☐ Yes ☐ No

If the pumps are electric, are there backup power sources? ☐ Yes ☐ No

(Reference: U.S. Army Corps of Engineers EM-1110-2-3101, 3102, 3103, 3104, and 3105)

Note: Include a copy of supporting documentation of data and analysis. Provide a map showing the flooded area and maximum ponding elevations for all interior watersheds that result in flooding.

11. OTHER DESIGN CRITERIA

1. The following items have been addressed as stated:

   Liquefaction ☐ is ☒ is not a problem
   Hydrocompaction ☐ is ☒ is not a problem
   Heave differential movement due to soils of high shrink/swell ☐ is ☒ is not a problem

2. For each of these problems, state the basic facts and corrective action taken:

   Problematic soil conditions not present

3. If the levee/floodwall is new or enlarged, will the structure adversely impact flood levels and/or flow velocities floodside of the structure? ☐ Yes ☒ No

Note: Attach supporting documentation

12. OPERATIONAL PLAN AND CRITERIA

1. Are the planned/installed works in full compliance with NFIP regulations, Section 44 CFR Ch. 1 1.65.10

   ☒ Yes ☐ No

2. Does the operation plan incorporate all the provisions for closure devices as required in Section 65.10(c)(1), of the NFIP regulations?

   ☒ Yes ☐ No

3. Does the operation plan incorporate all the provisions for interior drainage as required in Section 65.10(c)(2), of the NFIP regulations?

   ☒ Yes ☐ No

If the answer is No to any of the above, please explain below.

FOREE & VANN, INC.
9013 NORTH 24TH AVENUE, SUITE 7, PHOENIX, ARIZONA 85021-2851
TELEPHONE (602) 943-6997 FACSIMILE (602) 943-7179

October 2, 1998

Proposal 8476

Mr. Peter W. Martens, P.E.
President
THE MARWEST GROUP
4801 East Greenway Road
Scottsdale, Arizona 85254

RE: Levee Embankment and Foundation Stability
and Settlement Analysis
Mountain View Estates (Bullard Wash)
Northwest Corner of Vanburen and Bullard Avenue
Goodyear, Arizona

Dear Mr. Martens:

Compliance with local and national codes requires an evaluation of the levee system associated with the Bullard Wash channelization. This report is in response to the request of Mr. Wade Cook with Pinnacle Engineering, Inc. for an evaluation of the levee embankment and foundation stability, and settlement associated with the proposed channelization.

Embankment and Foundation Stability

The embankment design for the channelization of Bullard wash consists of a levee approximately 7 to 8 feet in height with a base of approximately 65 to 70 feet (reference plans from Pinnacle Engineering, Inc.). The find embankment slopes result in 4:1 (horizontal:vertical) ratios. The embankment soils will consist of silty sandy clay to silty clayey sand, placed in 6 inch lifts, and compacted to a minimum of 95% of the ASTM D1557 maximum density, with moisture maintained in the range of optimum to optimum + 4%. The top 8 inches of existing grade soils prior to fill placement will be placed to a minimum of 95% of the ASTM D1557 maximum density, with moisture in the range of optimum to optimum +4.

Evaluation of the aforementioned levee system included the following factors:

- Duration of significant flow of approximately six hours for the 100 year flood event.
- Depth of flooding associated with the proposed channel section.
- Possible seepage paths associated with the proposed levee system.

A levee design with Embankment slopes with a 4:1 ratio (14 degree slope) will not present slope stability problems (no quantitative analysis was performed due

to the gradual slopes). The factor of safety of such slopes against failure, including the anticipated seepage, should be in excess of 3, for all cases. Additionally, seepage forces will not result in detrimental effects due to short term flooding and high compaction of levee soils associated with a very wide levee base. Thus, the phreatic surface will not daylight on the dry side of the embankment.

Settlement

As mentioned previously the levee system is approximately 7 to 8 feet in height. The settlement associated with the levee system is broken down into two areas.

The first is compression of the embankment soils. The embankment soils are proposed to be placed at a very high density limiting the consolidation of the soils to 0.5 inches.

The second is consolidation of the foundation soils. Due to the over consolidated nature of the soils in the area and laboratory response to wetting data (refer to the Geotechnical Investigation Report dated March 14, 1997) the maximum anticipated consolidation of foundation soils is 0.5 inches.

The total settlement anticipated is 1.0 inch. Differential settlement of flood wall foundations are addressed in the Foundation Recommendation section of the previously mentioned Geotechnical Investigation Report.

Attached are the Levee/Floodwall System Analyses Forms associated with the aforementioned evaluation.

Should any questions arise concerning the content of this transmittal or if this firm can be of further service in this or any other matter, please contact this office at your convenience.

Respectfully submitted,

FOREE & VANN, INC.

Delbert A. Rapier, E.I.T.
Staff Engineer

Jeffry D. Vann, P.E.
Principal Engineer

cc. Addressee(1)
Mr. Wade Cook, P.E. / Pinnacle Engineering (3)
8712 East Vista Bonita, Scottsdale, Arizona 85255
Attachments (2)

Memorandum JE Fuller/ Hydrology & Geomorphology, Inc.

DATE: November 11, 1998

TO: Pinnacle Engineering/Bullard Wash CLOMR file

FROM: John Wallace, P.E.

RE: Summary of Interior Drainage Conditions

CC: Wade Cooke, Pinnacle Engineering

The interior drainage behind the west levee is documented in the drainage report prepared by Hook Engineering for the Mountain View Estates Subdivision. The interior drainage behind this levee is collected in Retention Basin Numbers 3 and 4 as shown in the Hook Engineering Drainage report. The pertinent calculation sheets from the Hook Engineering report, including storage-elevation data, are attached. Ponding in these retention basins is designed to infiltrate into the subsurface. The 18" RCP pipe through the west levee near Station 11+00 as shown on the Bullard Wash improvement plans (Appendix I of CLOMR report) is provided for emergency overflow only.

The interior drainage behind the east levee is documented on the attached sheet. Ponding at this location reaches an elevation of 982.1 assuming concurrent flow in the Bullard Wash allows no outflow through the 36" RCP outflow pipe provided through the levee at this location.

Attachments:

- From Hook Engineering Drainage Report for Mountain View Estates:
  - Cover page (1 sheet)
  - Appendix E (Site Retention Calculations) (4 sheets)
  - portion of Plate 3 showing locations of Retention Basins 3 and 4 (1 sheet)

- Ponding Analysis Sheet for East Levee (1 sheet)

FINAL DRAINAGE REPORT
FOR
MOUNTAIN VIEW ESTATES

Prepared For: **Marwest Group**
4801 East Greenway Road
Scottsdale, Arizona 85254

Submitted To: **City of Goodyear**
112 E. Western Road
Goodyear, Arizona 85338

Prepared By: **Hook Engineering, Inc.**
3221 N. 24th Street
Phoenix, Arizona 85016

Registered Professional Engineer (Civil)
CERTIFICATE NO.
32421
SHAWN D.
GUSTAFSON
Date Signed 10/16/98
ARIZONA, U.S.A.

October 16, 1998
HEI # 3561

APPENDIX E

Site Retention Calculations

SITE RETENTION CALCULATIONS:

Adequate retention can be provided as shown in the following calculations:

VOLUME REQUIRED:

Retention is required for runoff from the 100-year, 6-hour rainfall event produced on-site, including the half right-of-way for Van Buren Street.

Referenced Equation:

$$V = D/12 \times A \times C$$

Where:
V = Volume Required (cu. ft.)
D = 100-year, 6-hour precipitation depth = 3.0 inches
A = Contributing area (sq. ft.)
C = Weighted Runoff Coefficient for 100-year storm:

Average Single Family Residential	C = 0.68
Landscape / Retention areas	C = 0.58
Right-of-way for Buren Street	C = 0.95

Basin # 1:
A = 2.69 + 0.45 = 3.14 acres
C = (2.69 ac. x 0.68 + 0.45 ac. x 0.58) / 3.14 ac. = 0.67

Volume Required:

$$V = 3.0/12 \times (3.14 \text{ ac.} \times 43{,}560) \times 0.67 = 22{,}910 \text{ cu.ft.}$$

Volume Provided: (average area x depth)

Contour Elevation	Contour Area (sq.ft.)	Depth	Volume (cu.ft.)
981.0	1,736	---	---
984.0	9,744	3.0'	17,220

The retention volume provided in Basin # 1 is 5,690 cubic feet less than required. Excess runoff not contained in Basin #1 will overflow and be retained in Basin #2.

Basin # 2:

A = 5.35 + 7.17 + 2.21 + 4.40 + 2.92 = 22.05 acres

C = (19.13 ac. x 0.68 + 2.92 ac. x 0.58) / 22.05 ac. = 0.67

Volume Required:

V = 3.0/12 x (22.05 ac. x 43,560) x 0.67 = 160,883 cu.ft.
Plus excess runoff from Basin # 1 = 5,690
Total = 166,573 cu. ft.

Volume Provided: (average area x depth)

Contour Elevation	Contour Area (sq.ft.)	Depth	Volume (cu.ft.)
976.5	53,014	---	---
979.5	80,952	3.0'	200,949

The retention volume provided in Basin # 2 is 34,376 cubic feet greater than required.

Basin # 3:

A = 3.19 + 3.38 + 1.27 = 7.84 acres

C = (6.57 ac. x 0.68 + 1.27 ac. x 0.58) / 7.84 ac. = 0.66

Volume Required:

V = 3.0/12 x (7.84 ac. x 43,560) x 0.66 = 56,349 cu.ft.

Volume Provided: (average area x depth)

Contour Elevation	Contour Area (sq.ft.)	Depth	Volume (cu.ft.)
977.0	14,382	---	---
980.0	27,630	3.0'	63,018

The retention volume provided in Basin # 3 is 6,669 cubic feet greater than required.

Basin # 4:

A = 3.21 + 2.57 + 4.53 + 2.30 + 2.48 = 15.09 acres

C = (10.61 ac. x 0.68 + 2.30 x 0.95 + 2.48 ac. x 0.58) / 15.09 ac. = 0.72

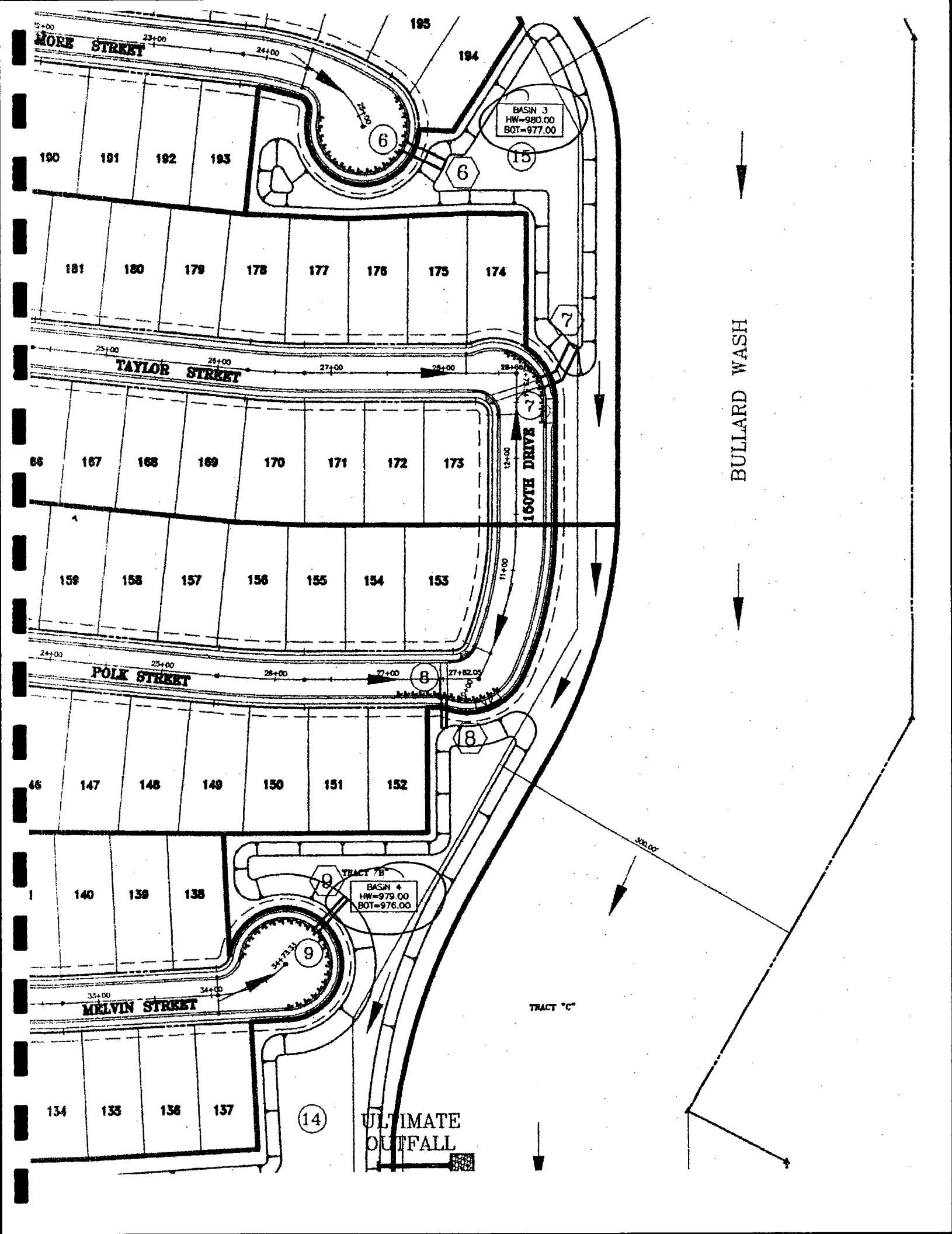
Volume Required:

V = 3.0/12 x (15.09 ac. x 43,560) x 0.72 = 118,318 cu.ft.

Volume Provided: (average area x depth)

Contour Elevation	Contour Area (sq.ft.)	Depth	Volume (cu.ft.)
976	30,076	---	---
979	63,021	3.0'	139,645

The retention volume provided in Basin # 4 is 21,327 cubic feet greater than required.


MORE STREET
TAYLOR STREET
POLK STREET
MELVIN STREET
160TH DRIVE
BULLARD WASH
BASIN 3
HW=980.00
BOT=977.00
BASIN 4
HW=979.00
BOT=976.00
TRACT "B"
TRACT "C"
ULTIMATE
OUTFALL
300.00'
190
191
192
193
194
195
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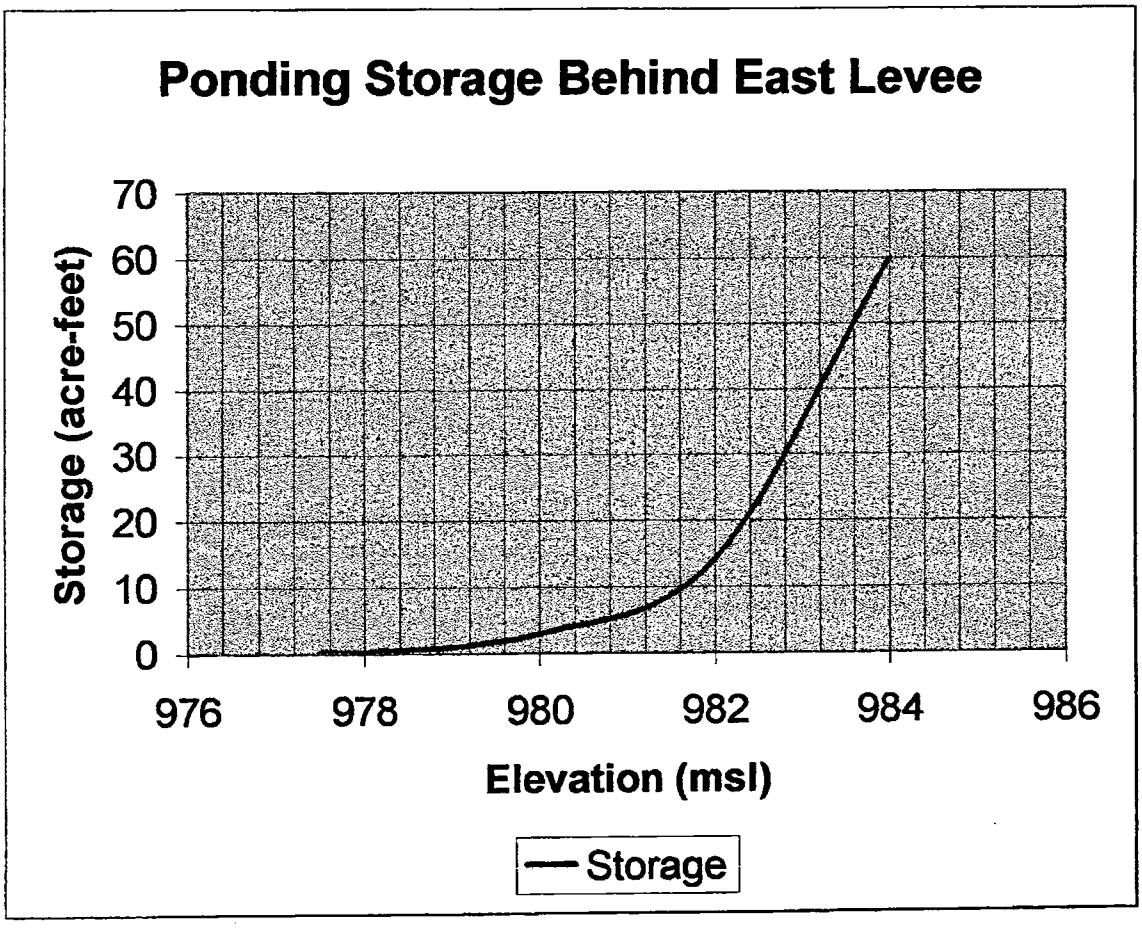
PROJ: Pinnacle Engineering/Bullard Wash CLOMR for Mountain View Estates
DETAIL: Analysis of Ponding behind East Levee (just north of Van Buren)

Drainage area concentrating flow at ponding area, A =	21 acres
100-year, 6-hour rainfall (from Hook drainage report), P =	3.00 inches
Runoff coefficient (Table 3.2 of Maricopa County Drainage Manual), C =	0.25
6-hour, ,100-year runoff volume = CPA =	15.75 acre-feet

Storage-Elevation table for ponding area behind east levee:

Elev (msl)	Depth (feet)	Area (acres)	Volume (ac-feet)
977.5	0	0	0
978	0.5	0.66	0.110
980	2.5	1.95	2.707
982	4.5	5.03	13.890
984	6.5	10.51	59.490

By interpolation from the storage-elevation table, the 100-yr, 6-hour runoff volume will pond to an elevation of approx. 982.1 ft msl.with no outflow through the 36" outflow pipe through levee



APPENDIX C

Survey Field Notes

GOODYEAR PROJECT

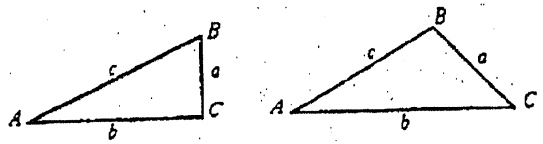
BENCH LOOP TIE TO R.M # 214

STA	+	H.I	−	ELEV.	
				989.49	R.M 214 M.C.H.D. BC.H.H (ESTRELLA PARKWAY) (REEMS RD) & VAN BUREN ST.
	5.00	994.49			
T.P.1			5.70	988.79	
	5.98	994.77			
PANEL 106			5.05	989.72	VINCE'S #106 ELEV: 989.72
	3.54	993.26			
PANEL 124			8.53	984.73	VINCE'S #124 ELEV: 984.74
	8.42	993.15			
			3.43	989.72	106
	5.81	995.53			
TP1			6.74	988.79	
	5.63	994.42			
			4.93	989.49	

PINNACLE ENGINEERING
8712 E. VISTA BONITA
SCOTTSDALE, ARIZONA 85255
(602) 585-6013

#54048A.CR5

FORMULAE FOR SOLVING RIGHT TRIANGLES



$\text{Sin } A = \frac{a}{c} = \text{Cos } B \qquad \text{Cot } A = \frac{b}{a} = \text{Tan } B$

$\text{Cos } A = \frac{b}{c} = \text{Sin } B \qquad \text{Sec } A = \frac{c}{b} = \text{Cosec } B$

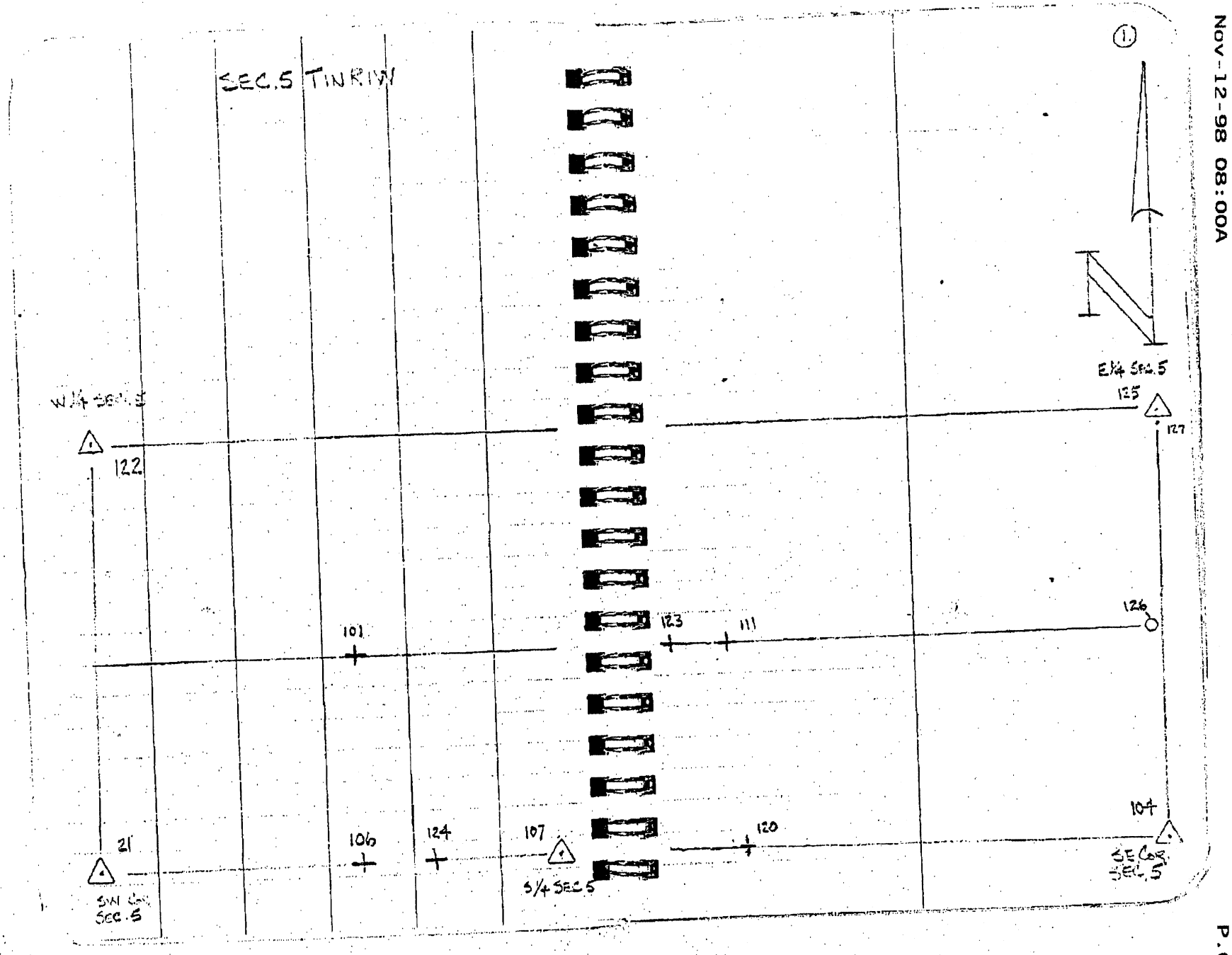
$\text{Tan } A = \frac{a}{b} = \text{Cot } B \qquad \text{Cosec } A = \frac{c}{a} = \text{Sec } B$

Given	Required	Solution
A, c	B, a, b	$B = 90° - A, a = c \sin A, b = c \cos A.$
A, b	B, a, c	$B = 90° - A, a = b \tan A, c = \frac{b}{\cos A}.$
A, a	B, b, c	$B = 90° - A, b = a \cot A, c = \frac{a}{\sin A}.$
a, c	A, B, b	$\sin A = \frac{a}{c} = \cos B, b = \sqrt{(c+a)(c-a)}$
a, b	A, B, c	$\tan A = \frac{a}{b} = \cot B, c = \sqrt{a^2 + b^2}$

FORMULAE FOR SOLVING OBLIQUE TRIANGLES

Given	Required	Solution
A, a, b	B, c	$\sin B = \frac{b \sin A}{a}, c = \frac{a \sin C}{\sin A}$
A, B, a	b	$b = \frac{a \sin B}{\sin A}$
a, b, C	A, c	$A + B = 180° - C, c = \frac{a \sin C}{\sin A}$
a, b, c	Area	side $\frac{a+b+c}{2}$, area $= \sqrt{s(s-a)(s-b)(s-c)}$
A, b, c	Area	area $= \frac{bc \sin A}{2}$
A, B, C, a	Area	area $= \frac{a^2 \sin B \sin C}{2 \sin A}$

MADE IN U.S.A.


SEC.5 T1N R1W
1
N
E1/4 SEC.5
125
127
W1/4 SEC.5
122
126
101
123
111
104
21
106
124
107
120
SW Cor. SEC.5
S1/4 SEC.5
SE Cor. SEC.5

②

PT #	DESC.
21	SW CORNER SEC/HH
101	PANEL Fd. REBAR
104	SW CORNER SEC 5 5/8" [illegible]
106	PANEL Fd. PK NAIL
107	S1/4 SEC 5 RR SPIKE
111	PANEL SET REBAR
120	PANEL SET PK NAIL
122	W1/4 SEC 5 SEC/HH
123	PANEL SET NAIL
124	PANEL SET PK NAIL
125	E1/4 SEC 5 Fd. AXLE 5/8" ROD, 1/4" SHAFT
126.	ALIQUOT - Fd. REBAR W/CAP #27747
127.	Fd. 5/8" IRON PIN W/CAP #862

+	H.I.	−	ELEV	ADJ ELEV	DESC
			1020.58		BC ON TOP OF S.E. ABUTMENT
0.91	1020.49				℄ I-10/BILLARD
		24.47	997.02		TP
4.10	1001.12				
		7.0	994.12		AXLE (E/4 SEC. 5) ≠ 125
6.73	1000.85				
		3.84	997.01		
24.63	1021.64				
		1.06	1020.58		E.O.C.: 000

(5)

+	HI	−	ELEV	Adj ELEV	DESC.
			994.12	994.12	AXLE (E/4 SEC 5)
4.84	998.96				
		5.87	993.09		TP
4.11	997.20				
		5.45	991.75		TP
3.16	994.91				
		6.06	988.85		TP
4.69	993.54				
		7.33	986.21		TP
2.29	988.50				
		6.61	981.89		#111 PANEL (SET REBAR)
5.08	986.97				
		4.04	982.93		#123 PANEL (SET NAIL)
8.43	991.36				
		3.75	987.61		
6.83	994.44				
		3.68	990.76		#101 PANEL (Fd REBAR)
4.69	995.45				
		5.86	989.59		TP
4.98	994.57				
		4.85	989.72		#106 PANEL (Fd PK NAIL)
3.72	993.44				
		8.70	984.74		#124 PANEL (SET PK NAIL)
2.55	987.29				
		8.33	978.96		TP

(6)

+	HI	−	ELEV.	Adj ELEV.		DESC.
			978.46			
5.33	983.79					
		3.83	979.96			#120 PANEL (SET PK NAIL)
9.64	989.60					
		1.73	987.87			TP
4.05	991.92					
		5.39	986.53			TP
4.36	990.89					
		3.19	987.70			"X" ON HDWL SW COR VANBUREN / ENGLAND
		3.16	987.73			# 104 SE COR SEC 5 (5/8" REBAR)
		2.75	988.14			TP
6.41	994.55					
		2.82	991.73			TP #126 (FD RBR W/CAP # 27747)
5.55	997.28					
		4.39	992.89			TP
6.09	998.98					
		4.90	994.08		EOL-004	AXLE (E/4 SEC. 5)

4/22/98

Photo I.D.

