DESIGN DATA REPORT
FINAL SUBMITTAL
for
LOOP 303 OUTFALL DRAINAGE SYSTEM
(WOODLANDS AVENUE TO GILA RIVER)
July 2012
WP #103484

FCD2011C015

WOOD/PATEL
MISSION: CLIENT SERVICE™

DESIGN DATA REPORT
FINAL SUBMITTAL
for
LOOP 303 OUTFALL DRAINAGE SYSTEM
(WOODLANDS AVENUE TO GILA RIVER)
July 2012
WP #103484

FCD2011C015

FCD P.C.N. 470.14.31

Prepared for:
Flood Control District of Maricopa County
2801 West Durango Street
Phoenix, Arizona 85009
Phone: (602) 506-1501
Fax: (602) 506-4601

Prepared by:
Wood, Patel & Associates, Inc.
2051 West Northern Avenue
Suite 100
Phoenix, Arizona 85021
Phone: (602) 335-8500
Fax: (602) 335-8580
Website: *www.woodpatel.com*

Prepared in Cooperation with:
Arizona Department of Transportation
1161 West Jackson Street
MD EM01
Phoenix, Arizona 85007
Phone: (602) 712-3062

In Association with:
Aztec Engineering
Project Engineering Consultants
RSP Architects
Ninyo & Moore

CERTIFICATE NO. 24999
JEFFREY R. MINCH
DATE SIGNED 7-25-12
ARIZONA U.S.A.

EXPIRES: 9/30/12

TABLE OF CONTENTS

1.0 INTRODUCTION **1**

2.0 HYDROLOGY **1**

2.1 Hydrology 1
2.2 Lateral Spillway Drainage Analysis 2
2.3 Freeway Runoff Analysis 2

3.0 HYDRAULICS **2**

3.1 Channel Profiles and Freeboard Estimation 2
3.2 Hydraulics for Other Elements 3

4.0 SCOUR ANALYSIS **3**

5.0 EARTHWORK CALCULATIONS **3**

6.0 STRUCTURAL CALCULATIONS **3**

7.0 INVENTORY OF UTILITIES **4**

APPENDICES

Appendix A Supporting Data for Hydrology

- Appendix A1 Project Hydrology Memo
- Appendix A2 Local Flow Calculations and Exhibits by Rational Method
- Appendix A3 Peak Flow Estimation for Adjacent Loop 303 Freeway

Appendix B Supporting Data for Hydraulics

- Appendix B1 Channel Profiles and Freeboard Calculations
- Appendix B2 HEC-RAS Modeling Results for the 100-Year Flow
- Appendix B3 Lateral Spillway Calculations
- Appendix B4 Trash Rack Calculations

Appendix C Scour Analysis Memo and Supporting Data

Appendix D Project Geometry and Earthwork Report

Appendix E Structural Calculations

Appendix F Inventory of Utilities

Appendix G CD with HEC-RAS, Plans, and Exhibits Electronic Files

Registered Professional Engineer (Civil)
CERTIFICATE NO. 24999
JEFFREY R. MACH
DATE SIGNED 7-25-12
ARIZONA U.S.A.
EXPIRES: 9/30/12

W:\2010Projects\103484 - Loop 303 Outfall Drainage\Project Support\Reports\Final Design Report\103484 Loop 303 Outfall Drainage System Data Design Report -Final Submittal 7-25-12.docx

1.0 INTRODUCTION

The Loop 303 Outfall Drainage System Project (Woodlands Avenue to Gila River) is the Flood Control District of Maricopa County's (FCDMC) contribution to the development of an overall regional drainage system along the Loop 303 Freeway corridor. Through an Inter-Governmental Agreement (IGA) with the Arizona Department of Transportation (ADOT), the Loop 303 Outfall Drainage System is the downstream-most portion of the regional drainage system for the Loop 303 freeway corridor. The facility will be used by ADOT as the future outlet of the Loop 303 freeway drainage systems and the FCDMC outfall for the White Tanks F.R.S. #4.

The north and upstream end is approximately 150-feet north of the centerline of Van Buren Street. The south and downstream end of the project is at the north bank of the Gila River. A Pre-Design Study was completed by Wood/Patel in October 2010 which detailed the design criteria, data and information about the project features, alternative analysis, and the selection of the preferred design alternative.

