2002P024

FINAL DRAINAGE REPORT FOR THE GERMANN ROAD BRIDGE

May 22, 2003

WOOD/PATEL

FINAL DRAINAGE REPORT
FOR THE
GERMANN ROAD BRIDGE

May 22, 2003

WP #021733

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TABLE OF CONTENTS

1.0 EXECUTIVE SUMMARY 1
2.0 INTRODUCTION 2
2.1 General Background 2
2.2 Scope of Work 2
3.0 DESCRIPTION OF STUDY AREA 3
3.1 Location 3
3.2 Existing Drainage Features 3
3.3 Existing and Proposed Utilities 3
3.4 Flood Insurance Rate Map 3
4.0 DRAINAGE DESIGN 4
4.1 404 Permit 4
4.2 Offsite Hydrology 4
4.3 Offsite Hydraulic Analysis 4
4.4 RWCD Crossing Structure 5
4.5 Pavement Drainage 6
5.0 MAINTENANCE ACCESS ISSUES FOR FCDMC AND RWCD 7
5.1 Flood Control District of Maricopa County (FCDMC) 7
5.2 Roosevelt Water Conservation District (RWCD) 7
6.0 CONCLUSIONS AND RECOMMENDATIONS 9

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PLATES

Plate 1 Vicinity Map

APPENDICES

Appendix A East Maricopa Floodway (EMF) Hydraulics
Appendix B Pavement Drainage Calculations

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1.0 EXECUTIVE SUMMARY

The Town of Gilbert proposes to extend Germann Road as a major arterial roadway along a section line alignment to provide an important east-west transportation link between Higley Road and Power Road. Construction of this extension will require crossings of both the Roosevelt Water Conservation District (RWCD) canal and the East Maricopa Floodway (EMF) and will involve the construction of a post-tensioned box-girder bridge over the EMF and a two-cell box culvert across the RWCD canal.

The south half of Germann Road currently terminates east of Higley Road at the RWCD and EMF western right-of-way. The north half of Germann Road has not been constructed and is included in this design. The project will also include the design of the approach roadway to tie in to the existing roadway west of the bridge crossing and will be coordinated with the design and construction of the Power Ranch portion of Germann Road east of the EMF.

The 100-year design discharge for the EMF was obtained from the Flood Control District of Maricopa County (District) and will be the original (NRCS) design discharge of 6,900 cfs. Required freeboard will be one (1) foot below the bridge soffit. The RWCD canal currently carries 375 cfs, which is adequate to meet current demand; however, the future water rights needs may necessitate an increase to as much as 500 cfs.

Based on the hydrologic information obtained from the District and the hydraulic analysis performed by Wood/Patel, there should be no adverse impact to the East Maricopa Floodway as a result of the construction or operation of the Germann Road Bridge crossing. The HEC-RAS model shows an increase, due to the presence of the bridge piers, of only 0.10 feet immediately upstream of the bridge. This decreases to 0.00 feet upstream of the existing drop structure.

The impacts to the EMF from a Water Quality perspective (404) are minimal and the approved 404 permit was obtained from the Corps of Engineers on March 6, 2003.

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2.0 INTRODUCTION

2.1 General Background

The Town of Gilbert proposes to extend Germann Road as a major arterial roadway along a section line alignment to provide an important east-west transportation link between Higley Road and Power Road. Construction of this extension will require crossings of both the Roosevelt Water Conservation District (RWCD) canal and the East Maricopa Floodway (EMF) and will involve the construction of a post-tensioned box-girder bridge over the EMF and a multi-cell box culvert across the RWCD canal. Germann Road currently terminates east of Higley Road at the RWCD and EMF western right-of-way. The project will include the design of the approach roadway to tie in to the existing roadway west of the bridge crossing and will be coordinated with the design and construction of Germann Road east of the EMF.

2.2 Scope of Work

Wood/Patel will provide all Engineering and project management services, including all utility approvals (including SRP & RWCD), all public and private agency coordination and approvals, and the preparation of construction drawings and final bid documents, including special provisions that are required for the bidding of this project.

The intent of this project is to minimize the involvement of Town of Gilbert staff to plan review only. The Town will authorize Wood/Patel to act as their representative in all elements of this project.

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3.0 DESCRIPTION OF STUDY AREA

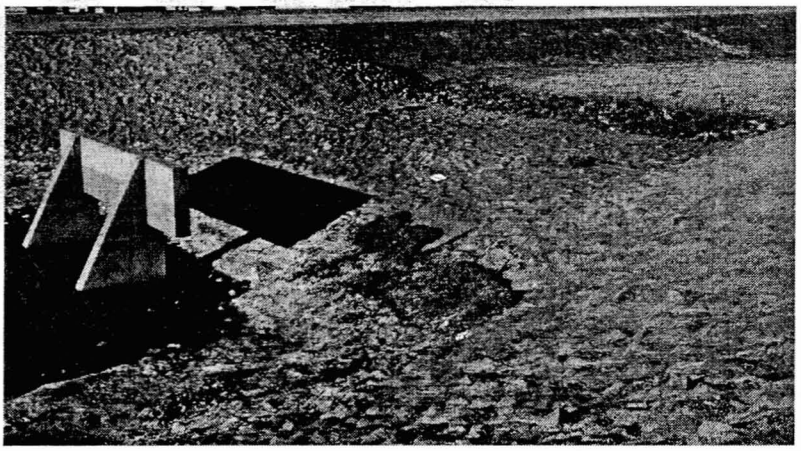
3.1 Location

The project is located along the Germann Road alignment approximately ½ mile east of the intersection with Higley Road between sections 2 and 11, Township 2 South, Range 6 East in southeastern Gilbert.

3.2 Existing Drainage Features

The East Maricopa Floodway, a large flood control facility, and the Roosevelt Water Conservation District (RWCD) canal both cross the proposed alignment and will require structures.

There is an existing drop structure in the EMF immediately upstream of the proposed bridge crossing location (see photo below) but it is not anticipated that the drop structure will be adversely impacted by the construction of the bridge.



3.3 Existing and Proposed Utilities

There are a number of existing utilities in the project area including water, sewer, gas, electric, and irrigation. The majority of these utilities will be unaffected by the construction of this project, however, some of the RWCD irrigation features may require relocation and the existing 16" waterline will be extended to the east side of the bridge.

3.4 Flood Insurance Rate Map

The Maricopa County, Arizona and Unincorporated Areas Flood Insurance Rate Map (FIRM) Community-Panel Number XXXXXX dated XXXX, indicates the site falls within Zone "XXX".

4.0 DRAINAGE DESIGN

4.1 404 Permit

Due to the minimal area of impact in the floodway (the area of the drilled shafts), the project was expected to fall under the Nationwide 14 provision of the 404 Permit. Wood/Patel coordinated with the Corps of Engineers, requested a 404 Permit under Nationwide 14, and was granted a Permit on March 10, 2003.

4.2 Offsite Hydrology

The 100-year design discharge for the EMF was obtained from the Flood Control District of Maricopa County (District) and is equal to the original Soil Conservation Service (SCS – now the Natural Resources Conservation Service or NRCS) design discharge of 6,900 cfs. Required freeboard for the design flow will be one (1) foot below the minimum bridge soffit elevation. The existing discharge in the EMF is approximately 12,438 cfs and is not contained within the channel; however, the District has agreed that the 6,900 cfs discharge will be acceptable for design.

The RWCD canal currently carries 375 cfs, which is adequate to meet current demand; however, the future water rights needs may necessitate an increase to as much as 500 cfs. The RWCD has requested that the structure be sized to accommodate this future increase.

4.3 Offsite Hydraulic Analysis

Several criteria were developed at the early stages of this project to guide the development of the bridge crossing design. These include:

- The bridge soffit elevation will provide a minimum of 1-foot of freeboard above the design water surface elevation (WSEL) in the EMF.
- The minimum bridge soffit elevation will be set equal to the existing top of bank. This criterion was included to address the existing discharge in the EMF, which is significantly above its hydraulic capacity. In discussions with the District, it was determined that, by providing for bank-full flow in the EMF, concerns regarding the existing discharge would be alleviated. The District agreed that any discharge which exceeded the capacity of the EMF would likely have overtopped the west bank of the EMF at some point upstream and, therefore, the bank-full discharge is all that would reach the structure.

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A HEC-RAS hydraulic model has been prepared for the EMF which demonstrates that the proposed structures do not adversely impact the water surface elevation. The results of the HEC-RAS hydraulic analyses are summarized in the following table and are further documented in Appendix A.

Cross-Section Location	WSEL in Existing Channel Design Flow (6900 cfs)	WSEL with Bridge Design Flow (6900 cfs)	WSEL Increase (ft)
Channel Upstream of Bridge & Drop	1311.92	1311.92	0.00
Upstream Side of Drop Structure	1312.10	1312.14	0.04
Upstream Side of Baffle Structure	1311.97	1312.07	0.10

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As documented in the above table, the increase in WSEL due to the presence of the bridge piers is negligible and will have no adverse affect on the performance of the EMF channel.

A Level I bridge scour analysis was also performed, based on the data generated in the HEC-RAS hydraulic model, which yielded an anticipated scour depth of approximately 14.9 feet. This scour depth will be accounted for in the design of the bridge foundations. Due to the regular shape of the EMF channel, significant contraction scour is not anticipated.

4.4 RWCD Crossing Structure

The RWCD canal carries a fairly constant flow of approximately 375 cfs. The existing canal is a shotcrete lined, trapezoidal channel with 2:1 side slopes, a six foot average depth and a top width of approximately 30 feet. The RWCD has requested that the Town of Gilbert install an oversized structure at this location to accommodate a possible increase in the capacity of the canal to meet future water rights needs. Based on this request, the proposed crossing structure is a two cell, 18 foot by 8 foot reinforced concrete box culvert (RCBC). Since this is a non-standard RCBC size, a special design will be required, however, the total cost still makes this the most economical option.

4.5 Pavement Drainage

The roadway is designed so that general drainage patterns are maintained wherever possible. Storm water will not create off-site flooding or adverse ponding within the right-of-way. Runoff from intersection streets is designed to maintain existing drainage conditions, as much as possible, and in no case will it adversely impact the improvements of this project. Pavement with curb and gutter (existing and proposed) will be checked to ensure that one lane of traffic remains dry in each direction, during peak flow of a 10-year storm frequency. The roadway may, however, be inundated during the 50 and 100-year storm events. Reduction of gutter flow by some means (adding inlets or adjusting roadway geometry) or an exemption from the Town Engineer must be provided where these criteria cannot be achieved.

Wood/Patel has coordinated the design of drainage facilities with current and on-going drainage studies and roadway design projects that affect the proposed improvements and utilized these facilities wherever possible.

Hydrologic analysis for pavement drainage is limited to Town of Gilbert right-of-way. Since the adjacent subdivisions have made provisions to accommodate the runoff from Germann Road, the only additional flow generated by this project originates between the west right-of-way of the RWCD canal and the high point on the bridge. The existing curb-opening scuppers/catch basins were used within Germann Road and runoff is directed to existing retention basins adjacent to the roadway alignment. These detention basins were originally sized to contain the 50-year, 24-hour runoff volume and , according to Town of Gilbert Design Standards, would have been sized to accommodate the runoff from the adjacent portion of Gilbert Road. The ability of these basins to accommodate the minimal additional flow generated on the bridge itself will be verified and increased retention will be provided where necessary.

The Rational Method calculations and an exhibit depicting the contributing areas is included in Appendix B.

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5.0 MAINTENANCE ACCESS ISSUES FOR FCDMC AND RWCD

5.1 Flood Control District of Maricopa County (FCDMC)

The existing EMF crossings north and south of the Germann Road crossing currently have at-grade maintenance access ramps and this is the general concept that was carried over to the Germann Road crossing. However, the east end of the Germann Road bridge has very little right-of-way to accommodate maintenance ramps and, in addition, there is an emergency outfall for the Power Ranch Neighborhood Six retention basin that is located at the southeast corner of the proposed Germann Road Bridge. The need to maintain this emergency outfall meant that an access ramp was not possible on the southeast corner of the bridge even if additional right-of-way were acquired.

In discussions with the District, several options emerged and they are as follows:

1. A maintenance turn-around at the southeast corner of the proposed bridge (this would require and easement from Power Ranch).
2. A dry weather turn-around in the bottom of the EMF channel with gate access to a cul-de-sac in Coronado Ranch which abuts the EMF right-of-way.
3. Gate access to the parking lot of the future fire station on the northeast corner of the proposed bridge.

A combination of options 1 and 3 is currently depicted on the plans.

Since the western maintenance road is shared with the RWCD, please refer to the following section for a description of its configuration and operation.

5.2 Roosevelt Water Conservation District (RWCD)

In discussions with the RWCD, it was clear that, although the majority of their maintenance crossings in the area are at-grade, non-signalized crossings. The RWCD staff feels that there is excessive time spent waiting for traffic to clear during emergencies and they requested that an improved crossing scenario be devised. Further discussions revealed that, since a right turn movement off of the maintenance road is simpler to make in high traffic conditions and there is a nearby left turn bay available, it would be acceptable to the RWCD to make a right turn off of their maintenance road, make a u-turn at the nearby left turn bay, and make another right turn back onto the next segment of maintenance road. A break in the median was also provided to facilitate straight across movements should traffic be clear. The curb & gutter in the vicinity of the

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maintenance roads was also changed to 4" roll to facilitate an easier traverse. The first 40 feet of the maintenance roads are paved with asphalt to allow rapid entrance and exit from the traveled lanes without excessive tire spin.

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6.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the hydrologic information obtained from the District and the hydraulic analysis performed by Wood/Patel, there should be no adverse impact to the East Maricopa Floodway as a result of the construction or operation of the Germann Road Bridge crossing. The HEC-RAS model shows an increase, due to the presence of the bridge piers, of only 0.10 feet immediately upstream of the bridge. This decreases to 0.00 feet upstream of the existing drop structure.

The impacts to the EMF from a Water Quality perspective (404) are minimal and the approved 404 permit was obtained from the Corps of Engineers on March 6, 2003.

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PLATES

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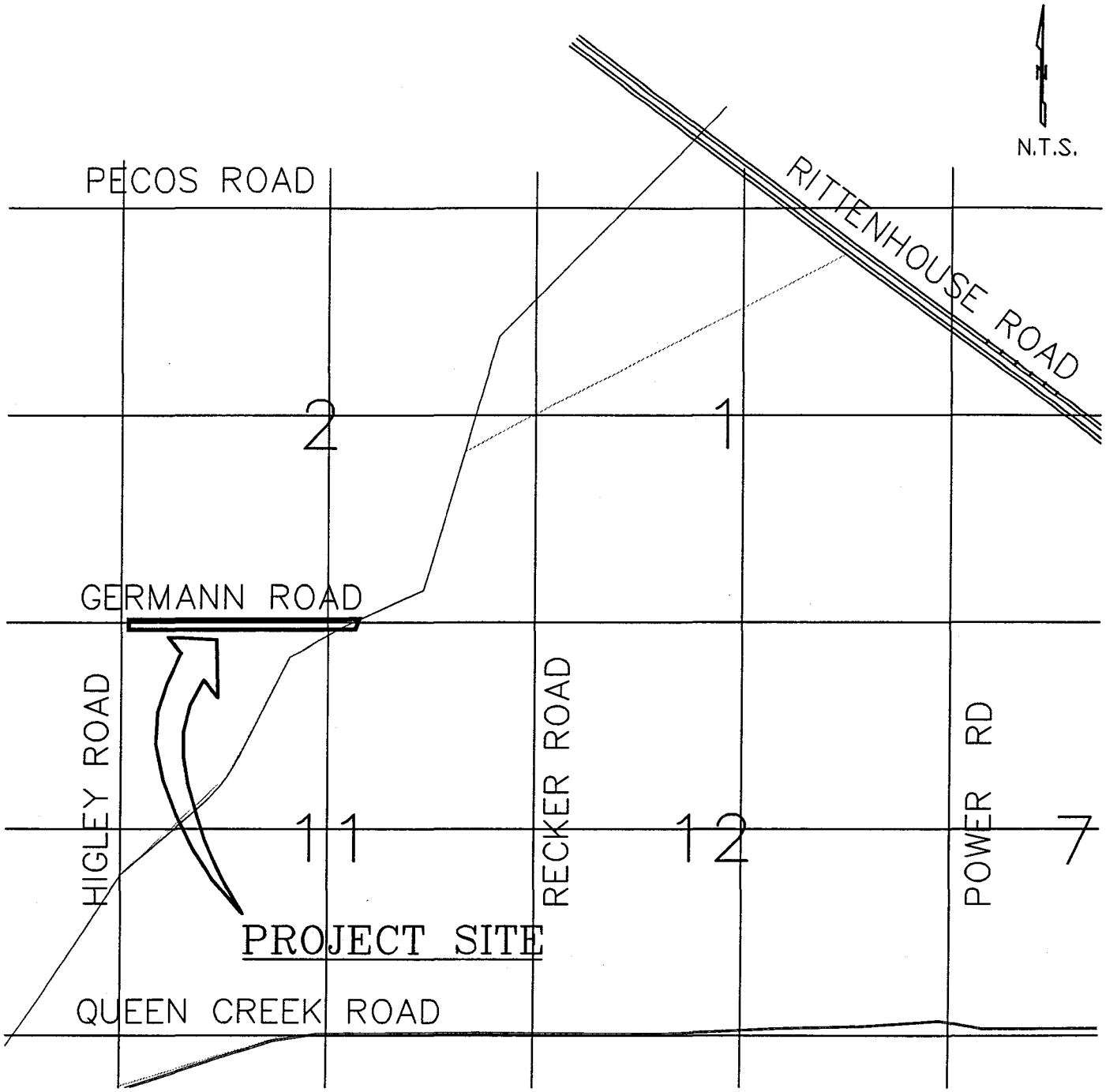
PLATE 1

Vicinity Map



GERMANN ROAD
VICINITY MAP

Wood, Patel & Associates, Inc.
2051 West Northern, Suite 100
Phoenix, Arizona 85021 (602) 335-8500

DRAWN BY: P. LOPEZ

JOB NO: 021733

DATE: 5/22/2003

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APPENDICES

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APPENDIX A

East Maricopa Floodway (EMF) Hydraulics

Existing Conditions HEC-RAS Model
Design Conditions HEC-RAS Model
Level 1 Bridge Scour Calculations

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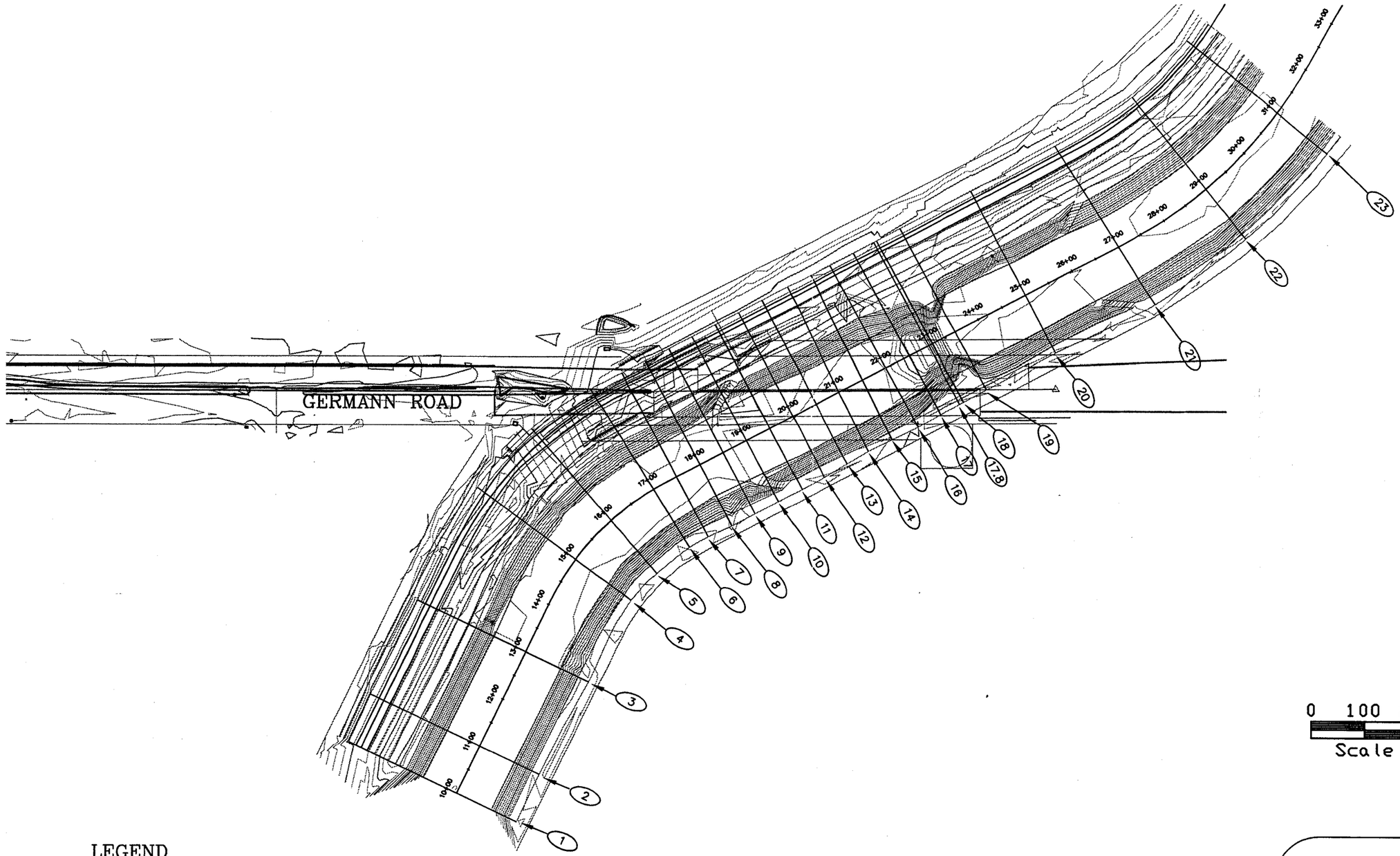
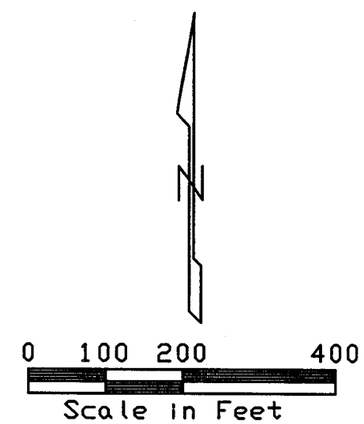
Existing Conditions HEC-RAS Model





LEGEND

(1) RIVER STATION

——— HEC RAS CROSS SECTION

GERMANN ROAD EMF
HYDRAULICS
EXHIBIT

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DRAWN BY: P. LOPEZ	PLATE #
JOB NO: 021733	DATE: 5/22/2003