TC 123 NAIL (PANEL)

BS C 101 [illegible] (PANEL)

FS To: Photo I.D.

#	N	E	Z	DESCRIPTION
200	11200.5566	12747.9344	988.26	4' FENCE COR (2" DIA.)
201	11207.1344	12704.1212	988.56	5' RR TIE (VERT) (.65X.65)
202	11202.5774	12153.0183	983.53	4' FENCE COR. (2" DIA.)
203	10007.0646	12593.8946	985.29	POWER POLE
204	10007.7566	12633.5397	986.27	Power Pole
205	9902.6854	11154.5601	983.76	COR CONCRETE CANAL
206	9827.9156	11158.3999	982.81	℄ 4X6" ACROSS CANAL ℄
207	9929.0875	11764.8533	977.78	Top ℄ 24" RCP

APPENDIX D

Hydrologic Analysis and Supporting Documentation

FLOOD CONTROL DISTRICT
of
Maricopa County

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

BOARD OF DIRECTORS
Jan Brewer
Fulton Brock
Andrew Kunasek
Don Stapley
Mary Rose Garrido Wilcox

September 25, 1998

Mr. John Wallace
2881 North Silver Spur Drive
Tucson, Arizona 85745

Dear Mr. Wallace:

The HEC-1 model "bullab3.dat," developed by the Flood Control District of Maricopa County, will be submitted to FEMA for the Bullard Wash Channel LOMR package.

I am enclosing the drainage maps for White Tanks ADMS and Bullard Wash Channel hydrology.

If you have any questions, please call me at (602) 506-3293.

Sincerely,

Bing Zhao, Ph.D., P.E.
Civil Engineer

+	HYDROGRAPH AT	D251	1948.	16.50	1264.	346.	333.	35.76
+	ROUTED TO	R251	1920.	16.75	1261.	346.	333.	35.76
+	2 COMBINED AT	CP266	1953.	16.75	1339.	369.	355.	36.09
+	DIVERSION TO	DI283	234.	16.75	152.	43.	42.	36.09
+	HYDROGRAPH AT	D266	1719.	16.75	1187.	326.	314.	36.09
+	ROUTED TO	R266	1714.	16.83	1186.	326.	314.	36.09
+	HYDROGRAPH AT	D252	411.	16.83	308.	91.	88.	36.66
+	ROUTED TO	R252	404.	17.33	305.	90.	87.	36.66
+	HYDROGRAPH AT	267	335.	13.17	79.	20.	19.	.50
+	2 COMBINED AT	1I267	485.	13.67	352.	109.	105.	37.16
+	2 COMBINED AT	CP267	2088.	16.83	1530.	434.	418.	37.49
+	DIVERSION TO	DI284	1275.	16.83	971.	284.	274.	37.49
+	HYDROGRAPH AT	D267	813.	16.83	560.	150.	144.	37.49
+	ROUTED TO	R267	805.	17.17	554.	150.	144.	37.49
+	2 COMBINED AT	CP268	3626.	13.67	2191.	684.	659.	47.97
+	ROUTED TO	SR268	3556.	13.83	2163.	666.	642.	47.97
+	ROUTED TO	R268	3279.	14.42	2109.	647.	624.	47.97
+	HYDROGRAPH AT	286	473.	13.08	109.	27.	26.	.70
+	2 COMBINED AT	1I286	3341.	14.42	2120.	673.	648.	48.67
+	HYDROGRAPH AT	288	160.	13.25	44.	11.	10.	.22
+	ROUTED TO	R288	153.	13.42	43.	11.	10.	.22
+	2 COMBINED AT	CP286	3400.	14.42	2132.	683.	658.	48.89
+	ROUTED TO	R286	3332.	14.58	2121.	678.	653.	48.89
+	HYDROGRAPH AT	287	223.	12.67	36.	9.	9.	.23

+	2 COMBINED AT	1I287	3332.	14.58	2121.	686.	661.	49.12
+	HYDROGRAPH AT	D266	234.	16.75	152.	43.	42.	36.09
+	ROUTED TO	R266	229.	17.33	151.	43.	41.	36.09
+	HYDROGRAPH AT	283	102.	13.08	23.	6.	6.	.16
+	2 COMBINED AT	CP283	229.	17.33	154.	48.	46.	36.25
+	ROUTED TO	R283	228.	17.58	154.	48.	46.	36.25
+	HYDROGRAPH AT	285B	83.	12.33	9.	2.	2.	.06
+	2 COMBINED AT	CP285B	228.	17.58	154.	50.	48.	36.32
+	ROUTED TO	SR285B	223.	17.75	153.	50.	48.	36.32
+	DIVERSION TO	DI297	219.	17.75	153.	50.	48.	36.32
+	HYDROGRAPH AT	D285B	5.	17.67	1.	0.	0.	36.32
+	ROUTED TO	R285B	4.	18.25	1.	0.	0.	36.32
+	HYDROGRAPH AT	D267	1275.	16.83	971.	284.	274.	37.49
+	ROUTED TO	R267	1259.	17.50	967.	282.	272.	37.49
+	HYDROGRAPH AT	284	326.	13.17	76.	19.	18.	.52
+	2 COMBINED AT	CP284	1259.	17.50	988.	300.	289.	38.01
+	ROUTED TO	SR284	1252.	17.67	957.	282.	271.	38.01
+	ROUTED TO	R284	1251.	17.75	956.	281.	271.	38.01
+	HYDROGRAPH AT	285A	82.	12.33	9.	2.	2.	.06
+	2 COMBINED AT	1I285A	1251.	17.75	956.	283.	273.	38.07
+	2 COMBINED AT	CP285A	1252.	17.75	957.	283.	273.	38.29
+	ROUTED TO	SR285A	1252.	17.83	957.	283.	273.	38.29
+	DIVERSION TO	1D297A	246.	17.83	238.	95.	91.	38.29
	HYDROGRAPH AT							

+		D285A	1006.	17.83	719.	189.	182.	38.29
+	ROUTED TO	R285A	1001.	18.00	717.	189.	182.	38.29
+	HYDROGRAPH AT	285	56.	12.33	6.	1.	1.	.04
+	2 COMBINED AT	CP285	1001.	18.00	717.	190.	183.	38.33
+	ROUTED TO	SR285	1000.	18.08	717.	190.	183.	38.33
+	DIVERSION TO	2D297A	273.	18.08	195.	52.	50.	38.33
+	HYDROGRAPH AT	D285	728.	18.08	522.	138.	133.	38.33
+	ROUTED TO	R285	721.	18.33	522.	138.	133.	38.33
+	2 COMBINED AT	CP287	3538.	14.67	2622.	822.	792.	49.96
+	ROUTED TO	SR287	2758.	18.42	2584.	816.	786.	49.96
+	ROUTED TO	R287	2754.	18.75	2571.	805.	775.	49.96
+	HYDROGRAPH AT	298	591.	13.00	122.	30.	29.	.84
+	2 COMBINED AT	CP298	2754.	18.75	2573.	834.	803.	50.80
+	ROUTED TO	SR298	2751.	18.83	2567.	827.	796.	50.80
+	ROUTED TO	R298	2746.	19.17	2553.	813.	783.	50.80
+	HYDROGRAPH AT	316	512.	13.17	122.	31.	29.	.82
+	2 COMBINED AT	CP316	2746.	19.17	2555.	841.	811.	50.82
+	ROUTED TO	R316	2742.	19.33	2541.	832.	802.	50.82
+	HYDROGRAPH AT	334	452.	13.00	95.	24.	23.	.64
+	2 COMBINED AT	1I334	2742.	19.33	2541.	855.	823.	51.46
+	HYDROGRAPH AT	D285	273.	18.08	195.	52.	50.	38.33
+	ROUTED TO	R285	271.	18.33	194.	52.	50.	38.33
+	HYDROGRAPH AT	D285A	246.	17.83	238.	95.	91.	38.29
+	ROUTED TO	R285A	246.	18.25	237.	92.	89.	38.29

+	HYDROGRAPH AT	297A	206.	12.92	39.	10.	9.	.27
+	2 COMBINED AT	1I297A	246.	18.25	237.	102.	98.	38.56
+	2 COMBINED AT	CP297A	517.	18.33	431.	153.	148.	38.60
+	ROUTED TO	R297A	508.	19.92	426.	146.	140.	38.60
+	HYDROGRAPH AT	315	278.	13.25	68.	17.	16.	.47
+	2 COMBINED AT	CP315	508.	19.92	426.	162.	156.	39.07
+	ROUTED TO	R315	505.	20.67	423.	148.	142.	39.07
+	2 COMBINED AT	CP334	3194.	19.50	2888.	1000.	964.	52.20
+	ROUTED TO	R334	3191.	19.75	2882.	987.	951.	52.20
+	HYDROGRAPH AT	335	277.	12.92	54.	13.	13.	.35
+	2 COMBINED AT	CP335	3191.	19.75	2882.	1000.	963.	52.55
+	ROUTED TO	R335	3187.	19.92	2876.	990.	954.	52.55
+	HYDROGRAPH AT	299	289.	13.00	61.	15.	15.	.40
+	ROUTED TO	R299	213.	14.42	61.	15.	15.	.40
+	HYDROGRAPH AT	317	341.	13.25	82.	21.	20.	.57
+	2 COMBINED AT	CP317	341.	13.25	140.	36.	34.	.97
+	ROUTED TO	R317	295.	13.83	136.	36.	34.	.97
+	HYDROGRAPH AT	300	353.	12.83	66.	16.	16.	.39
+	ROUTED TO	R300	264.	14.17	65.	16.	16.	.39
+	HYDROGRAPH AT	318	581.	12.67	97.	27.	26.	.62
+	2 COMBINED AT	CP318	580.	12.67	156.	43.	41.	1.01
+	ROUTED TO	R318	530.	12.92	154.	43.	41.	1.01
+	HYDROGRAPH AT	301	535.	12.17	46.	12.	12.	.30
+	ROUTED TO	R301	175.	14.00	46.	12.	12.	.30

+	HYDROGRAPH AT	319	577.	12.50	84.	23.	23.	.54
+	2 COMBINED AT	CP319	578.	12.50	127.	36.	34.	.84
+	ROUTED TO	R319	520.	12.83	126.	36.	34.	.84
+	HYDROGRAPH AT	337	744.	12.25	84.	25.	24.	.49
+	3 COMBINED AT	CP337	1120.	12.83	357.	103.	99.	2.34
+	ROUTED TO	SR337	373.	13.50	335.	103.	99.	2.34
+	DIVERSION TO	DI367	373.	13.50	335.	103.	99.	2.34
+	HYDROGRAPH AT	D337	0.	.08	0.	0.	0.	2.34
+	ROUTED TO	R337	0.	.08	0.	0.	0.	2.34
+	2 COMBINED AT	1I336	295.	13.83	136.	36.	34.	3.31
+	2 COMBINED AT	2I336	3195.	19.92	2901.	1021.	984.	55.86
+	HYDROGRAPH AT	336	552.	13.92	206.	57.	55.	1.28
+	2 COMBINED AT	CP336	3200.	19.83	2918.	1074.	1035.	57.14
+	ROUTED TO	SR336	3200.	19.92	2915.	1074.	1035.	57.14
+	HYDROGRAPH AT	336A	149.	14.00	54.	14.	13.	.37
+	2 COMBINED AT	CP336A	3200.	19.92	2918.	1087.	1047.	57.51
+	ROUTED TO	R336A	3198.	20.00	2915.	1081.	1041.	57.51
+	HYDROGRAPH AT	364A	99.	12.25	9.	2.	2.	.07
+	2 COMBINED AT	1I364A	3198.	20.00	2915.	1083.	1043.	57.58
+	HYDROGRAPH AT	336B	168.	12.00	9.	2.	2.	.08
+	ROUTED TO	SR336B	101.	12.17	9.	2.	2.	.08
+	ROUTED TO	R336B	82.	12.33	9.	2.	2.	.08
+	2 COMBINED AT	CP364A	3198.	20.00	2915.	1085.	1045.	57.66
	DIVERSION TO							

APPENDIX E

Hydraulic Analysis and Supporting Data

```
1*****************************************
 *  HEC-2 WATER SURFACE PROFILES          *
 *                                        *
 *  Version   4.6.2;  May 1991            *
 *                                        *
 *  RUN DATE    24SEP98    TIME   10:04:26 *
 *****************************************
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*************************************
*  U.S. ARMY CORPS OF ENGINEERS     *
*  HYDROLOGIC ENGINEERING CENTER    *
*  609 SECOND STREET, SUITE D       *
*  DAVIS, CALIFORNIA 95616-4687     *
*          (916) 756-1104           *
*************************************
```

```
X    X  XXXXXXX  XXXXX            XXXXX
X    X  X       X    X          X    X
X    X  X       X                    X
XXXXXXX  XXXX    X        XXXXX   XXXXX
X    X  X       X                X
X    X  X       X    X           X
X    X  XXXXXXX  XXXXX            XXXXXXX
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1

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THIS RUN EXECUTED 24SEP98 10:04:26

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************************************
 HEC-2 WATER SURFACE PROFILES

 Version   4.6.2;  May 1991
************************************
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End WLB Comment Records

```
T1      BULLARD WASH CLOMR - PINNACLE ENGINEERING/MARWEST DEVELOPMENT
T2      FLOODPLAIN/FLOODWAY RUN  FILE: BULL_CIM.DAT
T3      BULLARD WASH CLOMR       - FROM LOWER BUCKEYE ROAD TO MCDOWELL RD

        Modeling performed by JE Fuller/ Hydrology & Geomorphology, Inc.
        John Wallace, P.E. 520-623-3112
        The following revisions were made to the orginal FIS HEC-2 by WLB
        Hydrology:
          HEC-1 was revised by Stanley Consultants & FCDMC to reflect
             construction of Dysart Drain.  New Q100 values were input
             based on revised HEC-1 model (see discussion in TDN report).
             Revised discharges are shown in WLB comment cards next to
             original values
        Hydraulics:
          Original WLB model shortened to include only detailed study reach
             from Section 2.371 to Section 6.320.  Downstream WSEL matches
             original FIS.
          Section 3.625 (along center of Van Buren Road) replaced by Sections
             4.619 and 4.631 to model proposed culvert at Van Buren Road
             (12 celled 4'x10' reinforced box culvert)
          Sections 4.754, 4.811, 4.833 and 4.855 added to model to adequately
             define proposed Bullard Wash channel/levee improvements at
             Estrella Views Estates (upstream of Van Buren Street)
```

J1	ICHECK	INQ	NINV	IDIR	STRT	METRIC	HVINS	Q	WSEL	FQ
	0	2	0	0	0	0	0	0	943.66	0

J2	NPROF	IPLOT	PRFVS	XSECV	XSECH	FN	ALLDC	IBW	CHNIM	ITRACE
	1	0	0	0	0	0	0	0	0	0

```
J3  VARIABLE CODES FOR SUMMARY PRINTOUT

     38        43        1        53        21        22        54        51        4        8
     42        5        26        0        110        0        200
1
   24SEP98     10:04:26                                                                          PAGE   2


NC    .045      .07       .03       .1        .3
QT      3      3200      3200      3200
ET                        10.4

            ** BEGIN DETAILED FLOODPLAIN\FLOODWAY ANALYSIS.
               Q = Q AT CP336        (=4899 CFS). REVISED Q = 3200 CFS
X1    2.371       25      9975     10030       400       500       390
GR    949.7     8815       948      8940       946      9060       944      9145     944.5      9185
GR      944     9270       942      9315       940      9435     939.8      9520       940      9585
GR    940.6     9655       940      9710     939.4      9775       940      9815       942      9890
GR    942.3     9930       942      9975       940      9995     939.7     10000       940     10005
GR    940.7    10030       942     10385       944     10860       946     11400     949.7     11450

ET                        10.4
X1    2.435       20      9985     10085       335       335       335
GR      950     8650       948      8790       946      8890     945.2      9000       946      9090
GR      944     9250       942      9485     941.1      9720       942      9835     942.4      9950
GR      942     9985       940      9995     939.9     10000       940     10005     941.7     10085
GR      942    10360       944     10760       946     11320       948     11395     949.8     11420

QT      3      3191      3191      3191
ET                        9.1                                                                 9915     10138

               CROSS-SECTION 30 FEET SOUTH OF LOWER BUKEYE RD. "EXTENDED"

               Q = Q AT CP335        (= 4906 CFS). REVISED Q = 3191 CFS

X1    2.536       15      9965     10060       535       535       535
GR      951     9185       950      9300       948      9555       946      9710     945.5      9865
GR      944     9920     943.5      9935     943.8      9965     943.5     10000     943.7     10060
GR      944    10155     944.8     10500       946     10800       948     11280     950.2     11340

ET                        10.4

               DIVIDED FLOW OCCURS FOR THE NEXT TWO UPSTREAM CROSS-SECTIONS,
               HOWEVER, THESE FLOWS ARE EFFECTIVE DUE TO UPSTREM INFLOW AT
               X1= 2.883

X1    2.680       17      9925     10050       735       725       760
GR      954     9265       952      9400       950      9505       948      9645     947.2      9735
GR      948     9790     949.9      9805     948.8      9900       948      9905     947.3      9925
GR      946     9940     945.2     10000     945.6     10050       946     10165       948     10565
GR      950    10935       952     11160

ET                        10.4
X1    2.771       16      9985     10020       480       480       480
GR      954     9440       952      9545       950      9660     948.1      9810       950      9880
GR    951.4     9890       950      9900     949.4      9985     947.4     10000     948.2     10020
GR    947.3    10075       948     10210       950     10505     950.9     10795       952     11105
GR    953.5    11255
1
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ET                        9.1                                                                 9853     10130
X1    2.883       15      9985     10015       580       580       590
GR      958     9190       956      9360       954      9535       952      9640       950      9840
GR    949.6     9920     950.2      9985     948.5     10000     950.1     10015     949.2     10035
GR      950    10165       952     10385       954     10600       956     11230     956.5     11270
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QT      3     3194     3194     3194
ET                     9.1                                                  9875     10050

                Q = Q AT CP334      (= 4915 CFS). REVISED Q = 3194 CFS

X1    2.977     15     9980     10050     500     500     500
GR      960   9170      958      9345     956    9530     954     9660      952     9830
GR      951   9960    951.5      9980     950    9990   949.9    10000      950    10010
GR    952.1  10050      954     10480     956   10740     958    11200    958.5    11305

ET                     10.4
X1    3.070     13     9945     10025     485     495     490
GR    958.5   9510    953.8      9545   954.5    9600   954.5     9945      954     9960
GR    952.5   9975    954.2      9985   952.3   10000   953.2    10025    952.7    10060
GR      954  10290      956     10635     958   10875

QT      3     2742     2742     2742
ET                     9.1                                                  9788     10130

                Q = Q AT 1I334      (= 4432 CFS). REVISED Q = 2742 CFS

X1    3.167     18     9970     10020     475     515     510
GR    960.7   9530      956      9585     955    9625   955.4     9730    954.9     9865
GR    955.8   9935    955.1      9970     954    9990   953.9    10000      954    10005
GR    954.9  10020    954.5     10080   955.1   10120   954.8    10220      956    10425
GR      958  10770      960     10990     962   11230

ET                     10.4

                DIVIDED FLOW OCCURS FOR THE NEXT TWO UPSTREAM CROSS-SECTIONS,
                HOWEVER,THESE FLOWS ARE EFFECTIVE DUE TO UPSTREM INFLOW AT
                X1= 3.602

X1    3.291     23     9970     10020     660     650     655
GR      964   9530      962      9670   961.3    9690   961.8     9725    960.4     9770
GR    961.8   9785    960.1      9940   960.5    9970     960     9985      958     9995
GR    957.2  10000      958     10005     960   10015   960.1    10020      960    10025
GR      958  10040    957.2     10110   957.8   10360   957.6    10460      958    10700
GR      960  10910      962     10970     964   11600

ET                     10.4
X1    3.376     17     9985     10015     460     440     450
GR    967.9   9300      966      9370     964    9520     962     9630    960.5     9900
GR    961.9   9985      960      9995   958.3   10000     960    10005      961    10015
GR      960  10030    958.4     10055   958.6   10170   958.8    10365      960    10590
GR      962  10930      964     11490
1
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ET                     10.4
X1    3.491     17     9980     10020     605     605     605
GR      968   9255      966      9435     964    9555     962     9660    960.5     9930
GR    961.9   9980      960      9995   959.5   10000     960    10005    961.9    10020
GR      960  10040    959.6     10130     960   10240     962    10540      964    10735
GR      966  11000      968     11780

QT      3     2746     2746     2746
NC    .07      .07      .04       .1       .3
ET                     10.4

                CROSS-SECTION AT YUMA RD.

                Q = Q AT CP316      (= 4438 CFS). REVISED Q = 2746 CFS

X1    3.602     13     9880     10100     590     590     590
GR      970   9225      968      9450     966    9600     964     9750      962     9880
GR    961.9  10000      962     10100   963.2   10330     964    10445      966    10625
GR      968  10770    968.9     10945     970   11005
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ET                          9.1                                                   9600      10075

                 DIVIDED FLOW OCCURS FOR THE NEXT TWO UPSTREAM CROSS-SECTIONS,
                 HOWEVER, THESE FLOWS ARE EFFECTIVE DUE TO UPSTREM INFLOW AT
                 X1= 4.101

X1     3.702       20      9955     10055       535       490       525
GR       972     8720       970      8925       968      9115       966      9315       964      9550
GR     963.5     9620       964      9665     970.5      9750     970.5      9900       970      9920
GR       968     9935       964      9945     963.5      9950     963.9      9955     963.4     10000
GR       964    10055       966     10370       968     10660       970     10980       972     11360

ET                         10.4
X1     3.841       23      9955     10070       735       735       735
GR       976     8355       974      8700       972      8995       970      9130       968      9280
GR       966     9550     965.5      9650       966      9685     970.5      9700     970.2      9900
GR       970     9915       968      9925       966      9930     965.1      9935       966      9940
GR     967.1     9955     966.3     10000     967.3     10070       968     10260       970     10495
GR       972    10710       974     11090       976     11350

ET                          9.1                                                   9700      10095
X1     3.978       23      9930     10095       725       725       725
GR       978     8360       976      8690       974      8990       972      9180       970      9335
GR     968.8     9570       970      9705     970.5      9740     970.5      9885       970      9900
GR       968     9910     966.9      9915       968      9920       969      9930       968      9990
GR     967.9    10000       968     10015     968.4     10095       970     10300       972     10515
GR       974    10655       976     10850       978     11110
1
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ET                         10.4
X1     4.101       23      9960     10080       650       650       650
GR       980     8400       976      8715       974      8955       974      9255       972      9540
GR       971     9715     971.4      9780     970.2      9890     971.3      9920       970      9935
GR     968.7     9945       970      9950       971      9960       970      9985     969.8     10000
GR       970    10015     970.9     10080     970.7     10160       972     10400       974     10560
GR       976    10620       978     10915       980     11180

ET                         10.4
X1     4.237       19      9935     10075       715       715       715
GR       980     8695       978      9160     976.5      9270     977.4      9305       976      9390
GR       974     9535       972      9850     971.8      9870       972      9885     972.4      9910
GR     972.2     9920     972.6      9935       972      9940     971.3     10000       972     10075
GR       974    10290       976     10430       978     10600       980     10870

ET                         10.4
X1     4.356       16      9950     10070       630       630       630
GR     980.5     9300       980      9320       978      9430       976      9525       974      9725
GR     973.1     9895     973.5      9915     973.3      9935     973.5      9950     972.6     10000
GR     973.4    10070       974     10155       976     10360       978     10485       980     10615
GR       982    10870

ET                         10.4
X1     4.496       14      9975     10130       740       740       740
GR       984     9180       982      9365       980      9540       978      9645       976      9845
GR     974.8     9945     975.2      9975     974.4     10000       975     10130       976     10275
GR       978    10420       980     10540       982     10620       984     10840

QT         3     2754      2754      2754
NC                          .035
ET                         10.4

                 CROSS-SECTION AT VAN BUREN ST.
                 Q = Q AT CP298        (= 4446 CFS). REVISED Q = 2754 CFS
                 VanBuren Street - Proposed Reinforced Concrete Box Culvert
                 Begin Marwest Property Channelization and Levees

X1     4.619       18      9909     10075       648       648       648
X3        10                                                                 983       983
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GR      986      9220       984      9310       982      9450       980      9650       979      9670
GR      978      9725       977      9885       976      9909       976     10000       976     10042
GR    976.3     10075       977     10206       978     10290       980     10345       982     10480
GR      984     10650     985.1     10810       986     10950

SC   12.012       0.4       2.7                   4        10        62       8.1    976.12       976
X1    4.631         5      9873     10079        62        62        62
X2                           2                983.5
X3       10                                                      983.50    983.50
BT       -4      9677    981.91                9910    984.54               10033    984.92
BT               10143    983.09
GR    983.5      9873    976.12      9909    976.12     10000    976.12     10042    983.50     10079
1
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ET                        10.4
X1    4.701         4    9881.5   10118.5       370       370       370     .8692
GR   983.92    9881.5    976.92    9913.7    976.92   10086.3    983.92   10118.5

ET                        10.4
X1    4.754         4      9897     10103       280       280       280
GR   984.51      9897    977.51      9925    977.51     10075    984.51     10103

ET                        10.4
X1    4.811         4      9897     10103       300       300       300
GR   985.11      9897    978.11      9925    978.11     10075    985.11     10103

ET                        10.4
X1    4.833         4    9858.5   10141.5       120       120       120
GR   985.35    9858.5    978.35    9887.5    978.35   10112.5    985.35   10141.5

ET                        10.4
X1    4.855         5      9680     10175       115       115       115
GR   985.54      9680    978.57      9700    978.57      9850    978.76      9925    980.23     10175

NC                        0.04
ET                         9.1                                                   9850     10150

                End Marwest Property

X1    4.858        12      9705     10290        15        15        15
GR      988      9200       986      9420       984      9620       982      9705       980     10000
GR    980.3     10060       980     10090     980.5     10260       982     10290       984     10555
GR      986     10820       988     11220

ET                         9.1                                                   9875     10105
X1    5.009        14      9935     10100       800       840       795
GR      990      9190       988      9410       986      9575       984      9715       982      9820
GR    981.9      9860       982      9900     983.7      9935       982     10000     982.5     10100
GR      984     10270       986     10445       988     10700       990     10880