The purpose of this report is to document the supporting design data for the final submittal. It is not intended to be drainage report but a compilation of the key design calculations and supporting analyses.

The final design plans are submitted under separate cover. A CD containing the electronic files of the HEC-RAS models, design plans, and exhibits is located in Appendix G.

2.0 HYDROLOGY

2.1 Hydrology

The hydrology for the project was defined by the FCDMC and the design flow for the 100-year storm event is 480 cfs for the entire project limits. A Memo that documents the determination of the design flow is included in Appendix A1. This memo summarizes the estimated combination of future flows from the White Tanks F.R.S. #4 and the future Loop 303 Freeway Corridor.

2.2 Lateral Spillway Drainage Analysis

Peak flows for many local drainage areas into the channel were estimated using the rational method. The peak flow summary table and Rational Method calculation sheets are included in Appendix A2.

2.3 Freeway Runoff Analysis

A freeway runoff analysis was performed to determine the effects, if any, on the flow going through the proposed channel from the future adjacent Loop 303 freeway. These flows were determined using rational method hydrology with a synthetic rational hydrograph. The resulting flows from the future freeway were estimated to produce approximately 75 cfs for the 100-year event. This flow is assumed to be accounted for in the design discharge stated within the scope of work. See the memo in Appendix A3 – *Estimate of flows from the future adjacent freeway* for hydrologic calculations.

3.0 HYDRAULICS

3.1 Channel Profiles and Freeboard Estimation

Procedures outlined in the Drainage Design Manual for Maricopa County, Volume II, Hydraulics, revised January 1996, were used for all hydraulic calculations. The channel longitudinal slope was established by the Project Team to meet velocity and Froude number criteria. A HEC-RAS model was developed to model the channel hydraulics, the water-surface elevations, and culvert sizing. Manning's roughness coefficient, "n" value, was determined for the different types of conveyance systems using standard FCDMC values. The "n" value for the channel was determined to be 0.015 per a smooth finish construction method. The "n" value of the box culverts were determined to 0.013 as is standard with cast in place ADOT boxes. Freeboard was calculated for each channel section using FCDMC methodology. There are several areas of the proposed channel that do not meet the initial freeboard requirements. However, a freeboard modification waiver has been issued for these areas and has been included in Appendix B1. Appendix B1 also tabulates the channel profiles and freeboard calculations. Appendix B2 includes the HEC-RAS modeling results and cross section plots for the 100-year flow.

3.2 Hydraulics for Other Elements

Lateral spillways for local drainage areas were sized by using FlowMaster software and the calculations are included in Appendix B3. A total of three access barriers have been designed for two of the crossings along the proposed channel. The calculations for these access barriers, using FCDMC methodology, can be found in Appendix B4. The procedures used for all hydraulic calculations are outlined in the Drainage Design Manual for Maricopa County, Volume II, Hydraulics, revised January 1996.

4.0 SCOUR ANALYSIS

The Loop 303 Outfall Channel is a concrete lined channel. However, approximately 2,100 feet of the most downstream reach is within the Gila River floodplain and the outlet of the channel needs protection for erosion caused by both the flowing water from the Gila River and the outfall channel. Buried loose riprap is proposed to protect the channel outlet into the Gila River. A Memo documenting the scour elements and calculations is included in Appendix C. This erosion protection system is acknowledged to be sacrificial during a major flood event on the Gila River.

5.0 EARTHWORK CALCULATIONS

Earthwork calculations have been developed for the project reach using the end area method and the report is included in Appendix D. An end area report has been generated using Bentley's InRoads computer program for the project reach at approximately 100' intervals based on channel control line stationing. An estimated initial loss has been applied to the project graded area taking into consideration current land use and site conditions. In addition, shrinkage has been applied to project fill areas based on the Geotechnical Evaluation Report prepared for the project by Ninyo & Moore.

6.0 STRUCTURAL CALCULATIONS

The reinforced concrete channel lining has been designed per ADOT standards. A copy of the calculations for minimum channel slab thickness, longitudinal and lateral reinforcement is provided in Appendix E.