HEC-RAS Plan: wopierswobst River: RIVER-1 Reach: Reach-1

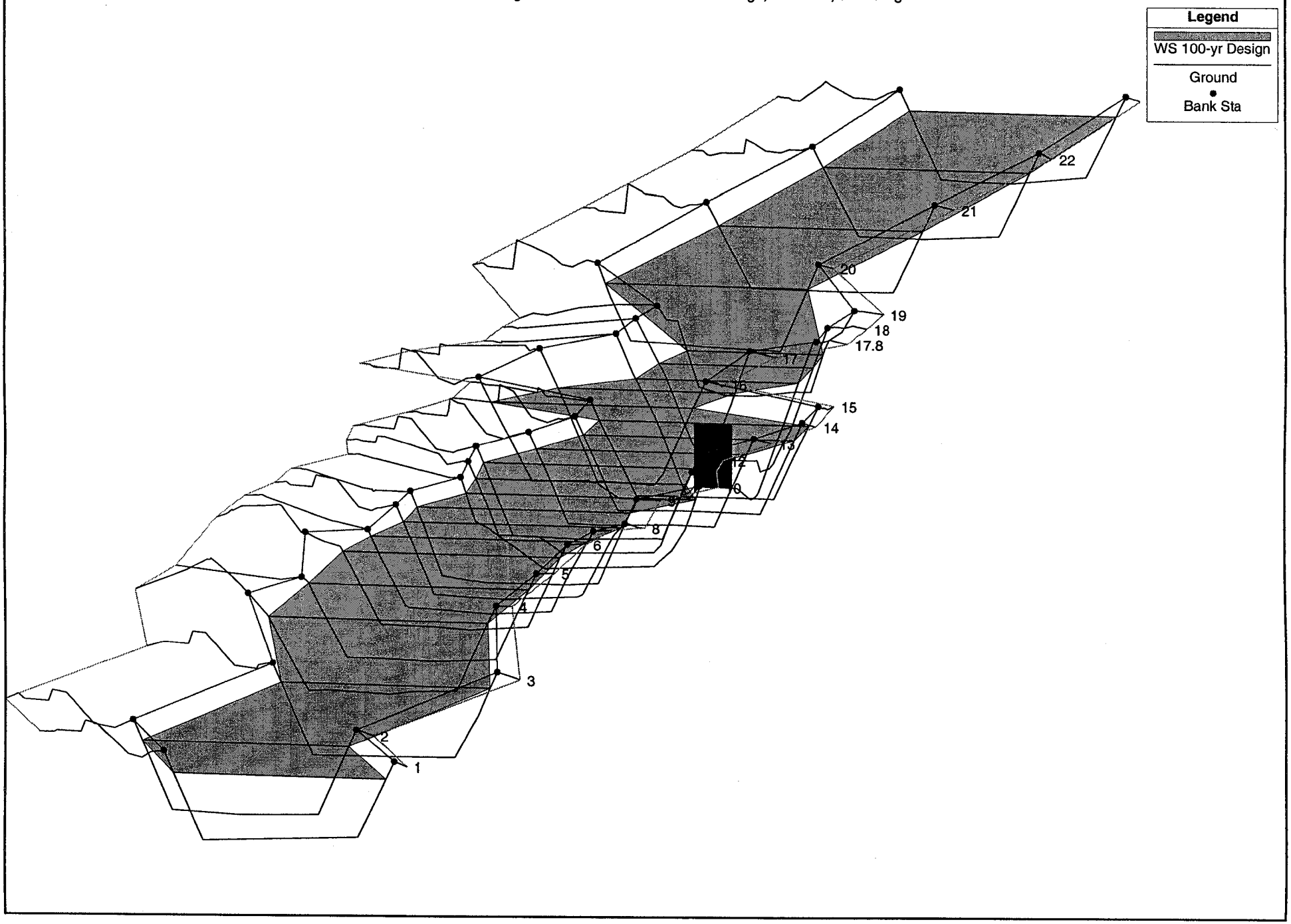
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Max Chl Dpth	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Reach-1	23	100-yr Design	6900.00	1306.92	1315.19	8.27	1311.33	1315.61	0.001191	5.20	1327.03	196.60	0.35
Reach-1	23	Bank Full Flow	10500.00	1306.92	1317.20	10.28	1312.60	1317.75	0.001230	6.01	1789.45	292.45	0.37
Reach-1	23	100-yr Existing	12438.00	1306.92	1318.12	11.20	1313.20	1318.72	0.001193	6.30	2087.63	340.09	0.37
Reach-1	22	100-yr Design	6900.00	1306.73	1314.96	8.23	1311.10	1315.38	0.001203	5.21	1323.35	196.64	0.35
Reach-1	22	Bank Full Flow	10500.00	1306.73	1316.95	10.22	1312.38	1317.52	0.001253	6.04	1772.55	306.51	0.37
Reach-1	22	100-yr Existing	12438.00	1306.73	1317.89	11.16	1313.00	1318.50	0.001205	6.31	2079.98	341.41	0.37
Reach-1	21	100-yr Design	6900.00	1307.10	1314.63	7.53	1311.29	1315.11	0.001491	5.58	1236.89	195.23	0.39
Reach-1	21	Bank Full Flow	10500.00	1307.10	1316.61	9.51	1312.55	1317.25	0.001491	6.39	1661.63	251.35	0.40
Reach-1	21	100-yr Existing	12438.00	1307.10	1317.54	10.44	1313.16	1318.23	0.001462	6.69	1919.32	305.50	0.41
Reach-1	20	100-yr Design	6900.00	1306.75	1314.31	7.56	1311.13	1314.81	0.001563	5.67	1217.03	194.03	0.40
Reach-1	20	Bank Full Flow	10500.00	1306.75	1316.29	9.54	1312.37	1316.95	0.001541	6.50	1627.30	249.59	0.41
Reach-1	20	100-yr Existing	12438.00	1306.75	1317.22	10.47	1312.96	1317.94	0.001498	6.81	1885.85	306.47	0.41
Reach-1	19	100-yr Design	6900.00	1306.70	1311.92	5.22	1311.92	1314.14	0.011112	11.97	576.58	130.16	1.00
Reach-1	19	Bank Full Flow	10500.00	1306.70	1313.42	6.72	1313.42	1316.25	0.010347	13.49	778.41	138.78	1.00
Reach-1	19	100-yr Existing	12438.00	1306.70	1314.22	7.51	1314.22	1317.24	0.010104	13.95	891.72	148.46	1.00
Reach-1	18	100-yr Design	6900.00	1299.00	1312.10	13.10	1306.40	1312.55	0.000936	5.38	1282.03	147.88	0.32
Reach-1	18	Bank Full Flow	10500.00	1299.00	1314.16	15.16	1308.12	1314.82	0.001171	6.56	1601.75	162.43	0.37
Reach-1	18	100-yr Existing	12438.00	1299.00	1315.02	16.02	1308.93	1315.81	0.001299	7.13	1744.82	168.54	0.39
Reach-1	17.8	100-yr Design	6900.00	1297.70	1311.97	14.27	1307.47	1312.48	0.001431	5.76	1197.06	155.85	0.37
Reach-1	17.8	Bank Full Flow	10500.00	1297.70	1314.02	16.32	1309.05	1314.75	0.001616	6.86	1531.17	169.26	0.40
Reach-1	17.8	100-yr Existing	12438.00	1297.70	1314.88	17.18	1309.80	1315.73	0.001735	7.41	1678.63	174.64	0.42
Reach-1	17	100-yr Design	6900.00	1299.09	1312.09	13.00	1304.87	1312.38	0.000514	4.27	1615.65	169.44	0.24
Reach-1	17	Bank Full Flow	10500.00	1299.09	1314.18	15.09	1306.47	1314.62	0.000667	5.29	1983.76	182.99	0.28
Reach-1	17	100-yr Existing	12438.00	1299.09	1315.06	15.97	1307.23	1315.58	0.000750	5.79	2147.03	188.69	0.30
Reach-1	16	100-yr Design	6900.00	1302.62	1311.98	9.36	1307.22	1312.34	0.000880	4.77	1446.70	193.94	0.31
Reach-1	16	Bank Full Flow	10500.00	1302.62	1314.09	11.46	1308.56	1314.57	0.000967	5.61	1872.46	216.34	0.33
Reach-1	16	100-yr Existing	12438.00	1302.62	1314.97	12.35	1309.19	1315.54	0.001022	6.02	2083.92	264.75	0.34
Reach-1	15	100-yr Design	6900.00	1303.01	1311.95	8.94	1307.28	1312.29	0.000864	4.68	1475.09	200.96	0.30
Reach-1	15	Bank Full Flow	10500.00	1303.01	1314.05	11.04	1308.57	1314.52	0.000931	5.49	1914.26	218.82	0.33
Reach-1	15	100-yr Existing	12438.00	1303.01	1314.94	11.93	1309.18	1315.48	0.000952	5.88	2143.37	278.21	0.33
Reach-1	14	100-yr Design	6900.00	1302.93	1311.92	8.99	1307.17	1312.25	0.000820	4.60	1500.93	201.73	0.30
Reach-1	14	Bank Full Flow	10500.00	1302.93	1314.02	11.09	1308.44	1314.47	0.000890	5.41	1957.22	268.84	0.32
Reach-1	14	100-yr Existing	12438.00	1302.93	1314.91	11.98	1309.05	1315.43	0.000899	5.78	2204.22	279.10	0.33
Reach-1	13	100-yr Design	6900.00	1302.94	1311.87	8.93	1307.14	1312.20	0.000825	4.61	1497.95	201.54	0.30
Reach-1	13	Bank Full Flow	10500.00	1302.94	1313.97	11.03	1308.41	1314.43	0.000888	5.41	1967.44	276.94	0.32
Reach-1	13	100-yr Existing	12438.00	1302.94	1314.87	11.93	1309.02	1315.38	0.000892	5.78	2217.94	282.90	0.32
Reach-1	12	100-yr Design	6900.00	1302.97	1311.83	8.86	1307.15	1312.16	0.000821	4.60	1500.42	201.54	0.30
Reach-1	12	Bank Full Flow	10500.00	1302.97	1313.93	10.96	1308.39	1314.38	0.000876	5.40	1979.30	279.39	0.32
Reach-1	12	100-yr Existing	12438.00	1302.97	1314.83	11.86	1309.00	1315.34	0.000880	5.76	2232.19	285.34	0.32
Reach-1	11	100-yr Design	6900.00	1303.00	1311.73	8.73	1307.66	1312.11	0.001040	4.94	1397.04	201.60	0.33
Reach-1	11	Bank Full Flow	10500.00	1303.00	1313.82	10.82	1308.88	1314.33	0.001056	5.72	1851.53	261.89	0.34
Reach-1	11	100-yr Existing	12438.00	1303.00	1314.71	11.71	1309.48	1315.28	0.001053	6.10	2086.70	271.39	0.35
Reach-1	10	100-yr Design	6900.00	1302.90	1311.72	8.82	1307.58	1312.05	0.000895	4.56	1512.41	220.27	0.31
Reach-1	10	Bank Full Flow	10500.00	1302.90	1313.82	10.92	1308.76	1314.26	0.000884	5.28	1999.85	267.88	0.32
Reach-1	10	100-yr Existing	12438.00	1302.90	1314.72	11.82	1309.31	1315.21	0.000885	5.64	2253.37	300.25	0.32
Reach-1	9	100-yr Design	6900.00	1302.83	1311.69	8.86	1306.90	1312.00	0.000767	4.48	1540.96	204.73	0.29
Reach-1	9	Bank Full Flow	10500.00	1302.83	1313.78	10.95	1308.13	1314.21	0.000827	5.28	2004.25	283.73	0.31
Reach-1	9	100-yr Existing	12438.00	1302.83	1314.67	11.84	1308.72	1315.16	0.000838	5.66	2268.71	309.27	0.32
Reach-1	8	100-yr Design	6900.00	1302.70	1311.63	8.93	1306.99	1311.96	0.000850	4.58	1505.21	208.97	0.30
Reach-1	8	Bank Full Flow	10500.00	1302.70	1313.73	11.03	1308.23	1314.17	0.000863	5.32	2011.41	277.12	0.31
Reach-1	8	100-yr Existing	12438.00	1302.70	1314.63	11.93	1308.84	1315.12	0.000866	5.68	2261.62	283.00	0.32
Reach-1	7	100-yr Design	6900.00	1302.70	1311.58	8.88	1307.07	1311.92	0.000884	4.65	1484.07	207.91	0.31
Reach-1	7	Bank Full Flow	10500.00	1302.70	1313.67	10.97	1308.33	1314.13	0.000892	5.41	1974.62	278.34	0.32
Reach-1	7	100-yr Existing	12438.00	1302.70	1314.56	11.86	1308.93	1315.08	0.000894	5.78	2232.18	299.42	0.33
Reach-1	6	100-yr Design	6900.00	1302.66	1311.54	8.88	1306.96	1311.87	0.000856	4.60	1499.73	208.23	0.30
Reach-1	6	Bank Full Flow	10500.00	1302.66	1313.63	10.97	1308.20	1314.07	0.001002	5.31	1985.62	269.19	0.33
Reach-1	6	100-yr Existing	12438.00	1302.66	1314.53	11.87	1308.81	1315.02	0.000984	5.63	2232.41	278.40	0.33
Reach-1	5	100-yr Design	6900.00	1302.70	1311.45	8.75	1306.86	1311.77	0.000834	4.54	1518.89	210.88	0.30
Reach-1	5	Bank Full Flow	10500.00	1302.70	1313.55	10.85	1308.09	1313.97	0.000838	5.20	2124.52	363.59	0.31
Reach-1	5	100-yr Existing	12438.00	1302.70	1314.47	11.77	1308.68	1314.91	0.000807	5.45	2456.56	363.59	0.31
Reach-1	4	100-yr Design	6900.00	1302.60	1311.34	8.74	1306.89	1311.68	0.000887	4.63	1489.09	210.21	0.31
Reach-1	4	Bank Full Flow	10500.00	1302.60	1313.41	10.81	1308.12	1313.86	0.000966	5.39	1947.13	248.58	0.33
Reach-1	4	100-yr Existing	12438.00	1302.60	1314.29	11.69	1308.72	1314.80	0.000990	5.77	2168.72	258.89	0.34

HEC-RAS Plan: wopierswobst River: RIVER-1 Reach: Reach-1 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Max Chl Dpth	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Reach-1	3	100-yr Design	6900.00	1302.60	1311.11	8.51	1306.82	1311.48	0.000974	4.86	1419.93	200.01	0.32
Reach-1	3	Bank Full Flow	10500.00	1302.60	1313.14	10.54	1308.09	1313.65	0.001040	5.70	1859.51	261.98	0.34
Reach-1	3	100-yr Existing	12438.00	1302.60	1314.02	11.42	1308.69	1314.59	0.001047	6.08	2100.37	281.70	0.35
Reach-1	2	100-yr Design	6900.00	1302.42	1310.91	8.49	1306.66	1311.28	0.000996	4.91	1405.71	198.19	0.32
Reach-1	2	Bank Full Flow	10500.00	1302.42	1312.92	10.50	1307.91	1313.43	0.001073	5.77	1834.01	257.39	0.35
Reach-1	2	100-yr Existing	12438.00	1302.42	1313.78	11.36	1308.52	1314.37	0.001090	6.16	2067.44	274.93	0.36
Reach-1	1	100-yr Design	6900.00	1302.85	1310.73	7.88	1307.20	1311.16	0.001301	5.27	1310.49	203.50	0.37
Reach-1	1	Bank Full Flow	10500.00	1302.85	1312.74	9.89	1308.41	1313.31	0.001302	6.05	1739.16	243.53	0.38
Reach-1	1	100-yr Existing	12438.00	1302.85	1313.61	10.75	1309.00	1314.25	0.001301	6.44	1964.93	273.69	0.38

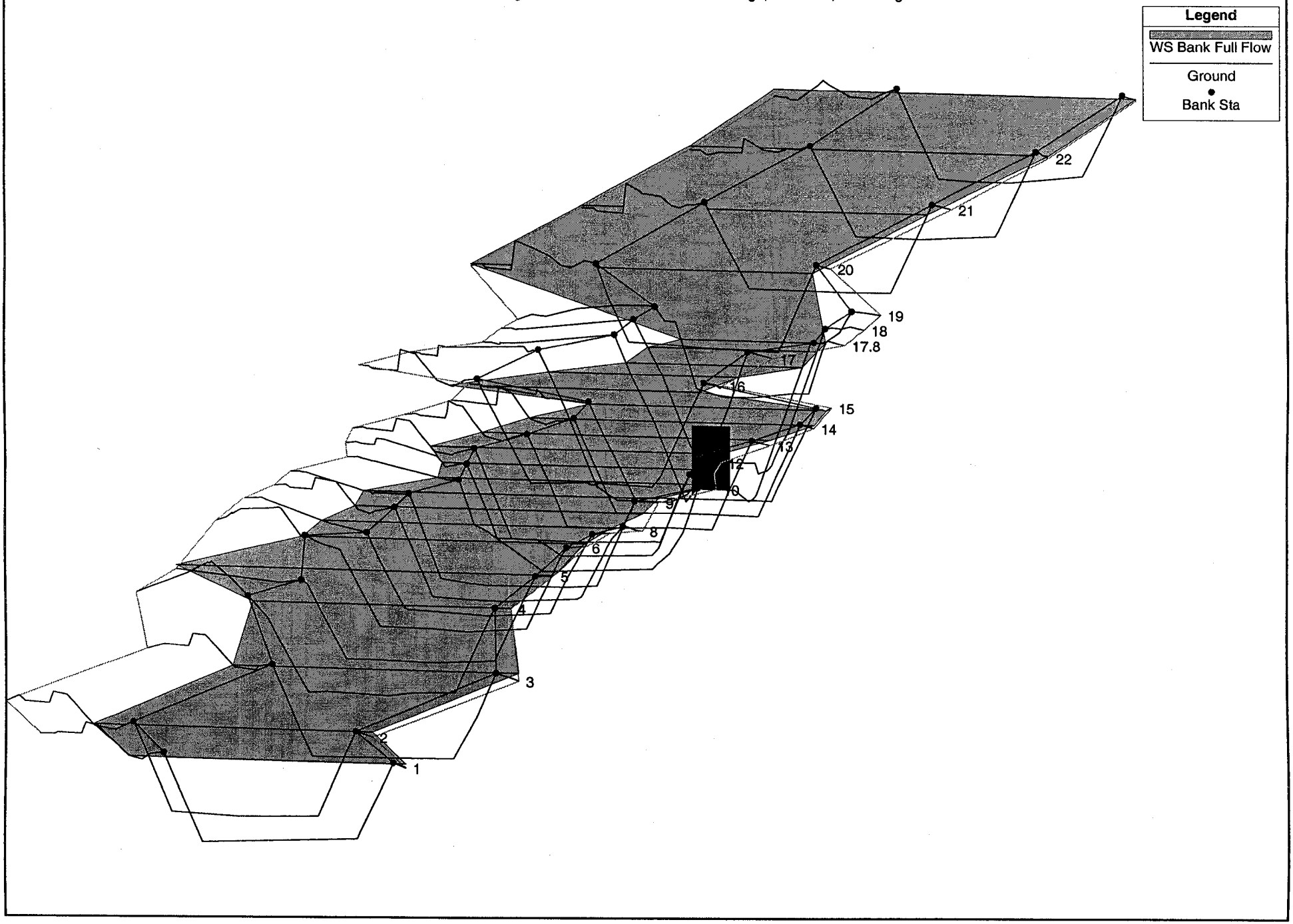
EMF / Existing Germann Road w/obstruction Plan: GermannEMF w/o Piers with obstruction 5/21/2003 6:35:11 PM

Geom: EMF / Existing German w/obstruction Flow: Design, Bank Full, & Existing



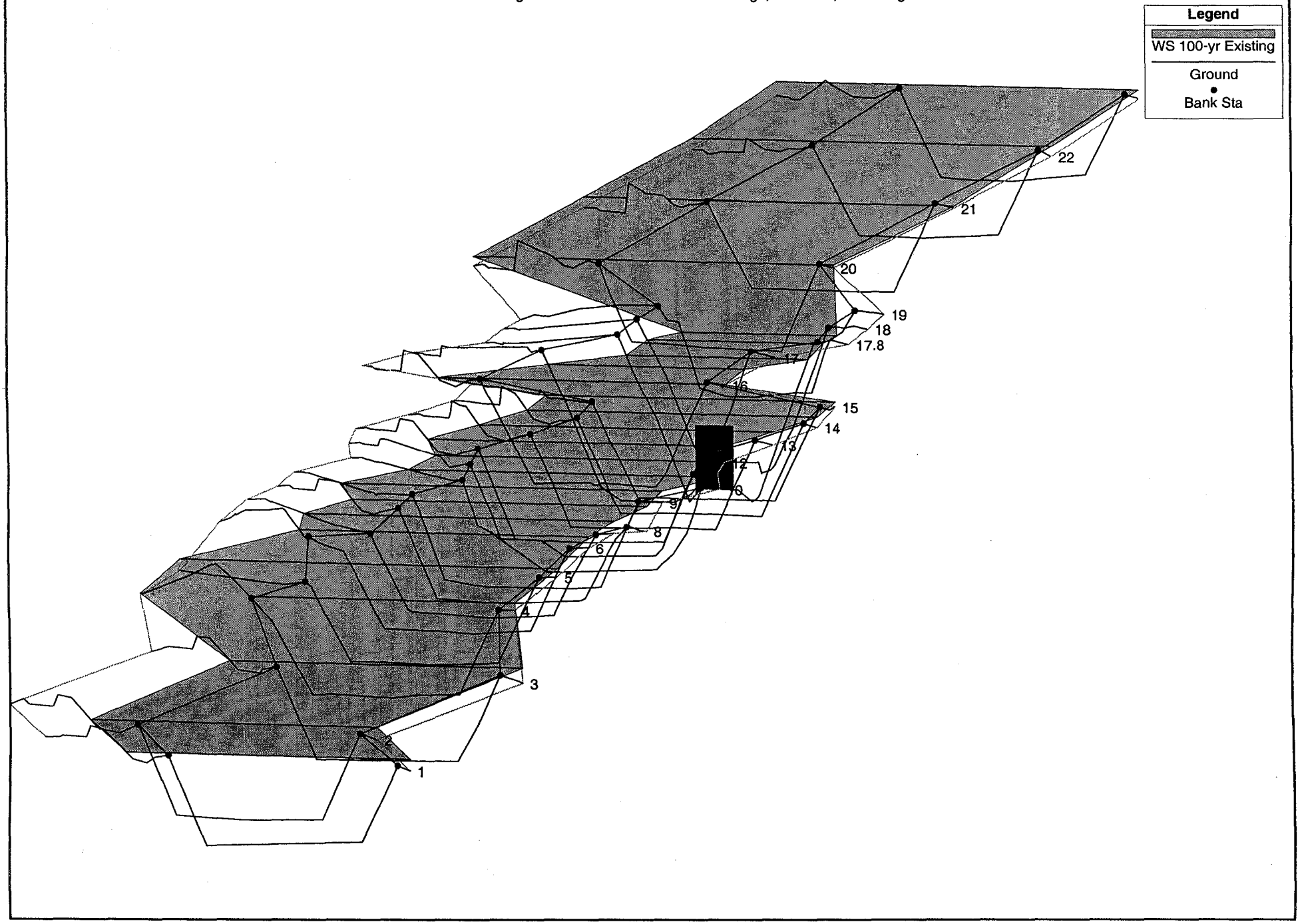
EMF / Existing Germann Road w/obstruction Plan: GermannEMF w/o Piers with obstruction 5/21/2003 6:35:11 PM

Geom: EMF / Existing German w/obstruction Flow: Design, Bank Full, & Existing



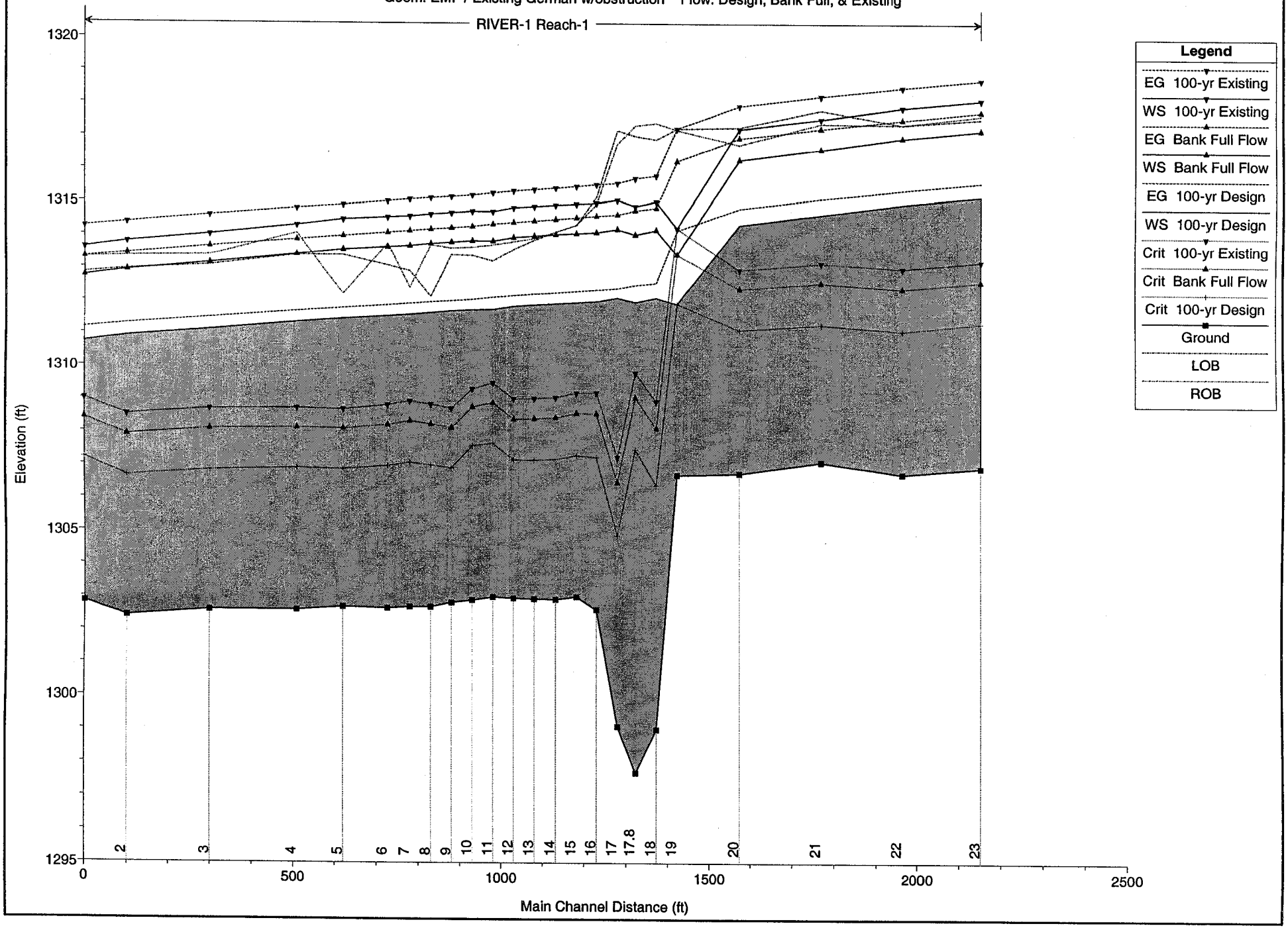
EMF / Existing Germann Road w/obstruction Plan: GermannEMF w/o Piers with obstruction 5/21/2003 6:35:11 PM

Geom: EMF / Existing German w/obstruction Flow: Design, Bank Full, & Existing



EMF / Existing Germann Road w/obstruction Plan: GermannEMF w/o Piers with obstruction 5/21/2003 6:35:11 PM

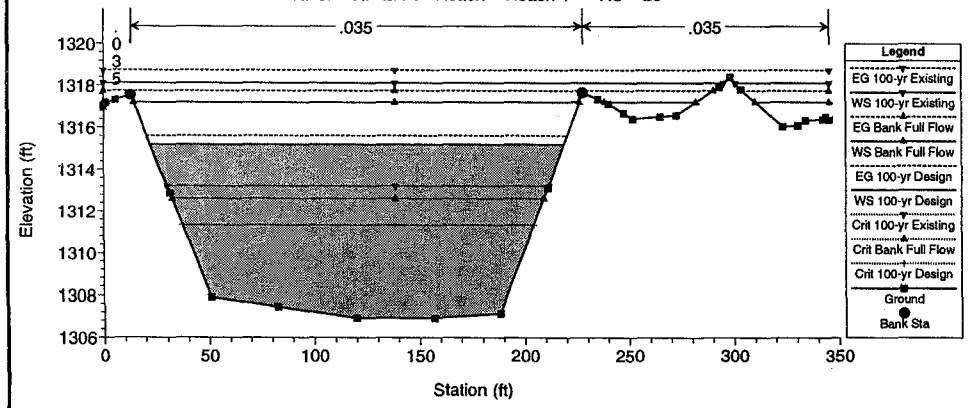
Geom: EMF / Existing German w/obstruction Flow: Design, Bank Full, & Existing



EMF / Existing Germann Road w/obstruction Plan: GermannEMF w/o Piers with obstruction 5/21/2003 6:35:11 PM

Geom: EMF / Existing German w/obstruction Flow: Design, Bank Full, & Existing

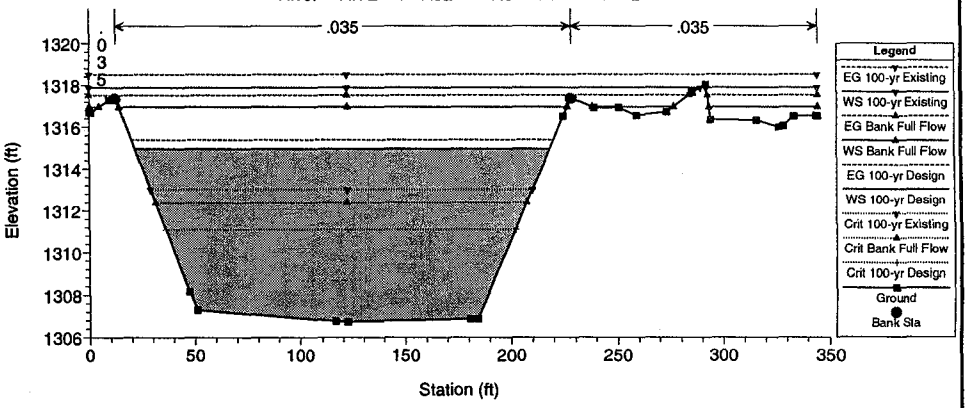
River = RIVER-1 Reach = Reach-1 RS = 23



EMF / Existing Germann Road w/obstruction Plan: GermannEMF w/o Piers with obstruction 5/21/2003 6:35:11 PM

Geom: EMF / Existing German w/obstruction Flow: Design, Bank Full, & Existing

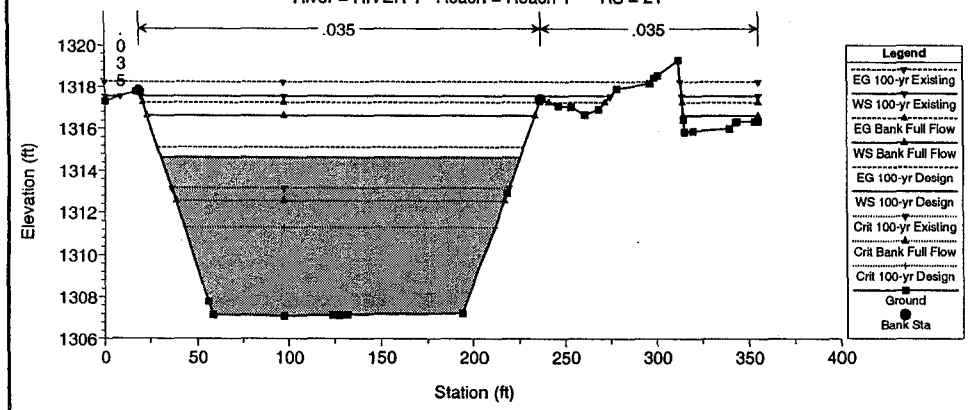
River = RIVER-1 Reach = Reach-1 RS = 22



EMF / Existing Germann Road w/obstruction Plan: GermannEMF w/o Piers with obstruction 5/21/2003 6:35:11 PM