ET                         9.1                                                   9865     10090
X1    5.153        12      9945     10090       775       730       765
GR      992      9110       990      9280       988      9480       986      9645     984.5      9800
GR    985.6      9945     984.3     10000     985.4     10090       986     10145       988     10410
GR      990     10480       992     10885

ET                        10.4
X1    5.282        13      9945     10055       690       665       680
GR      992      8865       990      9105       988      9440       986      9710     985.6      9850
GR      986      9915       987      9945       986      9960     985.5     10000       986     10055
GR      988     10230       990     10590       992     10870
1
   24SEP98     10:04:26                                                                          PAGE    7


NC      .07       .07      .035        .3        .5
ET                        10.4
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A 7-SPAN BRIDGE AT I-10

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X1    5.430      11    9899.9   10100.1     680     820     780
X3    10                                                     996     996
GR    1000     9050     997     9899.9    994.2    9900    994.2    9906     988     9919
GR     988    10000     988     10081     994.2   10094    994.2   10100     997   10100.1
GR    1000    10450

QT       3     3538    3538       3538
SB    1.05      1.6     2.6          0     162       6    1203       2     988       988
ET                     10.4
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Q = Q AT CP287 (= 5319 CFS). REVISED Q = 3538 CFS

```
X1    5.460      11    9899.9   10100.1     160     160     160
X2        0       0       1       995     997
X3    10                                                     997     997
BT        4    9050    1000               9899.9     997   10100.1     997
BT    10450    1000
GR    1000     9050     997     9899.9    994.2    9900    994.2    9906     988     9919
GR     988    10000     988     10081     994.2   10094    994.2   10100     997   10100.1
GR    1000    10450

NC     .07      .07     .04        .3       .5
ET                     10.4
X1    5.563      13    9850     10100     540     535     540
GR     996    8140    994.2      8850     994    9085     992    9470     990     9790
GR    990.9    9815    989.5      9850   988.5   10000   988.9   10100     990    10370
GR     992   10655     994     10920     996   11105

QT       3    3400    3400       3400
NC     .07      .07    .045        .1       .3
ET                     10.4
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CROSS-SECTION AT 280 FEET (ALONG FLOW PATH) NORTH OF MCDOWELL RD.

Q = Q AT CP286 (= 4662 CFS). REVISED Q = 3400 CFS

DIVIDED FLOW OCCURS FOR THE NEXT TWO UPSTREAM CROSS-SECTIONS,
HOWEVER, THESE FLOWS ARE EFFECTIVE DUE TO UPSTREM INFLOW AT
X1= 5.960

```
X1    5.727      21     9935     10135     870     835     870
GR     999    8415     998      8710     996    9045     994    9250    992.4     9690
GR     994    9730    996.1     9780   993.5    9800   993.5    9830   1000.4     9870
GR    1000    9890     994      9900     992    9935     991   10000    991.8    10135
GR     992   10190     994     10550    994.6   10565     994   10600     996    10890
GR     998   11170
1
```



```
ET                     10.4
X1    5.840      22     9970     10170     590     580     595
GR   1001.6    8460    1000      8815     998    9090     996    9400    994.5     9760
GR     996    9805    998.1     9840   993.5    9865   993.5    9895    998.6     9920
GR     998    9925     996      9940     994    9970   993.4   10000    993.7    10170
GR     994   10300     996     10605    996.3   10620   995.8   10650     996    10675
GR     998   10945    1000     11190

ET                     10.4
X1    5.960      16     9960     10150     640     610     635
GR    1002    8825    1000      9240     998    9760     997    9910    997.3     9960
GR     996    9990    995.9     10000     996   10010   996.2   10150     996    10230
GR   996.2   10520    997.3     10680     997   10715     998   10935    1000    11210
GR    1002   11560

ET                     10.4
X1    6.086      12     9900     10100     655     685     665
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GR     1004      8350      1002      9210      1000      9650     999.6      9810     999.2      9900
GR    998.3     10000     999.2     10100       999     10420     999.7     10495      1000     10720
GR     1002     10990      1004     11285

ET                          9.1                                                          9850     10270
X1    6.217        15      9900     10100       620       745       690
GR     1006      8300      1004      9175      1002      9565    1001.2      9630    1001.7      9665
GR   1000.6      9695    1000.3      9900    1000.1     10000    1000.3     10100    1000.7     10445
GR   1001.5     10535    1001.4     10600      1002     10730      1004     11080      1006     11110

ET                         10.4
X1    6.320        13      9900     10100       580       525       545
GR     1008      8860      1006      9230      1004      9555    1002.5      9660      1002      9670
GR   1001.3      9900    1000.9     10000    1001.4     10100      1002     10480    1003.1     10800
GR     1004     11030      1006     11060      1007     11220
1
   24SEP98      10:04:26                                                                          PAGE    9

    SECNO     DEPTH     CWSEL     CRIWS     WSELK      EG        HV        HL     CLOSS    L-BANK ELEV
    Q         QLOB      QCH       QROB      ALOB      ACH      AROB       VOL       TWA    R-BANK ELEV
    TIME      VLOB      VCH       VROB       XNL      XNCH       XNR       WIN     ELMIN    SSTA
    SLOPE     XLOBL     XLCH      XLOBR     ITRIAL     IDC     ICONT     CORAR    TOPWID    ENDST

 *PROF 1
0

 CCHV=     .100 CEHV=     .300
 *SECNO 2.371

            **  BEGIN DETAILED FLOODPLAIN\FLOODWAY ANALYSIS.
                Q = Q AT CP336        (=4899 CFS). REVISED Q = 3200 CFS
    2.371      4.26    943.66       .00    943.66    943.68       .02       .00       .00    942.00
   3200.0    2339.7     289.7     570.7    2077.8     174.0    1147.3        .0        .0    940.70
      .00      1.13      1.66       .50      .045      .030      .070      .000    939.40   9277.65
  .000244      400.      390.      500.         0         0         0       .00   1501.59  10779.24

 *SECNO 2.435

 3302 WARNING:  CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE,  KRATIO =   .56

    2.435      3.87    943.77       .00       .00    943.82       .05       .13       .01    942.00
   3200.0    1678.0     863.8     658.3    1197.4     299.6     842.0      22.1      11.3    941.70
      .06      1.40      2.88       .78      .045      .030      .070      .000    939.90   9276.89
  .000786      335.      335.      335.         2         0         0       .00   1437.33  10714.22

 *SECNO 2.536
 3685 20 TRIALS ATTEMPTED WSEL,CWSEL
 3693 PROBABLE MINIMUM SPECIFIC ENERGY
 3720 CRITICAL DEPTH ASSUMED

                CROSS-SECTION 30 FEET SOUTH OF LOWER BUKEYE RD. "EXTENDED"

                Q = Q AT CP335        (= 4906 CFS). REVISED Q = 3191 CFS

    2.536      1.90    945.40    945.40       .00    945.92       .52      1.07       .14    943.80
   3191.0     508.1    1363.0    1319.9     113.1     169.2     536.7      41.5      24.9    943.70
      .08      4.49      8.06      2.46      .045      .030      .070      .000    943.50   9868.70
  .012260      535.      535.      535.        20        11         0       .00    781.06  10649.76