For the private irrigation relocation due to the proposed channel, two steel pipe span systems were designed to deliver irrigation water over the proposed channel. The calculations for the structures and selection of pipe supports are provided in Appendix E.

7.0 INVENTORY OF UTILITIES

Utility coordination on the project plays an important role as there are numerous utilities affected by the project. A comprehensive list of utilities located within the project corridor was initially prepared and a list of utility contacts was then developed and confirmed. Utility mapping was compiled based on this information and used to develop the utility base file for the project. Additional field information was developed to supplement the mapping including utility potholing and utility designation for critical utility locations within the corridor. A Utility Tracking Report was developed for the project based on this information. Coordination meetings with the utilities are ongoing as the design is refined. Appendix F contains the list of utilities, a utility tracking report, and utility pothole data.

APPENDIX A
Supporting Data for Hydrology

APPENDIX A1

Project Hydrology Memo

PROJECT FILE MEMO Contract No. FCD2010C002

PROJECT: Loop 303 Outfall Drainage System

SUBJECT: Change of Design Discharge from 300 cfs to 480 cfs

FROM: Mike Duncan, Project Manager

A management meeting (Dam Safety branch, Project Management branch, and their Division manager) was held on November 9, 2010 to decide on an appropriate design discharge for the outlet of the White Tanks F.R.S. #4. Design work for this dam is currently in Phase 1 of a two-phase rehabilitation/upgrade. Based on full-open gate(s) on the principal outlet pipe (or pipes), 300 cfs is the best estimate for the peak discharge for the outlet of White Tanks F.R.S. #4, at this time. See footnote (1) below.

The most recent HEC-1 modeling from the design work for the I-10 / Loop 303 Traffic Interchange has a peak discharge of 182 cfs for the Loop 303 channel at Van Buren St.; see footnote (2) below.

Since the flow from the dam is not delayed by any gate closures, the two flows would be additive (for approx. 2 days), totaling 482 cfs. Then rounding to the nearest 10 cfs,

the design flow for the Loop 303 Outfall Channel is now **480 cfs**.

This is the new design discharge resulting from the management meeting.

Footnote (1) - In March 2010, Dave Degerness (project manager of W.T. FRS #4) made some estimates, based on HEC-1 models for various storm events. The peak discharges were approx. 270 cfs (for 100yr/24hr storm), 290 cfs (for 6-hour P.M.F.), and 280 cfs (for 72-hour P.M.F.). The typical hydrograph drain-down time is approximately 10 days.

Footnote (2) - At Van Buren St. just west of Cotton Lane, CPS13, the peak discharge is 182 cfs at 23.92 hr, (J2's model run of 01 OCT 2010 at 08:49:49), for Future Conditions with CIP in Place. The drain-down time is approximately 2 days. J2 is a sub-consultant to Aztec, who is designing the I-10 / Loop 303 traffic interchange upstream of this location.

APPENDIX A2

Local Flow Calculations and Exhibits by Rational Method

Loop 303 Outfall Drainage System **W/P Job: 103484**

LATERAL INFLOW CALCULATIONS

Flood Control District of Maricopa County

FCD # 2010C002

Location: Maricopa County/City of Goodyear

Segment	Station	Sub-basin Label	Area (acre)	Q100 (cfs)	Depth, D (ft)	Side Slopes, S (X:1)	Width, W (ft)	Length, L1 (ft)	Length, L2 (ft)	Headwater Depth (ft) (1)
WPA	19+85.15	1	31.2	24	1	4	5	4	10	0.85
WPA	25+88.98	2	58.4	54	1	4	5	4	20	0.92
WPA	37+11.80	5	8.6	9	1	4	5	4	5	0.71
WPA	42+51.77	6	80.6	77	1	10	14	10	30	0.89
WPA	58+20.71	7	60.6	55	0.5	10	14	5	55	0.48
WPA	77+29.22	8	50.6	56	0.5	4	5	2	55	0.49
WPA	66+00.67	9	4.1	6	0.5	4	5	2	10	0.34
WPA	79+00.00	10	9.0	11	0.5	10	14	5	15	0.37
WPA	96+01.45	11	15.2	19	1	4	5	4	10	0.73
WPA	110+11.65	12	0.6	1	0.5	4	5	2	1	0.48
WPA	110+81.46	13	3.6	5	0.5	10	14	5	5	0.48
WPA	115+61.94	14	14.2	21	1	10	14	10	10	0.78
WPA	132+41.46	15	27.0	42	1	4	5	4	15	0.94
WPA	145+01.88	16	16.2	21	1	4	5	4	10	0.78
Aztec	217+40.00	18	24.9	33	1	4	5	4	15	0.80
Aztec	229+10.00	19	14.3	21	1	4	5	4	10	0.78
Aztec	242+20.00	20	42.4	49	1	4	5	4	20	0.86
PEC	162+84.63	21	32.0	113	1	4	5	4	40	0.95
PEC	174+98.66	22	18.6	63	1	4	3.6	4	25	0.88