Geom: EMF / Existing German w/obstruction Flow: Design, Bank Full, & Existing

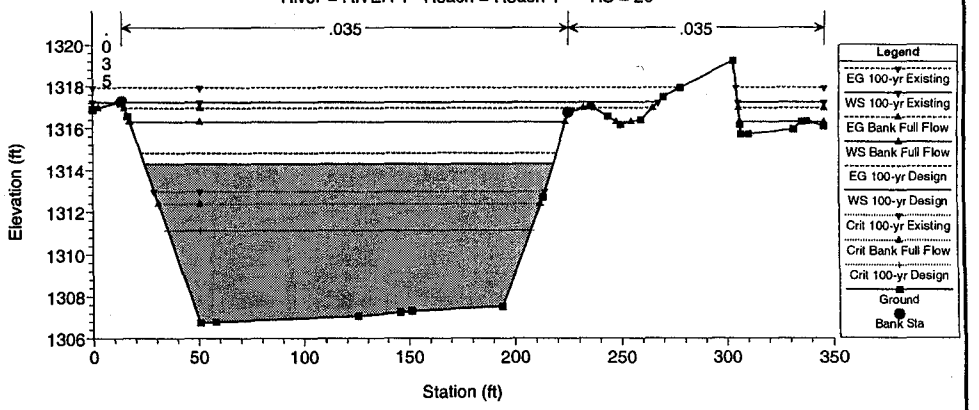
River = RIVER-1 Reach = Reach-1 RS = 21



EMF / Existing Germann Road w/obstruction Plan: GermannEMF w/o Piers with obstruction 5/21/2003 6:35:11 PM

Geom: EMF / Existing German w/obstruction Flow: Design, Bank Full, & Existing

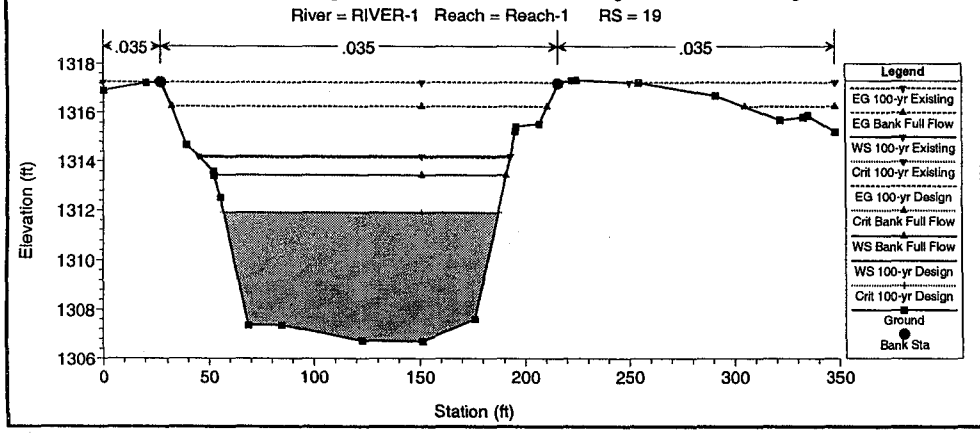
River = RIVER-1 Reach = Reach-1 RS = 20



EMF / Existing Germann Road w/obstruction Plan: GermannEMF w/o Piers with obstruction 5/21/2003 6:35:11 PM

Geom: EMF / Existing German w/obstruction Flow: Design, Bank Full, & Existing

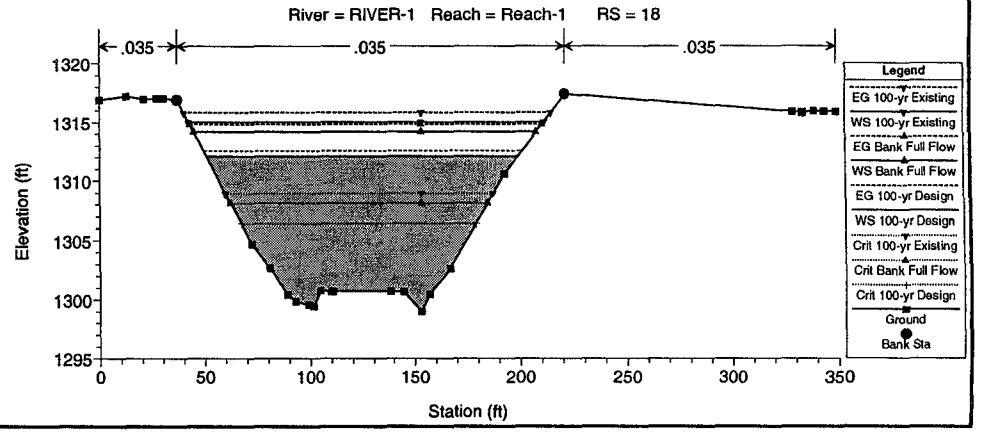
River = RIVER-1 Reach = Reach-1 RS = 19



EMF / Existing Germann Road w/obstruction Plan: GermannEMF w/o Piers with obstruction 5/21/2003 6:35:11 PM

Geom: EMF / Existing German w/obstruction Flow: Design, Bank Full, & Existing

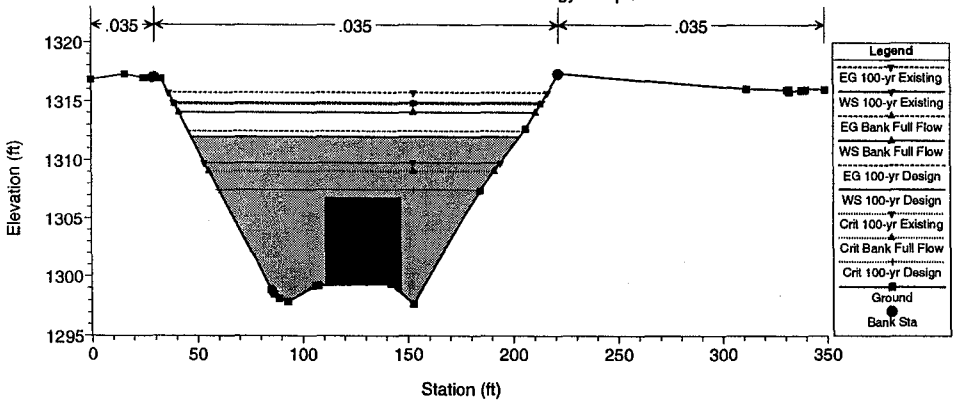
River = RIVER-1 Reach = Reach-1 RS = 18



EMF / Existing Germann Road w/obstruction Plan: GermannEMF w/o Piers with obstruction 5/21/2003 6:35:11 PM

Geom: EMF / Existing German w/obstruction Flow: Design, Bank Full, & Existing

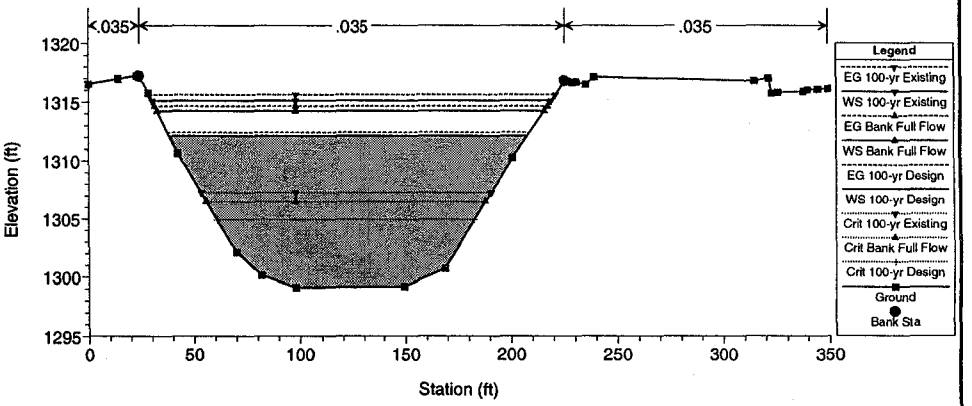
River = RIVER-1 Reach = Reach-1 RS = 17.8 Energy dissipater as blocked obstruction



EMF / Existing Germann Road w/obstruction Plan: GermannEMF w/o Piers with obstruction 5/21/2003 6:35:11 PM

Geom: EMF / Existing German w/obstruction Flow: Design, Bank Full, & Existing

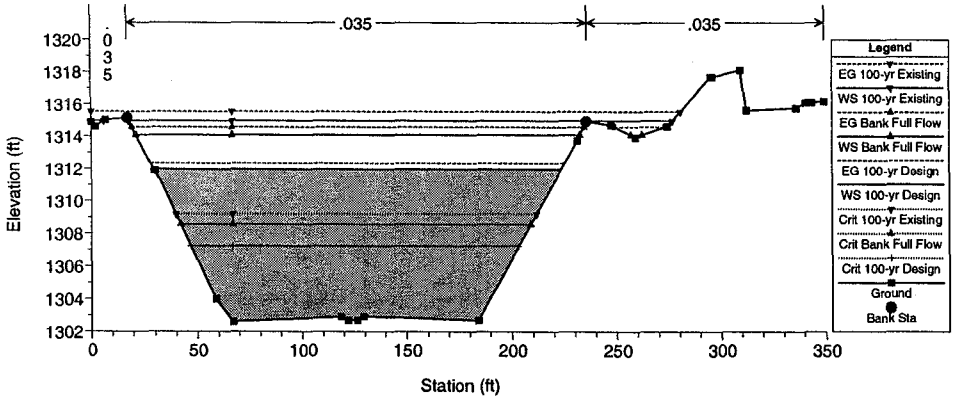
River = RIVER-1 Reach = Reach-1 RS = 17



EMF / Existing Germann Road w/obstruction Plan: GermannEMF w/o Piers with obstruction 5/21/2003 6:35:11 PM

Geom: EMF / Existing German w/obstruction Flow: Design, Bank Full, & Existing

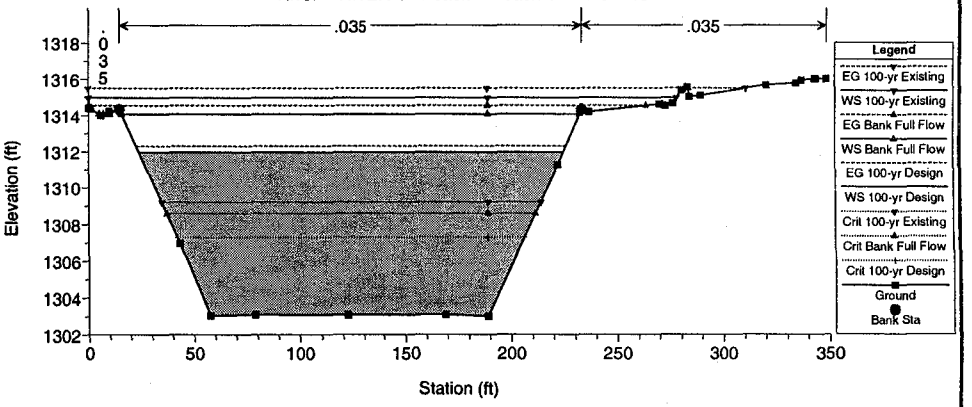
River = RIVER-1 Reach = Reach-1 RS = 16



EMF / Existing Germann Road w/obstruction Plan: GermannEMF w/o Piers with obstruction 5/21/2003 6:35:11 PM

Geom: EMF / Existing German w/obstruction Flow: Design, Bank Full, & Existing

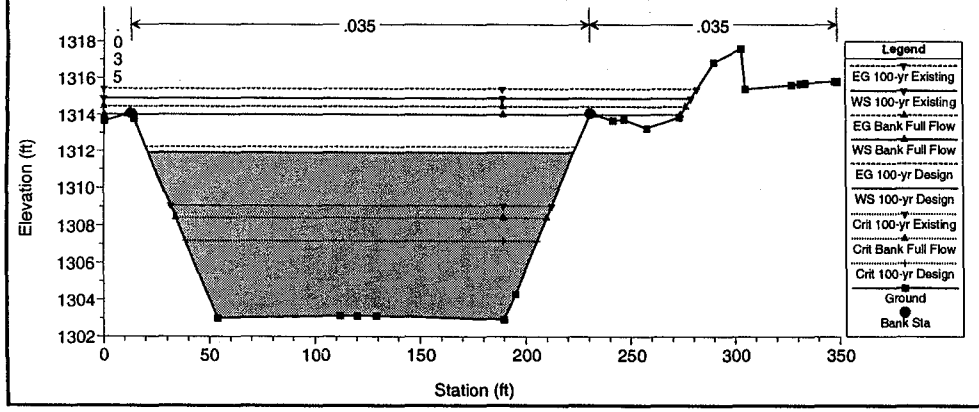
River = RIVER-1 Reach = Reach-1 RS = 15



EMF / Existing Germann Road w/obstruction Plan: GermannEMF w/o Piers with obstruction 5/21/2003 6:35:11 PM

Geom: EMF / Existing German w/obstruction Flow: Design, Bank Full, & Existing

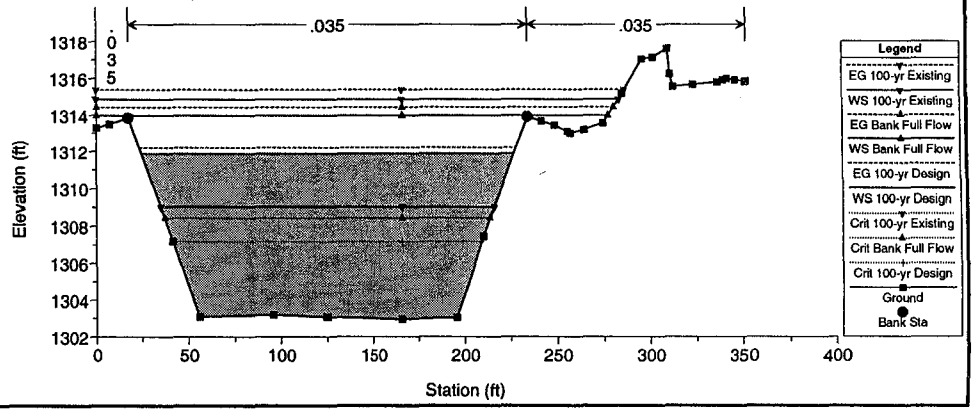
River = RIVER-1 Reach = Reach-1 RS = 14



EMF / Existing Germann Road w/obstruction Plan: GermannEMF w/o Piers with obstruction 5/21/2003 6:35:11 PM

Geom: EMF / Existing German w/obstruction Flow: Design, Bank Full, & Existing

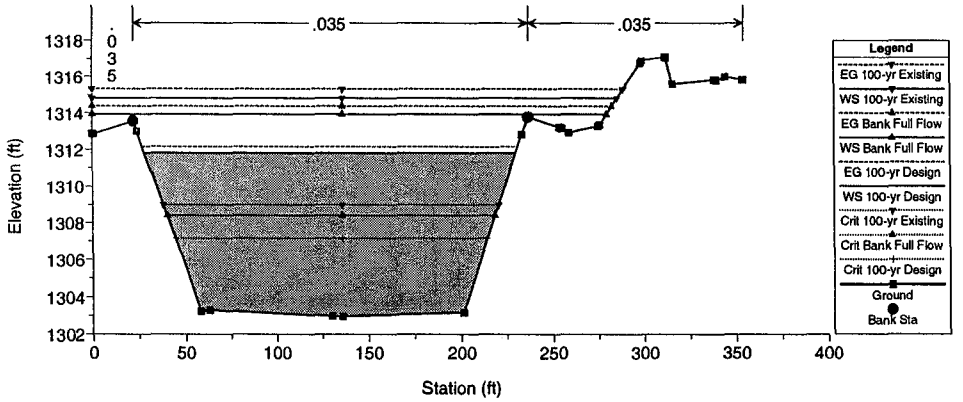
River = RIVER-1 Reach = Reach-1 RS = 13



EMF / Existing Germann Road w/obstruction Plan: GermannEMF w/o Piers with obstruction 5/21/2003 6:35:11 PM

Geom: EMF / Existing German w/obstruction Flow: Design, Bank Full, & Existing

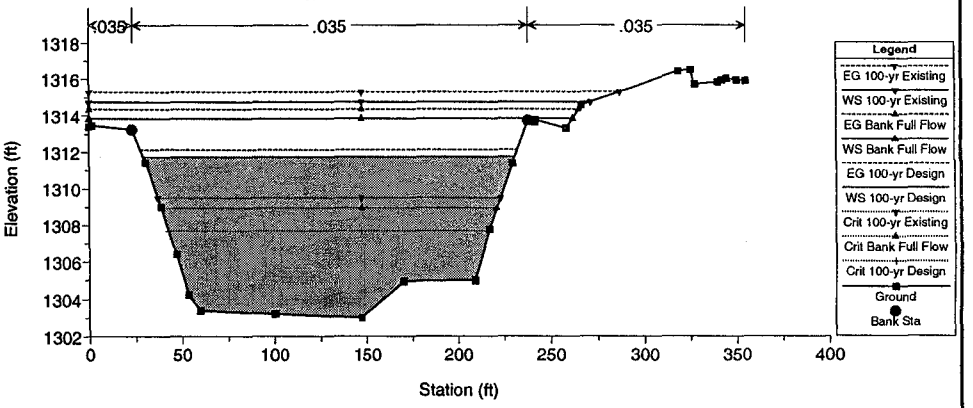
River = RIVER-1 Reach = Reach-1 RS = 12



EMF / Existing Germann Road w/obstruction Plan: GermannEMF w/o Piers with obstruction 5/21/2003 6:35:11 PM

Geom: EMF / Existing German w/obstruction Flow: Design, Bank Full, & Existing

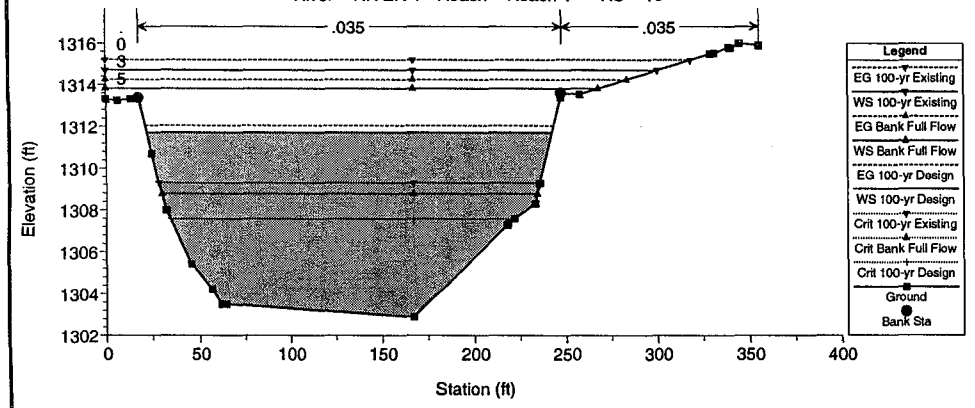
River = RIVER-1 Reach = Reach-1 RS = 11



EMF / Existing Germann Road w/obstruction Plan: GermannEMF w/o Piers with obstruction 5/21/2003 6:35:11 PM

Geom: EMF / Existing German w/obstruction Flow: Design, Bank Full, & Existing

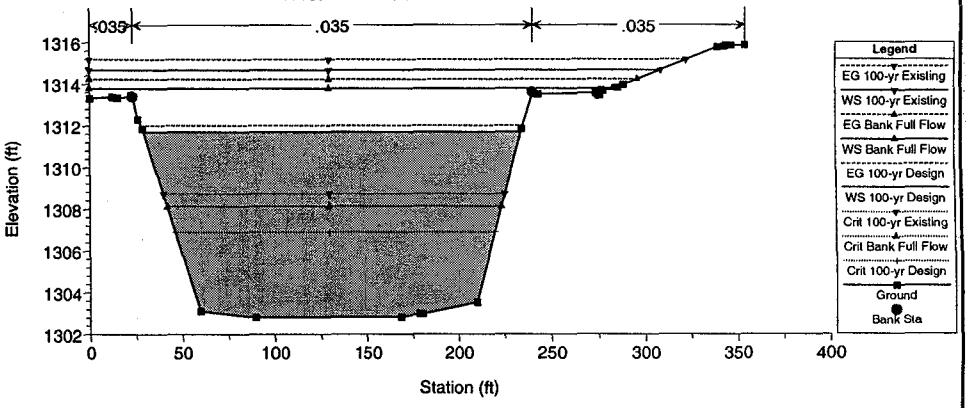
River = RIVER-1 Reach = Reach-1 RS = 10



EMF / Existing Germann Road w/obstruction Plan: GermannEMF w/o Piers with obstruction 5/21/2003 6:35:11 PM

Geom: EMF / Existing German w/obstruction Flow: Design, Bank Full, & Existing

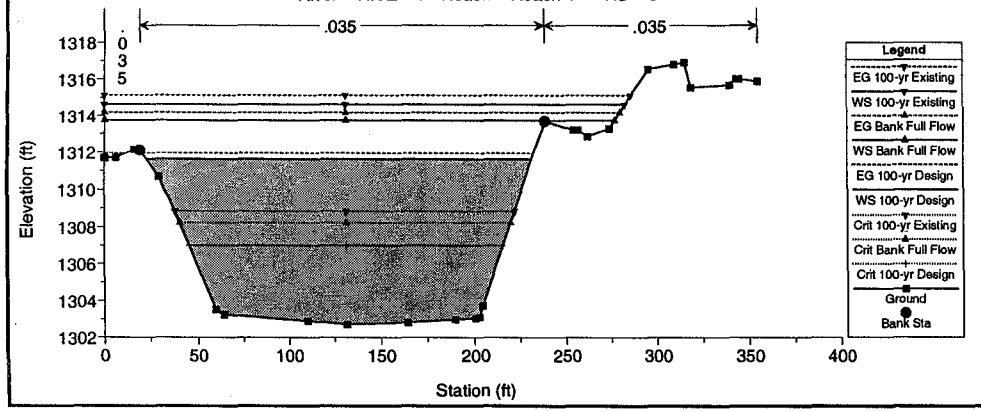
River = RIVER-1 Reach = Reach-1 RS = 9



EMF / Existing Germann Road w/obstruction Plan: GermannEMF w/o Piers with obstruction 5/21/2003 6:35:11 PM

Geom: EMF / Existing German w/obstruction Flow: Design, Bank Full, & Existing

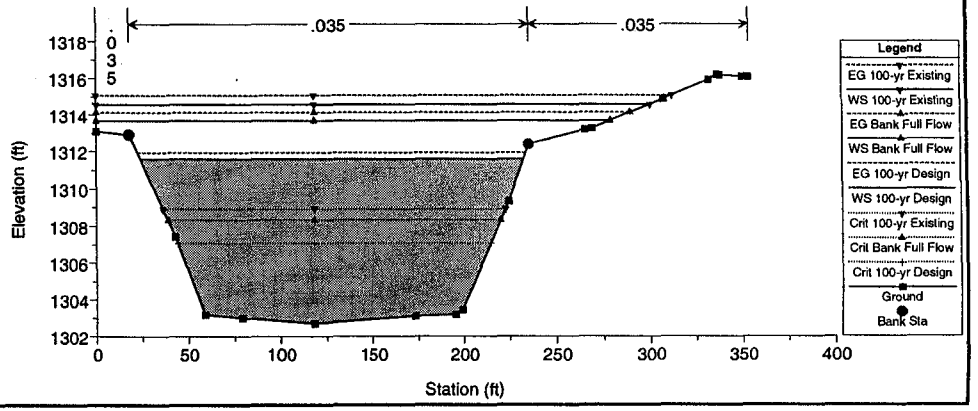
River = RIVER-1 Reach = Reach-1 RS = 8



EMF / Existing Germann Road w/obstruction Plan: GermannEMF w/o Piers with obstruction 5/21/2003 6:35:11 PM

Geom: EMF / Existing German w/obstruction Flow: Design, Bank Full, & Existing

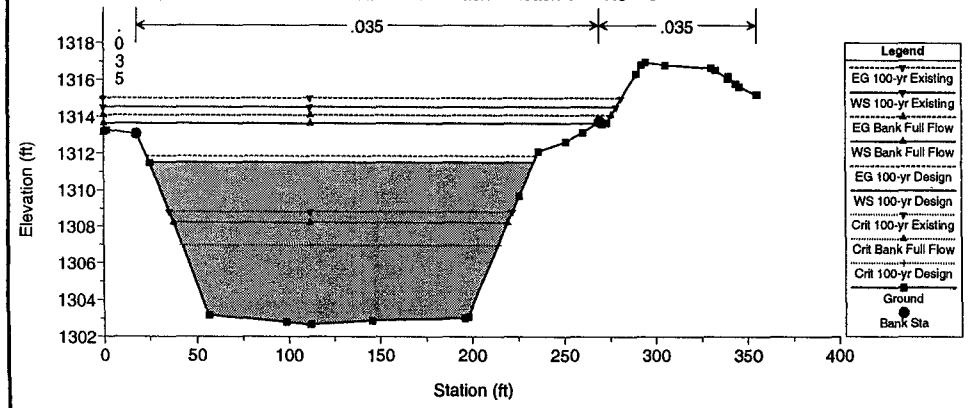
River = RIVER-1 Reach = Reach-1 RS = 7



EMF / Existing Germann Road w/obstruction Plan: GermannEMF w/o Piers with obstruction 5/21/2003 6:35:11 PM

Geom: EMF / Existing German w/obstruction Flow: Design, Bank Full, & Existing

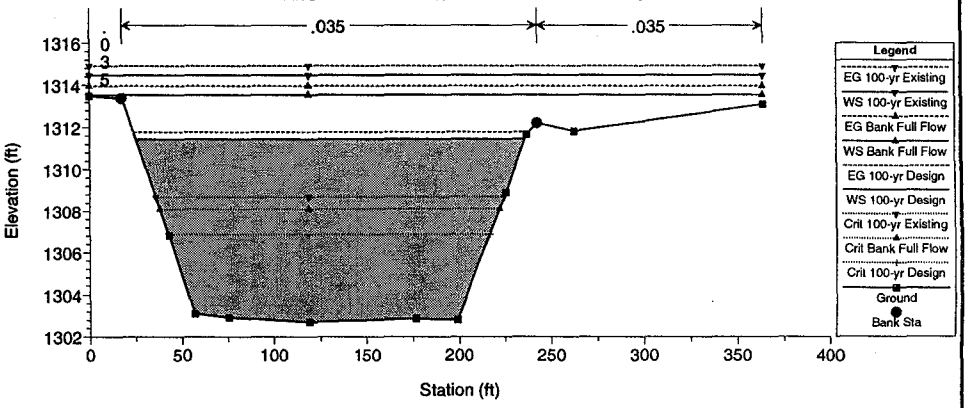
River = RIVER-1 Reach = Reach-1 RS = 6



EMF / Existing Germann Road w/obstruction Plan: GermannEMF w/o Piers with obstruction 5/21/2003 6:35:11 PM

Geom: EMF / Existing German w/obstruction Flow: Design, Bank Full, & Existing

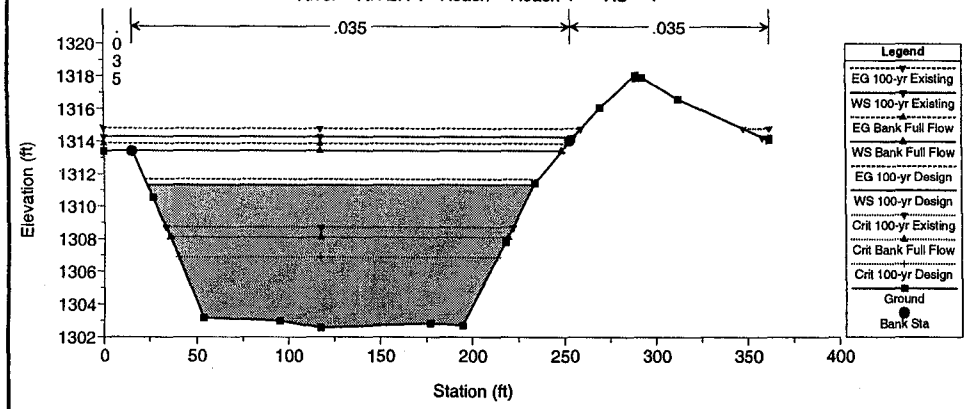
River = RIVER-1 Reach = Reach-1 RS = 5



EMF / Existing Germann Road w/obstruction Plan: GermannEMF w/o Piers with obstruction 5/21/2003 6:35:11 PM