 *SECNO 2.680

 3265 DIVIDED FLOW

1
   24SEP98      10:04:26                                                                          PAGE   10
```

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	CLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WIN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	COPAR	TOPWID	ENDST

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = 2.61

DIVIDED FLOW OCCURS FOR THE NEXT TWO UPSTREAM CROSS-SECTIONS,
HOWEVER, THESE FLOWS ARE EFFECTIVE DUE TO UPSTREM INFLOW AT
X1= 2.883

2.680	3.39	948.59	.00	.00	948.74	.16	2.79	.04	947.30
3191.0	234.9	1588.7	1367.4	177.5	368.3	990.5	61.3	39.6	945.60
.16	1.32	4.31	1.38	.045	.030	.070	.000	945.20	9603.54
.001797	735.	760.	725.	6	0	0	.00	964.41	10674.57

*SECNO 2.771

3265 DIVIDED FLOW

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = .51

2.771	2.78	950.08	.00	.00	950.27	.19	1.51	.01	949.40
3191.0	684.8	465.8	2040.4	260.4	70.9	777.8	75.9	49.6	948.20
.20	2.63	6.57	2.62	.045	.030	.070	.000	947.30	9655.17
.006890	480.	480.	480.	3	0	0	.00	858.07	10532.04

*SECNO 2.883

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = 1.72

2.883	3.83	952.33	.00	.00	952.44	.12	2.17	.01	950.20
3191.0	1565.5	446.7	1178.8	628.0	90.1	705.6	92.8	60.6	950.10
.26	2.49	4.96	1.67	.045	.030	.070	.000	948.50	9622.85
.002335	580.	590.	580.	3	0	0	.00	797.28	10420.12

*SECNO 2.977

Q = Q AT CP334 (= 4915 CFS). REVISED Q = 3194 CFS

2.977	3.78	953.68	.00	.00	954.07	.38	1.54	.08	951.50
3194.0	1452.7	1404.5	336.8	452.9	209.3	283.7	106.4	69.4	952.10
.29	3.21	6.71	1.19	.045	.030	.070	.000	949.90	9686.92
.004272	500.	500.	500.	3	0	0	.00	721.40	10408.32

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	CLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WIN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	COPAR	TOPWID	ENDST

*SECNO 3.070

3.070	3.32	955.62	.00	.00	955.75	.12	1.65	.03	954.50
3194.0	924.3	846.1	1423.6	480.7	186.3	843.4	120.2	79.3	953.20
.35	1.92	4.54	1.69	.045	.030	.070	.000	952.30	9531.43
.002739	485.	490.	495.	3	0	0	.00	1038.51	10569.93

*SECNO 3.167

Q = Q AT 1I334 (= 4432 CFS). REVISED Q = 2742 CFS

3.167	2.94	956.84	.00	.00	956.93	.09	1.18	.00	955.10
2742.0	1230.7	512.9	998.4	612.1	125.1	756.5	137.4	90.9	954.90
.41	2.01	4.10	1.32	.045	.030	.070	.000	953.90	9575.14
.002018	475.	510.	515.	3	0	0	.00	995.22	10570.36

*SECNO 3.291

3265 DIVIDED FLOW

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = .50

DIVIDED FLOW OCCURS FOR THE NEXT TWO UPSTREAM CROSS-SECTIONS,
HOWEVER, THESE FLOWS ARE EFFECTIVE DUE TO UPSTREM INFLOW AT
X1= 3.602

3.291	1.98	959.18	.00	.00	959.28	.10	2.34	.00	960.50
2742.0	.0	101.7	2640.3	.0	22.5	1078.8	156.9	104.5	960.10
.48	.00	4.52	2.45	.000	.030	.070	.000	957.20	9989.16
.008089	660.	655.	650.	2	0	0	.00	813.11	10822.67

*SECNO 3.376

3265 DIVIDED FLOW

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = 1.68

3.376	2.91	961.21	.00	.00	961.26	.06	1.98	.00	961.90
2742.0	53.3	92.2	2596.5	60.3	31.5	1392.1	169.9	113.5	961.00
.55	.88	2.93	1.87	.045	.030	.070	.000	958.30	9772.58
.002857	460.	450.	440.	3	0	0	.00	977.10	10795.34

1

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	CLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WIN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 3.491

3.491	3.10	962.60	.00	.00	962.66	.05	1.40	.00	961.90
2742.0	780.9	263.4	1697.6	446.8	78.3	1095.2	191.5	127.1	961.90
.64	1.75	3.36	1.55	.045	.030	.070	.000	959.50	9628.08
.001900	605.	605.	605.	4	0	0	.00	971.21	10599.29

CCHV= .100 CEHV= .300
*SECNO 3.602

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = .69

CROSS-SECTION AT YUMA RD.

Q = Q AT CP316 (= 4438 CFS). REVISED Q = 2746 CFS

3.602	2.20	964.10	.00	.00	964.28	.18	1.58	.04	962.00
2746.0	207.9	1872.8	665.2	144.2	474.3	405.0	209.4	138.5	962.00
.69	1.44	3.95	1.64	.070	.040	.070	.000	961.90	9742.06

.004057	590.	590.	590.	1	0	0	.00	712.46	10454.53

*SECNO 3.702

3265 DIVIDED FLOW

DIVIDED FLOW OCCURS FOR THE NEXT TWO UPSTREAM CROSS-SECTIONS,
HOWEVER, THESE FLOWS ARE EFFECTIVE DUE TO UPSTREM INFLOW AT
X1= 4.101

3.702	2.78	966.18	.00	.00	966.31	.13	2.03	.00	963.90
2746.0	1162.9	1047.1	536.0	616.9	249.5	371.6	222.8	147.7	964.00
.75	1.88	4.20	1.44	.070	.040	.070	.000	963.40	9297.73
.003770	535.	525.	490.	3	0	0	.00	851.16	10395.05

*SECNO 3.841

3265 DIVIDED FLOW

3.841	3.57	968.67	.00	.00	968.75	.08	2.43	.01	967.10
2746.0	1827.0	678.6	240.4	947.1	219.7	220.6	245.0	162.3	967.30
.84	1.93	3.09	1.09	.070	.040	.070	.000	965.10	9229.62
.002914	735.	735.	735.	3	0	0	.00	881.56	10338.92

1

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	CLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WIN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 3.978

3.978	3.81	970.71	.00	.00	970.83	.12	2.07	.01	969.00
2746.0	839.4	1433.3	473.2	630.3	402.6	337.0	267.9	178.8	968.40
.92	1.33	3.56	1.40	.070	.040	.070	.000	966.90	9279.88
.002796	725.	725.	725.	3	0	0	.00	1096.57	10376.45

*SECNO 4.101

4.101	3.93	972.63	.00	.00	972.72	.09	1.89	.00	971.00
2746.0	1074.1	986.5	685.4	675.3	276.5	468.3	288.7	194.4	970.90
1.00	1.59	3.57	1.46	.070	.040	.070	.000	968.70	9450.68
.003032	650.	650.	650.	2	0	0	.00	999.47	10450.15

*SECNO 4.237

4.237	3.17	974.47	.00	.00	974.58	.11	1.85	.00	972.60
2746.0	962.7	1368.3	415.0	672.3	392.1	324.8	311.8	209.4	972.00
1.08	1.43	3.49	1.28	.070	.040	.070	.000	971.30	9500.62
.002235	715.	715.	715.	2	0	0	.00	822.57	10323.19

*SECNO 4.356

4.356	3.26	975.86	.00	.00	975.96	.10	1.39	.00	973.50
2746.0	1092.4	1182.6	471.0	703.8	340.9	361.5	332.0	221.1	973.40
1.16	1.55	3.47	1.30	.070	.040	.070	.000	972.60	9538.80
.002167	630.	630.	630.	2	0	0	.00	807.05	10345.85

*SECNO 4.496

4.496	3.12	977.52	.00	.00	977.65	.13	1.68	.01	975.20
2746.0	611.2	1573.8	561.0	405.0	435.6	378.3	354.3	233.9	975.00
1.24	1.51	3.61	1.48	.070	.040	.070	.000	974.40	9692.35
.002385	740.	740.	740.	1	0	0	.00	693.32	10385.67

*SECNO 4.619

3495 OVERBANK AREA ASSUMED NON-EFFECTIVE, ELLEA= 983.00 ELREA= 983.00

CROSS-SECTION AT VAN BUREN ST.
Q = Q AT CP298 (= 4446 CFS). REVISED Q = 2754 CFS
VanBuren Street - Proposed Reinforced Concrete Box Culvert

1

Begin Marwest Property Channelization and Levees

4.619	3.15	979.15	.00	.00	979.59	.44	1.84	.09	976.00
2754.0	.0	2754.0	.0	.0	517.7	.0	367.2	240.3	976.30
1.27	.00	5.32	.00	.000	.035	.000	.000	976.00	9909.00
.003446	648.	648.	648.	2	0	0	.00	166.00	10075.00

SPECIAL CULVERT

SC	CUNO	CUNV	ENTLC	COFQ	RDLEN	RISE	SPAN	CULVIN	CHRT	SCL	ELCHU	ELCHD
	12	.012	.40	2.70	.00	4.00	10.00	62.00	8	1	976.12	976.00

CHART 8 - BOX CULVERT WITH FLARED WINGWALLS; NO INLET TOP EDGE BEVEL
SCALE 1 - WINGWALLS FLARED 30 TO 75 DEGREES

*SECNO 4.631

SPECIAL CULVERT OUTLET CONTROL
EGIC = 980.222 EGOC = 980.409 POWSE= 979.149 ELTRD= 983.500

SPECIAL CULVERT

EGIC	EGOC	H4	QWEIR	QCULV	VCH	ACULV	ELTRD	WEIRIN
980.22	980.41	.82	0.	2754.	4.543	480.0	983.50	0.

3495 OVERBANK AREA ASSUMED NON-EFFECTIVE, ELLEA= 983.50 ELREA= 983.50

4.631	3.97	980.09	.00	.00	980.41	.32	.82	.00	983.50
2754.0	.0	2754.0	.0	.0	606.3	.0	368.0	240.5	983.50
1.27	.00	4.54	.00	.000	.035	.000	.000	976.12	9889.63
.002152	62.	62.	62.	2	0	0	.00	172.29	10061.91

*SECNO 4.701

4.701	3.94	980.86	.00	.00	981.14	.28	.73	.00	983.92
2754.0	.0	2754.0	.0	.0	653.7	.0	373.4	242.0	983.92
1.30	.00	4.21	.00	.000	.035	.000	.000	976.92	9893.72
.001797	370.	370.	370.	2	0	0	.00	181.55	10075.28

*SECNO 4.754

4.754	3.87	981.38	.00	.00	981.66	.29	.52	.00	984.51
2754.0	.0	2754.0	.0	.0	639.5	.0	377.5	243.2	984.51
1.32	.00	4.31	.00	.000	.035	.000	.000	977.51	9909.54
.001924	280.	280.	280.	2	0	0	.00	180.92	10090.46

*SECNO 4.811

4.811	3.85	981.96	.00	.00	982.25	.29	.58	.00	985.11
2754.0	.0	2754.0	.0	.0	635.9	.0	381.9	244.4	985.11
1.33	.00	4.33	.00	.000	.035	.000	.000	978.11	9909.62
.001958	300.	300.	300.	2	0	0	.00	180.76	10090.38

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	CLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WIN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 4.833

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = 1.54

4.833	3.93	982.28	.00	.00	982.41	.13	.15	.02	985.35
2754.0	.0	2754.0	.0	.0	947.5	.0	384.1	245.0	985.35
1.35	.00	2.91	.00	.000	.035	.000	.000	978.35	9871.23
.000829	120.	120.	120.	2	0	0	.00	257.54	10128.77

*SECNO 4.855
3280 CROSS SECTION 4.86 EXTENDED 2.21 FEET

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = 1.60

4.855	3.86	982.43	.00	.00	982.47	.04	.06	.01	985.54
2754.0	.0	2754.0	.0	.0	1620.1	.0	387.5	246.0	980.23
1.37	.00	1.70	.00	.000	.035	.000	.000	978.57	9688.90
.000324	115.	115.	115.	0	0	0	.00	486.10	10175.00

*SECNO 4.858

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = .35

End Marwest Property

4.858	2.39	982.39	.00	.00	982.51	.11	.01	.02	982.00
2754.0	1.2	2749.2	3.7	3.2	1009.8	10.1	387.9	246.2	982.00
1.37	.36	2.72	.36	.070	.040	.070	.000	980.00	9688.41
.002593	15.	15.	15.	2	0	0	.00	653.31	10341.72

*SECNO 5.009

5.009	2.83	984.73	.00	.00	984.86	.13	2.35	.00	983.70
2754.0	988.9	1354.1	411.0	485.6	368.4	272.4	407.7	258.4	982.50
1.45	2.04	3.68	1.51	.070	.040	.070	.000	981.90	9664.64
.003354	800.	795.	840.	3	0	0	.00	668.30	10332.94

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	CLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WIN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 5.153

5.153	2.93	987.23	.00	.00	987.36	.12	2.50	.00	985.60
2754.0	1273.9	1258.3	221.7	686.7	340.1	185.1	428.2	270.9	985.40
1.53	1.86	3.70	1.20	.070	.040	.070	.000	984.30	9543.26
.003184	775.	765.	730.	3	0	0	.00	765.14	10308.40

*SECNO 5.282

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = 1.52

5.282	3.18	988.68	.00	.00	988.74	.05	1.37	.01	987.00
2754.0	1551.0	858.7	344.2	1149.4	311.3	336.2	451.8	284.9	986.00
1.64	1.35	2.76	1.02	.070	.040	.070	.000	985.50	9325.76
.001378	690.	680.	665.	3	0	0	.00	1027.00	10352.76

CCHV= .300 CEHV= .500
*SECNO 5.430

3301 HV CHANGED MORE THAN HVINS

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = .41

3495 OVERBANK AREA ASSUMED NON-EFFECTIVE, ELLEA= 996.00 ELREA= 996.00

A 7-SPAN BRIDGE AT I-10

5.430	2.44	990.44	.00	.00	991.15	.71	2.09	.33	997.00
2754.0	.0	2754.0	.0	.0	406.6	.0	470.4	295.1	997.00
1.67	.00	6.77	.00	.000	.035	.000	.000	988.00	9913.90
.008160	680.	780.	820.	1	0	0	.00	172.21	10086.10

SPECIAL BRIDGE

1
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SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WIN	EIMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

5227 DOWNSTREAM ELEV IS 990.10 , NOT 990.44 HYDRAULIC JUMP OCCURS DOWNSTREAM (IF LOW FLOW CONTROLS)

SB	XK	XKOR	COEQ	RDLEN	BWC	BWP	BAREA	SS	ELCHU	ELCHD
	1.05	1.60	2.60	.00	162.00	6.00	1203.00	2.00	988.00	988.00

*SECNO 5.460

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = 1.42

CLASS B LOW FLOW

3420 BRIDGE W.S.= 990.49 BRIDGE VELOCITY= 8.82 CALCULATED CHANNEL AREA= 401.

EGPRS	EGIWC	HB	QWEIR	QLOW	BAREA	TRAPEZOID AREA	ELLC	ELTRD	WEIRIN
.00	991.76	.00	0.	3538.	1203.	1190.	995.00	997.00	0.

3495 OVERBANK AREA ASSUMED NON-EFFECTIVE, ELLEA= 997.00 ELREA= 997.00

Q = Q AT CP287 (= 5319 CFS). REVISED Q = 3538 CFS

5.460	3.00	991.00	.00	.00	991.76	.76	.61	.00	997.00
3538.0	.0	3538.0	.0	.0	504.6	.0	472.0	295.7	997.00
1.67	.00	7.01	.00	.000	.035	.000	.000	988.00	9912.71
.006693	160.	160.	160.	0	0	0	.00	174.57	10087.29

CCHV= .300 CEHV= .500
*SECNO 5.563

3301 HV CHANGED MORE THAN HVINS

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = 3.63

5.563	4.11	992.61	.00	.00	992.65	.04	.67	.22	989.50
3538.0	464.7	1882.7	1190.6	692.3	934.0	1340.5	493.5	305.4	988.90
1.78	.67	2.02	.89	.070	.040	.070	.000	988.50	9351.44
.000508	540.	540.	535.	4	0	0	.00	1385.17	10736.61

SECNO	DEPTH	OWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WIN	EIMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

CCHV= .100 CEHV= .300
*SECNO 5.727

3265 DIVIDED FLOW

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = .21

CROSS-SECTION AT 280 FEET (ALONG FLOW PATH) NORTH OF MCDOWELL RD.

Q = Q AT CP286 (= 4662 CFS). REVISED Q = 3400 CFS

DIVIDED FLOW OCCURS FOR THE NEXT TWO UPSTREAM CROSS-SECTIONS,
HOWEVER, THESE FLOWS ARE EFFECTIVE DUE TO UPSTREM INFLOW AT
X1= 5.960

5.727	2.54	993.54	.00	.00	993.90	.37	1.15	.10	992.00
3400.0	337.4	2386.2	676.3	218.4	422.2	304.9	531.9	328.1	991.80
1.83	1.55	5.65	2.22	.070	.045	.070	.000	991.00	9375.48
.010814	870.	870.	835.	3	0	0	.00	933.58	10467.87

*SECNO 5.840

3265 DIVIDED FLOW

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = 2.23

5.840	2.90	996.30	.00	.00	996.39	.08	2.45	.03	994.00
3400.0	700.6	1644.6	1054.9	597.7	545.8	741.7	551.0	343.1	993.70
1.90	1.17	3.01	1.42	.070	.045	.070	.000	993.40	9353.27
.002183	590.	595.	580.	4	0	0	.00	1293.68	10715.70

*SECNO 5.960

5.960	2.19	998.09	.00	.00	998.18	.09	1.80	.00	997.30
3400.0	145.3	1175.1	2079.6	137.7	365.5	1117.9	576.1	361.1	996.20
1.98	1.06	3.21	1.86	.070	.045	.070	.000	995.90	9735.32
.003962	640.	635.	610.	4	0	0	.00	1212.73	10948.05

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	CLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WIN	EIMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 6.086

6.086	2.49	1000.79	.00	.00	1000.89	.10	2.71	.00	999.20
3400.0	477.0	1385.7	1537.3	354.0	408.9	905.6	601.6	380.9	999.20
2.06	1.35	3.39	1.70	.070	.045	.070	.000	998.30	9475.24
.004060	655.	665.	685.	4	0	0	.00	1352.00	10827.24

*SECNO 6.217

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = 1.54

6.217	2.51	1002.61	.00	.00	1002.66	.05	1.77	.00	1000.30
3400.0	814.4	1187.6	1398.0	630.3	482.5	1092.1	632.7	402.9	1000.30
2.18	1.29	2.46	1.28	.070	.045	.070	.000	1000.10	9445.53
.001716	620.	690.	745.	3	0	0	.00	1391.69	10837.22

*SECNO 6.320

6.320	2.70	1003.60	.00	.00	1003.66	.06	1.00	.00	1001.30
3400.0	699.5	1322.5	1378.0	504.7	495.2	1090.9	659.6	419.9	1001.40
2.26	1.39	2.67	1.26	.070	.045	.070	.000	1000.90	9582.92
.001952	580.	545.	525.	3	0	0	.00	1345.17	10928.09

1
PROFILE FOR STREAM BULLARD WASH CLOMR

PLOTTED POINTS (BY PRIORITY) E-ENERGY,W-WATER SURFACE,I-INVERT,C-CRITICAL W.S.,L-LEFT BANK,R-RIGHT BANK,M-LOWER END STA

ELEVATION	939.	949.	959.	969.	979.	989.	999.	1009.	1019.	1029.
SECNO	CUMDIS									
2.37	0.	IR LE M	.	.	.	.	.	.	.	.
	100.	I RLE M	.	.	.	.	.	.	.	.
	200.	I RLE M	.	.	.	.	.	.	.	.
	300.	I RLE M	.	.	.	.	.	.	.	.
2.43	400.	CIRLE M	.	.	.	.	.	.	.	.
	500.	CI L E M	.	.	.	.	.	.	.	.
	600.	C IL E .M	.	.	.	.	.	.	.	.
	700.	C IDWE .M	.	.	.	.	.	.	.	.
	800.	C IL E .M	.	.	.	.	.	.	.	.
2.54	900.	. I WE .M	.	.	.	.	.	.	.	.
	1000.	C IDWE .M	.	.	.	.	.	.	.	.
	1100.	C I E .M	.	.	.	.	.	.	.	.
	1200.	C IDWE . M	.	.	.	.	.	.	.	.
	1300.	C IL E . M	.	.	.	.	.	.	.	.
	1400.	C IRLE . M	.	.	.	.	.	.	.	.
	1500.	C IRL E. M	.	.	.	.	.	.	.	.
	1600.	C I IE. M	.	.	.	.	.	.	.	.
2.68	1700.	C I IE. M	.	.	.	.	.	.	.	.
	1800.	C IRL E M	.	.	.	.	.	.	.	.
	1900.	C I IE M	.	.	.	.	.	.	.	.
	2000.	C IRLE M	.	.	.	.	.	.	.	.
	2100.	C I WE M	.	.	.	.	.	.	.	.
2.77	2200.	C IRLE M	.	.	.	.	.	.	.	.
	2300.	C IRLE M	.	.	.	.	.	.	.	.
	2400.	C IRDWE M	.	.	.	.	.	.	.	.
	2500.	C IL E M	.	.	.	.	.	.	.	.
	2600.	C IRLE M	.	.	.	.	.	.	.	.
2.88	2700.	C I.L E M	.	.	.	.	.	.	.	.

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      2800.  C      I.L E  M .          .       .       .       .       .       .       .
      2900.  C       IL WE  M .         .       .       .       .       .       .       .
      3000.  C      I L E  M .          .       .       .       .       .       .       .
      3100.  C      I L E   M.          .       .       .       .       .       .       .
 2.98 3200.  C      .IIRWE  M.          .       .       .       .       .       .       .
      3300.  C      .I L E  M.          .       .       .       .       .       .       .
      3400.  C      .I L E  M.          .       .       .       .       .       .       .
      3500.  C      . IRIWE M.          .       .       .       .       .       .       .
      3600.  C      . I RIE M.          .       .       .       .       .       .       .
 3.07 3700.  C      .  IRIE M.          .       .       .       .       .       .       .
      3800.  C      .  IRIWE M.         .       .       .       .       .       .       .
      3900.  C      .   IL E M          .       .       .       .       .       .       .
      4000.  C      .   IL E M          .       .       .       .       .       .       .
      4100.  C      .   IRIE .M         .       .       .       .       .       .       .
 3.17 4200.  C      .    IIWE .M        .       .       .       .       .       .       .
      4300.  C      .    IRIE . M       .       .       .       .       .       .       .
      4400.  C      .     IIE . M       .       .       .       .       .       .       .
      4500.  C      .    I IE.  M       .       .       .       .       .       .       .
      4600.  C      .     I E.  M       .       .       .       .       .       .       .
      4700.  C      .     I EL   M      .       .       .       .       .       .       .
      4800.  C      .      I EL  M      .       .       .       .       .       .       .
 3.29 4900.  C      .      I EL   M     .       .       .       .       .       .       .
      5000.  C      .      I EL   M     .       .       .       .       .       .       .
      5100.  C      .      I .EL  M     .       .       .       .       .       .       .
      5200.  C      .       I.EL  M     .       .       .       .       .       .       .
      5300.  C      .       I.RE  M     .       .       .       .       .       .       .
 3.38 5400.  C      .       I. EL M     .       .       .       .       .       .       .
      5500.  C      .       I. EL M     .       .       .       .       .       .       .
      5600.  C      .       I. EL  M    .       .       .       .       .       .       .
      5700.  C      .       I. RE   M   .       .       .       .       .       .       .
      5800.  C      .        I RE   M   .       .       .       .       .       .       .
      5900.  C      .        I RE    M. .       .       .       .       .       .       .
 3.49 6000.  C      .        I  E     M.        .       .       .       .       .       .
      6100.  C      .        .I WE    M.        .       .       .       .       .       .
      6200.  C      .        .I IE    M.        .       .       .       .       .       .
      6300.  C      .        .I IE     M        .       .       .       .       .       .
      6400.  C      .        . IIE     M        .       .       .       .       .       .
 3.60 6500.  C      .        .  I E    .M       .       .       .       .       .       .
      6600.  C      .        .  I E    .M       .       .       .       .       .       .
      6700.  C      .        .  I WE   .M       .       .       .       .       .       .
      6800.  C      .        .  IL E   . M      .       .       .       .       .       .
      6900.  C      .        .   I E   . M      .       .       .       .       .       .
      7000.  C      .        .   IR E  . M      .       .       .       .       .       .
 3.70 7100.  C      .        .   IL E  . M      .       .       .       .       .       .
      7200.  C      .        .   IL E  . M      .       .       .       .       .       .
      7300.  C      .        .   IL WE .  M     .       .       .       .       .       .
      7400.  C      .        .    IL E .  M     .       .       .       .       .       .
      7500.  C      .        .    IL E .   M    .       .       .       .       .       .
      7600.  C      .        .    I IWE.   M    .       .       .       .       .       .
      7700.  C      .        .    I L E.    M   .       .       .       .       .       .
 3.84 7800.  C      .        .     I IE.     M  .       .       .       .       .       .
      7900.  C      .        .     I L E     M  .       .       .       .       .       .
      8000.  C      .        .     I L E     M  .       .       .       .       .       .
      8100.  C      .        .     I L E     M  .       .       .       .       .       .
      8200.  C      .        .      I IE      M.       .       .       .       .       .
      8300.  C      .        .      I L.E     M.       .       .       .       .       .
      8400.  C      .        .      I L.E     M.       .       .       .       .       .
 3.98 8500.  C      .        .       IRIE     M.       .       .       .       .       .
      8600.  C      .        .       IRL E    M.       .       .       .       .       .
      8700.  C      .        .       I L E    M.       .       .       .       .       .
      8800.  C      .        .       I RIE     M       .       .       .       .       .
      8900.  C      .        .        I.IWE    M       .       .       .       .       .
      9000.  C      .        .        I.L E    M       .       .       .       .       .
      9100.  C      .        .        I.L E    M       .       .       .       .       .
 4.10 9200.  C      .        .        I. IE     .M     .       .       .       .       .
      9300.  C      .        .         I IWE    .M     .       .       .       .       .
      9400.  C      .        .         I L E    .M     .       .       .       .       .
      9500.  C      .        .         I L E    .M     .       .       .       .       .
      9600.  C      .        .         .IL E    .M     .       .       .       .       .
      9700.  C      .        .         .IRL E   .M     .       .       .       .       .
      9800.  C      .        .         .IRL E   .M     .       .       .       .       .
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4.24  9900.  C     .     .     . IL E   .M     .     .     .     .     .
     10000.  C     .     .     . IL E   .M     .     .     .     .     .
     10100.  C     .     .     . IL  E  .M     .     .     .     .     .
     10200.  C     .     .     .  IL E  .M     .     .     .     .     .
     10300.  C     .     .     .  IL E  .M     .     .     .     .     .
     10400.  C     .     .     .  IL E  .M     .     .     .     .     .
4.36 10500.  C     .     .     .  IL WE .M     .     .     .     .     .
     10600.  C     .     .     .  IL  E . M    .     .     .     .     .
     10700.  C     .     .     .   IL E . M    .     .     .     .     .
     10800.  C     .     .     .   IL E  . M   .     .     .     .     .
     10900.  C     .     .     .   IL E  . M   .     .     .     .     .
     11000.  C     .     .     .   IL  E . M   .     .     .     .     .
     11100.  C     .     .     .    I  E .  M  .     .     .     .     .
     11200.  C     .     .     .   IL E .  M   .     .     .     .     .
4.50 11300.  C     .     .     .   IL E .   M  .     .     .     .     .
     11400.  C     .     .     .   IL WE.   M  .     .     .     .     .
     11500.  C     .     .     .   IL  E.   M  .     .     .     .     .
     11600.  C     .     .     .    I  E.    M .     .     .     .     .
     11700.  C     .     .     .    I  E.    M .     .     .     .     .
     11800.  C     .     .     .    IR WE    M .     .     .     .     .
4.62 11900.  C     .     .     .     I  E     M .     .     .     .     .
4.63 12000.  C     .     .     .     I  .E  L   .     .     .     .     .
     12100.  C     .     .     .     I  .E  L   .     .     .     .     .
     12200.  C     .     .     .     I  .E  L   .     .     .     .     .
4.70 12300.  C     .     .     .      I .WE  L  .     .     .     .     .
     12400.  C     .     .     .      I . E  L  .     .     .     .     .
     12500.  C     .     .     .      I . E  L  .     .     .     .     .
4.75 12600.  C     .     .     .      I . E  L  .     .     .     .     .
     12700.  C     .     .     .      I . E  L  .     .     .     .     .
     12800.  C     .     .     .       I. WE  L .     .     .     .     .
4.81 12900.  C     .     .     .       I.  E  L .     .     .     .     .
4.83 13000.  C     .     .     .       I.  E  L .     .     .     .     .
     13100.  C     .     .     .       I.R E  L .     .     .     .     .
4.86 13200.  C     .     .     .       I.R E  L .     .     .     .     .
4.86 13300.  C     .     .     .        .I E    M.     .     .     .     .
     13400.  C     .     .     .        .I E    M.     .     .     .     .
     13500.  C     .     .     .        .I IE   M.     .     .     .     .
     13600.  C     .     .     .        .I IE   M.     .     .     .     .
     13700.  C     .     .     .        . IIE    M     .     .     .     .
     13800.  C     .     .     .        . IRWE   M     .     .     .     .
     13900.  C     .     .     .        . IRIE   M     .     .     .     .
5.01 14000.  C     .     .     .        .  IIE   .M    .     .     .     .
     14100.  C     .     .     .        .  I IE  .M    .     .     .     .
     14200.  C     .     .     .        .  IRIE  .M    .     .     .     .
     14300.  C     .     .     .        .  IRIE  .M    .     .     .     .
     14400.  C     .     .     .        .   IL E . M   .     .     .     .
     14500.  C     .     .     .        .   IRIE . M   .     .     .     .
     14600.  C     .     .     .        .   IRIE . M   .     .     .     .
5.15 14700.  C     .     .     .        .    IL E . M  .     .     .     .
     14800.  C     .     .     .        .    IL E . M  .     .     .     .
     14900.  C     .     .     .        .    IRIE . M  .     .     .     .
     15000.  C     .     .     .        .    IRIWE. M  .     .     .     .
     15100.  C     .     .     .        .     IL E. M  .     .     .     .
     15200.  C     .     .     .        .     IL E. M  .     .     .     .
     15300.  C     .     .     .        .     IL E. M  .     .     .     .
5.28 15400.  C     .     .     .        .     IRIE. M  .     .     .     .
     15500.  C     .     .     .        .     I RIE  M .     .     .     .
     15600.  C     .     .     .        .      I RE  M .     .     .     .
     15700.  C     .     .     .        .      I EL  M .     .     .     .
     15800.  C     .     .     .        .      I WERL  M .   .     .     .
     15900.  C     .     .     .        .       I WE L  M.   .     .     .
     16000.  C     .     .     .        .       I .E  L  M.  .     .     .
     16100.  C     .     .     .        .       I .WE  RL M  .     .     .
5.43 16200.  C     .     .     .        .        I.WE    L .M .     .     .
     16300.  C     .     .     .        .        I.WE    L .M .     .     .
5.46 16400.  C     .     .     .        .        I. E    L .M .     .     .
     16500.  C     .     .     .        .        I. WE L  M   .     .     .
     16600.  C     .     .     .        .        I. WE L  M.  .     .     .
     16700.  C     .     .     .        .        I. WE   M .  .     .     .
     16800.  C     .     .     .        .        I. IE   M .  .     .     .
5.56 16900.  C     .     .     .        .        IL E  M .    .     .     .
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        17000.  C      .      .      .      .      IL E  M .      .      .      .      .
        17100.  C      .      .      .      .      IL WE M .      .      .      .      .
        17200.  C      .      .      .      .      IL E  M .      .      .      .      .
        17300.  C      .      .      .      .      IL E  M .      .      .      .      .
        17400.  C      .      .      .      .      .IL E  M .      .      .      .      .
        17500.  C      .      .      .      .      .IL E  M .      .      .      .      .
        17600.  C      .      .      .      .      .IL E  M .      .      .      .      .
        17700.  C      .      .      .      .      .IL E  M .      .      .      .      .
   5.73 17800.  C      .      .      .      .      . IIWE  M.      .      .      .      .
        17900.  C      .      .      .      .      . IL E  M.      .      .      .      .
        18000.  C      .      .      .      .      . IL E  M.      .      .      .      .
        18100.  C      .      .      .      .      . IL E  M       .      .      .      .
        18200.  C      .      .      .      .      . IL E  M       .      .      .      .
        18300.  C      .      .      .      .      .  I WE M       .      .      .      .
   5.84 18400.  C      .      .      .      .      .  IL E .M      .      .      .      .
        18500.  C      .      .      .      .      .  IL E .M      .      .      .      .
        18600.  C      .      .      .      .      .   IIWE .M     .      .      .      .
        18700.  C      .      .      .      .      .   IL E . M    .      .      .      .
        18800.  C      .      .      .      .      .    IIE . M    .      .      .      .
        18900.  C      .      .      .      .      .    IIE . M    .      .      .      .
   5.96 19000.  C      .      .      .      .      .     IIE. M    .      .      .      .
        19100.  C      .      .      .      .      .     IIE. M    .      .      .      .
        19200.  C      .      .      .      .      .     IL E M    .      .      .      .
        19300.  C      .      .      .      .      .      IIE  M   .      .      .      .
        19400.  C      .      .      .      .      .      IIE  M   .      .      .      .
        19500.  C      .      .      .      .      .      IL.E M   .      .      .      .
        19600.  C      .      .      .      .      .       IIE M   .      .      .      .
   6.09 19700.  C      .      .      .      .      .       IIE  M  .      .      .      .
        19800.  C      .      .      .      .      .       IL E M  .      .      .      .
        19900.  C      .      .      .      .      .       IL E M  .      .      .      .
        20000.  C      .      .      .      .      .        I E M  .      .      .      .
        20100.  C      .      .      .      .      .        I WE M .      .      .      .
        20200.  C      .      .      .      .      .        IL E M .      .      .      .
        20300.  C      .      .      .      .      .        IL E M .      .      .      .
   6.22 20400.  C      .      .      .      .      .        .I E  M .      .      .      .
        20500.  C      .      .      .      .      .        .I E  M .      .      .      .
        20600.  C      .      .      .      .      .        .I E M .      .      .      .