(1) Depth calculated using broadcrested weir calculation. Calculations ignore sideslope areas.

RATIONAL FOR WINDOWS

Flood Control District of Maricopa County Rational Method

Project Information

Project Name: Loop 303 Outfall Channel

Project Description: Lateral Inflow Hydrology

Drainage Point: 1

Location: Basin 1

Drainage Basin Data

Water Course Length: 2683.00 ft

Basin Area: 31.200 acres

High Elevation: 892.00 ft

Low Elevation: 890.00 ft

Average Slope: 0.0007 ft/ft

Roughness, Kb: 0.0307 (A)

10-Year Runoff Coefficient: 0.200

10-Year 6 Hour Rainfall Depth: 1.70 inches

Hydrological Summary Table

Parameter	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Q (cfs)	5	8	10	15	19	24
C	0.200	0.200	0.200	0.220	0.240	0.250
Tc (min)	55.9	46.9	43.4	38.9	36.3	34.2
i (in/hr)	0.8	1.3	1.6	2.2	2.6	3.0

Computed by: SMS, Wood/Patel
Monday, April 18, 2011 1:03:28 p

File: W:\2010Projects\103484 - Loop 303 Outfall Drainage\Project Support\Hydro\Rational\Lateral Inflow Rational Flows.rat

Author: Frank M. Koo, P.E.
Email: gufrank@engsoftwarecenter.com
URL: http://www.engsoftwarecenter.com/rational.html

RATIONAL FOR WINDOWS

Flood Control District of Maricopa County Rational Method

Project Information

Project Name: Loop 303 Outfall Channel

Project Description: Lateral Inflow Hydrology

Drainage Point: 2

Location: Basin 2

Drainage Basin Data

Water Course Length: 2767.00 ft

Basin Area: 58.400 acres

High Elevation: 896.00 ft

Low Elevation: 892.00 ft

Average Slope: 0.0014 ft/ft

Roughness, Kb: 0.0290 (A)

10-Year Runoff Coefficient: 0.200

10-Year 6 Hour Rainfall Depth: 1.70 inches

Hydrological Summary Table

Parameter	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Q (cfs)	13	19	23	34	44	54
C	0.200	0.200	0.200	0.220	0.240	0.250
Tc (min)	40.7	34.8	32.1	28.8	27.0	25.5
i (in/hr)	1.1	1.6	2.0	2.7	3.2	3.7

Computed by: SMS, Wood/Patel
Monday, April 18, 2011 1:03:28 p

File: W:\2010Projects\103484 - Loop 303 Outfall Drainage\Project Support\Hydro\Rational\Lateral Inflow Rational Flows.rat

Author: Frank M. Koo, P.E.
Email: gufrank@engsoftwarecenter.com
URL: http://www.engsoftwarecenter.com/rational.html

RATIONAL FOR WINDOWS

Flood Control District of Maricopa County Rational Method

Project Information

Project Name: Loop 303 Outfall Channel

Project Description: Lateral Inflow Hydrology

Drainage Point: 5

Location: Basin 5

Drainage Basin Data

Water Course Length: 1283.00 ft

Basin Area: 8.600 acres

High Elevation: 898.00 ft

Low Elevation: 897.00 ft

Average Slope: 0.0008 ft/ft

Roughness, Kb: 0.0342 (A)