Geom: EMF / Existing German w/obstruction Flow: Design, Bank Full, & Existing

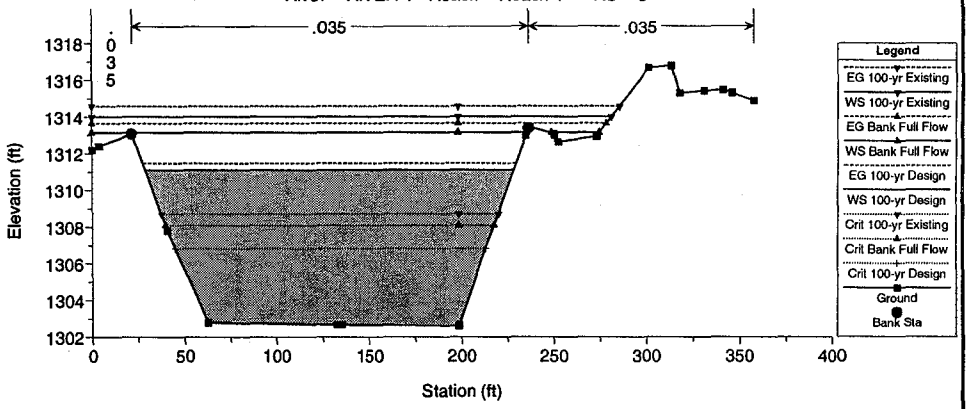
River = RIVER-1 Reach = Reach-1 RS = 4



EMF / Existing Germann Road w/obstruction Plan: GermannEMF w/o Piers with obstruction 5/21/2003 6:35:11 PM

Geom: EMF / Existing German w/obstruction Flow: Design, Bank Full, & Existing

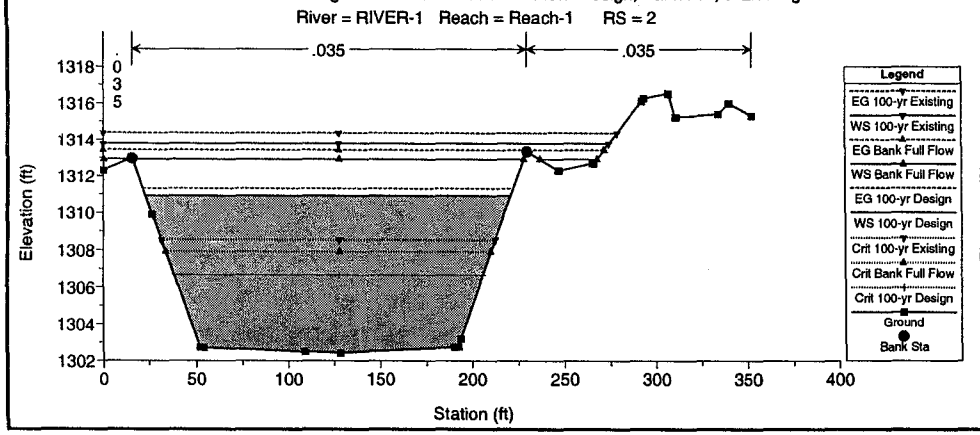
River = RIVER-1 Reach = Reach-1 RS = 3



EMF / Existing Germann Road w/obstruction Plan: GermannEMF w/o Piers with obstruction 5/21/2003 6:35:11 PM

Geom: EMF / Existing German w/obstruction Flow: Design, Bank Full, & Existing

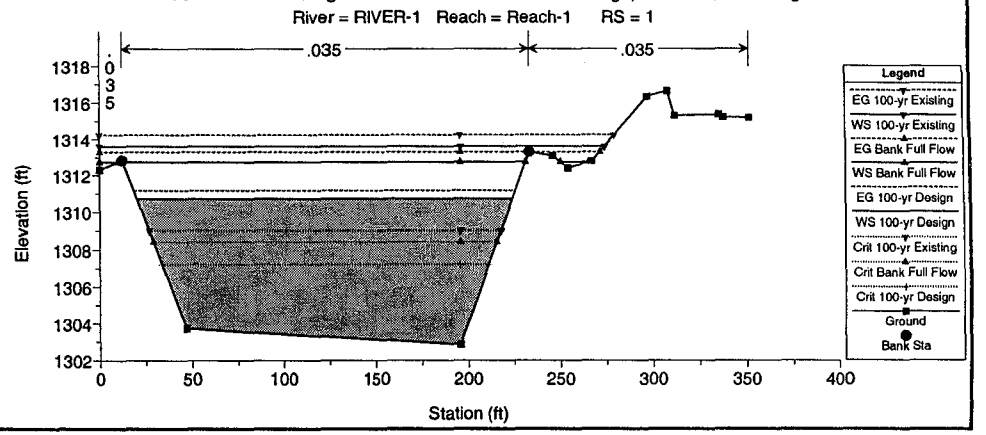
River = RIVER-1 Reach = Reach-1 RS = 2



EMF / Existing Germann Road w/obstruction Plan: GermannEMF w/o Piers with obstruction 5/21/2003 6:35:11 PM

Geom: EMF / Existing German w/obstruction Flow: Design, Bank Full, & Existing

River = RIVER-1 Reach = Reach-1 RS = 1



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                    HEC-RAS Version 3.1.1 May 2003
                     U.S. Army Corp of Engineers
                    Hydrologic Engineering Center
                      609 Second Street, Suite D
                     Davis, California 95616-4687
                           (916) 756-1104


          X     X  XXXXXX    XXXX        XXXX       XX      XXXX
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PROJECT DATA
Project Title: EMF / Existing Germann Road w/obstruction
Project File : GermanEMFnopiers.prj
Run Date and Time: 5/21/2003 6:35:11 PM

Project in English units

Project Description:
Germann Road crossing the EMF ******* Autodesk, Inc. HEC-2 Input Data file
****
********** Minimum Data Input **********

****

PLAN DATA

Plan Title: GermannEMF w/o Piers with obstruction
Plan File : w:\2002Projects\021733 - Germann Road Bridge\Hydraulics\HEC-RAS\GermanEMFnopiers.p02

Geometry Title: EMF / Existing German w/obstruction
Geometry File : w:\2002Projects\021733 - Germann Road Bridge\Hydraulics\HEC-RAS\GermanEMFnopiers.g02

Flow Title : Design, Bank Full, & Existing
Flow File : w:\2002Projects\021733 - Germann Road Bridge\Hydraulics\HEC-RAS\GermanEMFnopiers.f01

Plan Summary Information:

Number of:	Cross Sections	= 24	Mulitple Openings	=	0
	Culverts	= 0	Inline Structures	=	0
	Bridges	= 0	Lateral Structures	=	0

Computational Information

Water surface calculation tolerance	=	0.003
Critical depth calculaton tolerance	=	0.003
Maximum number of interations	=	20
Maximum difference tolerance	=	0.1
Flow tolerance factor	=	0.001

Computation Options
Critical depth computed at all cross sections
Conveyance Calculation Method: At breaks in n values only
Friction Slope Method: Average Conveyance
Computational Flow Regime: Mixed Flow

FLOW DATA

Flow Title: Design, Bank Full, & Existing
Flow File : w:\2002Projects\021733 - Germann Road Bridge\Hydraulics\HEC-RAS\GermanEMFnopiers.f01

Flow Data (cfs)

River	Reach	RS	100-yr Design	Bank Full Flow	100-yr Existing
RIVER-1	Reach-1	23	6900	10500	12438
RIVER-1	Reach-1	1	6900	10500	12438

Boundary Conditions

River	Reach	Profile	Upstream	Downstream
RIVER-1	Reach-1	100-yr Design	Normal S = 0.001	Normal S = 0.0013

GEOMETRY DATA

Geometry Title: EMF / Existing German w/obstruction
Geometry File : w:\2002Projects\021733 - Germann Road Bridge\Hydraulics\HEC-RAS\GermanEMFnopiers.g02

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 23

INPUT
Description:
Station Elevation Data num= 27

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1317	1.07	1317.18	5.82	1317.31	12.93	1317.55	31.19	1312.86
50.84	1307.9	82.41	1307.44	119.77	1306.92	156.92	1306.92	188.12	1307.13
211.01	1313.1	227.87	1317.65	235.25	1317.35	240	1317.11	247.24	1316.67
251.72	1316.4	264.56	1316.51	272.27	1316.56	293.1	1317.93	298.29	1318.39
303.52	1317.8	323.23	1316.03	330.27	1316.07	333.98	1316.32	342.05	1316.37
343.73	1316.5	345.61	1316.35						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.035	12.93	.035	227.87	.035

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
12.93	227.87	227.48	188.32	149.16	.1	.3

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 22

INPUT
Description:
Station Elevation Data num= 26

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1316.7	.71	1316.69	9.5	1317.28	12.46	1317.37	47.4	1308.16
50.93	1307.3	116.18	1306.77	121.9	1306.73	180.68	1306.87	184.37	1306.87
224.72	1316.5	228.21	1317.37	239.1	1316.91	250.6	1316.92	259.07	1316.54
273.31	1316.7	285.31	1317.65	291.92	1318.04	294.02	1316.34	315.74	1316.3
326.21	1316	328.31	1316.04	332.89	1316.49	333.28	1316.51	343.73	1316.53
344.17	1316.5								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.035	12.46	.035	228.21	.035

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
12.46	228.21	213.76	194.02	174.48	.1	.3

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 21

INPUT
Description:
Station Elevation Data num= 29

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1317.3	16.8	1317.78	18.47	1317.81	55.88	1307.78	58.55	1307.17
97.34	1307.1	123.68	1307.15	127.36	1307.13	131.71	1307.17	194.09	1307.22
218.54	1312.9	236.78	1317.4	246.49	1317.07	253.44	1317.03	260.89	1316.65
268.46	1316.9	278.46	1317.9	296.59	1318.16	298.91	1318.44	300.84	1318.55
312.09	1319.3	314.85	1316.45	315.49	1315.84	320.01	1315.87	339.92	1316
343.13	1316.3	344.04	1316.33	353.41	1316.33	355.38	1316.34		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.035	18.47	.035	236.78	.035

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
18.47	236.78	211.51	195.85	180.25	.1	.3

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 20

INPUT
Description:
Station Elevation Data num= 26

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1316.9	.21	1316.87	13.85	1317.28	16.54	1316.57	50.85	1306.75
58.34	1306.8	125.28	1307.07	145.97	1307.25	151.34	1307.32	194.39	1307.54
213.6	1312.7	225.76	1316.75	236.02	1317.05	244.15	1316.56	250.09	1316.17
259.69	1316.4	270.59	1317.48	278.31	1317.93	303.51	1319.24	306.89	1316.16
307.33	1315.7	311.03	1315.72	331.98	1315.94	335.86	1316.31	338.11	1316.33
346.24	1316.1								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.035	13.85	.035	225.76	.035

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
13.85	225.76	148.03	150.76	153.49	.1	.3

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 19

INPUT
Description:
Station Elevation Data num= 24

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1316.9	20.59	1317.21	27.31	1317.24	39.28	1314.68	52.31	1313.6
52.58	1313.4	55.81	1312.52	69.02	1307.35	84.93	1307.35	122.99	1306.72
151.44	1306.7	176.53	1307.61	195.96	1315.24	196.26	1315.44	207.37	1315.55
216.35	1317.2	223.01	1317.32	224.94	1317.33	254.67	1317.22	291.36	1316.7
321.99	1315.7	333.07	1315.82	335.21	1315.88	348.25	1315.22		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.035	27.31	.035	216.35	.035

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
27.31	216.35	49.99	49.99	50	.1	.3

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 18

INPUT
Description:
Station Elevation Data num= 29

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1316.9	12.66	1317.23	20.94	1316.95	27.01	1317.03	30.51	1317.05
36.96	1316.9	72.03	1304.73	80.85	1302.7	88.96	1300.46	92.97	1299.87
99.05	1299.6	101.48	1299.47	104.72	1300.77	110	1300.72	138.19	1300.73
144.53	1300.7	153	1299	156.74	1300.48	166.58	1302.64	192.31	1310.57
220.86	1317.4	220.9	1317.4	328.55	1315.88	333	1315.86	333.25	1315.87
333.3	1315.8	338.53	1315.95	343.51	1315.93	348.83	1315.9		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.035	36.96	.035	220.9	.035

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
36.96	220.9	50	50	50	.1	.3

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 17.8

INPUT
Description: Energy dissipater as blocked obstruction
Station Elevation Data num= 28

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1316.8	16.09	1317.26	25.1	1316.96	28.08	1317	29.81	1317.01
33.01	1316.9	85.23	1298.89	86.01	1298.72	86.74	1298.52	88.98	1298.19
92.98	1297.9	106.31	1299.21	107.69	1299.21	142.2	1299.33	152.76	1297.7
184.14	1307.4	206.02	1312.65	221.74	1317.32	311.36	1316.05	330.74	1315.97
331.8	1316	332.01	1315.81	337.6	1315.94	338.98	1315.95	339.24	1315.97
339.76	1316	348.86	1316	348.89	1315.99				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.035	29.81	.035	221.74	.035

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
29.81	221.74	41.41	42.36	44.04	.1	.3

Blocked Obstructions num= 1

Sta L	Sta R	Elev
111	147	1306.8

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 17

INPUT
Description:
Station Elevation Data num= 26

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1316.5	14.36	1316.93	23.05	1317.21	24.29	1317.18	28.51	1315.76
42.54	1310.6	70.07	1302.09	81.83	1300.12	98.18	1299.09	149.5	1299.15

168.96	1300.7	200.86	1310.22	225.53	1316.77	227.14	1316.73	228.74	1316.63
230.8	1316.7	235.19	1316.47	239.37	1317.09	314.43	1316.77	321.3	1316.98
322.64	1315.7	325.65	1315.79	337.5	1315.87	339.71	1316.01	344.16	1316.06
348.97	1316.1								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.035	24.29	.035	225.53	.035

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
24.29	225.53	49.99	49.99	49.99	.1	.3

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 16

INPUT
Description:
Station Elevation Data num= 28

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1314.9	1.86	1314.62	6.87	1315.03	17.32	1315.15	17.45	1315.1
29.99	1311.9	58.65	1303.99	66.89	1302.62	118.56	1302.92	121.93	1302.71
126.38	1302.7	129.35	1302.95	184	1302.71	231.18	1313.76	235.58	1314.93
247.3	1314.7	258.95	1313.94	273.96	1314.63	274.13	1314.62	294.96	1317.69
295.87	1317.7	309.35	1318.1	311.99	1315.62	312.06	1315.62	335.82	1315.77
340.25	1316.1	343.16	1316.09	349.11	1316.15				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.035	17.32	.035	235.58	.035

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
17.32	235.58	54.94	48.21	41.48	.1	.3

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 15

INPUT
Description:
Station Elevation Data num= 27

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1314.4	.99	1314.35	5.89	1313.99	9.77	1314.21	10.08	1314.11
14.81	1314.3	43.49	1306.96	57.82	1303.05	78.89	1303.1	122.33	1303.08
169.24	1303.1	189.37	1303.01	222.43	1311.26	233.5	1314.3	236.85	1314.18
270.24	1314.6	272.83	1314.51	276.54	1314.65	280.63	1315.37	283.74	1315.55
284.27	1315	289.59	1315.08	320.7	1315.66	334.73	1315.75	337.31	1315.92
343.77	1316	348.83	1316.01						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.035	14.81	.035	233.5	.035

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
14.81	233.5	49.99	49.99	49.99	.1	.3

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 14

INPUT
Description:
Station Elevation Data num= 25

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev

0	1313.7	.11	1313.67	13.15	1314.1	14.35	1313.8	53.92	1303
112.11	1303.12	120.34	1303.12	129.22	1303.12	189.84	1302.93	195.18	1304.3
230.91	1314.09	241.73	1313.71	247.15	1313.78	257.89	1313.29	273.29	1313.9
290.24	1316.85	303.15	1317.6	305.36	1315.43	327.39	1315.63	331.57	1315.7
333.46	1315.72	333.81	1315.74	348.03	1315.83	348.88	1315.84	349.04	1315.8

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.035	13.15	.035	230.91	.035

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
13.15	230.91	47.14	51.15	55.19	.1	.3

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 13

INPUT
Description:
Station Elevation Data num= 30

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1313.3	7.16	1313.51	17.49	1313.85	41.43	1307.19	55.73	1303.09
95.71	1303.2	124.82	1303.07	165.64	1302.94	195.39	1303.03	209.9	1307.44
233.54	1313.9	241.2	1313.68	248.28	1313.44	255.18	1313.1	256.81	1312.99
264.14	1313.2	274.26	1313.57	284.91	1315.17	295.4	1317.01	301.31	1317.11
309.17	1317.6	310.56	1316.23	312.29	1315.55	323.11	1315.65	336.23	1315.77
339.13	1315.9	341.43	1315.97	346	1315.89	351.49	1315.82	351.51	1315.81

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.035	17.49	.035	233.54	.035

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
17.49	233.54	50.04	50.04	50.07	.1	.3

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 12

INPUT
Description:
Station Elevation Data num= 29

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1312.9	.49	1312.87	22.24	1313.57	24.23	1313.02	58.36	1303.24
63.14	1303.3	130.36	1302.99	136.1	1302.97	201.39	1303.17	233.26	1312.85
236.79	1313.8	253.45	1313.25	254.38	1313.22	255.29	1313.18	258.85	1312.95
274.89	1313.3	275.73	1313.38	298.34	1316.78	298.95	1316.89	311.47	1317.09
311.96	1317.1	312.04	1317.04	315.67	1315.6	338.39	1315.82	339.33	1315.83
339.54	1315.8	344.34	1315.99	353.89	1315.83	354.15	1315.82		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.035	22.24	.035	236.79	.035

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
22.24	236.79	49.97	50.01	50.06	.1	.3

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 11

INPUT
Description:
Station Elevation Data num= 28

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1313.4	1.81	1313.44	22.71	1313.24	23.41	1313.21	30.68	1311.41
38.78	1309	46.96	1306.39	53.62	1304.25	59.95	1303.38	100.49	1303.21
147.43	1303	170.45	1304.93	209.17	1304.98	217.17	1307.75	229.66	1311.36
237.97	1313.7	241.66	1313.62	241.91	1313.74	258.4	1313.28	266.48	1314.53
318.43	1316.4	325.25	1316.47	327.22	1315.69	339.77	1315.81	341.92	1315.91
344.58	1316	349.74	1315.91	354.73	1315.88				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.035	23.41	.035	237.97	.035

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
23.41	237.97	49.94	50.02	50.1	.1	.3

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 10

INPUT
Description:
Station Elevation Data num= 31

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1313.3	6.08	1313.24	13.34	1313.31	17.8	1313.38	24.6	1310.7
32.19	1308	45.23	1305.42	56.37	1304.23	61.59	1303.51	64.03	1303.5
167.07	1302.9	217.63	1307.27	218.05	1307.27	218.41	1307.4	221.8	1307.6
233.23	1308.3	235.62	1309.29	246.89	1313.41	247.44	1313.63	257.58	1313.54
328.68	1315.5	330.97	1315.53	338.93	1315.81	339.27	1315.82	339.37	1315.78
340.01	1315.8	344.47	1316	344.59	1316	344.83	1316	355.12	1315.93
355.14	1315.9								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.035	17.8	.035	247.44	.035

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
17.8	247.44	49.99	50	50.02	.1	.3

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 9

INPUT
Description:
Station Elevation Data num= 29

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1313.3	12.04	1313.38	13.93	1313.35	15.21	1313.33	22.98	1313.4
25.9	1312.3	28.62	1311.85	59.73	1303.12	89.78	1302.83	168.61	1302.83
178.67	1303	180.33	1302.98	209.88	1303.54	234.39	1311.85	240.4	1313.6
243.13	1313.5	274.02	1313.56	274.38	1313.53	275.39	1313.44	276.09	1313.46
277.35	1313.7	278.18	1313.67	286.22	1313.83	289.39	1313.96	339.97	1315.77
343.54	1315.8	344.67	1315.86	347.29	1315.84	354.71	1315.84		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.035	22.98	.035	240.4	.035

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
22.98	240.4	49.96	50.01	50.07	.1	.3

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 8

INPUT
Description:
Station Elevation Data num= 30

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1311.7	.43	1311.67	6.08	1311.7	16.02	1312.15	19.12	1312.12
29.8	1310.7	59.6	1303.53	64.09	1303.25	110.12	1302.9	131.59	1302.7
164.35	1302.8	189.58	1302.98	200.46	1303.06	202.6	1303.1	204.38	1303.71
238.89	1313.7	254.57	1313.23	256.89	1313.23	262.32	1312.89	262.4	1312.88
274.26	1313.3	295.59	1316.54	309.67	1316.81	315.35	1316.92	318.95	1315.56
339.93	1315.7	343.51	1316.02	344	1316.02	345.02	1316.02	355.12	1315.9

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.035	19.12	.035	238.89	.035

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
19.12	238.89	50.04	50.03	50.06	.1	.3

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 7

INPUT
Description:
Station Elevation Data num= 19

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1313.1	17.92	1312.91	42.93	1307.44	58.81	1303.2	79.07	1303
118.22	1302.7	173.12	1303.11	195.26	1303.2	198.92	1303.46	223.97	1309.32
234.8	1312.4	264.77	1313.2	268.58	1313.26	306.88	1314.88	331.3	1315.91
336.02	1316.2	337.52	1316.16	349.67	1316.09	352.94	1316.07		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.035	17.92	.035	234.8	.035

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
17.92	234.8	40.73	53.36	66	.1	.3

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 6

INPUT
Description:
Station Elevation Data num= 28

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1313.2	1.62	1313.27	18.06	1313.08	25.38	1311.49	56.41	1303.18
98.35	1302.8	111.94	1302.66	145.26	1302.9	195.76	1303.02	197.73	1303.09
225.34	1309.7	235.94	1312.12	250.82	1312.65	260.18	1313.14	269.32	1313.74
270.69	1313.6	273.13	1313.67	289.5	1316.34	292.28	1316.82	294.56	1316.96
305.32	1316.8	330.37	1316.65	332.82	1316.52	339.36	1316.07	339.73	1316.19
343.74	1315.8	345.67	1315.64	355.14	1315.23				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.035	18.06	.035	269.32	.035

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
18.06	269.32	79.92	107.16	134.56	.1	.3

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 5

INPUT
Description:
Station Elevation Data num= 13

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1313.5	17.55	1313.39	42.95	1306.82	56.78	1303.1	75.45	1302.92
119.39	1302.7	176.69	1302.88	198.98	1302.82	225.55	1308.89	236.75	1311.66
242.51	1312.2	262.48	1311.82	363.59	1313.09				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.035	17.55	.035	242.51	.035

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
17.55	242.51	70.16	110.96	151.76	.1	.3

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 4

INPUT
Description:
Station Elevation Data num= 17

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1313.4	15.44	1313.39	26.64	1310.53	53.6	1303.18	95.11	1303.01
117.61	1302.6	177.08	1302.87	194.77	1302.73	218.14	1307.82	234	1311.42
253.27	1314.05	269.67	1316.1	289.01	1318.07	289.63	1317.89	292.76	1317.91
312.28	1316.6	361.68	1314.1						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.035	15.44	.035	253.27	.035

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
15.44	253.27	175.07	209.04	243.01	.1	.3

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 3

INPUT
Description:
Station Elevation Data num= 32

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1312.2	3.81	1312.41	4.04	1312.41	21.77	1313.07	40.6	1307.8
62.78	1302.8	132.29	1302.68	134	1302.68	134.42	1302.68	135.2	1302.69
198.64	1302.6	198.78	1302.68	235.42	1312.98	236.68	1313.38	237.83	1313.43
250.76	1313.1	251.1	1313	252.8	1312.64	252.87	1312.64	273.73	1312.93
274.03	1313	301.74	1316.67	301.76	1316.67	313.93	1316.79	313.95	1316.78
318.24	1315.3	331.11	1315.42	341.33	1315.48	341.43	1315.48	346.09	1315.34
346.15	1315.3	358.08	1314.88						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.035	21.77	.035	236.68	.035

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
21.77	236.68	200.12	200.04	200.01	.1	.3

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 2

INPUT
Description:

Station Elevation Data num= 29

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1312.3	14.8	1312.96	15.78	1312.95	26.77	1309.88	52.29	1302.71
54.16	1302.7	108.99	1302.49	128.15	1302.42	190.14	1302.74	192.64	1302.76
194.12	1303.2	229.89	1313.35	230.27	1313.34	247.13	1312.32	247.48	1312.29
265.94	1312.7	266.59	1312.69	292.66	1316.11	293.85	1316.26	307.03	1316.52
307.29	1316.5	311.17	1315.25	311.23	1315.23	311.61	1315.23	311.7	1315.24
334.57	1315.4	340.12	1315.99	340.47	1315.98	352.8	1315.31		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.035	15.78	.035	230.27	.035

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
15.78	230.27	100	100.01	100.03	.1	.3

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 1

INPUT
Description:
Station Elevation Data num= 14

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1312.3	12.16	1312.84	47.03	1303.73	195.62	1302.85	232.89	1313.3
245.55	1313.1	253.98	1312.4	266.97	1312.8	296.46	1316.33	307.51	1316.63
311.58	1315.3	334.95	1315.38	337.4	1315.21	351.29	1315.18		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.035	12.16	.035	232.89	.035

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
12.16	232.89	0	0	0	.1	.3

SUMMARY OF MANNING'S N VALUES

River:RIVER-1

Reach	River Sta.	n1	n2	n3
Reach-1	23	.035	.035	.035
Reach-1	22	.035	.035	.035
Reach-1	21	.035	.035	.035
Reach-1	20	.035	.035	.035
Reach-1	19	.035	.035	.035
Reach-1	18	.035	.035	.035
Reach-1	17.8	.035	.035	.035
Reach-1	17	.035	.035	.035
Reach-1	16	.035	.035	.035
Reach-1	15	.035	.035	.035
Reach-1	14	.035	.035	.035
Reach-1	13	.035	.035	.035
Reach-1	12	.035	.035	.035
Reach-1	11	.035	.035	.035
Reach-1	10	.035	.035	.035
Reach-1	9	.035	.035	.035
Reach-1	8	.035	.035	.035
Reach-1	7	.035	.035	.035
Reach-1	6	.035	.035	.035
Reach-1	5	.035	.035	.035
Reach-1	4	.035	.035	.035
Reach-1	3	.035	.035	.035
Reach-1	2	.035	.035	.035
Reach-1	1	.035	.035	.035