        20700.  C      .      .      .      .      .        .IR E M .      .      .      .
        20800.  C      .      .      .      .      .        .IL E M .      .      .      .
   6.32 20900.  C      .      .      .      .      .        . I E  M.      .      .      .
1
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 T1      WHITE TANKS / AGUA FRIA AREA DRAINAGE MASTER STUDY
 T2      100 - YEAR STORM EVENT   FLOODWAY RUN  FILE: 10.H2I
 T3      BULLARD WASH  (WASH 10) - FROM BUCKEYE CANAL TO DYSART DRAIN.

 J1  ICHECK    INQ      NINV     IDIR     STRT     METRIC   HVINS    Q        WSEL     FQ

       0        3        0        0        0        0        0        0     943.61      0

 J2  NPROF     IPLOT    PRFVS    XSECV    XSECH    FN       ALLDC    IBW      CHNIM    ITRACE

     14                 -1

1
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     SECNO    DEPTH    CWSEL    CRIWS    WSELK    EG       HV       HL       OLOSS    L-BANK ELEV
     Q        QLOB     QCH      QROB     ALOB     ACH      AROB     VOL      TWA      R-BANK ELEV
     TIME     VLOB     VCH      VROB     XNL      XNCH     XNR      WIN      EIMIN    SSTA
     SLOPE    XLOBL    XLCH     XLOBR    ITRIAL   IDC      ICONT    CORAR    TOPWID   ENDST

 *PROF 2
0

 CCHV=     .100 CEHV=     .300
 *SECNO 2.371
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 2800 NAT Q1=    2049.88  WSELK=     943.66  ENC Q1=    2049.88  WSEL=     944.66  RATIO=    .0000
 NAT Q1=    3471.  RATIOS LOB, CH, ROB=    .6866   .0845   .2290  WSEL=     944.66

3470 ENCROACHMENT STATIONS=     9506.2   10072.3  TYPE=      4  TARGET=         .409

            **  BEGIN DETAILED FLOODPLAIN\FLOODWAY ANALYSIS.
                Q = Q AT CP336        (=4899 CFS). REVISED Q = 3200 CFS
    2.371      4.21    943.61      .00    943.66    943.67      .06      .00      .00    942.00
   3200.0    2622.3     454.8    122.9    1437.6     171.3    119.8       .0       .0    940.70
      .00      1.82      2.66     1.03      .045      .030     .070     .000   939.40   9506.21
  .000634      400.      390.     500.         0         0        0      .00   566.08  10072.29


*SECNO 2.435
 2800 NAT Q1=    1141.04  WSELK=     943.77  ENC Q1=    1141.04  WSEL=     944.77  RATIO=    .0000
 NAT Q1=    2332.  RATIOS LOB, CH, ROB=    .5387   .2134   .2478  WSEL=     944.77

3302 WARNING:  CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE,  KRATIO =   .52


3470 ENCROACHMENT STATIONS=     9668.9   10085.0  TYPE=      4  TARGET=         .511
    2.435      3.95    943.85      .00    943.77    944.09      .24      .37      .05    942.00
   3200.0    1677.8    1522.2       .0     648.1     307.7       .0     10.3      3.8    941.70
      .03      2.59      4.95      .00      .045      .030     .000     .000   939.90   9668.89
  .002300      335.      335.     335.         2         0        0      .00   416.11  10085.00


*SECNO 2.536

3301 HV CHANGED MORE THAN HVINS

7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

3470 ENCROACHMENT STATIONS=     9915.0   10138.0  TYPE=      1  TARGET=      223.000

                CROSS-SECTION 30 FEET SOUTH OF LOWER BUKEYE RD. "EXTENDED"

1
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                Q = Q AT CP335        (= 4906 CFS). REVISED Q = 3191 CFS

    2.536      2.29    945.79    945.79    945.40    946.83     1.04     2.45      .24    943.80
   3191.0     632.7    1977.3     581.0     103.6     206.7    153.7     19.0      7.7    943.70
      .04      6.11      9.57      3.78      .045      .030     .070     .000   943.50   9915.00
  .013235      535.      535.      535.         4        11        0      .00   223.00  10138.00


*SECNO 2.680
 2800 NAT Q1=     752.81  WSELK=     948.59  ENC Q1=     752.81  WSEL=     949.59  RATIO=    .0000
 NAT Q1=    1494.  RATIOS LOB, CH, ROB=    .1370   .4073   .4556  WSEL=     949.59

3301 HV CHANGED MORE THAN HVINS


3302 WARNING:  CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE,  KRATIO =  2.64


3470 ENCROACHMENT STATIONS=     9925.0   10124.4  TYPE=      4  TARGET=         .496

                DIVIDED FLOW OCCURS FOR THE NEXT TWO UPSTREAM CROSS-SECTIONS,
                HOWEVER, THESE FLOWS ARE EFFECTIVE DUE TO UPSTREM INFLOW AT
                X1= 2.883

    2.680      4.34    949.54      .00    948.59    949.90      .36     3.01      .07    947.30
   3191.0       .0    2571.2     619.8        .0     486.6    283.3     29.6     11.3    945.60
      .09      .00      5.28      2.19      .000      .030     .070     .000   945.20   9925.00
  .001903      735.      760.     725.         3         0        0      .00   199.37  10124.37
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*SECNO 2.771
 2800 NAT Q1=     384.42  WSELK=     950.08  ENC Q1=     384.42  WSEL=     951.08  RATIO=    .0000
 NAT Q1=     951.  RATIOS LOB, CH, ROB=    .3075   .1146   .5779  WSEL=     951.08

3302 WARNING:  CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE,  KRATIO =   .51


3470 ENCROACHMENT STATIONS=     9972.4   10182.4  TYPE=      4  TARGET=         .596
     2.771      3.73    951.03       .00    950.08    951.54       .51      1.59       .04    949.40
    3191.0      70.8     903.2    2217.0      20.0     104.1     551.4      37.6      13.6    948.20
       .11      3.53      8.68      4.02      .045      .030      .070      .000    947.30   9972.38
   .007212      480.      480.      480.         3         0         0       .00    210.05  10182.43


*SECNO 2.883

3302 WARNING:  CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE,  KRATIO =  1.92

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    SECNO     DEPTH     CWSEL     CRIWS     WSELK     EG        HV        HL        OLOSS     L-BANK ELEV
    Q         QLOB      QCH       QROB      ALOB      ACH       AROB      VOL       TWA       R-BANK ELEV
    TIME      VLOB      VCH       VROB      XNL       XNCH      XNR       WIN       EIMIN     SSTA
    SLOPE     XLOBL     XLCH      XLOBR     ITRIAL    IDC       ICONT     COPAR     TOPWID    ENDST


3470 ENCROACHMENT STATIONS=     9853.0   10130.0  TYPE=      1  TARGET=      277.000
     2.883      4.84    953.34       .00    952.33    953.55       .21      1.98       .03    950.20
    3191.0    1536.9     665.0     989.2     462.9     120.4     439.3      48.9      16.8    950.10
       .16      3.32      5.52      2.25      .045      .030      .070      .000    948.50   9853.00
   .001963      580.      590.      580.         2         0         0       .00    277.00  10130.00


*SECNO 2.977

3470 ENCROACHMENT STATIONS=     9875.0   10050.0  TYPE=      1  TARGET=      175.000

                Q = Q AT CP334        (= 4915 CFS). REVISED Q = 3194 CFS

     2.977      4.51    954.41       .00    953.68    954.97       .56      1.31       .11    951.50
    3194.0    1360.8    1833.2        .0     324.9     260.0        .0      58.1      19.4 100000.00
       .18      4.19      7.05       .00      .045      .030      .000      .000    949.90   9875.00
   .003691      500.      500.      500.         3         0         0       .00    175.00  10050.00


*SECNO 3.070
 2800 NAT Q1=     610.33  WSELK=     955.62  ENC Q1=     610.33  WSEL=     956.62  RATIO=    .0000
 NAT Q1=    1372.  RATIOS LOB, CH, ROB=    .3604   .2139   .4258  WSEL=     956.62

3470 ENCROACHMENT STATIONS=     9846.1   10135.0  TYPE=      4  TARGET=         .555
     3.070      4.10    956.40       .00    955.62    956.76       .36      1.77       .02    954.50
    3194.0     556.8    1552.0    1085.2     187.1     247.9     381.3      66.0      22.0    953.20
       .21      2.98      6.26      2.85      .045      .030      .070      .000    952.30   9846.10
   .003559      485.      490.      495.         2         0         0       .00    288.85  10134.96


*SECNO 3.167

3470 ENCROACHMENT STATIONS=     9788.0   10130.0  TYPE=      1  TARGET=      342.000

                Q = Q AT LI334        (= 4432 CFS). REVISED Q = 2742 CFS

     3.167      3.96    957.86       .00    956.84    958.04       .17      1.26       .02    955.10
    2742.0    1252.6     850.9     638.6     476.3     175.8     339.3      76.4      25.6    954.90
       .26      2.63      4.84      1.88      .045      .030      .070      .000    953.90   9788.00
   .001788      475.      510.      515.         2         0         0       .00    342.00  10130.00
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SECNO     DEPTH     CWSEL     CRIWS     WSELK     EG        HV        HL        CLOSS     L-BANK ELEV
Q         QLOB      QCH       QROB      ALOB      ACH       AROB      VOL       TWA       R-BANK ELEV
TIME      VLOB      VCH       VROB      XNL       XNCH      XNR       WIN       ELMIN     SSTA
SLOPE     XLOBL     XLCH      XLOBR     ITRIAL    IDC       ICONT     CORAR     TOPWID    ENDST

*SECNO 3.291
 2800 NAT Q1=     304.87  WSELK=     959.18  ENC Q1=     304.87  WSEL=     960.18  RATIO=    .0000
 NAT Q1=     749.  RATIOS LOB, CH, ROB=    .0000   .0383   .9616  WSEL=     960.18

3265 DIVIDED FLOW

3302 WARNING:  CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE,  KRATIO =   .44

3470 ENCROACHMENT STATIONS=     9970.0   10284.7  TYPE=      4  TARGET=         .593

                DIVIDED FLOW OCCURS FOR THE NEXT TWO UPSTREAM CROSS-SECTIONS,
                HOWEVER, THESE FLOWS ARE EFFECTIVE DUE TO UPSTREM INFLOW AT
                X1= 3.602

    3.291      2.86    960.06       .00    959.18    960.31       .25      2.26       .02    960.50
   2742.0        .0     260.5    2481.5        .0      46.2     653.1      89.0      30.4    960.10
      .30       .00      5.64      3.80      .000      .030      .070      .000    957.20   9982.98
  .009263      660.      655.      650.         3         0         0       .00    298.43  10284.69

*SECNO 3.376
 2800 NAT Q1=     512.98  WSELK=     961.21  ENC Q1=     512.98  WSEL=     962.21  RATIO=    .0000
 NAT Q1=    1117.  RATIOS LOB, CH, ROB=    .0997   .0418   .8585  WSEL=     962.21

3302 WARNING:  CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE,  KRATIO =  1.83

3470 ENCROACHMENT STATIONS=     9985.0   10291.7  TYPE=      4  TARGET=         .541
    3.376      3.95    962.25       .00    961.21    962.37       .12      2.04       .01    961.90
   2742.0        .0     250.1    2491.9        .0      61.2     967.6      97.8      33.5    961.00
      .35       .00      4.09      2.58      .000      .030      .070      .000    958.30   9985.00
  .002765      460.      450.      440.         1         0         0       .00    306.73  10291.73

*SECNO 3.491
 2800 NAT Q1=     629.02  WSELK=     962.60  ENC Q1=     629.02  WSEL=     963.60  RATIO=    .0000
 NAT Q1=    1334.  RATIOS LOB, CH, ROB=    .3463   .0899   .5638  WSEL=     963.60

3470 ENCROACHMENT STATIONS=     9911.5   10234.0  TYPE=      4  TARGET=         .529
    3.491      4.12    963.62       .00    962.60    963.74       .12      1.37       .00    961.90
   2742.0     468.1     525.2    1748.7     177.5     118.6     794.4     112.5      37.8    961.90
      .41      2.64      4.43      2.20      .045      .030      .070      .000    959.50   9911.46
  .001897      605.      605.      605.         2         0         0       .00    322.58  10234.04
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SECNO     DEPTH     CWSEL     CRIWS     WSELK     EG        HV        HL        CLOSS     L-BANK ELEV
Q         QLOB      QCH       QROB      ALOB      ACH       AROB      VOL       TWA       R-BANK ELEV
TIME      VLOB      VCH       VROB      XNL       XNCH      XNR       WIN       ELMIN     SSTA
SLOPE     XLOBL     XLCH      XLOBR     ITRIAL    IDC       ICONT     CORAR     TOPWID    ENDST

CCHV=     .100 CEHV=     .300
*SECNO 3.602
 2800 NAT Q1=     431.14  WSELK=     964.10  ENC Q1=     552.89  WSEL=     965.10  RATIO=  -.2824
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 NAT Q1=     935.  RATIOS LOB, CH, ROB=    .1085   .5916   .2999  WSEL=     965.10

3470 ENCROACHMENT STATIONS=     9880.0   10100.0  TYPE=      4  TARGET=         .408

                CROSS-SECTION AT YUMA RD.

                Q = Q AT CP316        (= 4438 CFS). REVISED Q = 2746 CFS

     3.602      3.02    964.92      .00    964.10    965.20      .27     1.41      .04    962.00
    2746.0        .0    2746.0       .0        .0     653.2       .0    124.3     41.5    962.00
       .45       .00      4.20      .00      .000      .040     .000     .000   961.90   9880.00
   .003107      590.      590.     590.         2         0        0      .00   220.00  10100.00


*SECNO 3.702

3265 DIVIDED FLOW


3470 ENCROACHMENT STATIONS=     9600.0   10075.0  TYPE=      1  TARGET=      475.000

                DIVIDED FLOW OCCURS FOR THE NEXT TWO UPSTREAM CROSS-SECTIONS,
                HOWEVER, THESE FLOWS ARE EFFECTIVE DUE TO UPSTREM INFLOW AT
                X1= 4.101

     3.702      3.46    966.86      .00    966.18    967.21      .35     1.99      .02    963.90
    2746.0     841.0    1756.4    148.6     300.8     318.3     55.9    132.3     44.3    964.00
       .48      2.80      5.52     2.66      .070      .040     .070     .000   963.40   9600.00
   .004712      535.      525.     490.         2         0        0      .00   239.56  10075.00


*SECNO 3.841
 2800 NAT Q1=     508.66  WSELK=     968.67  ENC Q1=     508.66  WSEL=     969.67  RATIO=    .0000
 NAT Q1=    1064.  RATIOS LOB, CH, ROB=    .6109   .2379   .1512  WSEL=     969.67

3265 DIVIDED FLOW


3470 ENCROACHMENT STATIONS=     9588.6   10070.0  TYPE=      4  TARGET=         .522
     3.841      4.60    969.70      .00    968.67    969.89      .18     2.66      .02    967.10
    2746.0    1388.0    1358.0       .0     518.5     337.7       .0    145.2     48.5    967.30
       .54      2.68      4.02      .00      .070      .040     .000     .000   965.10   9588.62
   .002866      735.      735.     735.         3         0        0      .00   262.19  10070.00


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    SECNO     DEPTH     CWSEL     CRIWS     WSELK     EG        HV        HL        CLOSS     L-BANK ELEV
    Q         QLOB      QCH       QROB      ALOB      ACH       AROB      VOL       TWA       R-BANK ELEV
    TIME      VLOB      VCH       VROB      XNL       XNCH      XNR       WIN       ELMIN     SSTA
    SLOPE     XLOBL     XLCH      XLOBR     ITRIAL    IDC       ICONT     CORAR     TOPWID    ENDST


*SECNO 3.978

3470 ENCROACHMENT STATIONS=     9700.0   10095.0  TYPE=      1  TARGET=      395.000
     3.978      4.70    971.60      .00    970.71    971.82      .22     1.92      .01    969.00
    2746.0     510.0    2236.0       .0     334.8     550.1       .0    159.7     54.0 100000.00
       .60      1.52      4.06      .00      .070      .040     .000     .000   966.90   9700.00
   .002466      725.      725.     725.         3         0        0      .00   395.00  10095.00


*SECNO 4.101
 2800 NAT Q1=     498.66  WSELK=     972.63  ENC Q1=     498.66  WSEL=     973.63  RATIO=    .0000
 NAT Q1=    1107.  RATIOS LOB, CH, ROB=    .4193   .2951   .2857  WSEL=     973.63

3470 ENCROACHMENT STATIONS=     9852.5   10091.3  TYPE=      4  TARGET=         .549
     4.101      4.78    973.48      .00    972.63    973.75      .27     1.91      .02    971.00
    2746.0     880.6    1804.2     61.2     331.1     378.3     29.4    171.8     58.7    970.90
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      .64      2.66      4.77      2.08      .070      .040      .070      .000    968.70   9852.45
  .003566      650.      650.      650.         2         0         0       .00    238.89  10091.34


*SECNO 4.237
 2800 NAT Q1=     580.84  WSELK=     974.47  ENC Q1=     580.84  WSEL=     975.47  RATIO=    .0000
 NAT Q1=    1148.  RATIOS LOB, CH, ROB=    .3917   .4179   .1903  WSEL=     975.47

3470 ENCROACHMENT STATIONS=     9869.1   10075.0  TYPE=      4  TARGET=        .494
     4.237      4.20    975.50       .00    974.47    975.74       .24      1.99       .00    972.60
    2746.0     482.6    2263.4        .0     218.7     536.2        .0     184.1      62.4    972.00
       .70      2.21      4.22       .00      .070      .040      .000      .000    971.30   9869.05
  .002227      715.      715.      715.         1         0         0       .00    205.95  10075.00


*SECNO 4.356
 2800 NAT Q1=     589.96  WSELK=     975.86  ENC Q1=     589.96  WSEL=     976.86  RATIO=    .0000
 NAT Q1=    1150.  RATIOS LOB, CH, ROB=    .4188   .3652   .2160  WSEL=     976.86

3470 ENCROACHMENT STATIONS=     9852.4   10070.0  TYPE=      4  TARGET=        .487
     4.356      4.30    976.90       .00    975.86    977.12       .22      1.38       .00    973.50
    2746.0     796.8    1949.2        .0     351.9     466.1        .0     195.5      65.4    973.40
       .74      2.26      4.18       .00      .070      .040      .000      .000    972.60   9852.44
  .002157      630.      630.      630.         3         0         0       .00    217.56  10070.00


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    SECNO     DEPTH     CWSEL     CRIWS     WSELK     EG        HV        HL        CLOSS     L-BANK ELEV
    Q         QLOB      QCH       QROB      ALOB      ACH       AROB      VOL       TWA       R-BANK ELEV
    TIME      VLOB      VCH       VROB      XNL       XNCH      XNR       WIN       ELMIN     SSTA
    SLOPE     XLOBL     XLCH      XLOBR     ITRIAL    IDC       ICONT     CORAR     TOPWID    ENDST


*SECNO 4.496
 2800 NAT Q1=     562.28  WSELK=     977.52  ENC Q1=     562.28  WSEL=     978.52  RATIO=    .0000
 NAT Q1=    1071.  RATIOS LOB, CH, ROB=    .2611   .4988   .2401  WSEL=     978.52

3470 ENCROACHMENT STATIONS=     9957.7   10131.7  TYPE=      4  TARGET=        .475
     4.496      4.13    978.53       .00    977.52    978.82       .29      1.68       .02    975.20
    2746.0     124.3    2615.0       6.7      59.5     590.2       5.9     208.0      68.8    975.00
       .79      2.09      4.43      1.13      .070      .040      .070      .000    974.40   9957.69
  .002392      740.      740.      740.         2         0         0       .00    173.99  10131.68


*SECNO 4.619
 2800 NAT Q1=     469.17  WSELK=     979.15  ENC Q1=     745.98  WSEL=     980.15  RATIO=   -.5900
 NAT Q1=     746.  RATIOS LOB, CH, ROB=    .0000  1.0000   .0000  WSEL=     980.15

3470 ENCROACHMENT STATIONS=     9909.0   10075.0  TYPE=      4  TARGET=        .000

3495 OVERBANK AREA ASSUMED NON-EFFECTIVE, ELLEA=       983.00 ELREA=       983.00


                CROSS-SECTION AT VAN BUREN ST.
                Q = Q AT CP298        (= 4446 CFS). REVISED Q = 2754 CFS
                VanBuren Street - Proposed Reinforced Concrete Box Culvert
                Begin Marwest Property Channelization and Levees

     4.619      3.86    979.86       .00    979.15    980.15       .29      1.33       .00    976.00
    2754.0        .0    2754.0        .0        .0     636.2        .0     217.6      71.3    976.30
       .83       .00      4.33       .00      .000      .035      .000      .000    976.00   9909.00
  .001783      648.      648.      648.         2         0         0       .00    166.00  10075.00


SPECIAL CULVERT

SC  CUNO      CUNV      ENTLC     COFQ      RDLEN     RISE      SPAN      CULVIN    CHRT      SCL       ELCHU     ELCHD
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   12          .012      .40      2.70       .00      4.00     10.00     62.00      8         1       976.12    976.00

CHART  8 - BOX CULVERT WITH FLARED WINGWALLS; NO INLET TOP EDGE BEVEL
SCALE  1 - WINGWALLS FLARED 30 TO 75 DEGREES

*SECNO 4.631

SPECIAL CULVERT OUTLET CONTROL
EGIC =    980.222  EGOC =    980.694  POWSE=    979.864  ELTRD=    983.500

 2800 NAT Q1=     593.71  WSELK=     980.09  ENC Q1=     875.48  WSEL=     981.09  RATIO=   -.4746
 NAT Q1=     875.  RATIOS LOB, CH, ROB=    .0000  1.0000   .0000  WSEL=     981.09
1
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    SECNO     DEPTH     OWSEL     CRIWS     WSELK     EG        HV        HL        OLOSS     L-BANK ELEV
    Q         QLOB      QCH       QROB      ALOB      ACH       AROB      VOL       TWA       R-BANK ELEV
    TIME      VLOB      VCH       VROB      XNL       XNCH      XNR       WIN       EIMIN     SSTA
    SLOPE     XLOBL     XLCH      XLOBR     ITRIAL    IDC       ICONT     CORAR     TOPWID    ENDST


SPECIAL CULVERT

    EGIC      EGOC       H4      QWEIR     QCULV      VCH     ACULV     ELTRD    WEIRIN
   980.22    980.69      .54       0.     2754.     4.132     480.0    983.50       0.


3470 ENCROACHMENT STATIONS=     9873.0   10079.0  TYPE=      4  TARGET=        .000

3495 OVERBANK AREA ASSUMED NON-EFFECTIVE, ELLEA=       983.50 ELREA=       983.50

    4.631      4.31    980.43       .00    980.09    980.69       .27       .54       .00   1033.50
   2754.0        .0    2754.0        .0        .0     666.5        .0     218.5      71.5    983.50
      .84       .00      4.13       .00      .000      .035      .000      .000    976.12   9887.94
  .001611       62.       62.       62.         2         0         0       .00    175.71  10063.65


*SECNO 4.701
 2800 NAT Q1=     649.75  WSELK=     980.86  ENC Q1=     956.92  WSEL=     981.86  RATIO=   -.4728
 NAT Q1=     957.  RATIOS LOB, CH, ROB=    .0000  1.0000   .0000  WSEL=     981.86

3470 ENCROACHMENT STATIONS=     9881.5   10087.5  TYPE=      4  TARGET=        .000
    4.701      4.11    981.03       .00    980.86    981.28       .25       .59       .00   1033.92
   2754.0        .0    2754.0        .0        .0     683.8        .0     224.3      73.1    983.92
      .86       .00      4.03       .00      .000      .035      .000      .000    976.92   9893.06
  .001561      370.      370.      370.         2         0         0       .00    182.88  10075.94


*SECNO 4.754
 2800 NAT Q1=     627.93  WSELK=     981.38  ENC Q1=     930.89  WSEL=     982.38  RATIO=   -.4825
 NAT Q1=     931.  RATIOS LOB, CH, ROB=    .0000  1.0000   .0000  WSEL=     982.38

3470 ENCROACHMENT STATIONS=     9897.0   10103.0  TYPE=      4  TARGET=        .000
    4.754      3.97    981.48       .00    981.38    981.75       .27       .46       .01   1034.51
   2754.0        .0    2754.0        .0        .0     658.5        .0     228.6      74.2    984.51
      .88       .00      4.18       .00      .000      .035      .000      .000    977.51   9909.12
  .001756      280.      280.      280.         2         0         0       .00    181.76  10090.88


*SECNO 4.811
 2800 NAT Q1=     622.39  WSELK=     981.96  ENC Q1=     924.33  WSEL=     982.96  RATIO=   -.4851
 NAT Q1=     924.  RATIOS LOB, CH, ROB=    .0000  1.0000   .0000  WSEL=     982.96
1
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    SECNO     DEPTH     OWSEL     CRIWS     WSELK     EG        HV        HL        OLOSS     L-BANK ELEV
    Q         QLOB      QCH       QROB      ALOB      ACH       AROB      VOL       TWA       R-BANK ELEV
    TIME      VLOB      VCH       VROB      XNL       XNCH      XNR       WIN       EIMIN     SSTA
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    SLOPE     XLOBL     XLCH      XLOBR     ITRIAL    IDC       ICONT     COPAR     TOPWID    ENDST


3470 ENCROACHMENT STATIONS=     9897.0   10103.0  TYPE=      4  TARGET=         .000
     4.811      3.90    982.01       .00    981.96    982.30       .28       .54       .00   1035.11
    2754.0        .0    2754.0        .0        .0     646.7        .0     233.1      75.5    985.11
       .90       .00      4.26       .00      .000      .035      .000      .000    978.11   9909.38
   .001858      300.      300.      300.         2         0         0       .00    181.24  10090.62


*SECNO 4.833
 2800 NAT Q1=     956.48  WSELK=     982.28  ENC Q1=    1405.41  WSEL=     983.28  RATIO=   -.4694
 NAT Q1=    1405.  RATIOS LOB, CH, ROB=    .0000  1.0000   .0000  WSEL=     983.28

3302 WARNING:  CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE,  KRATIO =  1.53


3470 ENCROACHMENT STATIONS=     9858.5   10141.5  TYPE=      4  TARGET=         .000
     4.833      3.97    982.32       .00    982.28    982.45       .13       .14       .02   1035.35
    2754.0        .0    2754.0        .0        .0     959.5        .0     235.3      76.1    985.35
       .91       .00      2.87       .00      .000      .035      .000      .000    978.35   9871.04
   .000797      120.      120.      120.         2         0         0       .00    257.93  10128.96


*SECNO 4.855
 2800 NAT Q1=    1528.84  WSELK=     982.43  ENC Q1=    2349.34  WSEL=     983.43  RATIO=   -.5367
 NAT Q1=    2349.  RATIOS LOB, CH, ROB=    .0000  1.0000   .0000  WSEL=     983.43
3280 CROSS SECTION      4.86 EXTENDED      2.24 FEET


3302 WARNING:  CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE,  KRATIO =  1.59


3470 ENCROACHMENT STATIONS=     9680.0   10175.0  TYPE=      4  TARGET=         .000
     4.855      3.90    982.47       .00    982.43    982.51       .04       .05       .01   1035.54
    2754.0        .0    2754.0        .0        .0    1636.1        .0     238.7      77.1    980.23
       .93       .00      1.68       .00      .000      .035      .000      .000    978.57   9688.81
   .000314      115.      115.      115.         2         0         0       .00    486.19  10175.00


*SECNO 4.858

3302 WARNING:  CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE,  KRATIO =   .22

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    SECNO     DEPTH     CWSEL     CRIWS     WSELK     EG        HV        HL        CLOSS     L-BANK ELEV
    Q         QLOB      QCH       QROB      ALOB      ACH       AROB      VOL       TWA       R-BANK ELEV
    TIME      VLOB      VCH       VROB      XNL       XNCH      XNR       WIN       EIMIN     SSTA
    SLOPE     XLOBL     XLCH      XLOBR     ITRIAL    IDC       ICONT     COPAR     TOPWID    ENDST


3470 ENCROACHMENT STATIONS=     9850.0   10150.0  TYPE=      1  TARGET=     300.000

                End Marwest Property

     4.858      2.28    982.28       .00    982.39    982.62       .34       .01       .09 100000.00
    2754.0        .0    2754.0        .0        .0     588.8        .0     239.1      77.2 100000.00
       .93       .00      4.68       .00      .000      .040      .000      .000    980.00   9850.00
   .006548       15.       15.       15.         2         0         0       .00    300.00  10150.00


*SECNO 5.009

3302 WARNING:  CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE,  KRATIO =  1.51
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3470 ENCROACHMENT STATIONS=     9875.0   10105.0  TYPE=      1  TARGET=      230.000
     5.009      3.78    985.68       .00    984.73    985.93       .25      3.31       .01    983.70
    2754.0     455.1    2271.0      27.9     191.7     526.5      15.8     251.2      82.0    982.50
       .99      2.37      4.31      1.77      .070      .040      .070      .000    981.90   9875.00
   .002869      800.      795.      840.         4         0         0       .00    230.00  10105.00


*SECNO 5.153

3470 ENCROACHMENT STATIONS=     9865.0   10090.0  TYPE=      1  TARGET=      225.000
     5.153      3.79    988.09       .00    987.23    988.39       .30      2.44       .01    985.60
    2754.0     547.0    2207.0        .0     223.4     464.1        .0     263.7      86.1 100000.00
      1.04      2.45      4.76       .00      .070      .040      .000      .000    984.30   9865.00
   .003561      775.      765.      730.         3         0         0       .00    225.00  10090.00


*SECNO 5.282
 2800 NAT Q1=     741.78  WSELK=     988.68  ENC Q1=     741.78  WSEL=     989.68  RATIO=    .0000
 NAT Q1=    1426.  RATIOS LOB, CH, ROB=    .5628    .2686    .1686  WSEL=     989.68

3302 WARNING:  CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE,  KRATIO =  1.61


3470 ENCROACHMENT STATIONS=     9760.2   10055.0  TYPE=      4  TARGET=         .480
     5.282      4.22    989.72       .00    988.68    989.83       .11      1.43       .02    987.00
    2754.0    1348.4    1405.6        .0     708.9     424.9        .0     278.0      90.1    986.00
      1.11      1.90      3.31       .00      .070      .040      .000      .000    985.50   9760.21
   .001368      690.      680.      665.         2         0         0       .00    294.79  10055.00


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    SECNO     DEPTH     OWSEL     CRIWS     WSELK     EG        HV        HL        OLOSS     L-BANK ELEV
    Q         QLOB      QCH       QROB      ALOB      ACH       AROB      VOL       TWA       R-BANK ELEV
    TIME      VLOB      VCH       VROB      XNL       XNCH      XNR       WIN       ELMIN     SSTA
    SLOPE     XLOBL     XLCH      XLOBR     ITRIAL    IDC       ICONT     COPAR     TOPWID    ENDST


CCHV=     .300 CEHV=     .500
*SECNO 5.430
 2800 NAT Q1=     304.87  WSELK=     990.44  ENC Q1=     545.07  WSEL=     991.44  RATIO=  -.7878
 NAT Q1=     545.  RATIOS LOB, CH, ROB=    .0000  1.0000    .0000  WSEL=     991.44

3302 WARNING:  CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE,  KRATIO =   .62


3470 ENCROACHMENT STATIONS=     9899.9   10100.1  TYPE=      4  TARGET=         .000

3495 OVERBANK AREA ASSUMED NON-EFFECTIVE, ELLEA=       996.00 ELREA=       996.00


                A 7-SPAN BRIDGE AT I-10

     5.430      3.13    991.13       .00    990.44    991.55       .42      1.57       .15    997.00
    2754.0        .0    2754.0        .0        .0     527.6        .0     292.1      94.1    997.00
      1.15       .00      5.22       .00      .000      .035      .000      .000    988.00   9912.44
   .003511      680.      780.      820.         2         0         0       .00    175.13  10087.56


SPECIAL BRIDGE

SB  XK        XKOR      COFQ      RDLEN     BWC       BWP       BAREA     SS        ELCHU     ELCHD
     1.05      1.60      2.60       .00    162.00      6.00   1203.00      2.00    988.00    988.00

*SECNO 5.460

3302 WARNING:  CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE,  KRATIO =  1.51
```