10-Year Runoff Coefficient: 0.200

10-Year 6 Hour Rainfall Depth: 1.70 inches

Hydrological Summary Table

Parameter	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Q (cfs)	2	3	4	5	7	9
C	0.200	0.200	0.200	0.220	0.240	0.250
Tc (min)	34.9	30.1	27.8	25.1	23.6	22.2
i (in/hr)	1.2	1.8	2.2	2.9	3.4	4.0

Computed by: SMS, Wood/Patel
Monday, April 18, 2011 1:03:28 p

File: W:\2010Projects\103484 - Loop 303 Outfall Drainage\Project Support\Hydro\Rational\Lateral Inflow Rational Flows.rat

Author: Frank M. Koo, P.E.
Email: gufrank@engsoftwarecenter.com
URL: http://www.engsoftwarecenter.com/rational.html

RATIONAL FOR WINDOWS

Flood Control District of Maricopa County Rational Method

Project Information

Project Name: Loop 303 Outfall Channel

Project Description: Lateral Inflow Hydrology

Drainage Point: 6

Location: Basin 6

Drainage Basin Data

Water Course Length: 3530.00 ft

Basin Area: 80.600 acres

High Elevation: 906.00 ft

Low Elevation: 898.00 ft

Average Slope: 0.0023 ft/ft

Roughness, Kb: 0.0281 (A)

10-Year Runoff Coefficient: 0.200

10-Year 6 Hour Rainfall Depth: 1.70 inches

Hydrological Summary Table

Parameter	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Q (cfs)	18	27	33	48	63	77
C	0.200	0.200	0.200	0.220	0.240	0.250
Tc (min)	38.8	33.2	30.7	27.6	25.9	24.3
i (in/hr)	1.1	1.7	2.1	2.7	3.2	3.8

Computed by: SMS, Wood/Patel
Monday, April 18, 2011 1:03:28 p

File: W:\2010Projects\103484 - Loop 303 Outfall Drainage\Project Support\Hydro\Rational\Lateral Inflow Rational Flows.rat

Author: Frank M. Koo, P.E.
Email: gufrank@engsoftwarecenter.com
URL: http://www.engsoftwarecenter.com/rational.html

RATIONAL FOR WINDOWS

Flood Control District of Maricopa County Rational Method

Project Information

Project Name: Loop 303 Outfall Channel

Project Description: Lateral Inflow Hydrology

Drainage Point: 7

Location: Basin 7

Drainage Basin Data

Water Course Length: 4146.00 ft

Basin Area: 60.600 acres

High Elevation: 909.00 ft

Low Elevation: 898.00 ft

Average Slope: 0.0027 ft/ft

Roughness, Kb: 0.0289 (A)

10-Year Runoff Coefficient: 0.200

10-Year 6 Hour Rainfall Depth: 1.70 inches

Hydrological Summary Table

Parameter	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Q (cfs)	13	19	24	35	45	55
C	0.200	0.200	0.200	0.220	0.240	0.250
Tc (min)	41.4	35.3	32.6	29.3	27.4	25.9
i (in/hr)	1.1	1.6	2.0	2.6	3.1	3.6

Computed by: SMS, Wood/Patel
Monday, April 18, 2011 1:03:28 p

File: W:\2010Projects\103484 - Loop 303 Outfall Drainage\Project Support\Hydro\Rational\Lateral Inflow Rational Flows.rat

Author: Frank M. Koo, P.E.
Email: gufrank@engsoftwarecenter.com
URL: http://www.engsoftwarecenter.com/rational.html

RATIONAL FOR WINDOWS

Flood Control District of Maricopa County Rational Method

Project Information

Project Name: Loop 303 Outfall Channel

Project Description: Lateral Inflow Hydrology

Drainage Point: 8

Location: Basin 8

Drainage Basin Data

Water Course Length: 2515.00 ft

Basin Area: 50.600 acres

High Elevation: 908.00 ft

Low Elevation: 900.00 ft

Average Slope: 0.0032 ft/ft

Roughness, Kb: 0.0293 (A)

10-Year Runoff Coefficient: 0.200

10-Year 6 Hour Rainfall Depth: 1.70 inches

Hydrological Summary Table

Parameter	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Q (cfs)	15	21	25	36	46	56
C	0.200	0.200	0.200	0.220	0.240	0.250
Tc (min)	27.3	23.9	22.2	20.2	18.9	17.8
i (in/hr)	1.5	2.0	2.5	3.2	3.8	4.5