SUMMARY OF REACH LENGTHS

River: RIVER-1

Reach	River Sta.	Left	Channel	Right
Reach-1	23	227.48	188.32	149.16
Reach-1	22	213.76	194.02	174.48
Reach-1	21	211.51	195.85	180.25
Reach-1	20	148.03	150.76	153.49
Reach-1	19	49.99	49.99	50
Reach-1	18	50	50	50
Reach-1	17.8	41.41	42.36	44.04
Reach-1	17	49.99	49.99	49.99
Reach-1	16	54.94	48.21	41.48
Reach-1	15	49.99	49.99	49.99
Reach-1	14	47.14	51.15	55.19
Reach-1	13	50.04	50.04	50.07
Reach-1	12	49.97	50.01	50.06
Reach-1	11	49.94	50.02	50.1
Reach-1	10	49.99	50	50.02
Reach-1	9	49.96	50.01	50.07
Reach-1	8	50.04	50.03	50.06
Reach-1	7	40.73	53.36	66
Reach-1	6	79.92	107.16	134.56
Reach-1	5	70.16	110.96	151.76
Reach-1	4	175.07	209.04	243.01
Reach-1	3	200.12	200.04	200.01
Reach-1	2	100	100.01	100.03
Reach-1	1	0	0	0

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS
River: RIVER-1

Reach	River Sta.	Contr.	Expan.
Reach-1	23	.1	.3
Reach-1	22	.1	.3
Reach-1	21	.1	.3
Reach-1	20	.1	.3
Reach-1	19	.1	.3
Reach-1	18	.1	.3
Reach-1	17.8	.1	.3
Reach-1	17	.1	.3
Reach-1	16	.1	.3
Reach-1	15	.1	.3
Reach-1	14	.1	.3
Reach-1	13	.1	.3
Reach-1	12	.1	.3
Reach-1	11	.1	.3
Reach-1	10	.1	.3
Reach-1	9	.1	.3
Reach-1	8	.1	.3
Reach-1	7	.1	.3
Reach-1	6	.1	.3
Reach-1	5	.1	.3
Reach-1	4	.1	.3
Reach-1	3	.1	.3
Reach-1	2	.1	.3
Reach-1	1	.1	.3

DRAFT

Design Conditions HEC-RAS Model

HEC-RAS Plan: Plan 04 River: RIVER-1 Reach: Reach-1

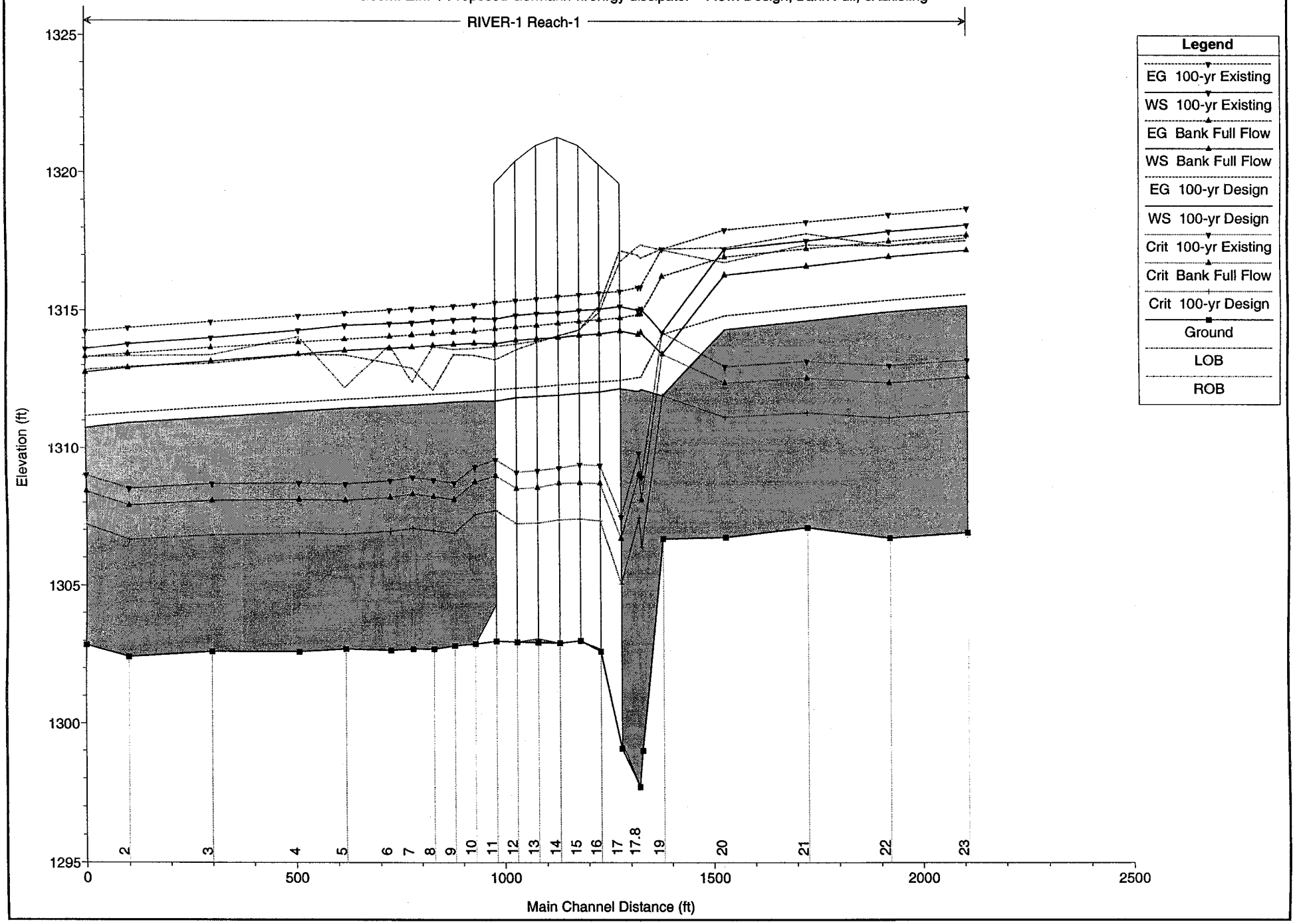
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Max Chl Dpth	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Reach-1	23	100-yr Design	6900.00	1306.92	1315.19	8.27	1311.33	1315.61	0.001191	5.20	1327.03	196.60	0.35
Reach-1	23	Bank Full Flow	10500.00	1306.92	1317.20	10.28	1312.60	1317.75	0.001230	6.01	1789.45	292.45	0.37
Reach-1	23	100-yr Existing	12438.00	1306.92	1318.12	11.20	1313.20	1318.72	0.001193	6.30	2087.63	340.09	0.37
Reach-1	22	100-yr Design	6900.00	1306.73	1314.96	8.23	1311.10	1315.38	0.001203	5.21	1323.35	196.64	0.35
Reach-1	22	Bank Full Flow	10500.00	1306.73	1316.95	10.22	1312.38	1317.52	0.001253	6.04	1772.55	306.51	0.37
Reach-1	22	100-yr Existing	12438.00	1306.73	1317.89	11.16	1313.00	1318.50	0.001205	6.31	2079.98	341.41	0.37
Reach-1	21	100-yr Design	6900.00	1307.10	1314.63	7.53	1311.29	1315.11	0.001491	5.58	1236.89	195.23	0.39
Reach-1	21	Bank Full Flow	10500.00	1307.10	1316.61	9.51	1312.55	1317.25	0.001491	6.39	1661.63	251.35	0.40
Reach-1	21	100-yr Existing	12438.00	1307.10	1317.54	10.44	1313.16	1318.23	0.001462	6.69	1919.32	305.50	0.41
Reach-1	20	100-yr Design	6900.00	1306.75	1314.31	7.56	1311.13	1314.81	0.001563	5.67	1217.03	194.03	0.40
Reach-1	20	Bank Full Flow	10500.00	1306.75	1316.29	9.54	1312.37	1316.95	0.001541	6.50	1627.30	249.59	0.41
Reach-1	20	100-yr Existing	12438.00	1306.75	1317.22	10.47	1312.96	1317.94	0.001498	6.81	1885.85	306.47	0.41
Reach-1	19	100-yr Design	6900.00	1306.70	1311.92	5.22	1311.92	1314.14	0.011114	11.97	576.55	130.15	1.00
Reach-1	19	Bank Full Flow	10500.00	1306.70	1313.42	6.72	1313.42	1316.25	0.010347	13.49	778.41	138.78	1.00
Reach-1	19	100-yr Existing	12438.00	1306.70	1314.22	7.51	1314.22	1317.24	0.010104	13.95	891.72	148.46	1.00
Reach-1	18	100-yr Design	6900.00	1299.00	1312.14	13.14	1306.40	1312.59	0.000923	5.35	1288.64	148.20	0.32
Reach-1	18	Bank Full Flow	10500.00	1299.00	1314.21	15.21	1308.12	1314.87	0.001153	6.52	1611.01	162.84	0.37
Reach-1	18	100-yr Existing	12438.00	1299.00	1315.08	16.08	1308.93	1315.86	0.001280	7.09	1754.27	168.93	0.39
Reach-1	17.8	100-yr Design	6900.00	1297.70	1312.07	14.37	1307.46	1312.57	0.001376	5.69	1213.21	156.58	0.36
Reach-1	17.8	Bank Full Flow	10500.00	1297.70	1314.15	16.45	1309.05	1314.86	0.001550	6.76	1553.09	170.07	0.39
Reach-1	17.8	100-yr Existing	12438.00	1297.70	1315.01	17.31	1309.80	1315.84	0.001665	7.31	1702.52	175.49	0.41
Reach-1	17	100-yr Design	6900.00	1299.31	1312.17	12.86	1305.08	1312.47	0.000722	4.41	1565.09	164.92	0.37
Reach-1	17	Bank Full Flow	10500.00	1299.31	1314.27	14.96	1306.71	1314.73	0.000951	5.45	1926.24	178.56	0.38
Reach-1	17	100-yr Existing	12438.00	1299.31	1315.15	15.84	1307.49	1315.70	0.001075	5.96	2085.75	184.26	0.39
Reach-1	16	100-yr Design	6900.00	1302.62	1312.05	9.43	1307.35	1312.42	0.001104	4.88	1414.14	189.47	0.32
Reach-1	16	Bank Full Flow	10500.00	1302.62	1314.16	11.54	1308.71	1314.67	0.001247	5.73	1833.99	214.88	0.33
Reach-1	16	100-yr Existing	12438.00	1302.62	1315.05	12.43	1309.37	1315.64	0.001331	6.14	2045.42	263.45	0.33
Reach-1	15	100-yr Design	6900.00	1303.05	1312.00	8.95	1307.42	1312.36	0.001135	4.81	1434.95	196.35	0.29
Reach-1	15	Bank Full Flow	10500.00	1303.05	1314.12	11.07	1308.73	1314.61	0.001253	5.62	1867.07	216.42	0.30
Reach-1	15	100-yr Existing	12438.00	1303.05	1315.01	11.96	1309.39	1315.57	0.001296	6.02	2095.76	274.07	0.30
Reach-1	14	100-yr Design	6900.00	1303.02	1311.93	8.91	1307.39	1312.30	0.001231	4.88	1414.52	191.84	0.32
Reach-1	14	Bank Full Flow	10500.00	1303.02	1314.03	11.01	1308.71	1314.54	0.001378	5.72	1850.92	259.92	0.34
Reach-1	14	100-yr Existing	12438.00	1303.02	1314.93	11.91	1309.27	1315.50	0.001412	6.10	2089.49	269.20	0.34
Reach-1	13	100-yr Design	6900.00	1302.94	1311.89	8.95	1307.27	1312.24	0.001080	4.74	1456.29	196.63	0.28
Reach-1	13	Bank Full Flow	10500.00	1302.94	1313.99	11.05	1308.56	1314.47	0.001195	5.55	1916.87	272.04	0.29
Reach-1	13	100-yr Existing	12438.00	1302.94	1314.89	11.95	1309.18	1315.42	0.001217	5.92	2163.67	278.02	0.29
Reach-1	12	100-yr Design	6900.00	1302.97	1311.84	8.86	1307.25	1312.18	0.001032	4.73	1457.76	196.56	0.31
Reach-1	12	Bank Full Flow	10500.00	1302.97	1313.93	10.96	1308.52	1314.41	0.001136	5.55	1926.09	274.39	0.32
Reach-1	12	100-yr Existing	12438.00	1302.97	1314.83	11.86	1309.12	1315.36	0.001158	5.91	2174.89	280.36	0.32
Reach-1	11	100-yr Design	6900.00	1304.31	1311.72	7.41	1307.72	1312.12	0.001252	5.07	1361.67	196.62	0.34
Reach-1	11	Bank Full Flow	10500.00	1304.31	1313.81	9.49	1308.99	1314.34	0.001311	5.87	1804.29	256.91	0.44
Reach-1	11	100-yr Existing	12438.00	1304.31	1314.69	10.38	1309.57	1315.30	0.001323	6.25	2034.73	266.11	0.43
Reach-1	10	100-yr Design	6900.00	1302.90	1311.72	8.82	1307.58	1312.05	0.000895	4.56	1512.41	220.27	0.31
Reach-1	10	Bank Full Flow	10500.00	1302.90	1313.82	10.92	1308.76	1314.26	0.000884	5.28	1999.85	267.88	0.32
Reach-1	10	100-yr Existing	12438.00	1302.90	1314.72	11.82	1309.31	1315.21	0.000885	5.64	2253.37	300.25	0.32
Reach-1	9	100-yr Design	6900.00	1302.83	1311.69	8.86	1306.90	1312.00	0.000767	4.48	1540.96	204.73	0.29
Reach-1	9	Bank Full Flow	10500.00	1302.83	1313.78	10.95	1308.13	1314.21	0.000827	5.28	2004.25	283.73	0.31
Reach-1	9	100-yr Existing	12438.00	1302.83	1314.67	11.84	1308.72	1315.16	0.000838	5.66	2268.71	309.27	0.32
Reach-1	8	100-yr Design	6900.00	1302.70	1311.63	8.93	1306.99	1311.96	0.000850	4.58	1505.21	208.97	0.30
Reach-1	8	Bank Full Flow	10500.00	1302.70	1313.73	11.03	1308.23	1314.17	0.000863	5.32	2011.41	277.12	0.31
Reach-1	8	100-yr Existing	12438.00	1302.70	1314.63	11.93	1308.84	1315.12	0.000866	5.68	2261.62	283.00	0.32
Reach-1	7	100-yr Design	6900.00	1302.70	1311.58	8.88	1307.07	1311.92	0.000884	4.65	1484.07	207.91	0.31
Reach-1	7	Bank Full Flow	10500.00	1302.70	1313.67	10.97	1308.33	1314.13	0.000892	5.41	1974.62	278.34	0.32
Reach-1	7	100-yr Existing	12438.00	1302.70	1314.56	11.86	1308.93	1315.08	0.000894	5.78	2232.18	299.42	0.33
Reach-1	6	100-yr Design	6900.00	1302.66	1311.54	8.88	1306.96	1311.87	0.000856	4.60	1499.73	208.23	0.30
Reach-1	6	Bank Full Flow	10500.00	1302.66	1313.63	10.97	1308.20	1314.07	0.001002	5.31	1985.62	269.19	0.33
Reach-1	6	100-yr Existing	12438.00	1302.66	1314.53	11.87	1308.81	1315.02	0.000984	5.63	2232.41	278.40	0.33
Reach-1	5	100-yr Design	6900.00	1302.70	1311.45	8.75	1306.86	1311.77	0.000834	4.54	1518.89	210.88	0.30
Reach-1	5	Bank Full Flow	10500.00	1302.70	1313.55	10.85	1308.09	1313.97	0.000838	5.20	2124.52	363.59	0.31
Reach-1	5	100-yr Existing	12438.00	1302.70	1314.47	11.77	1308.68	1314.91	0.000807	5.45	2456.56	363.59	0.31
Reach-1	4	100-yr Design	6900.00	1302.60	1311.34	8.74	1306.89	1311.68	0.000887	4.63	1489.09	210.21	0.31
Reach-1	4	Bank Full Flow	10500.00	1302.60	1313.41	10.81	1308.12	1313.86	0.000966	5.39	1947.13	248.58	0.33
Reach-1	4	100-yr Existing	12438.00	1302.60	1314.29	11.69	1308.72	1314.80	0.000990	5.77	2168.72	258.89	0.34

HEC-RAS Plan: Plan 04 River: RIVER-1 Reach: Reach-1 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Max Chl Dpth	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Reach-1	3	100-yr Design	6900.00	1302.60	1311.11	8.51	1306.82	1311.48	0.000974	4.86	1419.93	200.01	0.32
Reach-1	3	Bank Full Flow	10500.00	1302.60	1313.14	10.54	1308.08	1313.65	0.001040	5.70	1859.51	261.98	0.34
Reach-1	3	100-yr Existing	12438.00	1302.60	1314.02	11.42	1308.69	1314.59	0.001047	6.08	2100.37	281.70	0.35
Reach-1	2	100-yr Design	6900.00	1302.42	1310.91	8.49	1306.66	1311.28	0.000996	4.91	1405.71	198.19	0.32
Reach-1	2	Bank Full Flow	10500.00	1302.42	1312.92	10.50	1307.91	1313.43	0.001073	5.77	1834.01	257.39	0.35
Reach-1	2	100-yr Existing	12438.00	1302.42	1313.78	11.36	1308.52	1314.37	0.001090	6.16	2067.44	274.93	0.36
Reach-1	1	100-yr Design	6900.00	1302.85	1310.73	7.88	1307.20	1311.16	0.001301	5.27	1310.49	203.50	0.37
Reach-1	1	Bank Full Flow	10500.00	1302.85	1312.74	9.89	1308.42	1313.31	0.001302	6.05	1739.16	243.53	0.38
Reach-1	1	100-yr Existing	12438.00	1302.85	1313.61	10.75	1309.00	1314.25	0.001301	6.44	1964.93	273.69	0.38

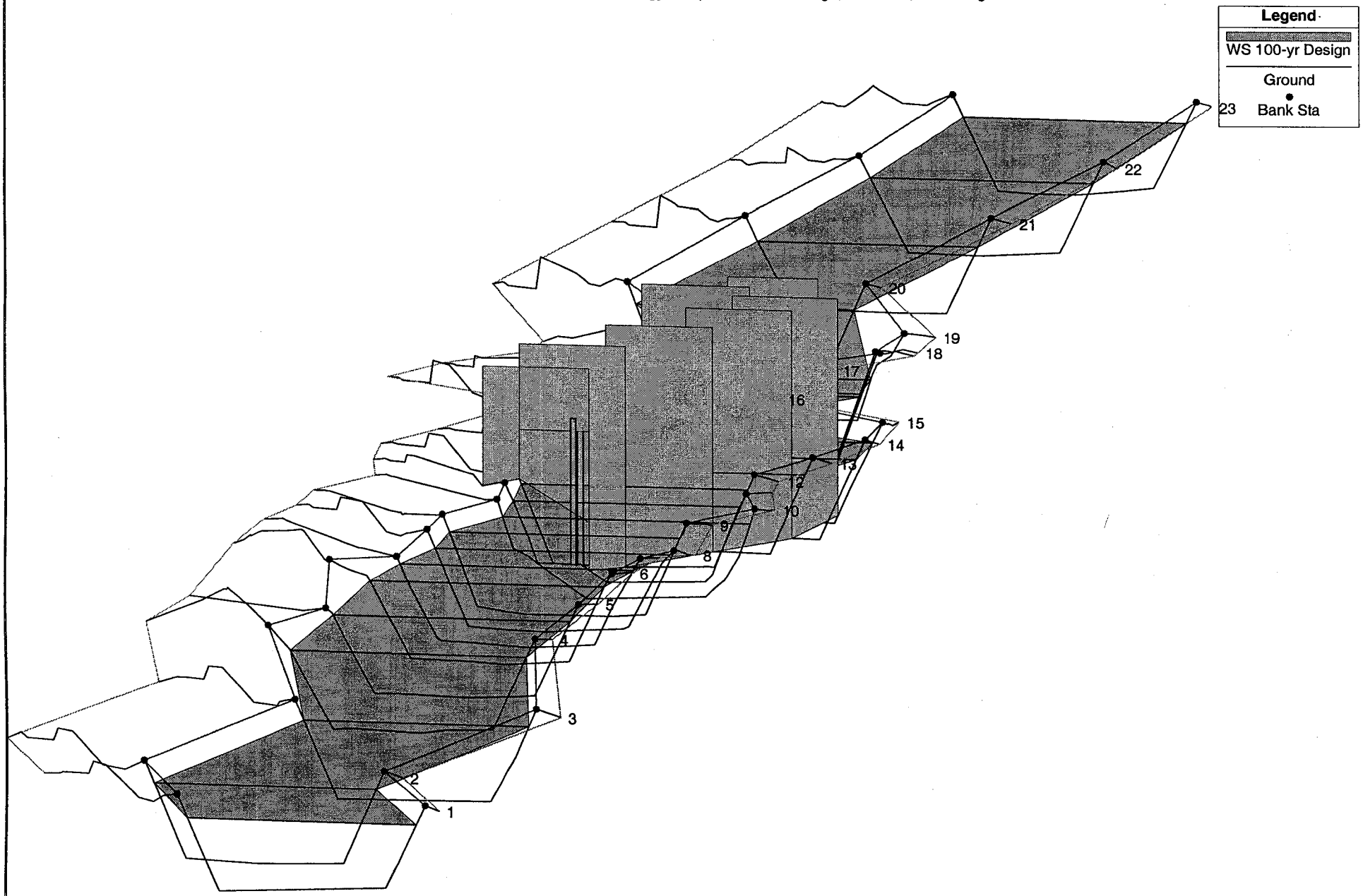
EMF / Germann Road Proposed Conditions Plan: EMF / Germann Road Proposed Conditions 5/21/2003 6:44:51 PM

Geom: EMF / Proposed Germann w/enrgy dissipator Flow: Design, Bank Full, & Existing



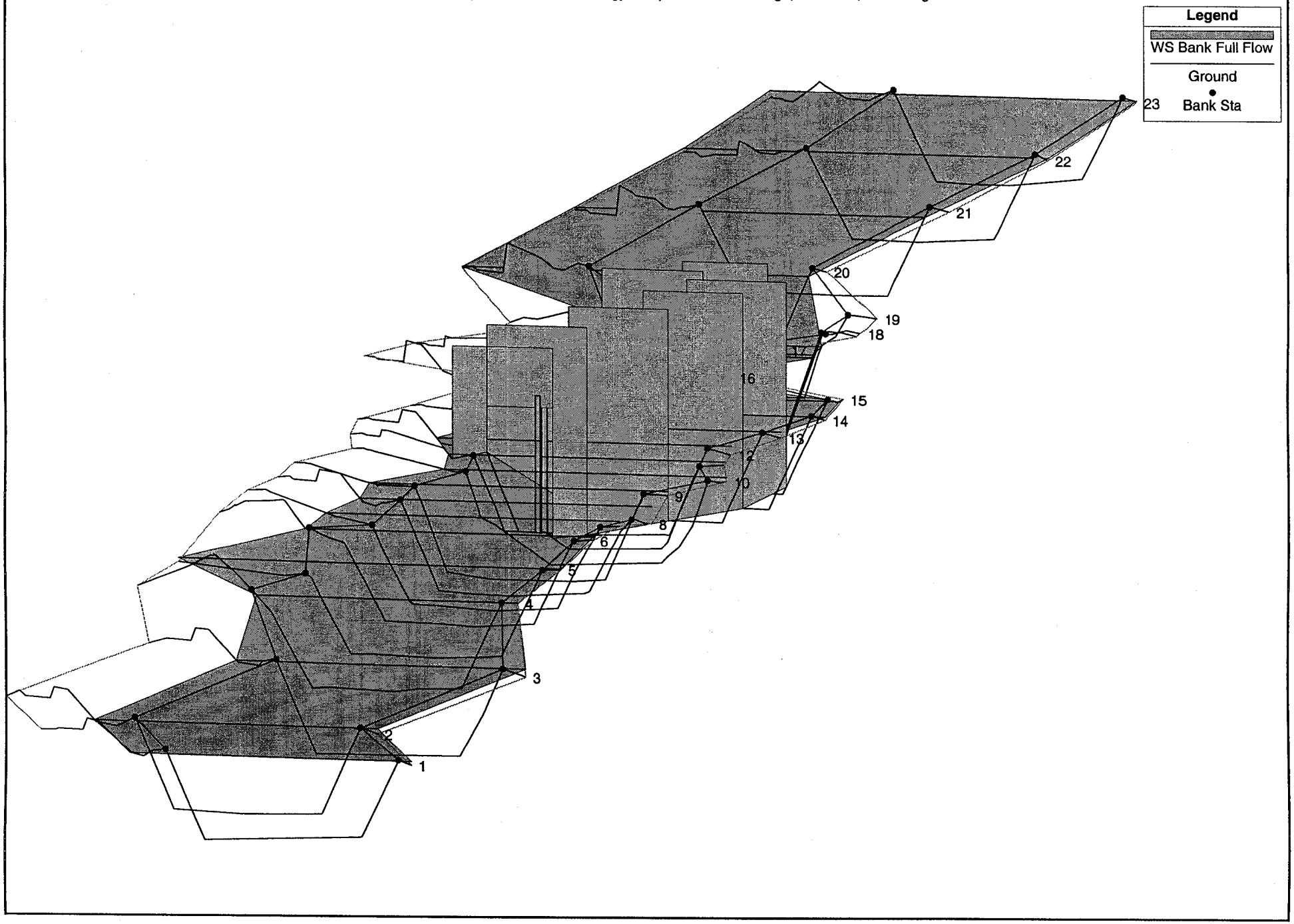
EMF / Germann Road Proposed Conditions Plan: EMF / Germann Road Proposed Conditions 5/21/2003 6:44:51 PM

Geom: EMF / Proposed Germann w/enrgy dissipator Flow: Design, Bank Full, & Existing



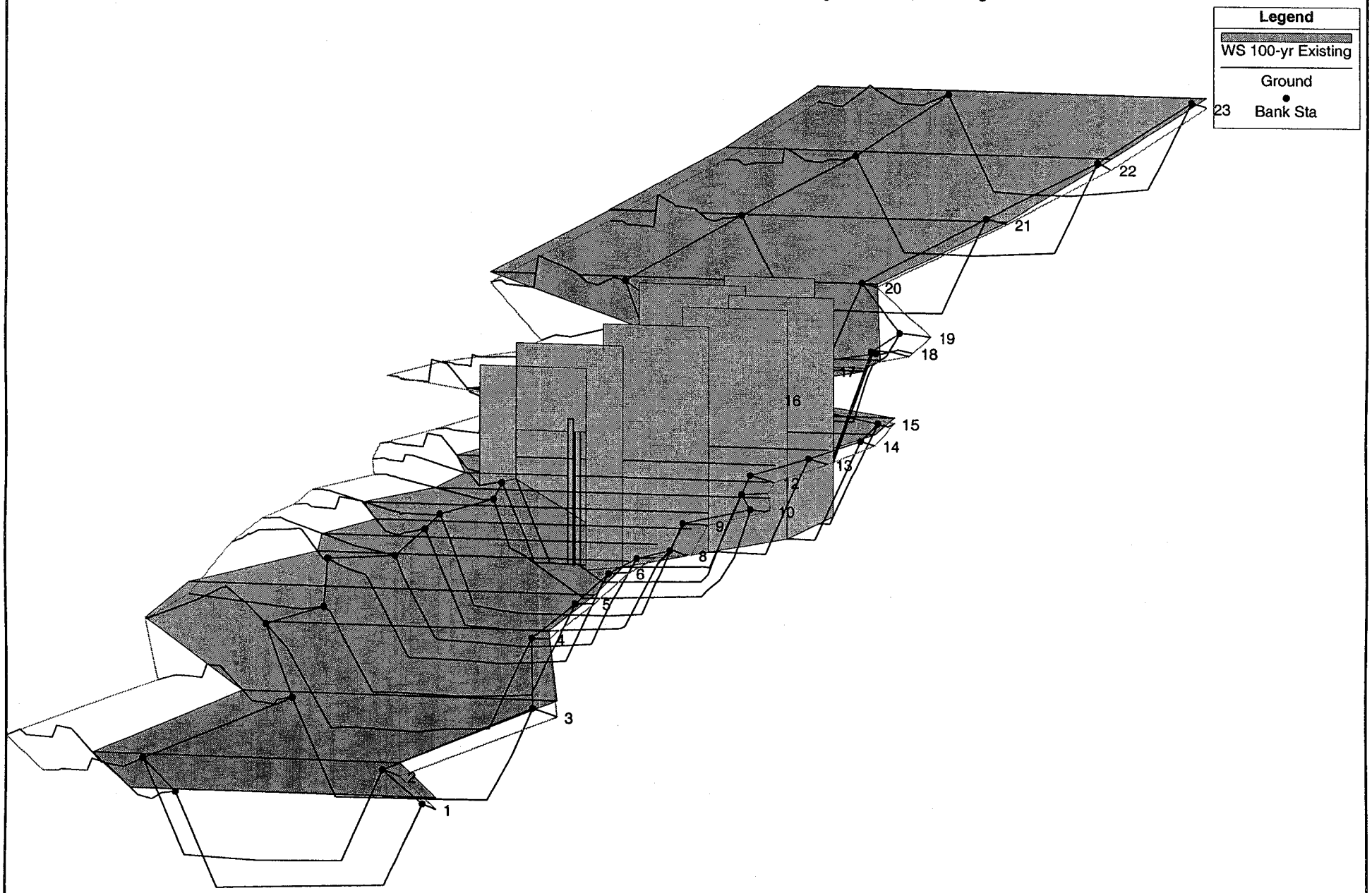
EMF / Germann Road Proposed Conditions Plan: EMF / Germann Road Proposed Conditions 5/21/2003 6:44:51 PM