CLASS A LOW FLOW

3420 BRIDGE W.S.= 991.01 BRIDGE VELOCITY= 7.24 CALCULATED CHANNEL AREA= 488.

EGRS	EGIWC	H3	QWEIR	QLOW	BAREA	TRAPEZOID AREA	ELLC	ELUFD	WEIRIN
.00	992.42	.06	0.	3538.	1203.	1190.	995.00	997.00	0.

3495 OVERBANK AREA ASSUMED NON-EFFECTIVE, ELLEA= 997.00 ELREA= 997.00

Q = Q AT CP287 (= 5319 CFS). REVISED Q = 3538 CFS

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5.460	4.00	992.00	.00	991.00	992.42	.42	.86	.00	997.00
3538.0	.0	3538.0	.0	.0	681.3	.0	294.3	94.8	997.00
1.16	.00	5.19	.00	.000	.035	.000	.000	988.00	9910.62
.002547	160.	160.	160.	0	0	0	.00	178.77	10089.38

CCHV= .300 CEHV= .500
*SECNO 5.563
2800 NAT Q1= 1569.96 WSELK= 992.61 ENC Q1= 1569.96 WSEL= 993.61 RATIO= .0000
NAT Q1= 2666. RATIOS LOB, CH, ROB= .1788 .4650 .3562 WSEL= 993.61

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = 1.83

3470 ENCROACHMENT STATIONS= 9850.0 10232.2 TYPE= 4 TARGET= .411

5.563	4.61	993.11	.00	992.61	993.20	.09	.68	.10	989.50
3538.0	.0	2794.2	743.8	.0	1055.7	520.1	308.3	98.3	988.90
1.22	.00	2.65	1.43	.000	.040	.070	.000	988.50	9850.00
.000758	540.	540.	535.	2	0	0	.00	382.23	10232.23

CCHV= .100 CEHV= .300
*SECNO 5.727
2800 NAT Q1= 326.95 WSELK= 993.54 ENC Q1= 435.95 WSEL= 994.54 RATIO= -.3334
NAT Q1= 843. RATIOS LOB, CH, ROB= .2247 .5170 .2582 WSEL= 994.54

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = .29

3470 ENCROACHMENT STATIONS= 9935.0 10135.0 TYPE= 4 TARGET= .483

CROSS-SECTION AT 280 FEET (ALONG FLOW PATH) NORTH OF MCDOWELL RD.

Q = Q AT CP286 (= 4662 CFS). REVISED Q = 3400 CFS

DIVIDED FLOW OCCURS FOR THE NEXT TWO UPSTREAM CROSS-SECTIONS,
HOWEVER, THESE FLOWS ARE EFFECTIVE DUE TO UPSTREM INFLOW AT
X1= 5.960

5.727	3.30	994.30	.00	993.54	994.85	.54	1.51	.14	992.00
3400.0	.0	3400.0	.0	.0	574.0	.0	329.5	104.0	991.80
1.26	.00	5.92	.00	.000	.045	.000	.000	991.00	9935.00
.008145	870.	870.	835.	2	0	0	.00	200.00	10135.00

*SECNO 5.840
2800 NAT Q1= 727.68 WSELK= 996.30 ENC Q1= 727.68 WSEL= 997.30 RATIO= .0000
NAT Q1= 1529. RATIOS LOB, CH, ROB= .2733 .3875 .3392 WSEL= 997.30

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   SECNO     DEPTH     CWSEL     CRIWS     WSELK     EG        HV        HL        CLOSS     L-BANK ELEV
   Q         QLOB      QCH       QROB      ALOB      ACH       AROB      VOL       TWA       R-BANK ELEV
   TIME      VLOB      VCH       VROB      XNL       XNCH      XNR       WIN       ELMIN     SSTA
   SLOPE     XLOBL     XLCH      XLOBR     ITRIAL    IDC       ICONT     CORAR     TOPWID    ENDST


3302 WARNING:  CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE,  KRATIO =  1.80


3470 ENCROACHMENT STATIONS=     9953.7   10240.4  TYPE=      4  TARGET=        .524
     5.840      3.75    997.15       .00    996.30    997.35       .20      2.47       .03    994.00
    3400.0      79.0    2770.7     550.2      42.5     714.8     236.9     340.2     107.3    993.70
      1.31      1.86      3.88      2.32      .070      .045      .070      .000    993.40   9953.68
   .002522      590.      595.      580.         3         0         0       .00    286.73  10240.40


*SECNO 5.960
 2800 NAT Q1=     540.19  WSELK=     998.09  ENC Q1=     540.19  WSEL=     999.09  RATIO=     .0000
 NAT Q1=    1263.  RATIOS LOB, CH, ROB=    .0977    .2968    .6055  WSEL=     999.09

3470 ENCROACHMENT STATIONS=     9960.0   10274.1  TYPE=      4  TARGET=        .572
     5.960      3.20    999.10       .00    998.09    999.33       .23      1.97       .01    997.30
    3400.0        .0    2361.3    1038.7        .0     556.7     376.1     354.1     111.7    996.20
      1.35       .00      4.24      2.76      .000      .045      .070      .000    995.90   9960.00
   .003985      640.      635.      610.         2         0         0       .00    314.06  10274.06


*SECNO 6.086
 2800 NAT Q1=     533.63  WSELK=    1000.79  ENC Q1=     533.63  WSEL=    1001.79  RATIO=     .0000
 NAT Q1=    1294.  RATIOS LOB, CH, ROB=    .2002    .3264    .4734  WSEL=    1001.79

3470 ENCROACHMENT STATIONS=     9900.0   10206.3  TYPE=      4  TARGET=        .587
     6.086      3.49   1001.79       .00   1000.79   1002.05       .26      2.72       .01    999.20
    3400.0        .0    2687.2     712.8        .0     608.6     279.2     368.1     116.4    999.20
      1.40       .00      4.42      2.55      .000      .045      .070      .000    998.30   9900.00
   .004125      655.      665.      685.         3         0         0       .00    306.32  10206.32


*SECNO 6.217

3302 WARNING:  CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE,  KRATIO =  1.61


3470 ENCROACHMENT STATIONS=     9850.0   10270.0  TYPE=      1  TARGET=      420.000
     6.217      3.56   1003.66       .00   1002.61   1003.76       .11      1.70       .02   1000.30
    3400.0     299.9    2081.9    1018.3     166.1     691.8     554.3     386.7     122.3   1000.30
      1.48      1.81      3.01      1.84      .070      .045      .070      .000   1000.10   9850.00
   .001588      620.      690.      745.         3         0         0       .00    420.00  10270.00


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   SECNO     DEPTH     CWSEL     CRIWS     WSELK     EG        HV        HL        CLOSS     L-BANK ELEV
   Q         QLOB      QCH       QROB      ALOB      ACH       AROB      VOL       TWA       R-BANK ELEV
   TIME      VLOB      VCH       VROB      XNL       XNCH      XNR       WIN       ELMIN     SSTA
   SLOPE     XLOBL     XLCH      XLOBR     ITRIAL    IDC       ICONT     CORAR     TOPWID    ENDST


*SECNO 6.320
 2800 NAT Q1=     769.56  WSELK=    1003.60  ENC Q1=     769.56  WSEL=    1004.60  RATIO=     .0000
 NAT Q1=    1626.  RATIOS LOB, CH, ROB=    .2121    .3240    .4639  WSEL=    1004.60