Computed by: SMS, Wood/Patel
Monday, April 18, 2011 1:03:28 p

File: W:\2010Projects\103484 - Loop 303 Outfall Drainage\Project Support\Hydro\Rational\Lateral Inflow Rational Flows.rat

Author: Frank M. Koo, P.E.
Email: gufrank@engsoftwarecenter.com
URL: http://www.engsoftwarecenter.com/rational.html

RATIONAL FOR WINDOWS

Flood Control District of Maricopa County Rational Method

Project Information

Project Name: Loop 303 Outfall Channel

Project Description: Lateral Inflow Hydrology

Drainage Point: 9

Location: Basin 9

Drainage Basin Data

Water Course Length: 779.00 ft

Basin Area: 4.100 acres

High Elevation: 901.00 ft

Low Elevation: 898.00 ft

Average Slope: 0.0039 ft/ft

Roughness, Kb: 0.0362 (A)

10-Year Runoff Coefficient: 0.200

10-Year 6 Hour Rainfall Depth: 1.70 inches

Hydrological Summary Table

Parameter	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Q (cfs)	2	2	3	4	5	6
C	0.200	0.200	0.200	0.220	0.240	0.250
Tc (min)	14.0	12.3	11.5	10.4	9.9	9.4
i (in/hr)	2.1	2.9	3.5	4.4	5.1	5.9

Computed by: SMS, Wood/Patel
Monday, April 18, 2011 1:03:28 p

File: W:\2010Projects\103484 - Loop 303 Outfall Drainage\Project Support\Hydro\Rational\Lateral Inflow Rational Flows.rat

Author: Frank M. Koo, P.E.
Email: gufrank@engsoftwarecenter.com
URL: http://www.engsoftwarecenter.com/rational.html

RATIONAL FOR WINDOWS

Flood Control District of Maricopa County Rational Method

Project Information

Project Name: Loop 303 Outfall Channel

Project Description: Lateral Inflow Hydrology

Drainage Point: 10

Location: Basin 10

Drainage Basin Data

Water Course Length: 1381.00 ft

Basin Area: 9.000 acres

High Elevation: 903.00 ft

Low Elevation: 900.00 ft

Average Slope: 0.0022 ft/ft

Roughness, Kb: 0.0340 (A)

10-Year Runoff Coefficient: 0.200

10-Year 6 Hour Rainfall Depth: 1.70 inches

Hydrological Summary Table

Parameter	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Q (cfs)	3	4	5	7	9	11
C	0.200	0.200	0.200	0.220	0.240	0.250
Tc (min)	23.9	21.0	19.4	17.7	16.6	15.7
i (in/hr)	1.6	2.2	2.7	3.4	4.1	4.7

Computed by: SMS, Wood/Patel
Monday, April 18, 2011 1:03:28 p

File: W:\2010Projects\103484 - Loop 303 Outfall Drainage\Project Support\Hydro\Rational\Lateral Inflow Rational Flows.rat

Author: Frank M. Koo, P.E.
Email: gufrank@engsoftwarecenter.com
URL: http://www.engsoftwarecenter.com/rational.html

RATIONAL FOR WINDOWS

Flood Control District of Maricopa County Rational Method

Project Information

Project Name: Loop 303 Outfall Channel

Project Description: Lateral Inflow Hydrology

Drainage Point: 11

Location: Basin 11

Drainage Basin Data

Water Course Length: 1487.00 ft

Basin Area: 15.200 acres

High Elevation: 909.00 ft

Low Elevation: 904.00 ft

Average Slope: 0.0034 ft/ft

Roughness, Kb: 0.0326 (A)

10-Year Runoff Coefficient: 0.200

10-Year 6 Hour Rainfall Depth: 1.70 inches

Hydrological Summary Table

Parameter	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Q (cfs)	5	7	9	12	16	19
C	0.200	0.200	0.200	0.220	0.240	0.250
Tc (min)	20.6	18.0	16.8	15.2	14.4	13.5
i (in/hr)	1.7	2.4	2.9	3.7	4.4	5.1