Geom: EMF / Proposed Germann w/enrgy dissipator Flow: Design, Bank Full, & Existing



EMF / Germann Road Proposed Conditions Plan: EMF / Germann Road Proposed Conditions 5/21/2003 6:44:51 PM

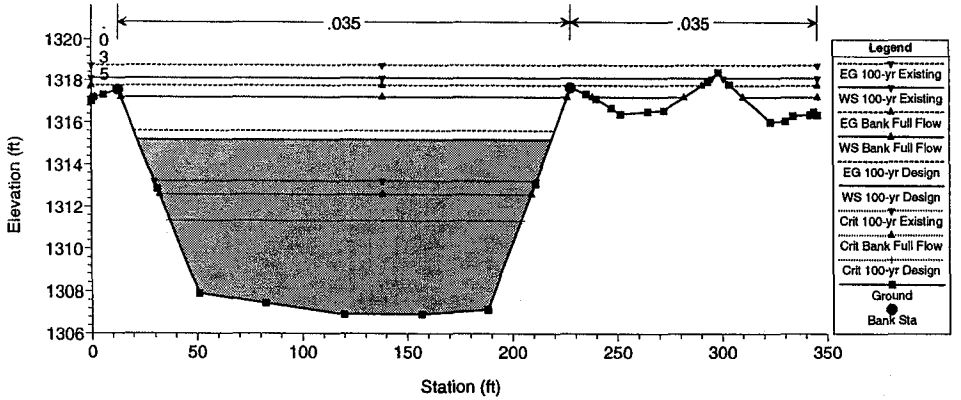
Geom: EMF / Proposed Germann w/enrgy dissipator Flow: Design, Bank Full, & Existing



EMF / Germann Road Proposed Conditions Plan: EMF / Germann Road Proposed Conditions 5/21/2003 6:44:51 PM

Geom: EMF / Proposed Germann w/enrgy dissipator Flow: Design, Bank Full, & Existing

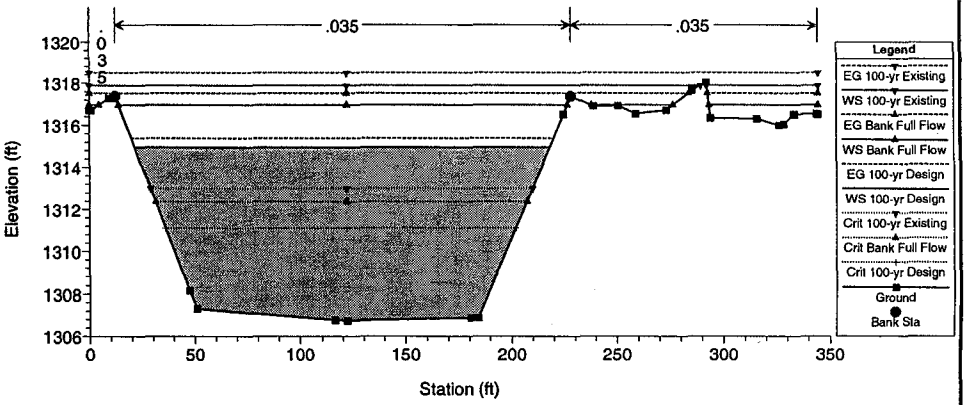
River = RIVER-1 Reach = Reach-1 RS = 23



EMF / Germann Road Proposed Conditions Plan: EMF / Germann Road Proposed Conditions 5/21/2003 6:44:51 PM

Geom: EMF / Proposed Germann w/enrgy dissipator Flow: Design, Bank Full, & Existing

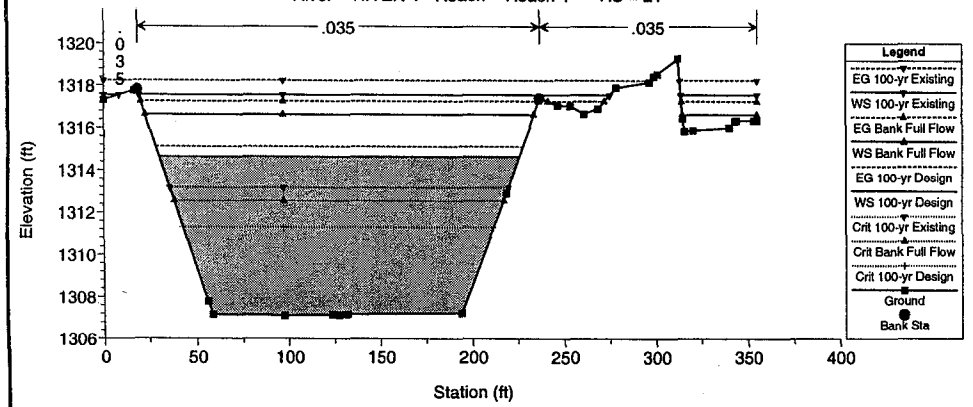
River = RIVER-1 Reach = Reach-1 RS = 22



EMF / Germann Road Proposed Conditions Plan: EMF / Germann Road Proposed Conditions 5/21/2003 6:44:51 PM

Geom: EMF / Proposed Germann w/enrgy dissipator Flow: Design, Bank Full, & Existing

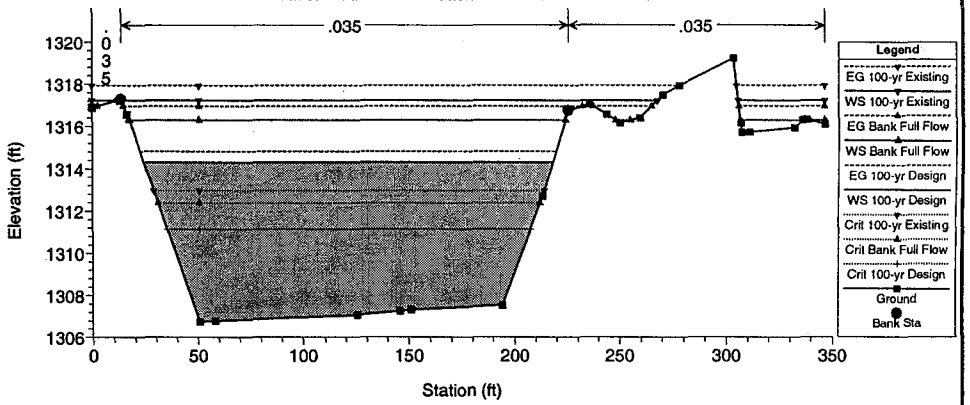
River = RIVER-1 Reach = Reach-1 RS = 21



EMF / Germann Road Proposed Conditions Plan: EMF / Germann Road Proposed Conditions 5/21/2003 6:44:51 PM

Geom: EMF / Proposed Germann w/enrgy dissipator Flow: Design, Bank Full, & Existing

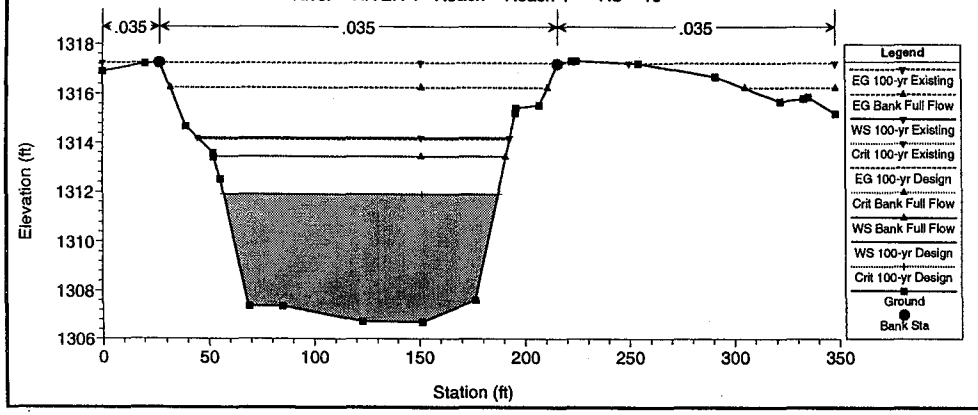
River = RIVER-1 Reach = Reach-1 RS = 20



EMF / Germann Road Proposed Conditions Plan: EMF / Germann Road Proposed Conditions 5/21/2003 6:44:51 PM

Geom: EMF / Proposed Germann w/enrgy dissipator Flow: Design, Bank Full, & Existing

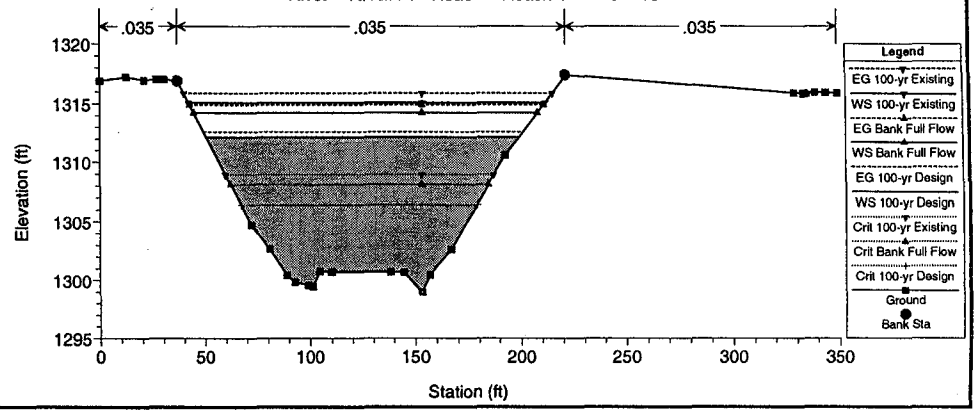
River = RIVER-1 Reach = Reach-1 RS = 19



EMF / Germann Road Proposed Conditions Plan: EMF / Germann Road Proposed Conditions 5/21/2003 6:44:51 PM

Geom: EMF / Proposed Germann w/enrgy dissipator Flow: Design, Bank Full, & Existing

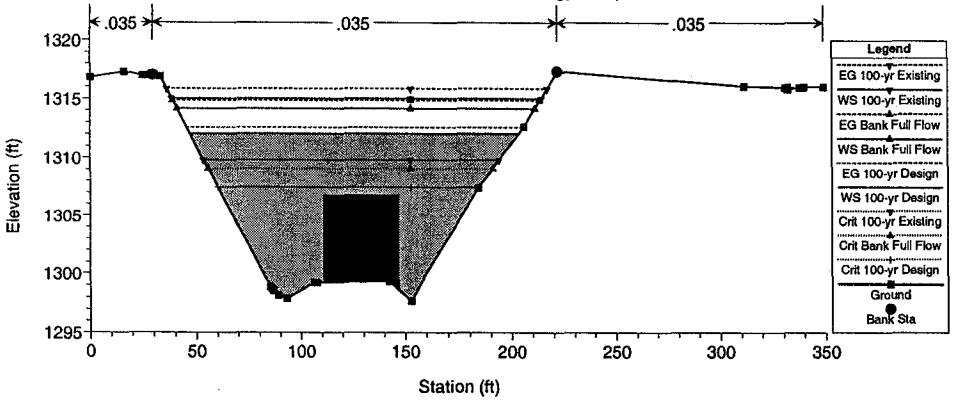
River = RIVER-1 Reach = Reach-1 RS = 18



EMF / Germann Road Proposed Conditions Plan: EMF / Germann Road Proposed Conditions 5/21/2003 6:44:51 PM

Geom: EMF / Proposed Germann w/enrgy dissipator Flow: Design, Bank Full, & Existing

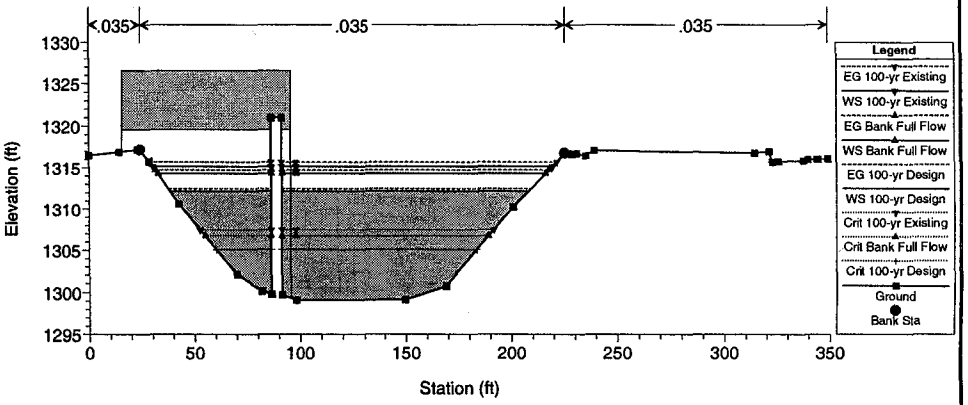
River = RIVER-1 Reach = Reach-1 RS = 17.8 Energy Dissipater as blocked obstruction



EMF / Germann Road Proposed Conditions Plan: EMF / Germann Road Proposed Conditions 5/21/2003 6:44:51 PM

Geom: EMF / Proposed Germann w/enrgy dissipator Flow: Design, Bank Full, & Existing

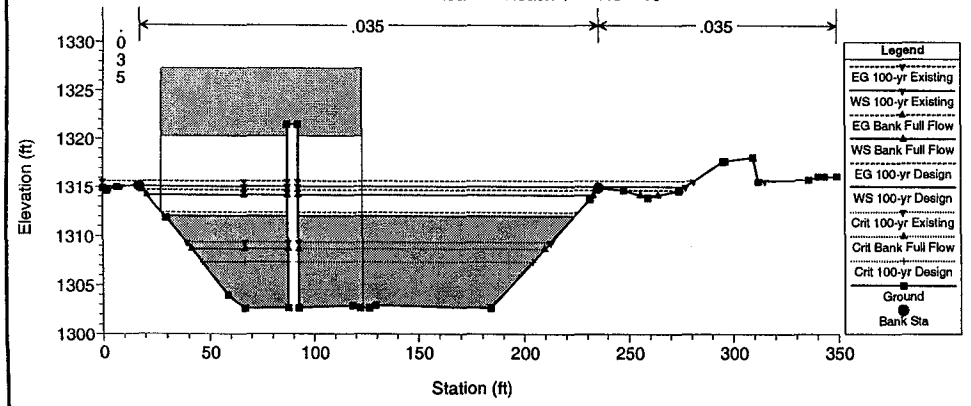
River = RIVER-1 Reach = Reach-1 RS = 17



EMF / Germann Road Proposed Conditions Plan: EMF / Germann Road Proposed Conditions 5/21/2003 6:44:51 PM

Geom: EMF / Proposed Germann w/enrgy dissipator Flow: Design, Bank Full, & Existing

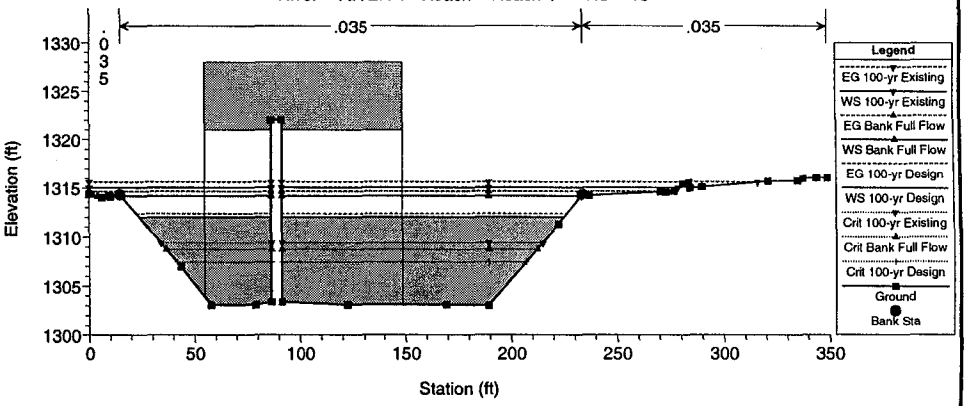
River = RIVER-1 Reach = Reach-1 RS = 16



EMF / Germann Road Proposed Conditions Plan: EMF / Germann Road Proposed Conditions 5/21/2003 6:44:51 PM

Geom: EMF / Proposed Germann w/enrgy dissipator Flow: Design, Bank Full, & Existing

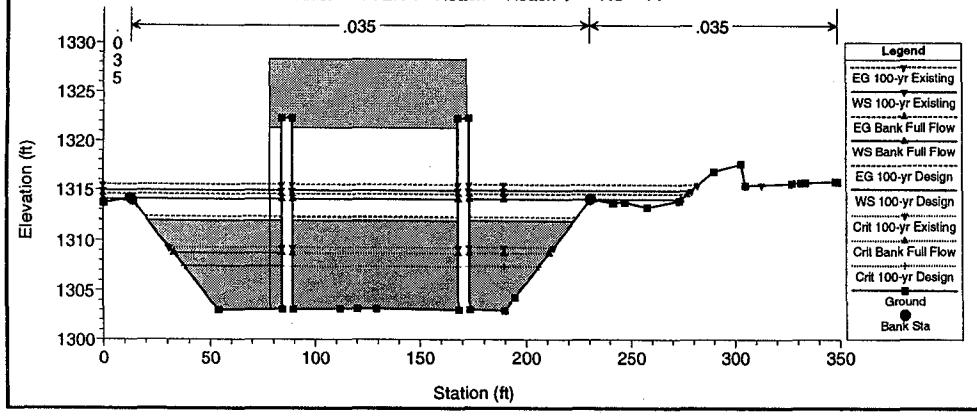
River = RIVER-1 Reach = Reach-1 RS = 15



EMF / Germann Road Proposed Conditions Plan: EMF / Germann Road Proposed Conditions 5/21/2003 6:44:51 PM

Geom: EMF / Proposed Germann w/enrgy dissipator Flow: Design, Bank Full, & Existing

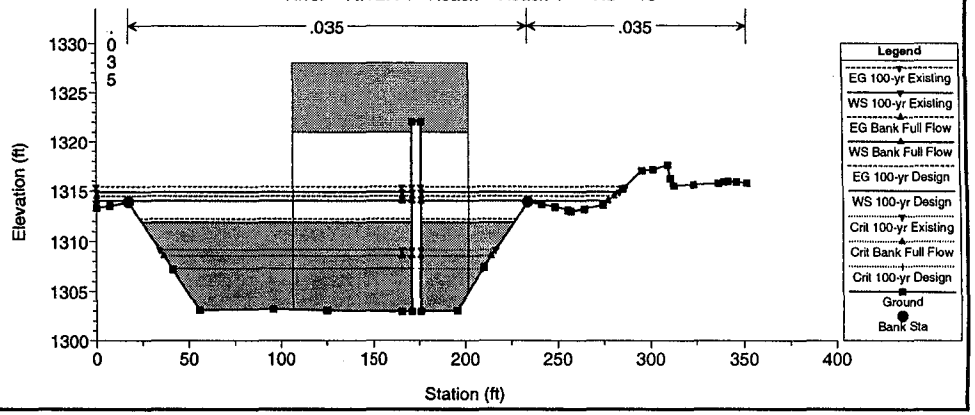
River = RIVER-1 Reach = Reach-1 RS = 14



EMF / Germann Road Proposed Conditions Plan: EMF / Germann Road Proposed Conditions 5/21/2003 6:44:51 PM

Geom: EMF / Proposed Germann w/enrgy dissipator Flow: Design, Bank Full, & Existing

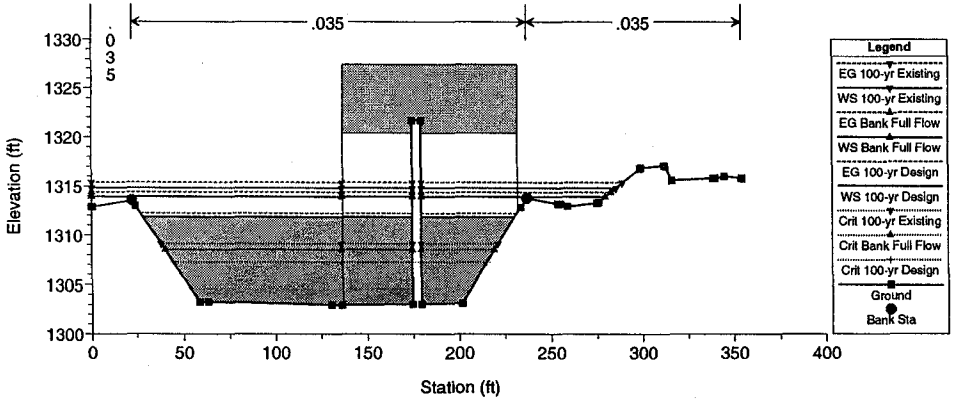
River = RIVER-1 Reach = Reach-1 RS = 13



EMF / Germann Road Proposed Conditions Plan: EMF / Germann Road Proposed Conditions 5/21/2003 6:44:51 PM

Geom: EMF / Proposed Germann w/enrgy dissipator Flow: Design, Bank Full, & Existing

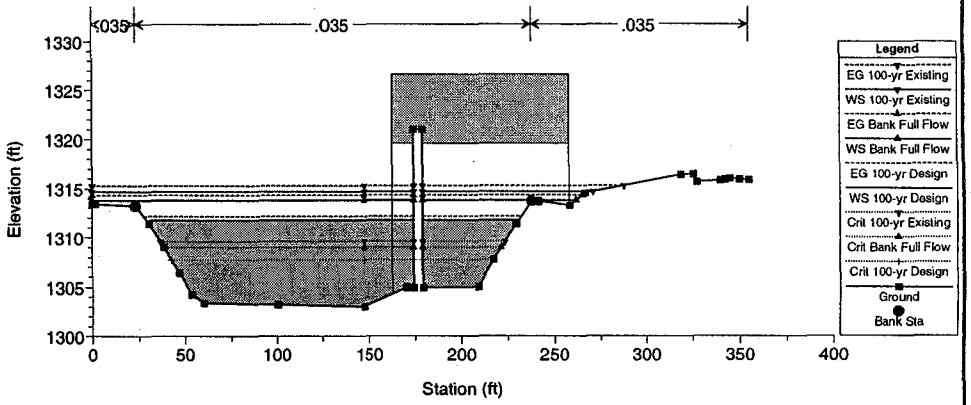
River = RIVER-1 Reach = Reach-1 RS = 12



EMF / Germann Road Proposed Conditions Plan: EMF / Germann Road Proposed Conditions 5/21/2003 6:44:51 PM

Geom: EMF / Proposed Germann w/enrgy dissipator Flow: Design, Bank Full, & Existing

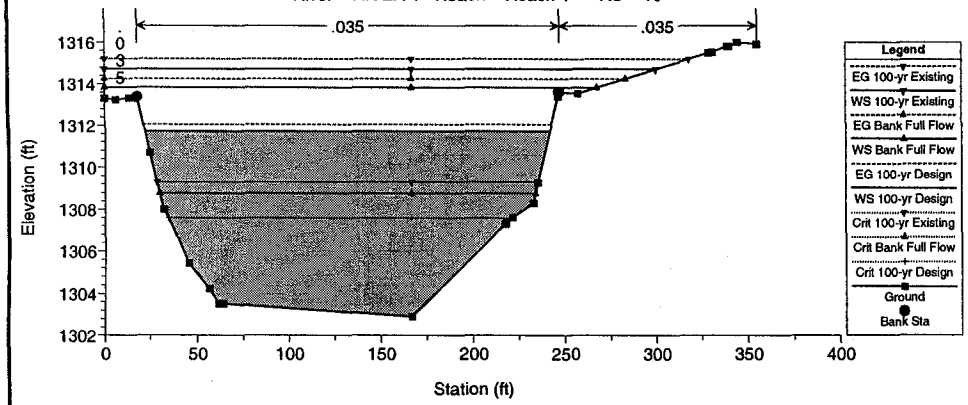
River = RIVER-1 Reach = Reach-1 RS = 11



EMF / Germann Road Proposed Conditions Plan: EMF / Germann Road Proposed Conditions 5/21/2003 6:44:51 PM

Geom: EMF / Proposed Germann w/enrgy dissipator Flow: Design, Bank Full, & Existing

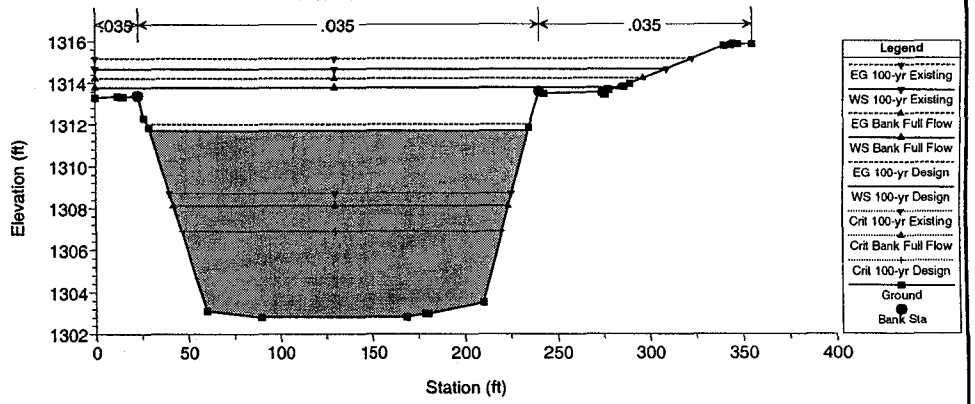
River = RIVER-1 Reach = Reach-1 RS = 10



EMF / Germann Road Proposed Conditions Plan: EMF / Germann Road Proposed Conditions 5/21/2003 6:44:51 PM

Geom: EMF / Proposed Germann w/enrgy dissipator Flow: Design, Bank Full, & Existing