3470 ENCROACHMENT STATIONS=     9900.0   10279.3  TYPE=      4  TARGET=        .527
     6.320      3.70   1004.60       .00   1003.60   1004.73       .14       .96       .01   1001.30
    3400.0        .0    2319.8    1080.2        .0     693.4     546.9     403.1     127.3   1001.40
      1.53       .00      3.35      1.98      .000      .045      .070      .000   1000.90   9900.00
   .001999      580.      545.      525.         2         0         0       .00    379.29  10279.29
```

THIS RUN EXECUTED 24SEP98 10:04:27

****
HEC-2 WATER SURFACE PROFILES

Version 4.6.2; May 1991
****

NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

BULLARD WASH CLOMR

SUMMARY PRINTOUT

	SECNO	Q	CWSEL	SSTA	STCHL	STCHR	ENDST	DIFWSX	TOPWID	DEPTH	ELMIN	10*KS	VCH
	2.371	3200.00	943.66	9277.65	9975.00	10030.00	10779.24	.00	1501.59	4.26	939.40	2.44	1.66
	2.371	3200.00	943.61	9506.21	9975.00	10030.00	10072.29	.00	566.08	4.21	939.40	6.34	2.66
*	2.435	3200.00	943.77	9276.89	9985.00	10085.00	10714.22	.11	1437.33	3.87	939.90	7.86	2.88
*	2.435	3200.00	943.85	9668.89	9985.00	10085.00	10085.00	.24	416.11	3.95	939.90	23.00	4.95
*	2.536	3191.00	945.40	9868.70	9965.00	10060.00	10649.76	1.63	781.06	1.90	943.50	122.60	8.06
*	2.536	3191.00	945.79	9915.00	9965.00	10060.00	10138.00	1.94	223.00	2.29	943.50	132.35	9.57
*	2.680	3191.00	948.59	9603.54	9925.00	10050.00	10674.57	3.19	964.41	3.39	945.20	17.97	4.31
*	2.680	3191.00	949.54	9925.00	9925.00	10050.00	10124.37	3.74	199.37	4.34	945.20	19.03	5.28
*	2.771	3191.00	950.08	9655.17	9985.00	10020.00	10532.04	1.49	858.07	2.78	947.30	68.90	6.57
*	2.771	3191.00	951.03	9972.38	9985.00	10020.00	10182.43	1.49	210.05	3.73	947.30	72.12	8.68
*	2.883	3191.00	952.33	9622.85	9985.00	10015.00	10420.12	2.25	797.28	3.83	948.50	23.35	4.96
*	2.883	3191.00	953.34	9853.00	9985.00	10015.00	10130.00	2.31	277.00	4.84	948.50	19.63	5.52
	2.977	3194.00	953.68	9686.92	9980.00	10050.00	10408.32	1.36	721.40	3.78	949.90	42.72	6.71
	2.977	3194.00	954.41	9875.00	9980.00	10050.00	10050.00	1.07	175.00	4.51	949.90	36.91	7.05
	3.070	3194.00	955.62	9531.43	9945.00	10025.00	10569.93	1.94	1038.51	3.32	952.30	27.39	4.54
	3.070	3194.00	956.40	9846.10	9945.00	10025.00	10134.96	1.99	288.85	4.10	952.30	35.59	6.26
	3.167	2742.00	956.84	9575.14	9970.00	10020.00	10570.36	1.22	995.22	2.94	953.90	20.18	4.10
	3.167	2742.00	957.86	9788.00	9970.00	10020.00	10130.00	1.46	342.00	3.96	953.90	17.88	4.84
*	3.291	2742.00	959.18	9989.16	9970.00	10020.00	10822.67	2.33	813.11	1.98	957.20	80.89	4.52
*	3.291	2742.00	960.06	9982.98	9970.00	10020.00	10284.69	2.20	298.43	2.86	957.20	92.63	5.64
*	3.376	2742.00	961.21	9772.58	9985.00	10015.00	10795.34	2.03	977.10	2.91	958.30	28.57	2.93
*	3.376	2742.00	962.25	9985.00	9985.00	10015.00	10291.73	2.19	306.73	3.95	958.30	27.65	4.09

	SECNO	Q	CWSEL	SSTA	STCHL	STCHR	ENDST	DIFWSX	TOPWID	DEPTH	ELMIN	10*KS	VCH
	3.491	2742.00	962.60	9628.08	9980.00	10020.00	10599.29	1.40	971.21	3.10	959.50	19.00	3.36
	3.491	2742.00	963.62	9911.46	9980.00	10020.00	10234.04	1.37	322.58	4.12	959.50	18.97	4.43
*	3.602	2746.00	964.10	9742.06	9880.00	10100.00	10454.53	1.49	712.46	2.20	961.90	40.57	3.95
	3.602	2746.00	964.92	9880.00	9880.00	10100.00	10100.00	1.31	220.00	3.02	961.90	31.07	4.20
	3.702	2746.00	966.18	9297.73	9955.00	10055.00	10395.05	2.08	851.16	2.78	963.40	37.70	4.20

	3.702	2746.00	966.86	9600.00	9955.00	10055.00	10075.00	1.94	239.56	3.46	963.40	47.12	5.52
	3.841	2746.00	968.67	9229.62	9955.00	10070.00	10338.92	2.49	881.56	3.57	965.10	29.14	3.09
	3.841	2746.00	969.70	9588.62	9955.00	10070.00	10070.00	2.84	262.19	4.60	965.10	28.66	4.02
	3.978	2746.00	970.71	9279.88	9930.00	10095.00	10376.45	2.04	1096.57	3.81	966.90	27.96	3.56
	3.978	2746.00	971.60	9700.00	9930.00	10095.00	10095.00	1.90	395.00	4.70	966.90	24.66	4.06
	4.101	2746.00	972.63	9450.68	9960.00	10080.00	10450.15	1.92	999.47	3.93	968.70	30.32	3.57
	4.101	2746.00	973.48	9852.45	9960.00	10080.00	10091.34	1.87	238.89	4.78	968.70	35.66	4.77
	4.237	2746.00	974.47	9500.62	9935.00	10075.00	10323.19	1.84	822.57	3.17	971.30	22.35	3.49
	4.237	2746.00	975.50	9869.05	9935.00	10075.00	10075.00	2.02	205.95	4.20	971.30	22.27	4.22
	4.356	2746.00	975.86	9538.80	9950.00	10070.00	10345.85	1.40	807.05	3.26	972.60	21.67	3.47
	4.356	2746.00	976.90	9852.44	9950.00	10070.00	10070.00	1.41	217.56	4.30	972.60	21.57	4.18
	4.496	2746.00	977.52	9692.35	9975.00	10130.00	10385.67	1.66	693.32	3.12	974.40	23.85	3.61
	4.496	2746.00	978.53	9957.69	9975.00	10130.00	10131.68	1.63	173.99	4.13	974.40	23.92	4.43
	4.619	2754.00	979.15	9909.00	9909.00	10075.00	10075.00	1.63	166.00	3.15	976.00	34.46	5.32
	4.619	2754.00	979.86	9909.00	9909.00	10075.00	10075.00	1.33	166.00	3.86	976.00	17.83	4.33
	4.631	2754.00	980.09	9889.63	9873.00	10079.00	10061.91	.94	172.29	3.97	976.12	21.52	4.54
	4.631	2754.00	980.43	9887.94	9873.00	10079.00	10063.65	.57	175.71	4.31	976.12	16.11	4.13
	4.701	2754.00	980.86	9893.72	9881.50	10087.50	10075.28	.78	181.55	3.94	976.92	17.97	4.21
	4.701	2754.00	981.03	9893.06	9881.50	10087.50	10075.94	.60	182.88	4.11	976.92	15.61	4.03
	4.754	2754.00	981.38	9909.54	9897.00	10103.00	10090.46	.51	180.92	3.87	977.51	19.24	4.31
	4.754	2754.00	981.48	9909.12	9897.00	10103.00	10090.88	.45	181.76	3.97	977.51	17.56	4.18
	4.811	2754.00	981.96	9909.62	9897.00	10103.00	10090.38	.58	180.76	3.85	978.11	19.58	4.33
	4.811	2754.00	982.01	9909.38	9897.00	10103.00	10090.62	.53	181.24	3.90	978.11	18.58	4.26
*	4.833	2754.00	982.28	9871.23	9858.50	10141.50	10128.77	.32	257.54	3.93	978.35	8.29	2.91
*	4.833	2754.00	982.32	9871.04	9858.50	10141.50	10128.96	.31	257.93	3.97	978.35	7.97	2.87
*	4.855	2754.00	982.43	9688.90	9680.00	10175.00	10175.00	.15	486.10	3.86	978.57	3.24	1.70
*	4.855	2754.00	982.47	9688.81	9680.00	10175.00	10175.00	.15	486.19	3.90	978.57	3.14	1.68
*	4.858	2754.00	982.39	9688.41	9705.00	10290.00	10341.72	-.04	653.31	2.39	980.00	25.93	2.72
*	4.858	2754.00	982.28	9850.00	9705.00	10290.00	10150.00	-.19	300.00	2.28	980.00	65.48	4.68

	SECNO	Q	CWSEL	SSTA	STCHL	STCHR	ENDST	DIFWSX	TOPWID	DEPTH	EIMIN	10*KS	VCH
	5.009	2754.00	984.73	9664.64	9935.00	10100.00	10332.94	2.34	668.30	2.83	981.90	33.54	3.68
*	5.009	2754.00	985.68	9875.00	9935.00	10100.00	10105.00	3.40	230.00	3.78	981.90	28.69	4.31
	5.153	2754.00	987.23	9543.26	9945.00	10090.00	10308.40	2.51	765.14	2.93	984.30	31.84	3.70
	5.153	2754.00	988.09	9865.00	9945.00	10090.00	10090.00	2.41	225.00	3.79	984.30	35.61	4.76
*	5.282	2754.00	988.68	9325.76	9945.00	10055.00	10352.76	1.45	1027.00	3.18	985.50	13.78	2.76
*	5.282	2754.00	989.72	9760.21	9945.00	10055.00	10055.00	1.63	294.79	4.22	985.50	13.68	3.31
*	5.430	2754.00	990.44	9913.90	9899.90	10100.10	10086.10	1.76	172.21	2.44	988.00	81.60	6.77
*	5.430	2754.00	991.13	9912.44	9899.90	10100.10	10087.56	1.41	175.13	3.13	988.00	35.11	5.22
*	5.460	3538.00	991.00	9912.71	9899.90	10100.10	10087.29	.56	174.57	3.00	988.00	66.93	7.01
*	5.460	3538.00	992.00	9910.62	9899.90	10100.10	10089.38	.87	178.77	4.00	988.00	25.47	5.19
*	5.563	3538.00	992.61	9351.44	9850.00	10100.00	10736.61	1.62	1385.17	4.11	988.50	5.08	2.02
*	5.563	3538.00	993.11	9850.00	9850.00	10100.00	10232.23	1.11	382.23	4.61	988.50	7.58	2.65
*	5.727	3400.00	993.54	9375.48	9935.00	10135.00	10467.87	.92	933.58	2.54	991.00	108.14	5.65
*	5.727	3400.00	994.30	9935.00	9935.00	10135.00	10135.00	1.19	200.00	3.30	991.00	81.45	5.92

*	5.840	3400.00	996.30	9353.27	9970.00	10170.00	10715.70	2.77	1293.68	2.90	993.40	21.83	3.01
*	5.840	3400.00	997.15	9953.68	9970.00	10170.00	10240.40	2.85	286.73	3.75	993.40	25.22	3.88
	5.960	3400.00	998.09	9735.32	9960.00	10150.00	10948.05	1.79	1212.73	2.19	995.90	39.62	3.21
	5.960	3400.00	999.10	9960.00	9960.00	10150.00	10274.06	1.95	314.06	3.20	995.90	39.85	4.24
	6.086	3400.00	1000.79	9475.24	9900.00	10100.00	10827.24	2.70	1352.00	2.49	998.30	40.60	3.39
	6.086	3400.00	1001.79	9900.00	9900.00	10100.00	10206.32	2.70	306.32	3.49	998.30	41.25	4.42
*	6.217	3400.00	1002.61	9445.53	9900.00	10100.00	10837.22	1.82	1391.69	2.51	1000.10	17.16	2.46
*	6.217	3400.00	1003.66	9850.00	9900.00	10100.00	10270.00	1.86	420.00	3.56	1000.10	15.88	3.01
	6.320	3400.00	1003.60	9582.92	9900.00	10100.00	10928.09	.99	1345.17	2.70	1000.90	19.52	2.67
	6.320	3400.00	1004.60	9900.00	9900.00	10100.00	10279.29	.94	379.29	3.70	1000.90	19.99	3.35

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BULLARD WASH CLOMR

SUMMARY PRINTOUT TABLE 110

	SECNO	CWSEL	DIFKWS	EG	TOPWID	QLOB	QCH	QROB	PERENC	STENCL	STCHL	STCHR	STENCR
	2.371	943.66	.00	943.68	1501.59	2339.69	289.65	570.66	.00	.00	9975.00	10030.00	.00
	2.371	943.61	-.05	943.67	566.08	2622.32	454.81	122.86	.41	9506.21	9975.00	10030.00	10072.29
*	2.435	943.77	.00	943.82	1437.33	1677.95	863.76	658.29	.00	.00	9985.00	10085.00	.00
*	2.435	943.85	.08	944.09	416.11	1677.75	1522.24	.00	.51	9668.89	9985.00	10085.00	10085.00
*	2.536	945.40	.00	945.92	781.06	508.07	1362.98	1319.94	.00	.00	9965.00	10060.00	.00
*	2.536	945.79	.39	946.83	223.00	632.72	1977.31	580.96	223.00	9915.00	9965.00	10060.00	10138.00
*	2.680	948.59	.00	948.74	964.41	234.86	1588.70	1367.44	.00	.00	9925.00	10050.00	.00
*	2.680	949.54	.95	949.90	199.37	.00	2571.15	619.85	.50	9925.00	9925.00	10050.00	10124.37
*	2.771	950.08	.00	950.27	858.07	684.77	465.80	2040.43	.00	.00	9985.00	10020.00	.00
*	2.771	951.03	.96	951.54	210.05	70.78	903.20	2217.02	.60	9972.38	9985.00	10020.00	10182.43
*	2.883	952.33	.00	952.44	797.28	1565.48	446.74	1178.78	.00	.00	9985.00	10015.00	.00
*	2.883	953.34	1.02	953.55	277.00	1536.89	664.95	989.16	277.00	9853.00	9985.00	10015.00	10130.00
	2.977	953.68	.00	954.07	721.40	1452.66	1404.51	336.82	.00	.00	9980.00	10050.00	.00
	2.977	954.41	.72	954.97	175.00	1360.80	1833.20	.00	175.00	9875.00	9980.00	10050.00	10050.00
	3.070	955.62	.00	955.75	1038.51	924.34	846.10	1423.56	.00	.00	9945.00	10025.00	.00
	3.070	956.40	.77	956.76	288.85	556.79	1551.98	1085.23	.56	9846.10	9945.00	10025.00	10134.96
	3.167	956.84	.00	956.93	995.22	1230.74	512.91	998.36	.00	.00	9970.00	10020.00	.00
	3.167	957.86	1.02	958.04	342.00	1252.55	850.89	638.55	342.00	9788.00	9970.00	10020.00	10130.00
*	3.291	959.18	.00	959.28	813.11	.00	101.68	2640.32	.00	.00	9970.00	10020.00	.00
*	3.291	960.06	.89	960.31	298.43	.00	260.55	2481.45	.59	9970.00	9970.00	10020.00	10284.69
*	3.376	961.21	.00	961.26	977.10	53.26	92.23	2596.51	.00	.00	9985.00	10015.00	.00
*	3.376	962.25	1.04	962.37	306.73	.00	250.06	2491.94	.54	9985.00	9985.00	10015.00	10291.73
	3.491	962.60	.00	962.66	971.21	780.92	263.43	1697.65	.00	.00	9980.00	10020.00	.00
	3.491	963.62	1.01	963.74	322.58	468.06	525.24	1748.70	.53	9911.46	9980.00	10020.00	10234.04
*	3.602	964.10	.00	964.28	712.46	207.92	1872.83	665.24	.00	.00	9880.00	10100.00	.00
	3.602	964.92	.83	965.20	220.00	.00	2746.00	.00	.41	9880.00	9880.00	10100.00	10100.00
	3.702	966.18	.00	966.31	851.16	1162.91	1047.07	536.02	.00	.00	9955.00	10055.00	.00
	3.702	966.86	.68	967.21	239.56	841.00	1756.43	148.58	475.00	9600.00	9955.00	10055.00	10075.00
	3.841	968.67	.00	968.75	881.56	1827.05	678.60	240.35	.00	.00	9955.00	10070.00	.00
	3.841	969.70	1.04	969.89	262.19	1388.00	1358.00	.00	.52	9588.62	9955.00	10070.00	10070.00

	3.978	970.71	.00	970.83	1096.57	839.42	1433.34	473.25	.00	.00	9930.00	10095.00	.00
	3.978	971.60	.89	971.82	395.00	510.04	2235.96	.00	395.00	9700.00	9930.00	10095.00	10095.00

	SECNO	CWSEL	DIFKWS	EG	TOPWID	QLOB	QCH	QROB	PERENC	STENCL	STCHL	STCHR	STENCR
	4.101	972.63	.00	972.72	999.47	1074.12	986.48	685.40	.00	.00	9960.00	10080.00	.00
	4.101	973.48	.85	973.75	238.89	880.65	1804.19	61.16	.55	9852.45	9960.00	10080.00	10091.34
	4.237	974.47	.00	974.58	822.57	962.69	1368.27	415.04	.00	.00	9935.00	10075.00	.00
	4.237	975.50	1.03	975.74	205.95	482.62	2263.38	.00	.49	9869.05	9935.00	10075.00	10075.00
	4.356	975.86	.00	975.96	807.05	1092.40	1182.59	471.00	.00	.00	9950.00	10070.00	.00
	4.356	976.90	1.04	977.12	217.56	796.85	1949.15	.00	.49	9852.44	9950.00	10070.00	10070.00
	4.496	977.52	.00	977.65	693.32	611.19	1573.83	560.97	.00	.00	9975.00	10130.00	.00
	4.496	978.53	1.01	978.82	173.99	124.34	2614.97	6.69	.48	9957.69	9975.00	10130.00	10131.68
	4.619	979.15	.00	979.59	166.00	.00	2754.00	.00	.00	.00	9909.00	10075.00	.00
	4.619	979.86	.72	980.15	166.00	.00	2754.00	.00	.00	9909.00	9909.00	10075.00	10075.00
	4.631	980.09	.00	980.41	172.29	.00	2754.00	.00	.00	.00	9873.00	10079.00	.00
	4.631	980.43	.34	980.69	175.71	.00	2754.00	.00	.00	9873.00	9873.00	10079.00	10079.00
	4.701	980.86	.00	981.14	181.55	.00	2754.00	.00	.00	.00	9881.50	10087.50	.00
	4.701	981.03	.17	981.28	182.88	.00	2754.00	.00	.00	9881.50	9881.50	10087.50	10087.50
	4.754	981.38	.00	981.66	180.92	.00	2754.00	.00	.00	.00	9897.00	10103.00	.00
	4.754	981.48	.10	981.75	181.76	.00	2754.00	.00	.00	9897.00	9897.00	10103.00	10103.00
	4.811	981.96	.00	982.25	180.76	.00	2754.00	.00	.00	.00	9897.00	10103.00	.00
	4.811	982.01	.06	982.30	181.24	.00	2754.00	.00	.00	9897.00	9897.00	10103.00	10103.00
*	4.833	982.28	.00	982.41	257.54	.00	2754.00	.00	.00	.00	9858.50	10141.50	.00
*	4.833	982.32	.05	982.45	257.93	.00	2754.00	.00	.00	9858.50	9858.50	10141.50	10141.50
*	4.855	982.43	.00	982.47	486.10	.00	2754.00	.00	.00	.00	9680.00	10175.00	.00
*	4.855	982.47	.04	982.51	486.19	.00	2754.00	.00	.00	9680.00	9680.00	10175.00	10175.00
*	4.858	982.39	.00	982.51	653.31	1.18	2749.15	3.67	.00	.00	9705.00	10290.00	.00
*	4.858	982.28	-.11	982.62	300.00	.00	2754.00	.00	300.00	9850.00	9705.00	10290.00	10150.00
	5.009	984.73	.00	984.86	668.30	988.88	1354.14	410.98	.00	.00	9935.00	10100.00	.00
*	5.009	985.68	.95	985.93	230.00	455.06	2271.04	27.90	230.00	9875.00	9935.00	10100.00	10105.00
	5.153	987.23	.00	987.36	765.14	1273.92	1258.34	221.75	.00	.00	9945.00	10090.00	.00
	5.153	988.09	.85	988.39	225.00	547.00	2207.00	.00	225.00	9865.00	9945.00	10090.00	10090.00
*	5.282	988.68	.00	988.74	1027.00	1551.04	858.74	344.21	.00	.00	9945.00	10055.00	.00
*	5.282	989.72	1.04	989.83	294.79	1348.43	1405.57	.00	.48	9760.21	9945.00	10055.00	10055.00
*	5.430	990.44	.00	991.15	172.21	.00	2754.00	.00	.00	.00	9899.90	10100.10	.00
*	5.430	991.13	.69	991.55	175.13	.00	2754.00	.00	.00	9899.90	9899.90	10100.10	10100.10
*	5.460	991.00	.00	991.76	174.57	.00	3538.00	.00	.00	.00	9899.90	10100.10	.00
*	5.460	992.00	1.00	992.42	178.77	.00	3538.00	.00	.00	.00	9899.90	10100.10	.00

	SECNO	CWSEL	DIFKWS	EG	TOPWID	QLOB	QCH	QROB	PERENC	STENCL	STCHL	STCHR	STENCR
*	5.563	992.61	.00	992.65	1385.17	464.75	1882.67	1190.58	.00	.00	9850.00	10100.00	.00
*	5.563	993.11	.49	993.20	382.23	.00	2794.21	743.79	.41	9850.00	9850.00	10100.00	10232.23
*	5.727	993.54	.00	993.90	933.58	337.43	2386.22	676.35	.00	.00	9935.00	10135.00	.00
*	5.727	994.30	.77	994.85	200.00	.00	3400.00	.00	.48	9935.00	9935.00	10135.00	10135.00

*	5.840	996.30	.00	996.39	1293.68	700.58	1644.56	1054.86	.00	.00	9970.00	10170.00	.00
*	5.840	997.15	.84	997.35	286.73	79.05	2770.75	550.20	.52	9953.68	9970.00	10170.00	10240.40
	5.960	998.09	.00	998.18	1212.73	145.33	1175.10	2079.57	.00	.00	9960.00	10150.00	.00
	5.960	999.10	1.00	999.33	314.06	.00	2361.28	1038.71	.57	9960.00	9960.00	10150.00	10274.06
	6.086	1000.79	.00	1000.89	1352.00	476.98	1385.72	1537.30	.00	.00	9900.00	10100.00	.00
	6.086	1001.79	1.00	1002.05	306.32	.00	2687.19	712.81	.59	9900.00	9900.00	10100.00	10206.32
*	6.217	1002.61	.00	1002.66	1391.69	814.38	1187.57	1398.04	.00	.00	9900.00	10100.00	.00
*	6.217	1003.66	1.05	1003.76	420.00	299.86	2081.89	1018.25	420.00	9850.00	9900.00	10100.00	10270.00
	6.320	1003.60	.00	1003.66	1345.17	699.47	1322.48	1378.05	.00	.00	9900.00	10100.00	.00
	6.320	1004.60	.99	1004.73	379.29	.00	2319.82	1080.18	.53	9900.00	9900.00	10100.00	10279.29

1

SUMMARY OF ERRORS AND SPECIAL NOTES

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WARNING SECNO=     2.435  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
WARNING SECNO=     2.435  PROFILE=  2  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

CAUTION SECNO=     2.536  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=     2.536  PROFILE=  1  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO=     2.536  PROFILE=  1  20 TRIALS ATTEMPTED TO BALANCE WSEL
CAUTION SECNO=     2.536  PROFILE=  2  CRITICAL DEPTH ASSUMED
CAUTION SECNO=     2.536  PROFILE=  2  MINIMUM SPECIFIC ENERGY

WARNING SECNO=     2.680  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
WARNING SECNO=     2.680  PROFILE=  2  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

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WARNING SECNO=     2.771  PROFILE=  2  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

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WARNING SECNO=     2.883  PROFILE=  2  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

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WARNING SECNO=     3.602  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

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WARNING SECNO=     5.009  PROFILE=  2  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

WARNING SECNO=     5.282  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
WARNING SECNO=     5.282  PROFILE=  2  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

WARNING SECNO=     5.430  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
WARNING SECNO=     5.430  PROFILE=  2  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

CAUTION SECNO=     5.460  PROFILE=  1  HYDRAULIC JUMP D.S.
WARNING SECNO=     5.460  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
WARNING SECNO=     5.460  PROFILE=  2  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
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WARNING SECNO= 5.563 PROFILE= 1 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
WARNING SECNO= 5.563 PROFILE= 2 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

WARNING SECNO= 5.727 PROFILE= 1 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

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WARNING SECNO= 5.727 PROFILE= 2 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

WARNING SECNO= 5.840 PROFILE= 1 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
WARNING SECNO= 5.840 PROFILE= 2 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

WARNING SECNO= 6.217 PROFILE= 1 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
WARNING SECNO= 6.217 PROFILE= 2 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

1

FLOODWAY DATA, BULLARD WASH CLOMR
PROFILE NO. 2

STATION	FLOODWAY WIDTH	FLOODWAY SECTION AREA	FLOODWAY MEAN VELOCITY	WATER SURFACE ELEVATION WITH FLOODWAY	WATER SURFACE ELEVATION WITHOUT FLOODWAY	DIFFERENCE
2.371	566.	1729.	1.9	943.7	943.7	.0
2.435	416.	956.	3.3	943.9	943.8	.1
2.536	223.	464.	6.9	945.8	945.4	.4
2.680	199.	770.	4.1	949.6	948.6	1.0
2.771	210.	676.	4.7	951.1	950.1	1.0
2.883	277.	1023.	3.1	953.3	952.3	1.0
2.977	175.	585.	5.5	954.4	953.7	.7
3.070	289.	816.	3.9	956.4	955.6	.8
3.167	342.	991.	2.8	957.8	956.8	1.0
3.291	302.	699.	3.9	960.1	959.2	.9
3.376	307.	1029.	2.7	962.2	961.2	1.0
3.491	323.	1090.	2.5	963.6	962.6	1.0
3.602	220.	653.	4.2	964.9	964.1	.8
3.702	475.	675.	4.1	966.9	966.2	.7
3.841	481.	856.	3.2	969.7	968.7	1.0
3.978	395.	885.	3.1	971.6	970.7	.9
4.101	239.	739.	3.7	973.5	972.6	.9
4.237	206.	755.	3.6	975.5	974.5	1.0
4.356	218.	818.	3.4	976.9	975.9	1.0
4.496	174.	656.	4.2	978.5	977.5	1.0
4.619	166.	636.	4.3	979.8	979.1	.7
4.631	176.	667.	4.1	980.4	980.1	.3
4.701	183.	684.	4.0	981.1	980.9	.2
4.754	182.	659.	4.2	981.5	981.4	.1
4.811	181.	647.	4.3	982.1	982.0	.1
4.833	258.	960.	2.9	982.3	982.3	.0
4.855	486.	1636.	1.7	982.4	982.4	.0
4.858	300.	589.	4.7	982.3	982.4	-.1
5.009	230.	734.	3.8	985.7	984.7	1.0
5.153	225.	687.	4.0	988.1	987.2	.9
5.282	295.	1134.	2.4	989.7	988.7	1.0
5.430	175.	528.	5.2	991.1	990.4	.7
5.460	179.	681.	5.2	992.0	991.0	1.0
5.563	382.	1576.	2.2	993.1	992.6	.5
5.727	200.	574.	5.9	994.3	993.5	.8
5.840	287.	994.	3.4	997.1	996.3	.8
5.960	314.	933.	3.6	999.1	998.1	1.0
6.086	306.	888.	3.8	1001.8	1000.8	1.0
6.217	420.	1412.	2.4	1003.6	1002.6	1.0
6.320	379.	1240.	2.7	1004.6	1003.6	1.0

APPENDIX F

Erosion and Sediment Transport Analysis Supporting Documentation

Memorandum JE Fuller/ Hydrology & Geomorphology, Inc.

DATE: September 15, 1998

TO: Wade Cooke, P.E., Pinnacle Engineering

FROM: John Wallace, P.E.

RE: Bullard Wash Channel Improvements

CC: File

I have prepared this memo to document the Level 1 scour and sedimentation analysis of the referenced improvements called for in our scope of work.

Attached is a calculation sheet showing estimated scour depths along the channel based on the City of Tucson (COT) Drainage Design Manual. The COT scour equations have been used by our Tempe office in the past for Maricopa County projects and provide a reasonable scour potential estimate. As you can see from the attached sheet, 100-year scour depth estimates for the proposed channelization improvements indicate minimal scour potential. In fact, due to the low velocities and relatively high width-to-depth ratio of the channel, the only noticeable scour potential occurs where the 555-foot radius bend occurs. At this location the potential exists for approximately 1.2 feet of scour (0.25 ft anti-dune trough depth plus 0.92 ft bend scour). It is probably prudent to assume that a similar scour potential will exist along the contraction segments of the levee at the north property line. To address the erosion potential it may be appropriate to include a rock blanket along these two segments. I believe a rock blanket (d50 = 6 inches, blanket thickness = 2 x d50 = one foot) extending three feet up the 4:1 side slope and three feet into the channel would provide more than adequate protection against the minimal bend scour potential identified. The attached rip-rap sizing chart from ADWR SSA 7-98, "Watercourse Bank Stabilization", demonstrates the conservative sizing of the rock rip-rap. The rock blanket will allow for collapse of the rock into any scour path that may develop along the toe of the embankment at these locations.

Per our discussion regarding FEMA levee documentation requirements, I also performed a more general assessment of embankment erosion potential. Chapter 5 of the Maricopa County Drainage Design Manual (Vol. II, Hydraulics) covers open channel design. Per Chapter 6 (page 6-10), earth lined channels are appropriate for subcritical flow conditions where side slopes are 4:1 or flatter and a grade control is provided. With the proposed culvert structure at Van Buren Street acting as a grade control, all of the above conditions are satisfied for the Bullard Wash improvements. In addition, Tables 6.1 and 6.3 identify maximum permissible velocities for channels with erodible linings. The maximum channel velocity per the HEC-2 model of the proposed improvements is 4.4 feet per second, while the above tables indicate permissible velocities of 2.5 to 6.0 feet per second depending on the type of soil in the earthen channel lining (see attached copy of Table 6.1 which relates permissible velocity to soil embankment type). I recommend consulting your geotechnical engineer regarding the type of soil to be used in constructing the channel improvements to confirm the adequacy of the channel lining.

It should be noted that Table 6.3 of the Maricopa County manual identifies it for use on channels where the discharge is less than 2,500 cubic feet per second (cfs), while the 100-year discharge for our design exceeds 2,700 cfs. However, page 6-5 of the manual indicates that use of Table 6.3 for major drains is applicable if grade control is established, which the Van Buren Street culvert will provide. For this reason it seems to me that the proposed improvements satisfy the intent of the Maricopa County design criteria for earth lined channels which should in turn satisfy FEMA.

Attachments

Depth of Scour

Bullard Wash Channelization at Estrella Views Estates (upstream of Van Buren Street)

GENERAL SCOUR

Per COT Drainage Design Manual, Equation 6.4:

given:	Vm =	4.28	fps	
	Ymax =	3.90	feet	
	Yh =	3.57	feet	
	Se =	0.0019	ft/ft	
found:	Zgs =	0.00	feet	(if a negative value is calculated, result appears as 0)

ANTI-DUNE TROUGH DEPTH

Per COT Drainage Design Manual, Equation 6.5:

given:	Vm =	4.28	fps
	g =	32.17	accelaration due to gravity (ft/s^2)
found:	Za =	0.25	feet

LOW-FLOW THALWEG

The proposed improvements include a design low-flow channel for irrigation which will preclude the development of a low-flow thalweg scour component

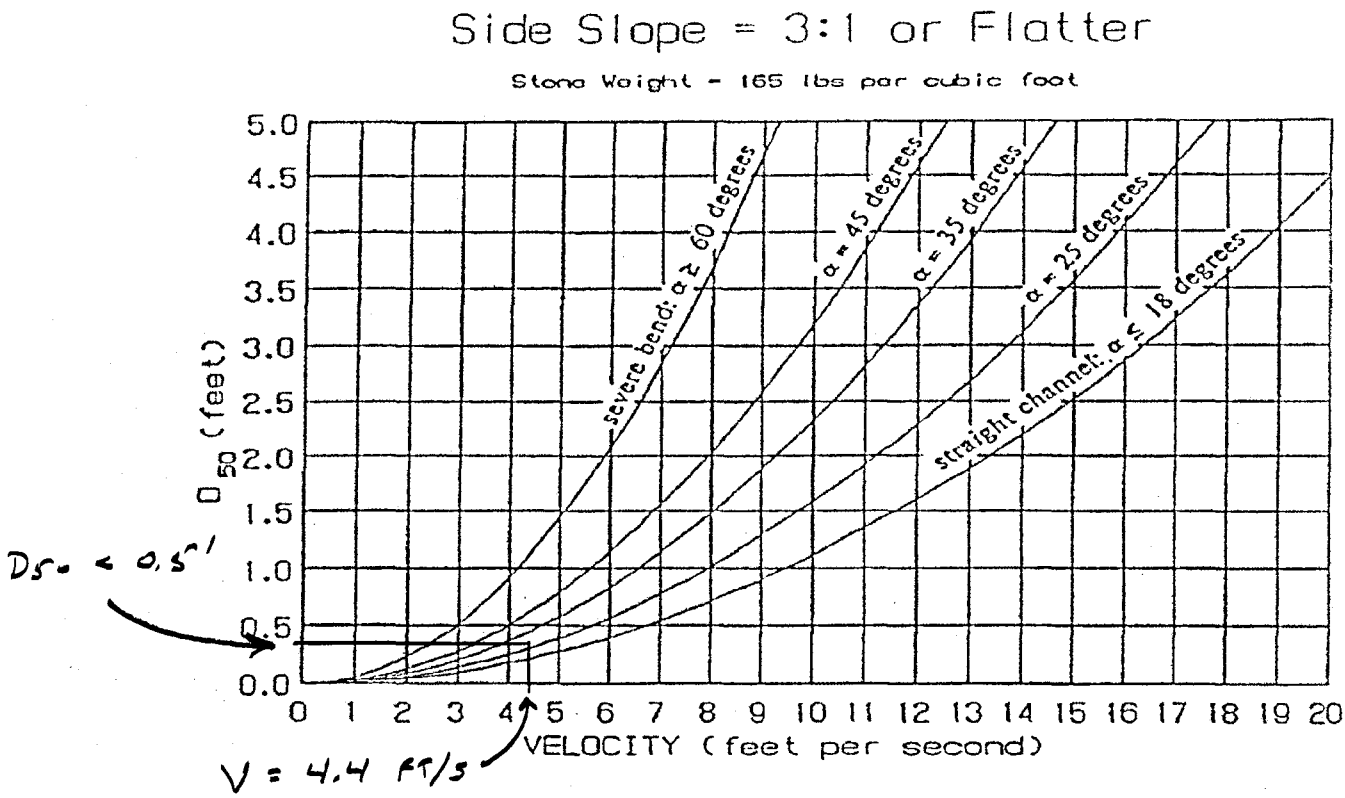
therefore: Zlft = 0.00 feet

BEND SCOUR

Per COT Drainage Design Manual, Equation 6.6:

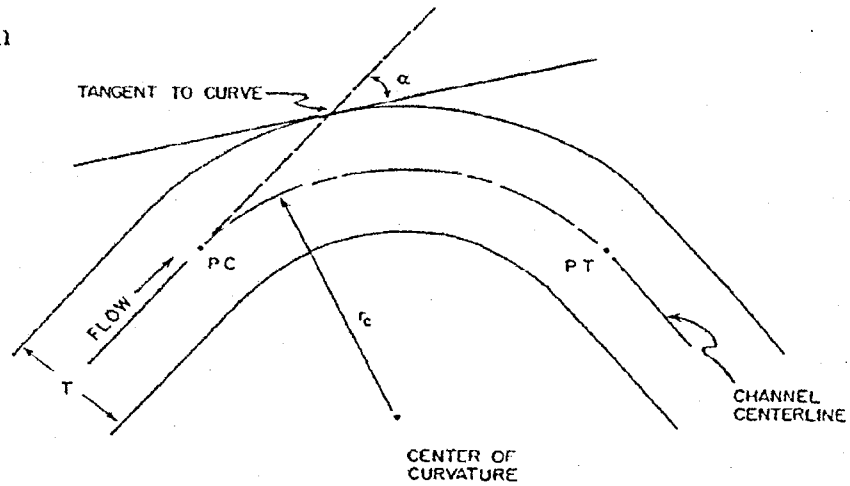
given:	Vm =	4.28	fps	
	Ymax =	3.90	feet	
	Yh =	3.57	feet	
	Se =	0.0019	ft/ft	
	rc =	555.00	feet	
	T =	181.00	feet	
	rc/T =	3.07		(calculated rc/T is limited to 0.5 < rc/T < 10.21)
found:	Zbs =	0.92	feet	(using rc/T and substituting Eqn. 6.7 into Eqn. 6.6)

Level 2 Median Riprap Stone Size (D_{50})



NOTE: For side slope = 2:1 multiply D_{50} determined from chart by 1.14. Side slopes steeper than 2:1 should not be used.

Definition Sketch for bend angle α



PT = Downstream point of tangency to the centerline radius of curvature.
PC = Upstream point of curvature at the centerline radius of curvature.

SOURCE: SIMONS, LI & ASSOCIATES, INC. (1988)

Table 6.1
Maximum Permissible Velocities for Roadside Drainage Channels with Erodible Linings
(USDOT, FHWA, 1961 and 1983)

Soils Type of Lining (Earth, No Vegetation)	Permissible Velocity [1], ft/s
Fine Sand (noncolloidal)	2.5
Sandy Loam (noncolloidal)	2.5
Silt Loam (noncolloidal)	3.0
Ordinary Firm Loam	3.5
Fine Gravel	5.0
Stiff Clay (very colloidal)	5.0
Graded, Loam to Cobbles (noncolloidal)	5.0
Graded, Silt to Cobbles (noncolloidal)	5.5
Alluvial Silts (noncolloidal)	3.5
Alluvial Silts (colloidal)	5.0
Coarse Gravel (noncolloidal)	6.0
Cobbles and Shingles	5.5
Shales and Hard Pans	6.0

(1) For sinuous channels multiply permissible velocity by:
0.95 for slightly sinuous;
0.90 for moderately sinuous; and
0.80 for highly sinuous

6.3.2.3 Low Flow Channels: The majority of storm events will be less than the design storm, resulting in frequent low flow conditions. Low flows in earth- or grass-lined trapezoidal channels will deposit sediment and develop their own pilot channel which will be meandering and could direct low flows into the channel banks causing bank erosion. Design of low flow channels will prevent meandering and will direct low flows in a controlled manner.

Rounding the channel bottom to approximate a parabolic shape will cause the centerline of the channel to act as a low flow channel. Alternatively, the channel bottom could be graded into a shallow V-shape to lower the centerline.

Because of the potential for long-term channel aggradation, base flows and crop irrigation return flows may require specific consideration. Waterways which are normally dry often have somewhat continuous low flows after urbanization because of

APPENDIX G

Digital Data Files

APPENDIX H

Hydrology Exhibit Maps

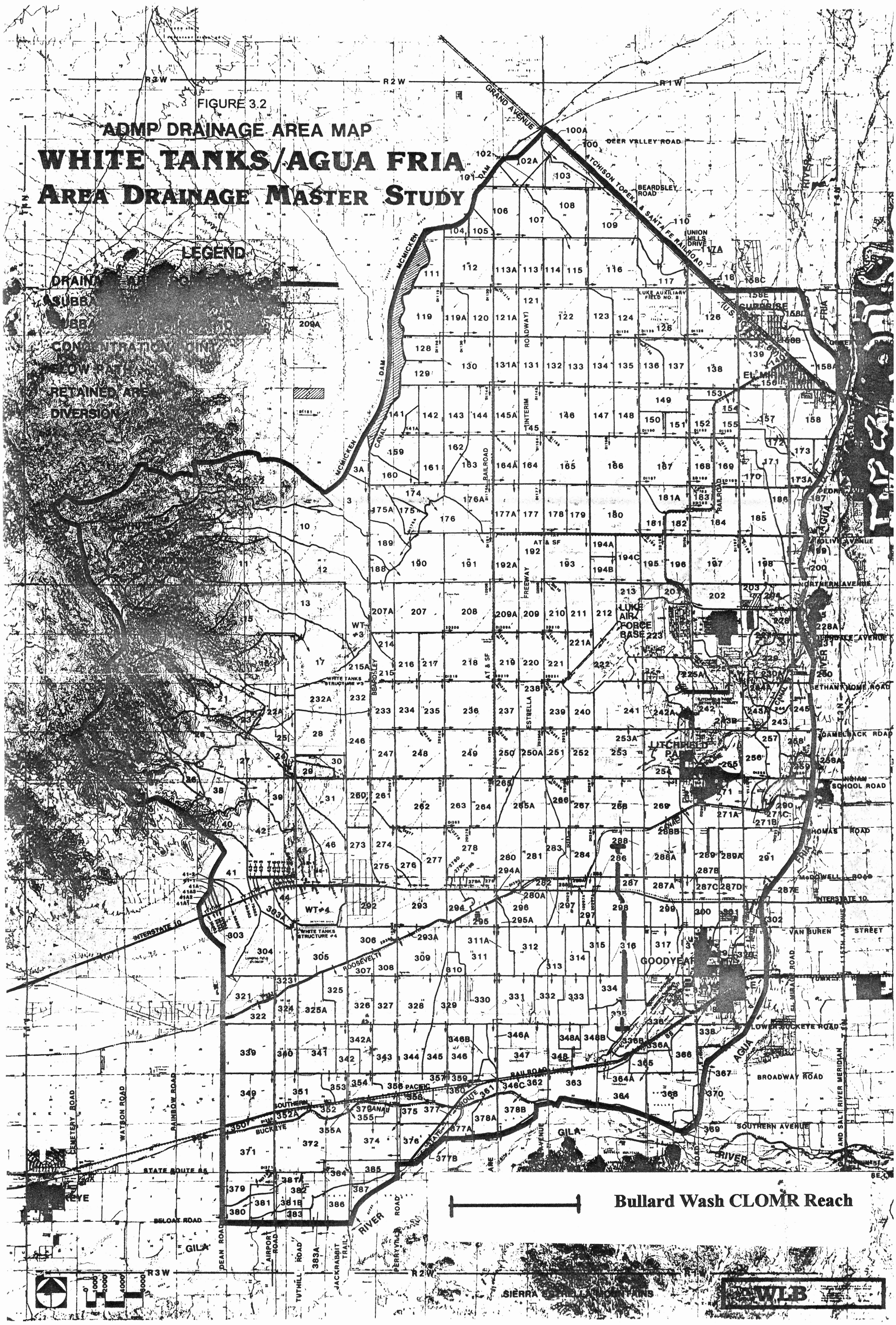


FIGURE 3.2
ADMP DRAINAGE AREA MAP
WHITE TANKS/AGUA FRIA
AREA DRAINAGE MASTER STUDY
LEGEND
DRAINAGE AREA
SUBBASIN
SUBBASIN
CONCENTRATION POINT
BELOW PATH
RETAINED AREA
DIVERSION
Bullard Wash CLOMR Reach
R3W
R2W
R1W
GRAND AVENUE
DEER VALLEY ROAD
BEARDSLEY ROAD
UNION HILLS DRIVE
ATCHISON TOPEKA & SANTA FE RAILROAD
MCMICKEN DAM
MCMICKEN CANAL
LUKE AUXILIARY FIELD NO. 8
SURPRISE
EL MIRAGE
LUKE AIR FORCE BASE
LITCHFIELD PARK
GOODYEAR
WT #3
WT #4
WHITE TANKS STRUCTURE #3
WHITE TANKS STRUCTURE #4
INTERSTATE 10
ROOSEVELT
AT & SF RAILROAD
SOUTHERN PACIFIC RAILROAD
STATE ROUTE 85
BUCKEYE
GILA RIVER
AGUA FRIA RIVER
PEORIA AVENUE
OLIVE AVENUE
NORTHERN AVENUE
GLENDALE AVENUE
BETHANY HOME ROAD
CAMELBACK ROAD
INDIAN SCHOOL ROAD
THOMAS ROAD
McDOWELL ROAD
VAN BUREN STREET
BROADWAY ROAD
SOUTHERN AVENUE
BELOAT ROAD
CEMETERY ROAD
WATSON ROAD
RAINBOW ROAD
DEAN ROAD
AIRPORT ROAD
TUTHILL ROAD
JACKRABBIT TRAIL
PERRYVILLE ROAD
ESTRELLA FREEWAY
SIERRA ESTRELLA MOUNTAINS
GILA AND SALT RIVER MERIDIAN
WLB

APPENDIX I

Hydraulics Exhibit Maps
(Bullard Wash Channel Plans, under separate cover)

APPENDIX J

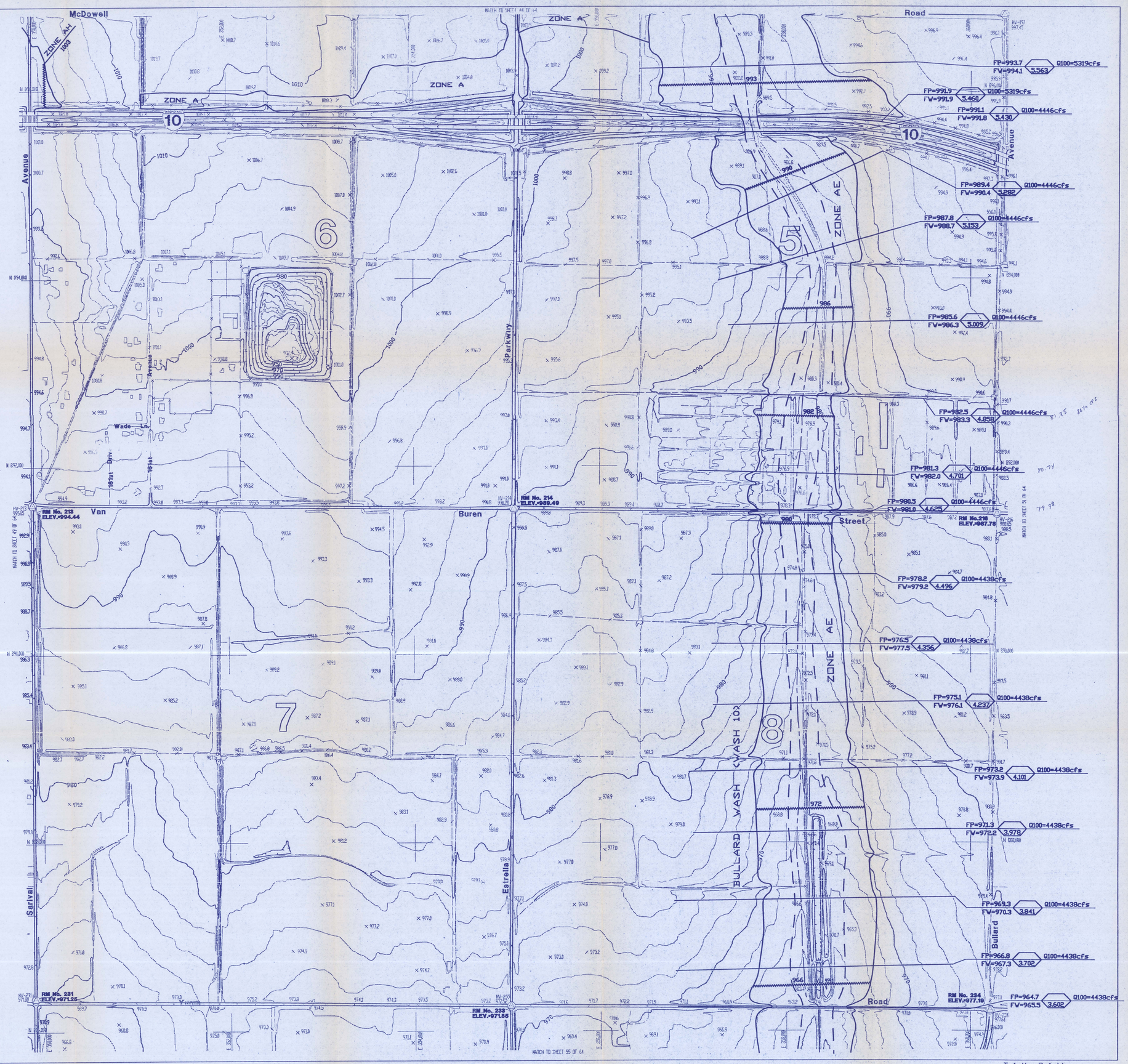
Floodplain Work Study Maps

WHITE TANKS/AGUA FRIA

AREA DRAINAGE MASTER STUDY

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

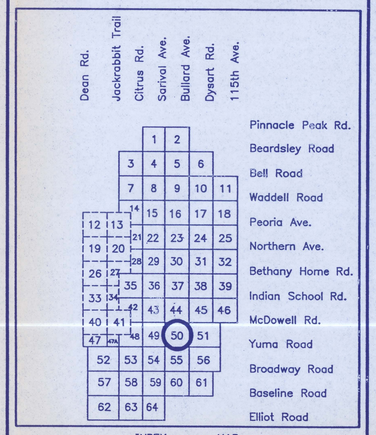
EXISTING FIS FLOODPLAIN MAP



T 1 N , R 1 W
FIRM PANEL NO. 2060, 2070

REFERENCE MARKS (RM'S)

NO.	ELEVATION	DESCRIPTION
213	994.44	Maricopa County Highway Dept. Brass Cap in Hand Hole, Sarival Ave. and Van Buren St.
214	989.49	Maricopa County Highway Dept. Brass Cap in Hand Hole, Estrella Parkway (Reems Rd.) and Van Buren St.
216	987.78	1/2" Iron Pin in Hand Hole, Bullard Ave. and Van Buren St.
231	971.25	Maricopa County Highway Dept. Brass Cap in Hand Hole, Sarival Ave. and Yuma Rd.
233	971.85	Brass Cap in Hand Hole, Reems Rd. and Yuma Rd.
234	977.19	Rod in Concrete in Hand Hole, Bullard Ave. and Yuma Rd.



INDEX MAP

N

400 200 0 400 800 1200

BASE MAP: WHITE TANKS/AGUA FRIA A.D.M.S. TOPOGRAPHIC MAPS
CONTOUR INTERVAL = 2'

LEGEND

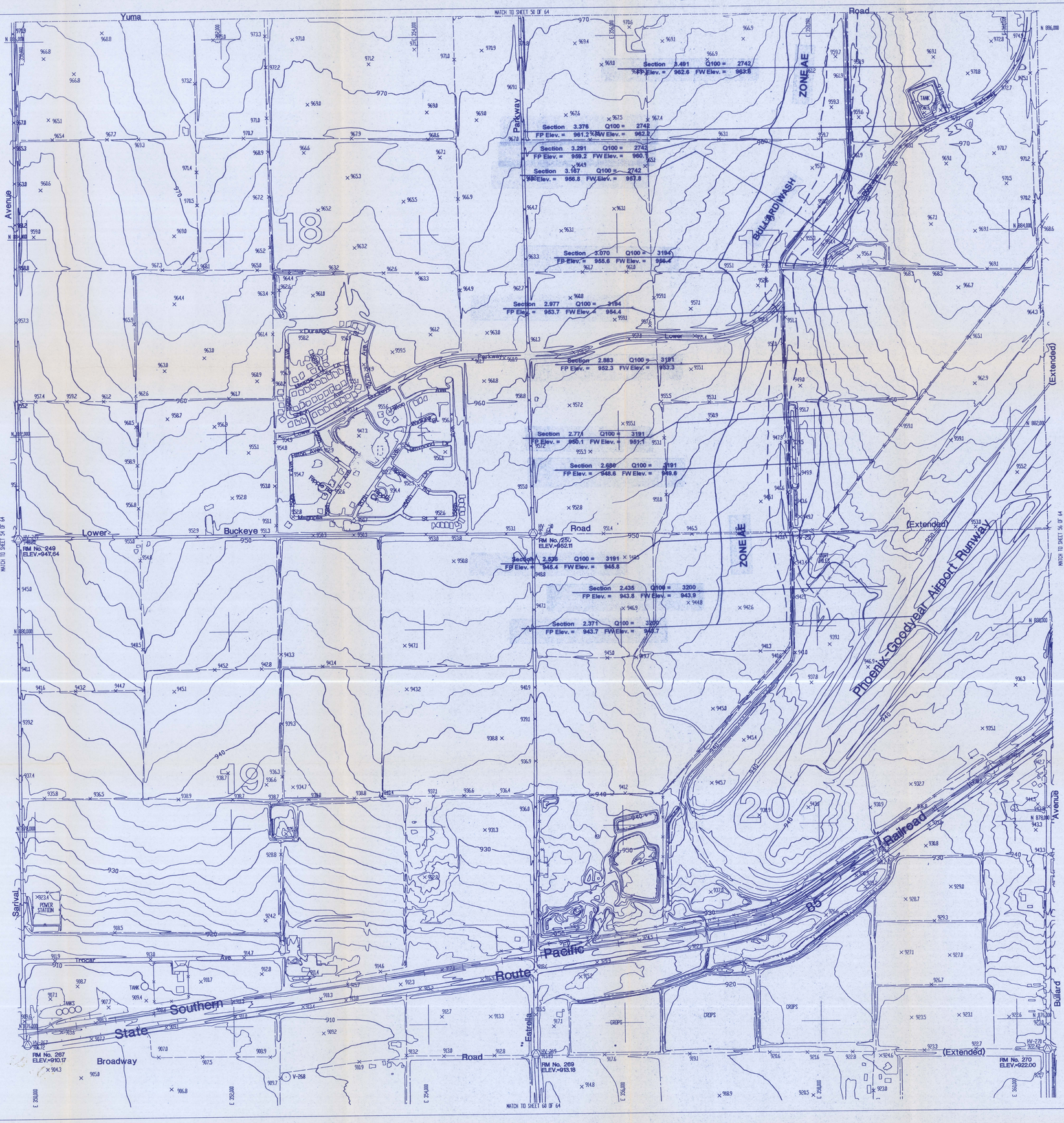
1.452	CROSS SECTION NUMBER
FP=1158.9	FLOODPLAIN WATER SURFACE ELEVATION = 1158.9
FW=1159.8	FLOODWAY WATER SURFACE ELEVATION = 1159.8
Q100=764cfs	100-YEAR PEAK DISCHARGE = 764 CUBIC FEET PER SEC.
1157	BASE FLOOD ELEVATION
	STREAM CENTERLINE
	FLOODWAY BOUNDARY
	FLOODPLAIN BOUNDARY
RM NO. 100	ELEVATION REFERENCE MARK
ZONE AE	FLOOD INSURANCE RATE ZONE

SHEET TITLE: **FLOODPLAIN MAP**

STUDY CONSULTANT: **The WLB Group** INC.

MAPPING COMPANY: Cooper Aerial of Phoenix, Inc.

SHEET 50 OF 64 | DATE FLOWN 12/22/89



WHITE TANKS/AGUA FRIA

AREA DRAINAGE MASTER STUDY

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

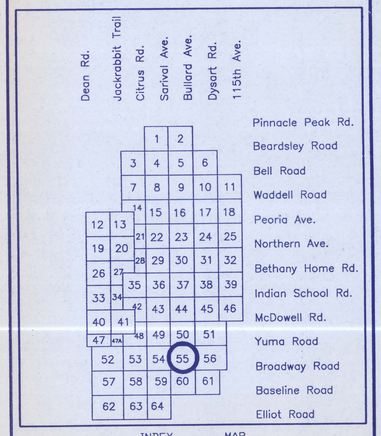
LEGEND

Section 2.883	- HEC-2 section number
Q100 = 3191	- 100-year discharge (cfs)
FP Elev. = 952.3	- 100-year floodplain elevation
FW Elev. = 953.3	- Floodway elevation
	- Floodplain boundary
	- Floodway boundary
	- Stream centerline (sta=10000)
ZONE AE	- Flood Insurance Rate Zone

CLOMR FLOODPLAIN MAP

REFERENCE MARKS (RM'S)

NO.	ELEVATION	DESCRIPTION
249	947.64	Maricopa County Highway Dept. Brass Cap in Hand Hole, Sarival Ave. and Lower Buckeye Rd.
250	952.11	Maricopa County Highway Dept. Brass Cap in Hand Hole, Estrella Pkwy. and Lower Buckeye Rd.
267	910.17	"X" Chiseled on Concrete Base Power Pole at Northeast Corner, Intersection of Sarival Ave. and Broadway Rd.
269	913.18	Brass Cap in Hand Hole, Estrella Pkwy. (Reems Rd.) and Broadway Rd.
270	922.00	Maricopa County Highway Dept. Brass Cap in Hand Hole, Bullard Ave. and Broadway Rd.



N

400 200 0 400 800 1200

CERTIFICATION

This is to certify that the horizontal and vertical control surveys on which this map was based were prepared under my supervision during the time from December, 1989 to April, 1990. The topography was developed from photogrammetric methods by Cooper Aerial Survey Co. and checked with field surveyed profiles conducted under my supervision. It was determined with the field surveys that over 90% of the contour lines and spot elevations were within one foot of the true elevation.

REGISTERED LAND SURVEYOR CERTIFICATE NO. 16176 MARK T. GAVAN ARIZONA, U.S.A.

MARK T. GAVAN, R.L.S.

SHEET TITLE: **TOPOGRAPHIC MAP**

STUDY CONSULTANT: **The WLB Group** INC.

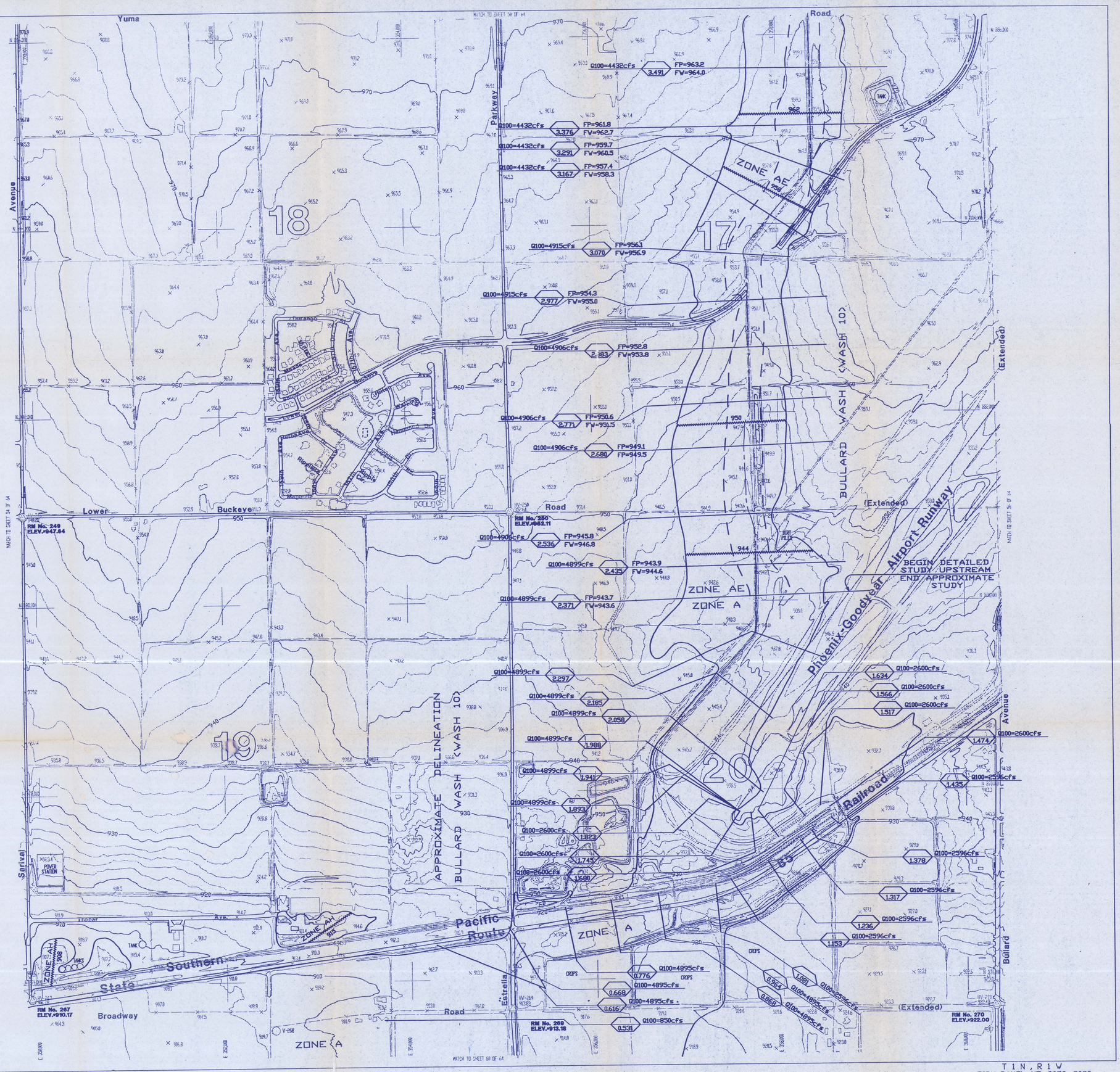
MAPPING COMPANY: Cooper Aerial of Phoenix, Inc.

SHEET 55 OF 64 | DATE FLOWN 12/22/89

WHITE TANKS/AGUA FRIA
AREA DRAINAGE MASTER STUDY

FLOOD CONTROL DISTRICT
OF MARICOPA COUNTY

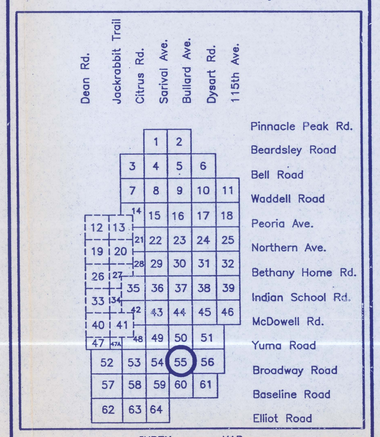
EXISTING FIS FLOODPLAIN MAP



T1N, R1W
FIRM PANEL NO. 2070, 2090

REFERENCE MARKS (RM'S)

NO.	ELEVATION	DESCRIPTION
249	947.64	Maricopa County Highway Dept. Brass Cap in Hand Hole, Sarival Ave. and Lower Buckeye Rd.
250	952.11	Maricopa County Highway Dept. Brass Cap in Hand Hole, Estrella Pkwy. and Lower Buckeye Rd.
267	910.17	"X" Chiseled on Concrete Base Power Pole at Northeast Corner, Intersection of Sarival Ave. and Broadway Rd.
269	913.18	Brass Cap in Hand Hole, Estrella Pkwy. (Reems Rd.) and Broadway Rd.
270	922.00	Maricopa County Highway Dept. Brass Cap in Hand Hole, Bullard Ave. and Broadway Rd.



400 200 0 400 800 1200
BASE MAP: WHITE TANKS/AGUA FRIA A.D.M.S. TOPOGRAPHIC MAPS
CONTOUR INTERVAL = 2'

LEGEND

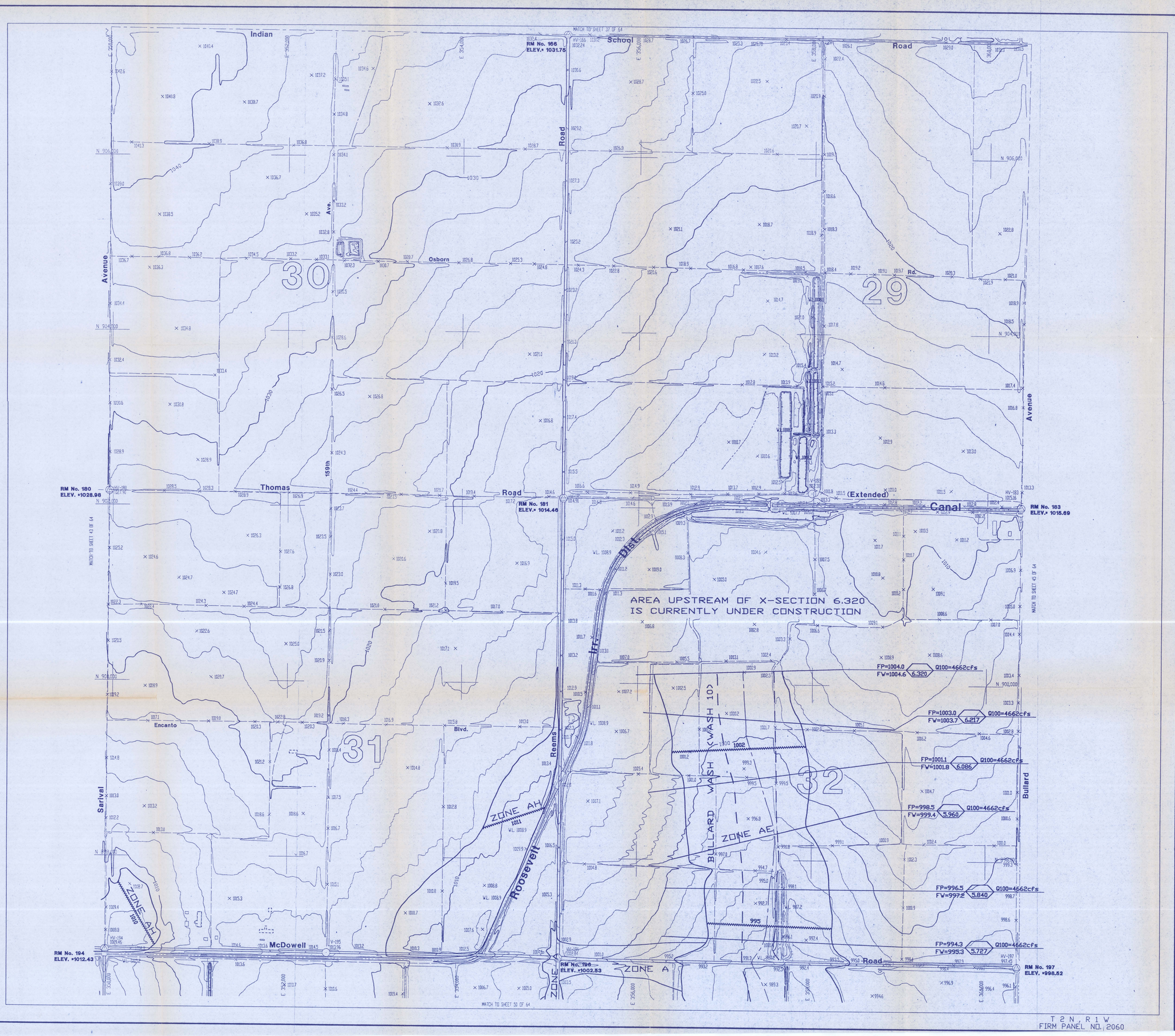
1.452	CROSS SECTION NUMBER
FP=1158.9	FLOODPLAIN WATER SURFACE ELEVATION = 1158.9
FV=1159.8	FLOODWAY WATER SURFACE ELEVATION = 1159.8
Q100=764cfs	100-YEAR PEAK DISCHARGE = 764 CUBIC FEET PER SEC.
1157	BASE FLOOD ELEVATION
	STREAM CENTERLINE
	FLOODWAY BOUNDARY
	FLOODPLAIN BOUNDARY
RM NO. 100	ELEVATION REFERENCE MARK
ZONE AE	FLOOD INSURANCE RATE ZONE

SHEET TITLE: **FLOODPLAIN MAP**

STUDY CONSULTANT: **The WLB Group** INC.

MAPPING COMPANY: Cooper Aerial of Phoenix, Inc.

SHEET 55 OF 64 | DATE FLOWN 12/22/89



T 2 N, R 1 W
FIRM PANEL NO. 2060

WHITE TANKS/AGUA FRIA

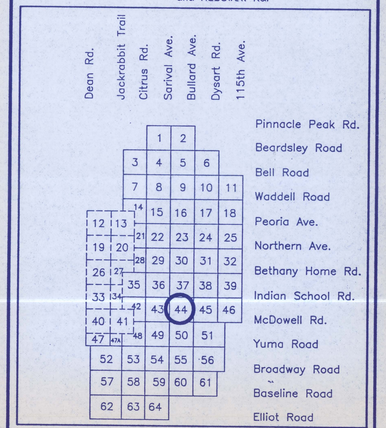
AREA DRAINAGE MASTER STUDY

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

EXISTING FIS FLOODPLAIN MAP

REFERENCE MARKS (RM'S)

NO.	ELEVATION	DESCRIPTION
166	1031.75	Maricopa County Highway Dept. Brass Cap in Hand Hole, Reems Rd. and Indian School Rd.
180	1028.98	Chiseled Square on Top Concrete Headwall at Northwest Corner Intersection of Sarival Ave. and Thomas Rd.
181	1014.46	Maricopa County Highway Dept. Brass Cap in Hand Hole, Reems Rd. and Thomas Rd.
183	1015.69	Brass Cap in Southeast Corner of Bridge on Bullard Ave. over the R.I.D. Canal Stamped- 1983 LS 6450 (R.I.D.-2-33-14)
194	1012.43	'X' Chiseled on Top of Concrete Headwall at Southeast Corner of Intersection of Sarival Ave. and Thomas Rd.
196	1002.53	Brass Cap in Hand Hole, ± 45' South of Intersection of Reems Rd. and McDowell Rd.
197	998.52	'X' Chiseled on Top of Concrete Wing Southeast Corner of Intersection of Bullard Ave. and McDowell Rd.



INDEX MAP

N

400 200 0 400 800 1200

BASE MAP: WHITE TANKS/AGUA FRIA A.D.M.S. TOPOGRAPHIC MAPS
CONTOUR INTERVAL = 2'

LEGEND

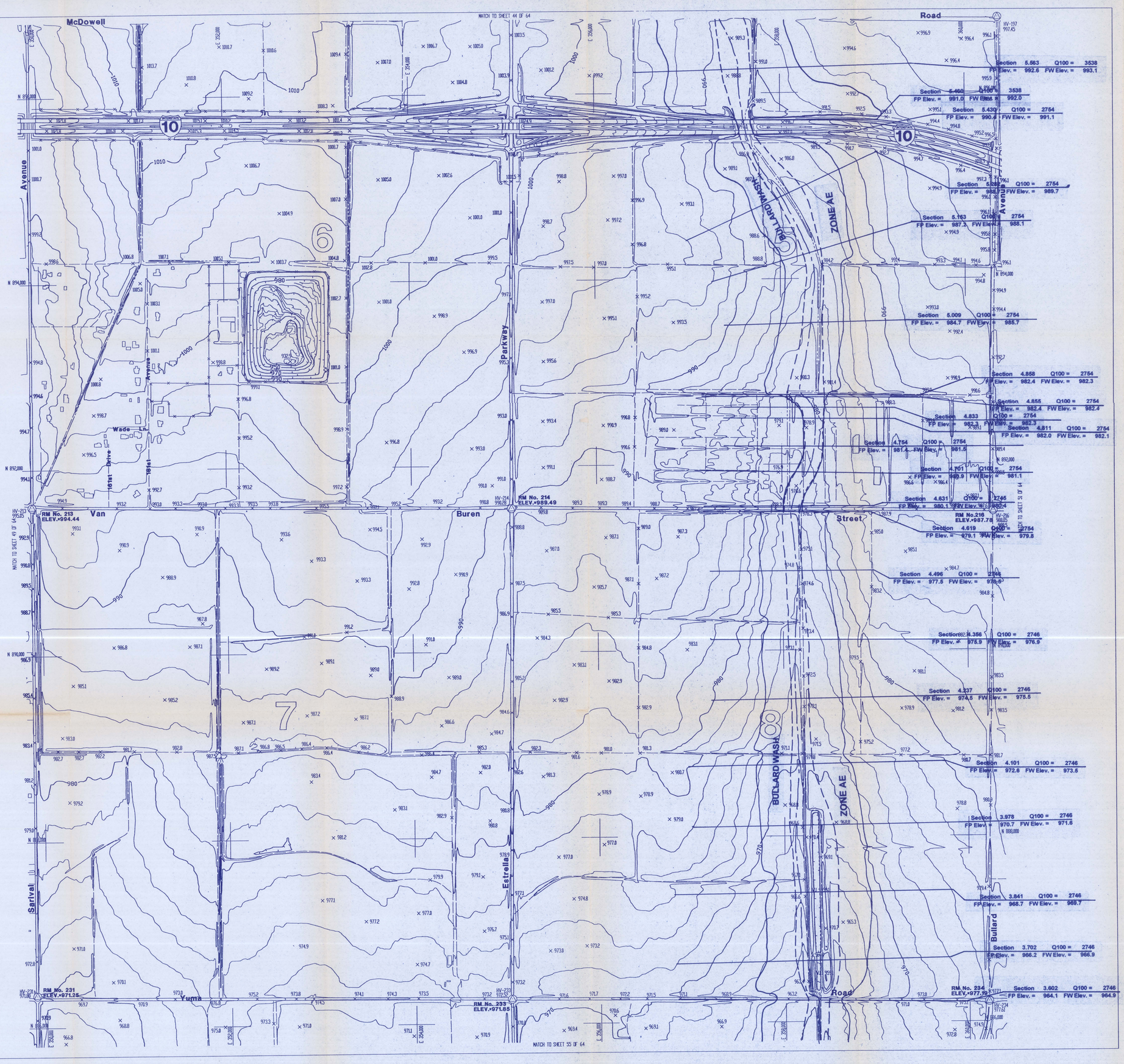
1.452	CROSS SECTION NUMBER
FP=1158.9	FLOODPLAIN WATER SURFACE ELEVATION = 1158.9
FW=1159.8	FLOODWAY WATER SURFACE ELEVATION = 1159.8
Q100=764cfs	100-YEAR PEAK DISCHARGE = 764 CUBIC FEET PER SEC.
1157	BASE FLOOD ELEVATION
	STREAM CENTERLINE
	FLOODWAY BOUNDARY
	FLOODPLAIN BOUNDARY
RM NO. 100	ELEVATION REFERENCE MARK
ZONE AE	FLOOD INSURANCE RATE ZONE

SHEET TITLE: **FLOODPLAIN MAP**

STUDY CONSULTANT: **The WLB Group** INC.

MAPPING COMPANY: Cooper Aerial of Phoenix, Inc.

SHEET 44 OF 64 | DATE FLOWN 12/22/89



WHITE TANKS/AGUA FRIA

AREA DRAINAGE MASTER STUDY

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

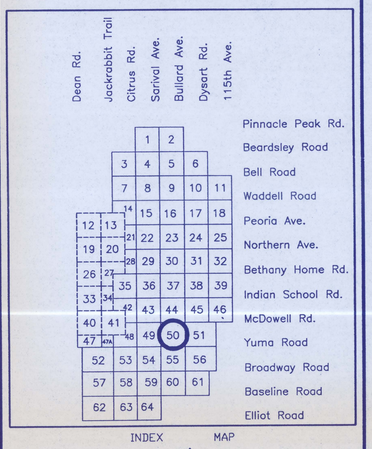
LEGEND

Section 2.883	- HEC-2 section number
Q100 = 3191	- 100-year discharge (cfs)
FP Elev. = 982.3	- 100-year floodplain elevation
FW Elev. = 953.3	- Floodway elevation
	- Floodplain boundary
	- Floodway boundary
	- Stream centerline (sta=10000)
ZONE AE	- Flood Insurance Rate Zone

CLOMR FLOODPLAIN MAP

REFERENCE MARKS (RM'S)

NO.	ELEVATION	DESCRIPTION
213	994.44	Maricopa County Highway Dept. Brass Cap in Hand Hole, Sarival Ave. and Van Buren St.
214	989.49	Maricopa County Highway Dept. Brass Cap in Hand Hole, Estrella Parkway (Reems Rd.) and Van Buren St.
216	987.78	1/2" Iron Pin in Hand Hole, Bullard Ave. and Van Buren St.
231	971.25	Maricopa County Highway Dept. Brass Cap in Hand Hole, Sarival Ave. and Yuma Rd.
233	971.85	Brass Cap in Hand Hole, Reems Rd. and Yuma Rd.
234	977.19	Rod in Concrete in Hand Hole, Bullard Ave. and Yuma Rd.



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REGISTERED LAND SURVEYOR CERTIFICATE NO. 16137 MARK T. GAVAN ARIZONA, U.S.A.

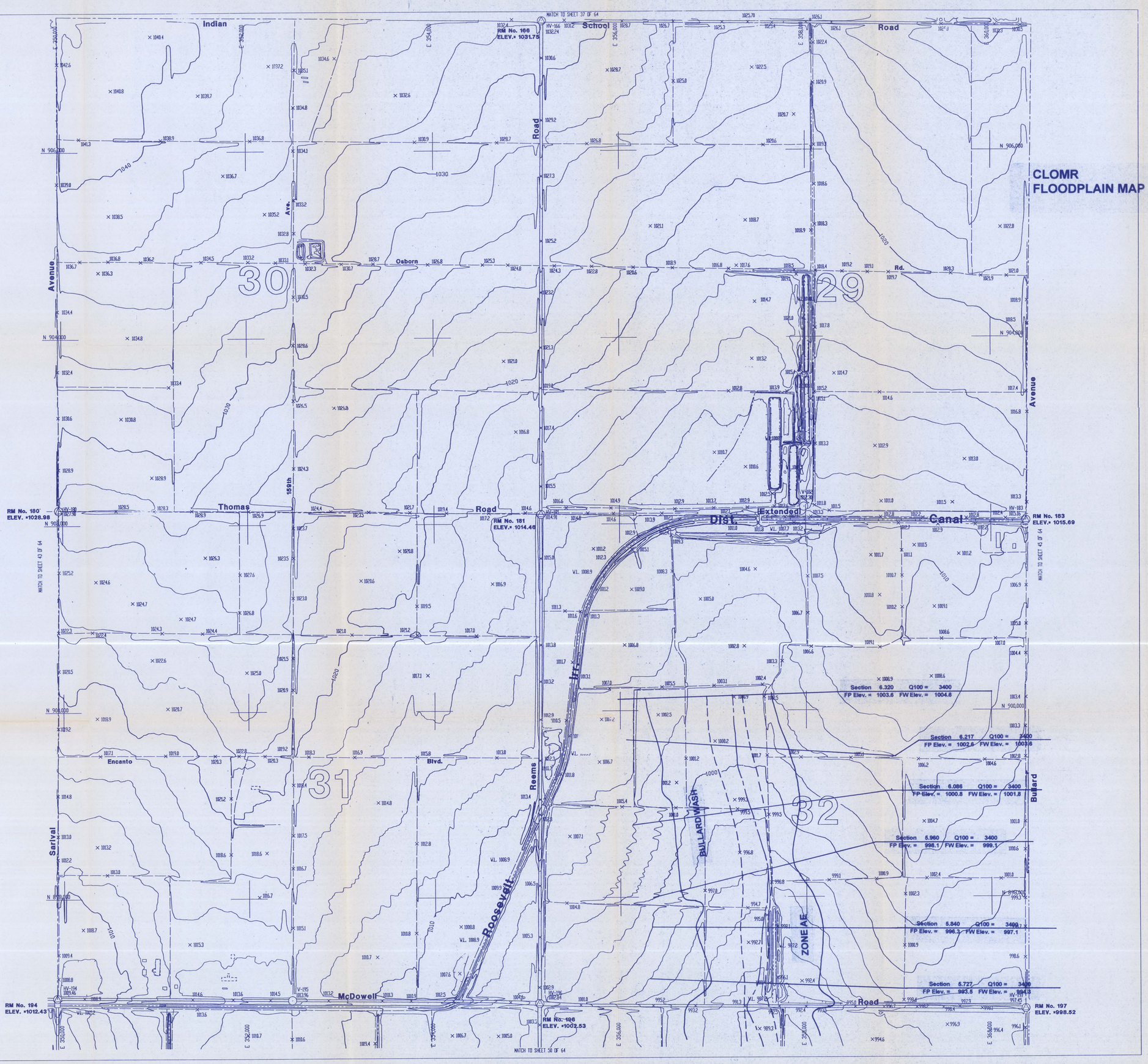
MARK T. GAVAN, R.L.S.

SHEET TITLE: **TOPOGRAPHIC MAP**

STUDY CONSULTANT: **The WLB Group** INC.

MAPPING COMPANY: Cooper Aerial of Phoenix, Inc.

SHEET 50 OF 64 | DATE FLOWN 12/22/89



WHITE TANKS/AGUA FRIA

AREA DRAINAGE MASTER STUDY

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

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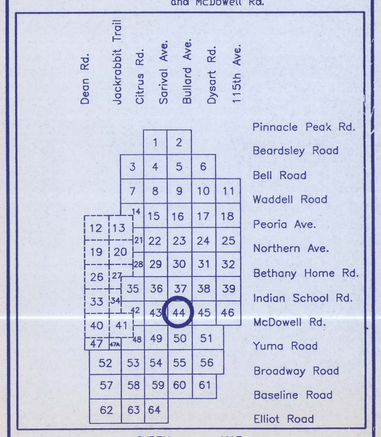

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REGISTERED LAND SURVEYOR MARK T. GAVAN ARIZONA, U.S.A.

MARK T. GAVAN, R.L.S.

SHEET TITLE: **TOPOGRAPHIC MAP**

STUDY CONSULTANT: **The WLB Group** INC.

MAPPING COMPANY: Cooper Aerial of Phoenix, Inc.

SHEET 44 OF 64 | DATE FLOWN 12/22/89