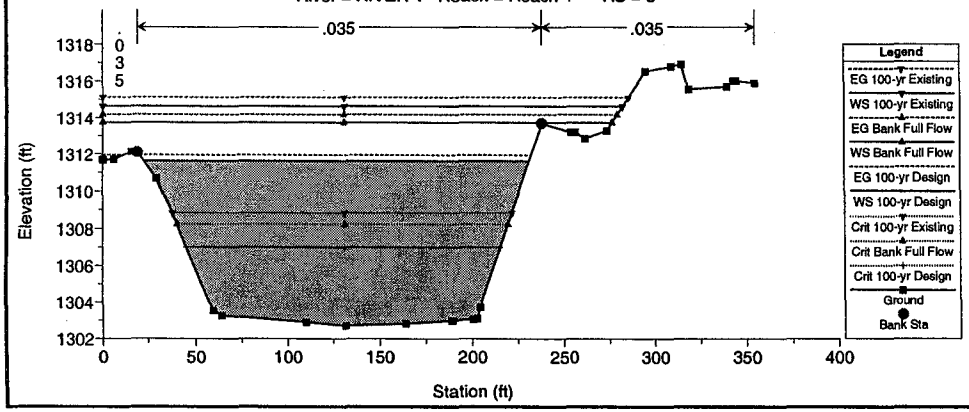
River = RIVER-1 Reach = Reach-1 RS = 9



EMF / Germann Road Proposed Conditions Plan: EMF / Germann Road Proposed Conditions 5/21/2003 6:44:51 PM

Geom: EMF / Proposed Germann w/enrgy dissipator Flow: Design, Bank Full, & Existing

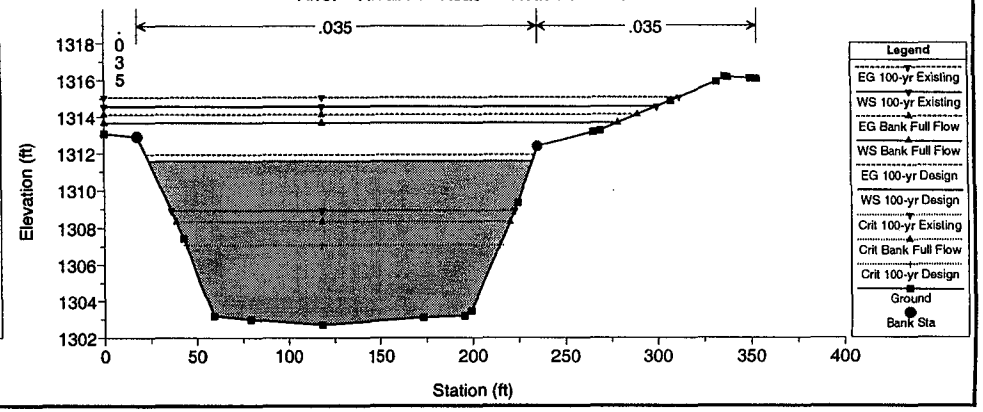
River = RIVER-1 Reach = Reach-1 RS = 8



EMF / Germann Road Proposed Conditions Plan: EMF / Germann Road Proposed Conditions 5/21/2003 6:44:51 PM

Geom: EMF / Proposed Germann w/enrgy dissipator Flow: Design, Bank Full, & Existing

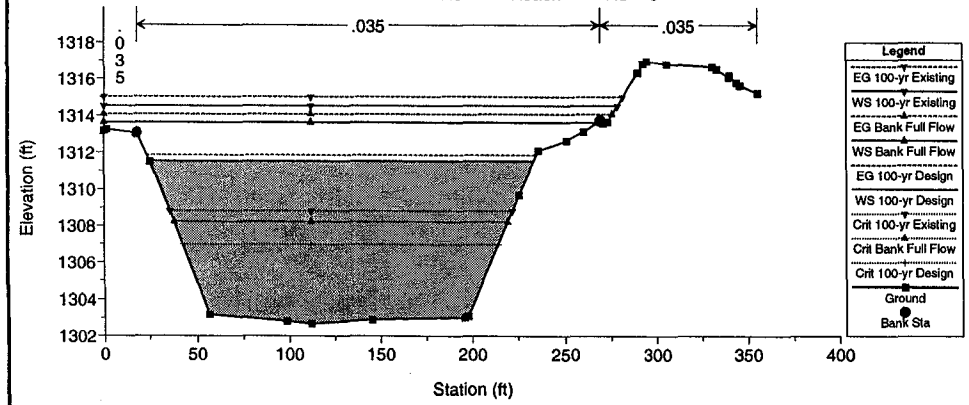
River = RIVER-1 Reach = Reach-1 RS = 7



EMF / Germann Road Proposed Conditions Plan: EMF / Germann Road Proposed Conditions 5/21/2003 6:44:51 PM

Geom: EMF / Proposed Germann w/enrgy dissipator Flow: Design, Bank Full, & Existing

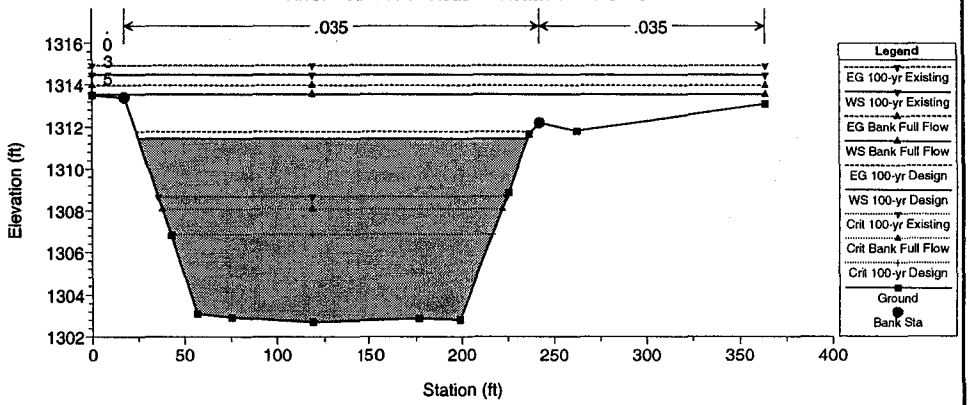
River = RIVER-1 Reach = Reach-1 RS = 6



EMF / Germann Road Proposed Conditions Plan: EMF / Germann Road Proposed Conditions 5/21/2003 6:44:51 PM

Geom: EMF / Proposed Germann w/enrgy dissipator Flow: Design, Bank Full, & Existing

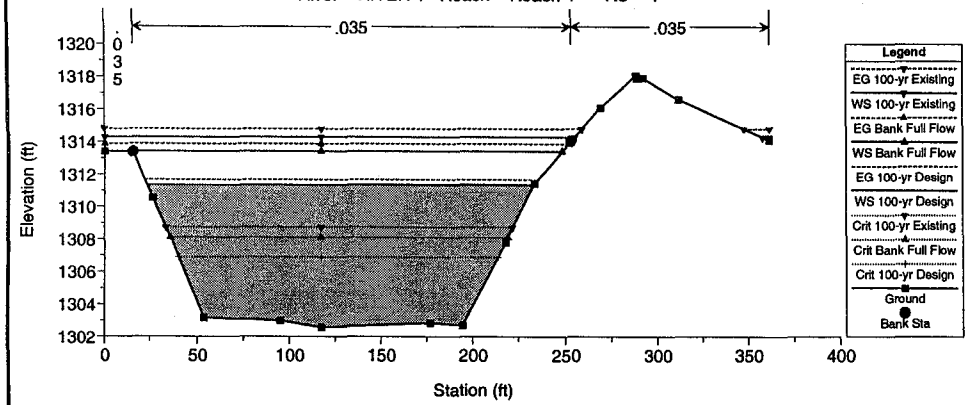
River = RIVER-1 Reach = Reach-1 RS = 5



EMF / Germann Road Proposed Conditions Plan: EMF / Germann Road Proposed Conditions 5/21/2003 6:44:51 PM

Geom: EMF / Proposed Germann w/enrgy dissipator Flow: Design, Bank Full, & Existing

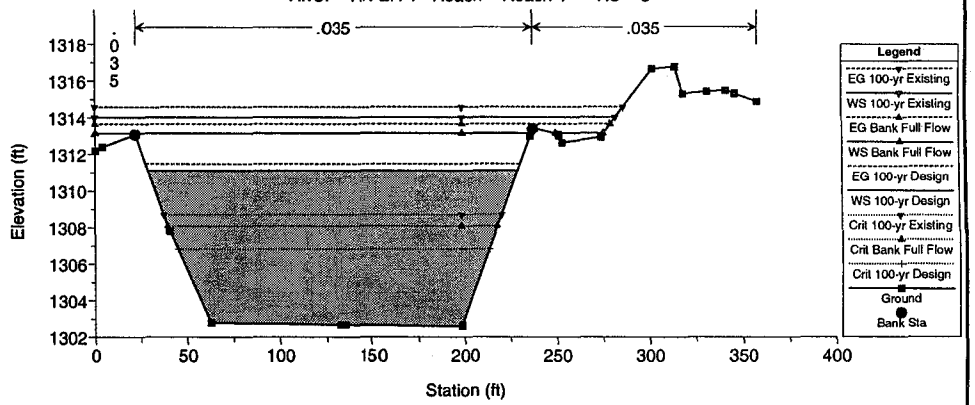
River = RIVER-1 Reach = Reach-1 RS = 4



EMF / Germann Road Proposed Conditions Plan: EMF / Germann Road Proposed Conditions 5/21/2003 6:44:51 PM

Geom: EMF / Proposed Germann w/enrgy dissipator Flow: Design, Bank Full, & Existing

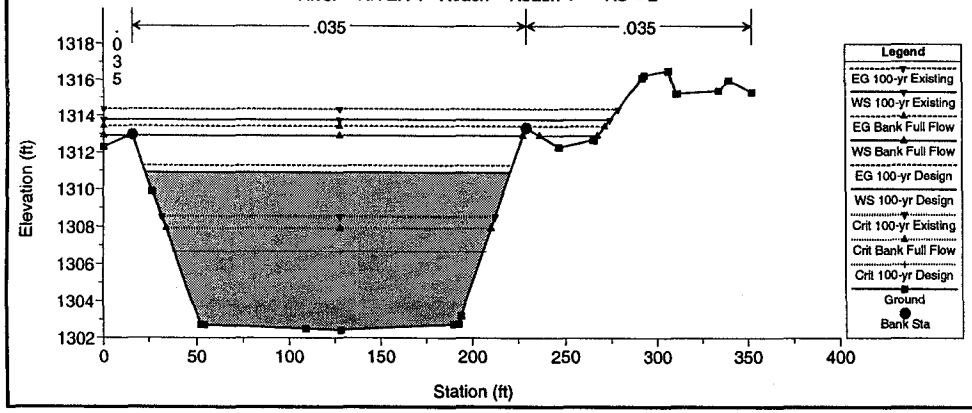
River = RIVER-1 Reach = Reach-1 RS = 3



EMF / Germann Road Proposed Conditions Plan: EMF / Germann Road Proposed Conditions 5/21/2003 6:44:51 PM

Geom: EMF / Proposed Germann w/enrgy dissipator Flow: Design, Bank Full, & Existing

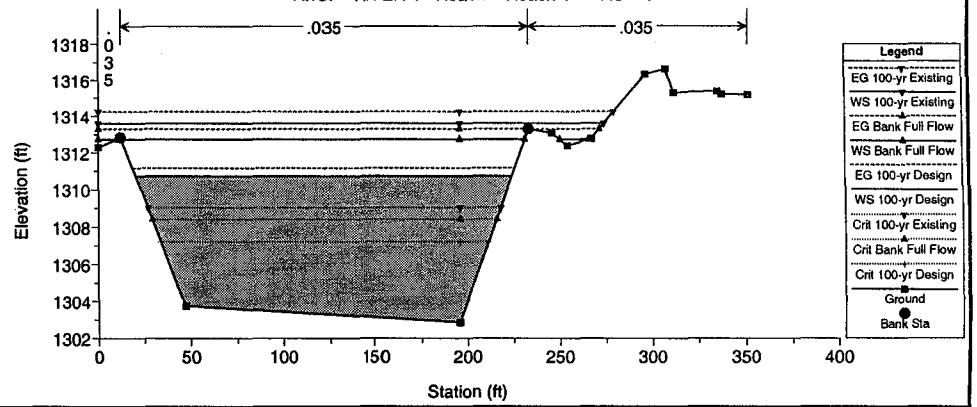
River = RIVER-1 Reach = Reach-1 RS = 2



EMF / Germann Road Proposed Conditions Plan: EMF / Germann Road Proposed Conditions 5/21/2003 6:44:51 PM

Geom: EMF / Proposed Germann w/enrgy dissipator Flow: Design, Bank Full, & Existing

River = RIVER-1 Reach = Reach-1 RS = 1



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                    HEC-RAS Version 3.1.1 May 2003
                     U.S. Army Corp of Engineers
                    Hydrologic Engineering Center
                      609 Second Street, Suite D
                     Davis, California 95616-4687
                           (916) 756-1104


          X     X  XXXXXX    XXXX        XXXX       XX      XXXX
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PROJECT DATA
Project Title: EMF / Germann Road Proposed Conditions
Project File : GermanEMFBridge.prj
Run Date and Time: 5/21/2003 6:44:51 PM

Project in English units

Project Description:
Germann Road crossing the EMF ******* Autodesk, Inc. HEC-2 Input Data file ********
********** Minimum Data Input **********

****
******* Autodesk,
Inc. HEC-2 Input Data file ********
********** Minimum Data Input
****
****

PLAN DATA

Plan Title: EMF / Germann Road Proposed Conditions
Plan File : w:\2002Projects\021733 - Germann Road Bridge\Hydraulics\HEC-RAS\GermanEMFBridge.p05

Geometry Title: EMF / Proposed Germann w/enrgy dissipator
Geometry File : w:\2002Projects\021733 - Germann Road Bridge\Hydraulics\HEC-RAS\GermanEMFBridge.g03

Flow Title : Design, Bank Full, & Existing
Flow File : w:\2002Projects\021733 - Germann Road Bridge\Hydraulics\HEC-RAS\GermanEMFBridge.f01

Plan Summary Information:

Number of:	Cross Sections	= 24	Mulitple Openings	=	0
	Culverts	= 0	Inline Structures	=	0
	Bridges	= 0	Lateral Structures	=	0

Computational Information
Water surface calculation tolerance = 0.003
Critical depth calculaton tolerance = 0.003
Maximum number of interations = 20
Maximum difference tolerance = 0.1
Flow tolerance factor = 0.001

Computation Options
Critical depth computed at all cross sections

Conveyance Calculation Method: At breaks in n values only
Friction Slope Method: Average Conveyance
Computational Flow Regime: Mixed Flow

FLOW DATA

Flow Title: Design, Bank Full, & Existing
Flow File : w:\2002Projects\021733 - Germann Road Bridge\Hydraulics\HEC-RAS\GermanEMFBridge.f01

Flow Data (cfs)

River	Reach	RS	100-yr Design	Bank Full Flow	100-yr Existing
RIVER-1	Reach-1	23	6900	10500	12438
RIVER-1	Reach-1	1	6900	10500	12438

Boundary Conditions

River	Reach	Profile	Upstream	Downstream
RIVER-1	Reach-1	100-yr Design	Normal S = 0.001	Normal S = 0.0013

GEOMETRY DATA

Geometry Title: EMF / Proposed Germann w/enrgy dissipator
Geometry File : w:\2002Projects\021733 - Germann Road Bridge\Hydraulics\HEC-RAS\GermanEMFBridge.g03

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 23

INPUT
Description:
Station Elevation Data num= 27

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1317	1.07	1317.18	5.82	1317.31	12.93	1317.55	31.19	1312.86
50.84	1307.9	82.41	1307.44	119.77	1306.92	156.92	1306.92	188.12	1307.13
211.01	1313.1	227.87	1317.65	235.25	1317.35	240	1317.11	247.24	1316.67
251.72	1316.4	264.56	1316.51	272.27	1316.56	293.1	1317.93	298.29	1318.39
303.52	1317.8	323.23	1316.03	330.27	1316.07	333.98	1316.32	342.05	1316.37
343.73	1316.5	345.61	1316.35						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.035	12.93	.035	227.87	.035

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
12.93	227.87	227.48	188.32	149.16	.1	.3

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 22

INPUT
Description:
Station Elevation Data num= 26

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1316.7	.71	1316.69	9.5	1317.28	12.46	1317.37	47.4	1308.16
50.93	1307.3	116.18	1306.77	121.9	1306.73	180.68	1306.87	184.37	1306.87
224.72	1316.5	228.21	1317.37	239.1	1316.91	250.6	1316.92	259.07	1316.54

273.31	1316.7	285.31	1317.65	291.92	1318.04	294.02	1316.34	315.74	1316.3
326.21	1316	328.31	1316.04	332.89	1316.49	333.28	1316.51	343.73	1316.53
344.17	1316.5								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.035	12.46	.035	228.21	.035

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
12.46	228.21	213.76	194.02	174.48	.1	.3

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 21

INPUT
Description:
Station Elevation Data num= 29

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1317.3	16.8	1317.78	18.47	1317.81	55.88	1307.78	58.55	1307.17
97.34	1307.1	123.68	1307.15	127.36	1307.13	131.71	1307.17	194.09	1307.22
218.54	1312.9	236.78	1317.4	246.49	1317.07	253.44	1317.03	260.89	1316.65
268.46	1316.9	278.46	1317.9	296.59	1318.16	298.91	1318.44	300.84	1318.55
312.09	1319.3	314.85	1316.45	315.49	1315.84	320.01	1315.87	339.92	1316
343.13	1316.3	344.04	1316.33	353.41	1316.33	355.38	1316.34		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.035	18.47	.035	236.78	.035

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
18.47	236.78	211.51	195.85	180.25	.1	.3

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 20

INPUT
Description:
Station Elevation Data num= 26

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1316.9	.21	1316.87	13.85	1317.28	16.54	1316.57	50.85	1306.75
58.34	1306.8	125.28	1307.07	145.97	1307.25	151.34	1307.32	194.39	1307.54
213.6	1312.7	225.76	1316.75	236.02	1317.05	244.15	1316.56	250.09	1316.17
259.69	1316.4	270.59	1317.48	278.31	1317.93	303.51	1319.24	306.89	1316.16
307.33	1315.7	311.03	1315.72	331.98	1315.94	335.86	1316.31	338.11	1316.33
346.24	1316.1								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.035	13.85	.035	225.76	.035

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
13.85	225.76	148.03	150.76	153.49	.1	.3

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 19

INPUT
Description:
Station Elevation Data num= 24

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1316.9	20.59	1317.21	27.31	1317.24	39.28	1314.68	52.31	1313.6

52.58	1313.4	55.81	1312.52	69.02	1307.35	84.93	1307.35	122.99	1306.72
151.44	1306.7	176.53	1307.61	195.96	1315.24	196.26	1315.44	207.37	1315.55
216.35	1317.2	223.01	1317.32	224.94	1317.33	254.67	1317.22	291.36	1316.7
321.99	1315.7	333.07	1315.82	335.21	1315.88	348.25	1315.22		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.035	27.31	.035	216.35	.035

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
27.31	216.35	49.99	49.99	50	.1	.3

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 18

INPUT
Description:
Station Elevation Data num= 29

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1316.9	12.66	1317.23	20.94	1316.95	27.01	1317.03	30.51	1317.05
36.96	1316.9	72.03	1304.73	80.85	1302.7	88.96	1300.46	92.97	1299.87
99.05	1299.6	101.48	1299.47	104.72	1300.77	110	1300.72	138.19	1300.73
144.53	1300.7	153	1299	156.74	1300.48	166.58	1302.64	192.31	1310.57
220.86	1317.4	220.9	1317.4	328.55	1315.88	333	1315.86	333.25	1315.87
333.3	1315.8	338.53	1315.95	343.51	1315.93	348.83	1315.9		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.035	36.96	.035	220.9	.035

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
36.96	220.9	8.6	7.64	5.96	.1	.3

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 17.8

INPUT
Description: Energy Dissipater as blocked obstruction
Station Elevation Data num= 28

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1316.8	16.09	1317.26	25.1	1316.96	28.08	1317	29.81	1317.01
33.01	1316.9	85.23	1298.89	86.01	1298.72	86.74	1298.52	88.98	1298.19
92.98	1297.9	106.31	1299.21	107.69	1299.21	142.2	1299.33	152.76	1297.7
184.14	1307.4	206.02	1312.65	221.74	1317.32	311.36	1316.05	330.74	1315.97
331.8	1316	332.01	1315.81	337.6	1315.94	338.98	1315.95	339.24	1315.97
339.76	1316	348.86	1316	348.89	1315.99				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.035	29.81	.035	221.74	.035

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
29.81	221.74	41.41	42.36	44.04	.1	.3

Blocked Obstructions num= 1

Sta L	Sta R	Elev
111	147	1306.8

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 17

INPUT

Description:
Station Elevation Data num= 30

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1316.5	14.36	1316.93	23.05	1317.21	24.29	1317.18	28.51	1315.76
42.54	1310.6	70.07	1302.09	81.83	1300.12	86.5	1299.8	86.5	1321
91.5	1321	91.5	1299.7	98.18	1299.09	149.5	1299.15	168.96	1300.7
200.86	1310.22	225.53	1316.77	227.14	1316.73	228.74	1316.63	230.8	1316.7
235.19	1316.47	239.37	1317.09	314.43	1316.77	321.3	1316.98	322.64	1315.7
325.65	1315.79	337.5	1315.87	339.71	1316.01	344.16	1316.06	348.97	1316.1

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.035	24.29	.035	225.53	.035

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
24.29	225.53	49.99	49.99	49.99	.1	.3

Cross Section Lid
num= 2

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord
15.5	1326.6	1319.6	95.8	1326.6	1319.6

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 16

INPUT
Description:
Station Elevation Data num= 32

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1314.9	1.86	1314.62	6.87	1315.03	17.32	1315.15	17.45	1315.1
29.99	1311.9	58.65	1303.99	66.89	1302.62	87.5	1302.7	87.5	1321.5
92.5	1321.5	92.5	1302.7	118.56	1302.92	121.93	1302.71	126.38	1302.7
129.35	1302.95	184	1302.71	231.18	1313.76	235.58	1314.93	247.3	1314.7
258.95	1313.94	273.96	1314.63	274.13	1314.62	294.96	1317.69	295.87	1317.7
309.35	1318.1	311.99	1315.62	312.06	1315.62	335.82	1315.77	340.25	1316.1
343.16	1316.09	349.11	1316.15						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.035	17.32	.035	235.58	.035

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
17.32	235.58	54.94	48.21	41.48	.1	.3

Cross Section Lid
num= 2

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord
27.7	1327.3	1320.3	123.3	1327.3	1320.3

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 15

INPUT
Description:
Station Elevation Data num= 31

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1314.4	.99	1314.35	5.89	1313.99	9.77	1314.21	10.08	1314.11
14.81	1314.3	43.49	1306.96	57.82	1303.05	78.89	1303.1	86.5	1303.4
86.5	1322	91.5	1322	91.5	1303.4	122.33	1303.08	169.24	1303.1
189.37	1303.01	222.43	1311.26	233.5	1314.3	236.85	1314.18	270.24	1314.6
272.83	1314.51	276.54	1314.65	280.63	1315.37	283.74	1315.55	284.27	1315
289.59	1315.08	320.7	1315.66	334.73	1315.75	337.31	1315.92	343.77	1316
348.83	1316.01								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val

```
       0    .035   14.81    .035   233.5    .035

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         14.81   233.5             49.99   49.99   49.99             .1       .3
Cross Section Lid
    num=       2
     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord
    54.7    1328    1321   148.4    1328    1321

CROSS SECTION


RIVER: RIVER-1
REACH: Reach-1            RS: 14

INPUT
Description:
Station Elevation Data    num=      33
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0  1313.7     .11 1313.67   13.15  1314.1   14.35  1313.8   53.92    1303
    84.5 1303.05    84.5  1322.3    89.5  1322.3    89.5 1303.05  112.11 1303.12
  120.34 1303.12  129.22 1303.12   168.5 1303.02   168.5  1322.3   173.5  1322.3
   173.5 1303.02  189.84 1302.93  195.18  1304.3  230.91 1314.09  241.73 1313.71
  247.15 1313.78  257.89 1313.29  273.29  1313.9  290.24 1316.85  303.15  1317.6
  305.36 1315.43  327.39 1315.63  331.57  1315.7  333.46 1315.72  333.81 1315.74
  348.03 1315.83  348.88 1315.84  349.04  1315.8

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0    .035   13.15    .035  230.91    .035

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         13.15  230.91             47.14   51.15   55.19             .1       .3
Cross Section Lid
    num=       2
     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord
    78.6  1328.3  1321.3   172.6  1328.3  1321.3

CROSS SECTION


RIVER: RIVER-1
REACH: Reach-1            RS: 13

INPUT
Description:
Station Elevation Data    num=      34
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0  1313.3    7.16 1313.51   17.49 1313.85   41.43 1307.19   55.73 1303.09
   95.71  1303.2  124.82 1303.07  165.64 1302.94     171 1302.95     171    1322
     176    1322     176 1302.95  195.39 1303.03   209.9 1307.44  233.54  1313.9
   241.2 1313.68  248.28 1313.44  255.18  1313.1  256.81 1312.99  264.14  1313.2
  274.26 1313.57  284.91 1315.17   295.4 1317.01  301.31 1317.11  309.17  1317.6
  310.56 1316.23  312.29 1315.55  323.11 1315.65  336.23 1315.77  339.13  1315.9
  341.43 1315.97     346 1315.89  351.49 1315.82  351.51 1315.81

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0    .035   17.49    .035  233.54    .035

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         17.49  233.54             50.04   50.04   50.07             .1       .3
Cross Section Lid
    num=       2
     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord
   106.7    1328    1321   201.5    1328    1321

CROSS SECTION
```

RIVER: RIVER-1
REACH: Reach-1 RS: 12

INPUT
Description:
Station Elevation Data num= 33

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1312.9	.49	1312.87	22.24	1313.57	24.23	1313.02	58.36	1303.24
63.14	1303.3	130.36	1302.99	136.1	1302.97	174.5	1303.07	174.5	1321.7
179.5	1321.7	179.5	1303.07	201.39	1303.17	233.26	1312.85	236.79	1313.8
253.45	1313.25	254.38	1313.22	255.29	1313.18	258.85	1312.95	274.89	1313.3
275.73	1313.38	298.34	1316.78	298.95	1316.89	311.47	1317.09	311.96	1317.1
312.04	1317.04	315.67	1315.6	338.39	1315.82	339.33	1315.83	339.54	1315.8
344.34	1315.99	353.89	1315.83	354.15	1315.82				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.035	22.24	.035	236.79	.035

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
22.24	236.79	49.97	50.01	50.06	.1	.3

Cross Section Lid
num= 2

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord
136.8	1327.4	1320.4	231.7	1327.4	1320.4

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 11

INPUT
Description:
Station Elevation Data num= 32

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1313.4	1.81	1313.44	22.71	1313.24	23.41	1313.21	30.68	1311.41
38.78	1309	46.96	1306.39	53.62	1304.25	59.95	1303.38	100.49	1303.21
147.43	1303	170.45	1304.93	174.5	1304.93	174.6	1321	179.4	1321
179.5	1304.93	209.17	1304.98	217.17	1307.75	229.66	1311.36	237.97	1313.7
241.66	1313.62	241.91	1313.74	258.4	1313.28	266.48	1314.53	318.43	1316.4
325.25	1316.47	327.22	1315.69	339.77	1315.81	341.92	1315.91	344.58	1316
349.74	1315.91	354.73	1315.88						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.035	23.41	.035	237.97	.035

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
23.41	237.97	49.94	50.02	50.1	.1	.3

Cross Section Lid
num= 2

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord
163.1	1326.6	1319.6	258	1326.6	1319.6

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 10

INPUT
Description:
Station Elevation Data num= 31

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1313.3	6.08	1313.24	13.34	1313.31	17.8	1313.38	24.6	1310.7
32.19	1308	45.23	1305.42	56.37	1304.23	61.59	1303.51	64.03	1303.5
167.07	1302.9	217.63	1307.27	218.05	1307.27	218.41	1307.4	221.8	1307.6
233.23	1308.3	235.62	1309.29	246.89	1313.41	247.44	1313.63	257.58	1313.54
328.68	1315.5	330.97	1315.53	338.93	1315.81	339.27	1315.82	339.37	1315.78

340.01	1315.8	344.47	1316	344.59	1316	344.83	1316	355.12	1315.93
355.14	1315.9								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.035	17.8	.035	247.44	.035

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
17.8	247.44	49.99	50	50.02	.1	.3

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 9

INPUT
Description:
Station Elevation Data num= 29

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1313.3	12.04	1313.38	13.93	1313.35	15.21	1313.33	22.98	1313.4
25.9	1312.3	28.62	1311.85	59.73	1303.12	89.78	1302.83	168.61	1302.83
178.67	1303	180.33	1302.98	209.88	1303.54	234.39	1311.85	240.4	1313.6
243.13	1313.5	274.02	1313.56	274.38	1313.53	275.39	1313.44	276.09	1313.46
277.35	1313.7	278.18	1313.67	286.22	1313.83	289.39	1313.96	339.97	1315.77
343.54	1315.8	344.67	1315.86	347.29	1315.84	354.71	1315.84		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.035	22.98	.035	240.4	.035

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
22.98	240.4	49.96	50.01	50.07	.1	.3

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 8

INPUT
Description:
Station Elevation Data num= 30

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1311.7	.43	1311.67	6.08	1311.7	16.02	1312.15	19.12	1312.12
29.8	1310.7	59.6	1303.53	64.09	1303.25	110.12	1302.9	131.59	1302.7
164.35	1302.8	189.58	1302.98	200.46	1303.06	202.6	1303.1	204.38	1303.71
238.89	1313.7	254.57	1313.23	256.89	1313.23	262.32	1312.89	262.4	1312.88
274.26	1313.3	295.59	1316.54	309.67	1316.81	315.35	1316.92	318.95	1315.56
339.93	1315.7	343.51	1316.02	344	1316.02	345.02	1316.02	355.12	1315.9

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.035	19.12	.035	238.89	.035

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
19.12	238.89	50.04	50.03	50.06	.1	.3

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 7

INPUT
Description:
Station Elevation Data num= 19

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1313.1	17.92	1312.91	42.93	1307.44	58.81	1303.2	79.07	1303
118.22	1302.7	173.12	1303.11	195.26	1303.2	198.92	1303.46	223.97	1309.32

234.8	1312.4	264.77	1313.2	268.58	1313.26	306.88	1314.88	331.3	1315.91
336.02	1316.2	337.52	1316.16	349.67	1316.09	352.94	1316.07		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.035	17.92	.035	234.8	.035

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
17.92	234.8	40.73	53.36	66	.1	.3

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 6

INPUT
Description:
Station Elevation Data num= 28

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1313.2	1.62	1313.27	18.06	1313.08	25.38	1311.49	56.41	1303.18
98.35	1302.8	111.94	1302.66	145.26	1302.9	195.76	1303.02	197.73	1303.09
225.34	1309.7	235.94	1312.12	250.82	1312.65	260.18	1313.14	269.32	1313.74
270.69	1313.6	273.13	1313.67	289.5	1316.34	292.28	1316.82	294.56	1316.96
305.32	1316.8	330.37	1316.65	332.82	1316.52	339.36	1316.07	339.73	1316.19
343.74	1315.8	345.67	1315.64	355.14	1315.23				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.035	18.06	.035	269.32	.035

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
18.06	269.32	79.92	107.16	134.56	.1	.3

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 5

INPUT
Description:
Station Elevation Data num= 13

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1313.5	17.55	1313.39	42.95	1306.82	56.78	1303.1	75.45	1302.92
119.39	1302.7	176.69	1302.88	198.98	1302.82	225.55	1308.89	236.75	1311.66
242.51	1312.2	262.48	1311.82	363.59	1313.09				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.035	17.55	.035	242.51	.035

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
17.55	242.51	70.16	110.96	151.76	.1	.3

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 4

INPUT
Description:
Station Elevation Data num= 17

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1313.4	15.44	1313.39	26.64	1310.53	53.6	1303.18	95.11	1303.01
117.61	1302.6	177.08	1302.87	194.77	1302.73	218.14	1307.82	234	1311.42
253.27	1314.05	269.67	1316.1	289.01	1318.07	289.63	1317.89	292.76	1317.91
312.28	1316.6	361.68	1314.1						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.035	15.44	.035	253.27	.035

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
15.44	253.27	175.07	209.04	243.01	.1	.3

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 3

INPUT
Description:
Station Elevation Data num= 32

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1312.2	3.81	1312.41	4.04	1312.41	21.77	1313.07	40.6	1307.8
62.78	1302.8	132.29	1302.68	134	1302.68	134.42	1302.68	135.2	1302.69
198.64	1302.6	198.78	1302.68	235.42	1312.98	236.68	1313.38	237.83	1313.43
250.76	1313.1	251.1	1313	252.8	1312.64	252.87	1312.64	273.73	1312.93
274.03	1313	301.74	1316.67	301.76	1316.67	313.93	1316.79	313.95	1316.78
318.24	1315.3	331.11	1315.42	341.33	1315.48	341.43	1315.48	346.09	1315.34
346.15	1315.3	358.08	1314.88						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.035	21.77	.035	236.68	.035

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
21.77	236.68	200.12	200.04	200.01	.1	.3

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 2

INPUT
Description:
Station Elevation Data num= 29

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1312.3	14.8	1312.96	15.78	1312.95	26.77	1309.88	52.29	1302.71
54.16	1302.7	108.99	1302.49	128.15	1302.42	190.14	1302.74	192.64	1302.76
194.12	1303.2	229.89	1313.35	230.27	1313.34	247.13	1312.32	247.48	1312.29
265.94	1312.7	266.59	1312.69	292.66	1316.11	293.85	1316.26	307.03	1316.52
307.29	1316.5	311.17	1315.25	311.23	1315.23	311.61	1315.23	311.7	1315.24
334.57	1315.4	340.12	1315.99	340.47	1315.98	352.8	1315.31		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.035	15.78	.035	230.27	.035

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
15.78	230.27	100	100.01	100.03	.1	.3

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 1

INPUT
Description:
Station Elevation Data num= 14

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1312.3	12.16	1312.84	47.03	1303.73	195.62	1302.85	232.89	1313.3
245.55	1313.1	253.98	1312.4	266.97	1312.8	296.46	1316.33	307.51	1316.63
311.58	1315.3	334.95	1315.38	337.4	1315.21	351.29	1315.18		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.035	12.16	.035	232.89	.035

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
12.16	232.89	0	0	0	.1	.3

SUMMARY OF MANNING'S N VALUES

River:RIVER-1

Reach	River Sta.	n1	n2	n3
Reach-1	23	.035	.035	.035
Reach-1	22	.035	.035	.035
Reach-1	21	.035	.035	.035
Reach-1	20	.035	.035	.035
Reach-1	19	.035	.035	.035
Reach-1	18	.035	.035	.035
Reach-1	17.8	.035	.035	.035
Reach-1	17	.035	.035	.035
Reach-1	16	.035	.035	.035
Reach-1	15	.035	.035	.035
Reach-1	14	.035	.035	.035
Reach-1	13	.035	.035	.035
Reach-1	12	.035	.035	.035
Reach-1	11	.035	.035	.035
Reach-1	10	.035	.035	.035
Reach-1	9	.035	.035	.035
Reach-1	8	.035	.035	.035
Reach-1	7	.035	.035	.035
Reach-1	6	.035	.035	.035
Reach-1	5	.035	.035	.035
Reach-1	4	.035	.035	.035
Reach-1	3	.035	.035	.035
Reach-1	2	.035	.035	.035
Reach-1	1	.035	.035	.035

SUMMARY OF REACH LENGTHS

River: RIVER-1

Reach	River Sta.	Left	Channel	Right
Reach-1	23	227.48	188.32	149.16
Reach-1	22	213.76	194.02	174.48
Reach-1	21	211.51	195.85	180.25
Reach-1	20	148.03	150.76	153.49
Reach-1	19	49.99	49.99	50
Reach-1	18	8.6	7.64	5.96
Reach-1	17.8	41.41	42.36	44.04
Reach-1	17	49.99	49.99	49.99
Reach-1	16	54.94	48.21	41.48
Reach-1	15	49.99	49.99	49.99
Reach-1	14	47.14	51.15	55.19
Reach-1	13	50.04	50.04	50.07
Reach-1	12	49.97	50.01	50.06
Reach-1	11	49.94	50.02	50.1
Reach-1	10	49.99	50	50.02
Reach-1	9	49.96	50.01	50.07
Reach-1	8	50.04	50.03	50.06
Reach-1	7	40.73	53.36	66
Reach-1	6	79.92	107.16	134.56
Reach-1	5	70.16	110.96	151.76
Reach-1	4	175.07	209.04	243.01

Reach-1	3	200.12	200.04	200.01
Reach-1	2	100	100.01	100.03
Reach-1	1	0	0	0

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS
River: RIVER-1

Reach	River Sta.	Contr.	Expan.
Reach-1	23	.1	.3
Reach-1	22	.1	.3
Reach-1	21	.1	.3
Reach-1	20	.1	.3
Reach-1	19	.1	.3
Reach-1	18	.1	.3
Reach-1	17.8	.1	.3
Reach-1	17	.1	.3
Reach-1	16	.1	.3
Reach-1	15	.1	.3
Reach-1	14	.1	.3
Reach-1	13	.1	.3
Reach-1	12	.1	.3
Reach-1	11	.1	.3
Reach-1	10	.1	.3
Reach-1	9	.1	.3
Reach-1	8	.1	.3
Reach-1	7	.1	.3
Reach-1	6	.1	.3
Reach-1	5	.1	.3
Reach-1	4	.1	.3
Reach-1	3	.1	.3
Reach-1	2	.1	.3
Reach-1	1	.1	.3

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Level 1 Bridge Scour Calculations

PIER SCOUR CALCULATION SHEET

Consultant: **Wood, Patel & Associates, Inc.** Project # **021733** **Sheet # 1 of 1**

References: **FHWA's HEC-18 (Fourth edition) and Interum Procedure for Estimating Pier Scour with Debris**

Project Name: **Germann Road Bridge Scour @ EMF** Date: **05/22/2003**

Engineer: **R. Hiner** Checked By: _____ Structure #: _____

HYDROLOGIC/HYDRAULIC PARAMETERS

Return Interval	**100**	yrs.	Hydraulics Source	FEMA HEC-2	
Hydrology Source	FEMA HEC-1		Flow Top Width (T)	194	ft.
Discharge (Q)	6900	cfs	Flow Area (A)	1447	ft^2
Water Surface Elev.	1311.98	ft.	Channel Slope (S)	0.00080	ft/ft
Thalweg Elevation	1302.62	ft.	Max. Velocity (Vm)	6.20	ft/sec
Max. Depth of Flow (Y1)	**9.36**	ft.	Froude Number (Fr)	**0.40004**	(Vm^2*T/g*A)^.5

PIER SCOUR CALCULATIONS

Pier Type: Stemwall _____ Columns x
Foundation Type: Spread Ftng _____ Piles/Drilled Shaft x

K1 = 1.1 Correction factor for pier nose shape (assume square nose pier K1=1.1 Table 2, pg. 40, HEC-18. For multiple column piers and stemwalls skewed to the flow, K1=1.0)

0 degrees (0 degrees for circular columns considered independantly)

Angle of Attack (theta) = 0 radians (15 degree min. for stemwall piers if potential channel meandering)

Pier Width (Wp) = 5 ft. Number of Columns/Piles per bent: 2

Dist. Between Columns = 20 ft. (Clear space must exceed 5 pier diameters for independent analysis)

Debris Blockout (Wd) = 4 ft. (Based on debris potential; low = 2 ft., medium = 3 ft., high = 4 ft.)

Length of Pier (L) = 4 ft. Coefficient for bed condition K3= 1.1 (Table 1, pg. 39)

Effective Pier Length (L') = 6 ft. (sum of pier diameters plus debris width)

Effective Pier Width (a) = 9.00 ft. (The greater of Wp*cos(theta)+Wd or (Wp*cos(theta)+Wd)/2+L'sin(theta))

K2 = 1.0 (For stemwall, multiple column, and single column piers K2=1.0)

K4 = 1.0 (Armoring factor for bed material. If unknown, assume K4=1.0)

Colorado State University Equation (HEC-18 pg. 52)

$$Y_s = Y_1 2.0 K_1 K_2 K_3 K_4 \left(\frac{a}{Y_1}\right)^{0.65} Fr^{0.43}$$

Depth of Pier Scour Hole = **14.89** ft.
Elev. @ Btm of Scour Hole= **1287.73** ft.
Elev. @ Bottom of Footing= _____ ft.
Elev. @ Min. Tip of Pile= _____ ft.

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APPENDIX B

Pavement Drainage Calculations

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On-Site Hydrology (Rational Method)

Flood Control District of Maricopa County
Drainage Design Manual Rational Method

Computed by: PLOPEZ Date: 5/14/2003

LOCATION DATA

Location: GERMANN ROAD

Project Name: GERMANN RD Subarea id: ~~4~~ G1 G2

Drainage Area Cover: URBAN

DESIGN DATA

Drainage Area	2.1000	acres
Watercourse Length	2008.0000	feet
Top Elevation	1328.0000	feet
Bottom Elevation	1307.0000	feet
Slope	0.010	feet/feet
Roughness Coefficient (Kb)	0.0380	
10-year, 6-Hour Rainfall	1.8900	inches

Hydrological Summary Table

Parameter	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Q (cfs)	4	6	7	9	10	12
C	0.950	0.950	0.950	0.950	0.950	0.950
Tc (min)	16.7	14.7	13.7	12.5	11.8	11.2
i (in/hr)	2.1	3.0	3.5	4.6	5.3	6.1

Street Capacity Calculations

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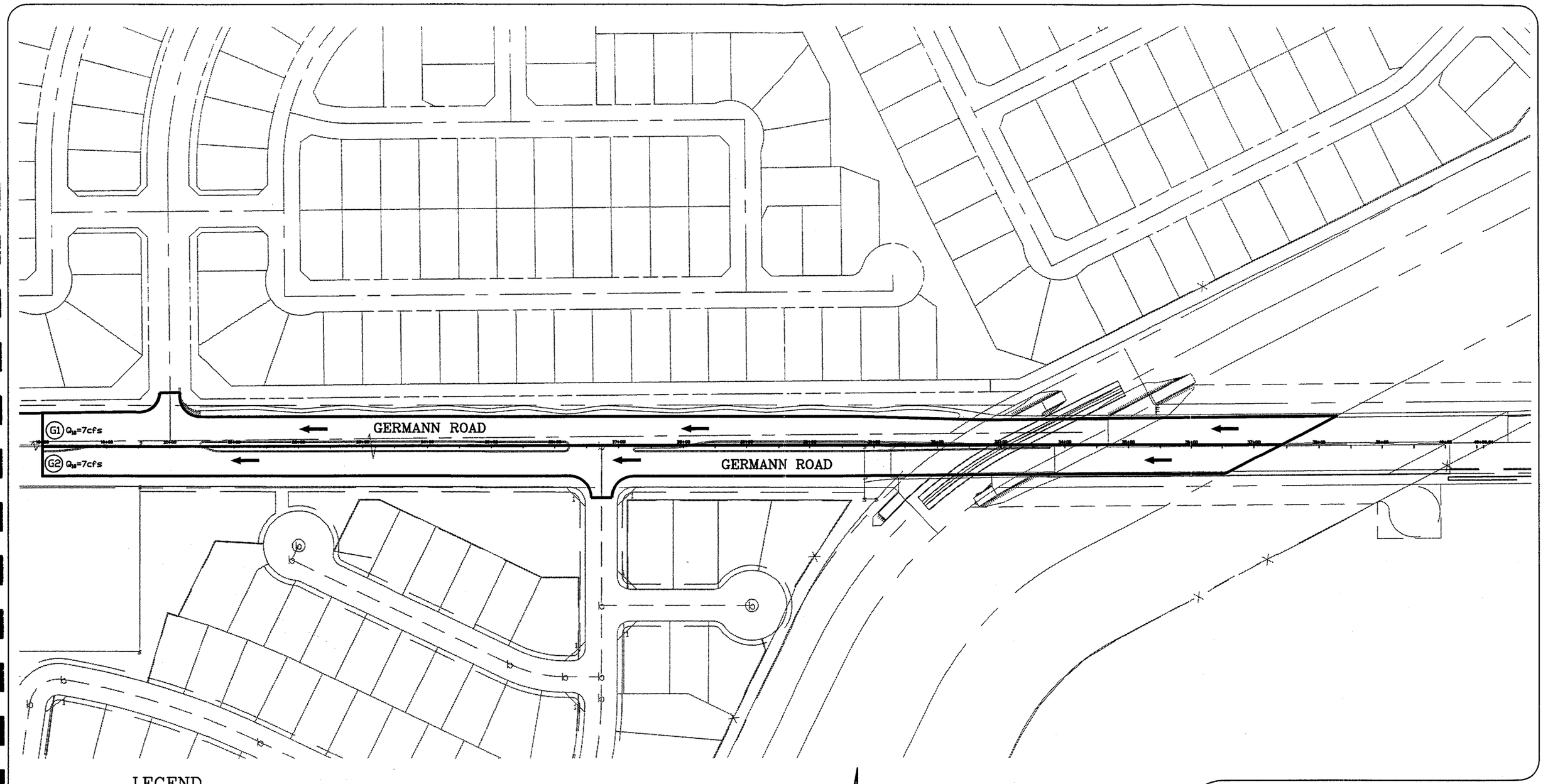

LEGEND

(G1)	CONCENTRATION POINT IDENTIFICATION
Q_{10}=3cfs	ESTIMATED 10YR FLOWRATE
←	FLOW DIRECTION ARROW
—	SUB-BASIN BOUNDARY

N

0 75 150 300

Scale in Feet

GERMANN ROAD
DRAINAGE MAP

Wood, Patel & Associates, Inc.
2051 West Northern, Suite 100
Phoenix, Arizona 85021 (602) 335-8500

DRAWN BY: P. LOPEZ	PLATE #
JOB NO: 021733	DATE: 5/22/2003

GERMANN ROAD
INFRASTRUCTURE
STREET CAPACITY
CALCULATIONS
DATE: 22 MAY 2003

Street Capacity

STA	Road Way Grade %	Cross Slope (ft/ft)	Spread (ft)	Velocity (ft/s)	Q_{allow} (cfs)	Q_{10} (cfs)
1800	0.35	0.025	18.13	2.46	10.19	7
2145	0.35	0.025	18.13	2.46	10.19	7
2150	0.54	0.025	18.13	3.06	12.68	7
2730	0.54	0.025	18.13	3.06	12.68	7
2735	0.25	0.025	18.13	2.09	8.66	7
2935	0.25	0.025	18.13	2.09	8.66	7
2950	0.38	0.025	18.13	2.33	9.66	7
3000	0.92	0.025	18.13	3.31	13.69	7
3050	1.45	0.025	18.13	4.28	17.72	7
3100	1.98	0.025	18.13	5.25	21.75	7
3150	2.51	0.025	18.13	6.22	25.77	7
3200	3.05	0.025	18.13	7.20	29.80	3
3215	3.18	0.025	18.13	7.44	30.81	3
3425	3.18	0.025	18.13	7.44	30.81	3
3450	3.00	0.025	18.13	7.10	29.40	3
3500	2.56	0.025	18.13	6.28	26.00	3
3600	1.68	0.025	18.13	4.69	19.44	3
3700	0.81	0.025	18.13	3.11	12.88	3

GERMANN ROAD
INFRASTRUCTURE
STREET CAPACITY
RATING CURVE
DATE: 22 MAY 2003

Rating Curve

Road Way Grade %	Cross Slope (ft/ft)	Spread (ft)	Velocity (ft/s)	Q_{allow} (cfs)
0.25	0.025	18.13	2.09	8.66
0.35	0.025	18.13	2.27	9.41
0.45	0.025	18.13	2.45	10.16
0.55	0.025	18.13	2.64	10.92
0.65	0.025	18.13	2.82	11.67
0.75	0.025	18.13	3.00	12.43
0.85	0.025	18.13	3.18	13.18
0.95	0.025	18.13	3.36	13.93
1.05	0.025	18.13	3.55	14.69
1.15	0.025	18.13	3.73	15.44
1.25	0.025	18.13	3.91	16.20
1.35	0.025	18.13	4.09	16.95
1.45	0.025	18.13	4.28	17.71
1.55	0.025	18.13	4.46	18.46
1.65	0.025	18.13	4.64	19.21
1.75	0.025	18.13	4.82	19.97
1.85	0.025	18.13	5.00	20.72
1.95	0.025	18.13	5.19	21.48
2.05	0.025	18.13	5.37	22.23
2.15	0.025	18.13	5.55	22.98
2.25	0.025	18.13	5.73	23.74
2.35	0.025	18.13	5.91	24.49
2.45	0.025	18.13	6.10	25.25
2.55	0.025	18.13	6.28	26.00
2.65	0.025	18.13	6.46	26.76
2.75	0.025	18.13	6.64	27.51
2.85	0.025	18.13	6.82	28.26
2.95	0.025	18.13	7.01	29.02
3.05	0.025	18.13	7.19	29.77
3.15	0.025	18.13	7.37	30.53
3.20	0.025	18.13	7.46	30.90

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

05-19-2003

PROJECT NAME- 021733 TRACS NO.-
HIGHWAY NAME- GERMANN RD DESIGNER - P.L.
LOCATION - STA 18+00 → 21+45 CHECKER - PAGE
Ver 3.40: December 1995

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.348
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.025
Shoulder Width-Ft.--	=	1.417
Shoulder Slope-Ft./Ft.--Ss	=	0.025
Gutter Width-Ft.--W	=	1.417
Gutter Slope-Ft./Ft.--Sw	=	0.058
Gutter Depression-Inches--	=	0.986
Manning's 'N	=	0.016
Flow-CFS--Q	=	10.191
SPREAD-Ft.--T	=	18.130
Average Velocity-V-fps	=	2.461
FLOW in Gutter-CFS--Q	=	2.133
% Flow in Gutter-CFS	=	20.933
Velocity of Flow in Gutter-fps	=	3.281
Depth at Curb Line-Inches--d	=	6.000

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

05-19-2003

PROJECT NAME- 021733 TRACS NO.-
HIGHWAY NAME- GERMANN RD DESIGNER - P.L.
LOCATION - STA 21+50 -> 27+30 CHECKER - PAGE
Ver 3.40: December 1995

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.539
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.025
Shoulder Width-Ft.--	=	1.417
Shoulder Slope-Ft./Ft.--Ss	=	0.025
Gutter Width-Ft.--W	=	1.417
Gutter Slope-Ft./Ft.--Sw	=	0.058
Gutter Depression-Inches--	=	0.986
Manning's 'N	=	0.016
Flow-CFS--Q	=	12.683
SPREAD-Ft.--T	=	18.130
Average Velocity-V-fps	=	3.062
FLOW in Gutter-CFS--Q	=	2.655
% Flow in Gutter-CFS	=	20.933
Velocity of Flow in Gutter-fps	=	4.083
Depth at Curb Line-Inches--d	=	6.000

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

05-19-2003

PROJECT NAME- 021733 TRACS NO.-
HIGHWAY NAME- GERMANN RD DESIGNER - P.L.
LOCATION - STA 27+35 → 29+35 CHECKER - PAGE
Ver 3.40: December 1995

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.251 ←
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.025
Shoulder Width-Ft.--	=	1.417
Shoulder Slope-Ft./Ft.--Ss	=	0.025
Gutter Width-Ft.--W	=	1.417
Gutter Slope-Ft./Ft.--Sw	=	0.058
Gutter Depression-Inches--	=	0.986
Manning's 'N	=	0.016
Flow-CFS--Q	=	8.655
SPREAD-Ft.--T	=	18.130
Average Velocity-V-fps	=	2.090
FLOW in Gutter-CFS--Q	=	1.812
% Flow in Gutter-CFS	=	20.933
Velocity of Flow in Gutter-fps	=	2.786
Depth at Curb Line-Inches--d	=	6.000

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

05-19-2003

PROJECT NAME- 021733 TRACS NO.-
HIGHWAY NAME- GERMANN RD DESIGNER - P.L.
LOCATION - STA 32+15 → 34+25 CHECKER - PAGE
Ver 3.40: December 1995

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	3.180 ←
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.025
Shoulder Width-Ft.--	=	1.417
Shoulder Slope-Ft./Ft.--Ss	=	0.025
Gutter Width-Ft.--W	=	1.417
Gutter Slope-Ft./Ft.--Sw	=	0.058
Gutter Depression-Inches--	=	0.986
Manning's 'N	=	0.016
Flow-CFS--Q	=	30.808
SPREAD-Ft.--T	=	18.130
Average Velocity-V-fps	=	7.439
FLOW in Gutter-CFS--Q	=	6.449
% Flow in Gutter-CFS	=	20.933
Velocity of Flow in Gutter-fps	=	9.917
Depth at Curb Line-Inches--d	=	6.000

Catch Basin Calculations

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GERMANN ROAD
INFRASTRUCTURE
STREET RUNOFF
DATE: 22 MAY 2003

Concentration Point	Station[1]	Q_{10} [2] (cfs)	Drainage Structure	Curb Opening Required (ft)
G1	18+00 EB	7	4-6' Existing Scuppers	18
G2	18+00 WB	7	-	18

1.) Note: WB = west bound; EB = east bound.

2.) Note: Estimated 10yr-6hr discharge.

ARIZONA DEPARTMENT OF TRANSPORTATION
DRAINAGE DESIGN SECTION

05-19-2003

PROJECT NAME- 021753 TRACS NO.-
HIGHWAY NAME- GERMANN RD DESIGNER - P.L.
LOCATION - STA 18+00 CURB OPENING CHECKER - PAGE
Ver 3.40: December 1995

CURB OPENING INLET -- ON GRADE

GUTTER FLOW HYDRAULICS
GUTTER DESCRIPTION

Roadway Grade-% Per cent--G	=	0.348
Roadway Cross-Slope-Ft./Ft.--Sx	=	0.025
Shoulder Width-Ft.--	=	1.417
Shoulder Slope-Ft./Ft.--Ss	=	0.025
Gutter Width-Ft.--W	=	1.417
Gutter Slope-Ft./Ft.--Sw	=	0.058
Gutter Depression-Inches--	=	0.986
Manning's 'N	=	0.016
Flow-CFS--Q	=	7.000 ← Q_{10}
SPREAD-Ft.--T	=	15.713
Average Velocity-V-fps	=	2.244
FLOW in Gutter-CFS--Q	=	1.687
% Flow in Gutter-CFS	=	24.098
Velocity of Flow in Gutter-fps	=	2.987
Depth at Curb Line-Inches--d	=	5.275

CURB OPENING--ADOT STD. C-15.20

Flow-CFS--Q	=	7.000
Gutter Velocity at INLET-fps	=	3.361
GUTTER FLOW at INLET-CFS--Q	=	2.227
Depth at INLET Curb Line-Inches--d	=	7.105
Local Gutter Depression-Inches	=	2.000
Length of opening: TOTAL Intercept--Ft.	=	17.877 ← 24' PROVIDED
Capture Ratio -- CURB OPENING	=	0.800

LENGTH	Efficiency	Q(Captured)	Q(By-Pass)
3.083	0.289	2.021	4.979
6.583	0.562	3.937	3.063
9.583	0.749	5.243	1.757
13.583	0.923	6.463	0.537
20.583	1.000	7.000	0.000