Computed by: SMS, Wood/Patel
Monday, April 18, 2011 1:03:28 p

File: W:\2010Projects\103484 - Loop 303 Outfall Drainage\Project Support\Hydro\Rational\Lateral Inflow Rational Flows.rat

Author: Frank M. Koo, P.E.
Email: gufrank@engsoftwarecenter.com
URL: http://www.engsoftwarecenter.com/rational.html

RATIONAL FOR WINDOWS

Flood Control District of Maricopa County Rational Method

Project Information

Project Name: Loop 303 Outfall Channel

Project Description: Lateral Inflow Hydrology

Drainage Point: 12

Location: Basin 12

Drainage Basin Data

Water Course Length: 307.00 ft

Basin Area: 0.600 acres

High Elevation: 912.00 ft

Low Elevation: 909.50 ft

Average Slope: 0.0081 ft/ft

Roughness, Kb: 0.0414 (A)

10-Year Runoff Coefficient: 0.200

10-Year 6 Hour Rainfall Depth: 1.70 inches

Hydrological Summary Table

Parameter	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Q (cfs)	0	0	1	1	1	1
C	0.200	0.200	0.200	0.220	0.240	0.250
Tc (min)	6.6	5.8	5.5	5.1	5.0	5.0
i (in/hr)	2.8	3.9	4.7	5.7	6.5	7.4

Computed by: SMS, Wood/Patel
Monday, April 18, 2011 1:03:28 p

File: W:\2010Projects\103484 - Loop 303 Outfall Drainage\Project Support\Hydro\Rational\Lateral Inflow Rational Flows.rat

Author: Frank M. Koo, P.E.
Email: gufrank@engsoftwarecenter.com
URL: http://www.engsoftwarecenter.com/rational.html

RATIONAL FOR WINDOWS

Flood Control District of Maricopa County Rational Method

Project Information

Project Name: Loop 303 Outfall Channel

Project Description: Lateral Inflow Hydrology

Drainage Point: 13

Location: Basin 13

Drainage Basin Data

Water Course Length: 889.00 ft

Basin Area: 3.600 acres

High Elevation: 915.00 ft

Low Elevation: 910.00 ft

Average Slope: 0.0056 ft/ft

Roughness, Kb: 0.0365 (A)

10-Year Runoff Coefficient: 0.200

10-Year 6 Hour Rainfall Depth: 1.70 inches

Hydrological Summary Table

Parameter	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Q (cfs)	2	2	3	4	5	5
C	0.200	0.200	0.200	0.220	0.240	0.250
Tc (min)	13.2	11.6	10.8	9.9	9.4	8.9
i (in/hr)	2.1	3.0	3.6	4.5	5.2	6.0

Computed by: SMS, Wood/Patel
Monday, April 18, 2011 1:03:28 p

File: W:\2010Projects\103484 - Loop 303 Outfall Drainage\Project Support\Hydro\Rational\Lateral Inflow Rational Flows.rat

Author: Frank M. Koo, P.E.
Email: gufrank@engsoftwarecenter.com
URL: http://www.engsoftwarecenter.com/rational.html

RATIONAL FOR WINDOWS

Flood Control District of Maricopa County Rational Method

Project Information

Project Name: Loop 303 Outfall Channel

Project Description: Lateral Inflow Hydrology

Drainage Point: 14

Location: Basin 14

Drainage Basin Data

Water Course Length: 1419.00 ft

Basin Area: 14.200 acres

High Elevation: 925.00 ft

Low Elevation: 914.00 ft

Average Slope: 0.0078 ft/ft

Roughness, Kb: 0.0328 (A)

10-Year Runoff Coefficient: 0.200

10-Year 6 Hour Rainfall Depth: 1.70 inches

Hydrological Summary Table

Parameter	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Q (cfs)	6	8	10	14	17	21
C	0.200	0.200	0.200	0.220	0.240	0.250
Tc (min)	14.5	12.8	11.9	10.8	10.3	9.7
i (in/hr)	2.0	2.8	3.4	4.4	5.0	5.8

Computed by: SMS, Wood/Patel
Monday, April 18, 2011 1:03:28 p

File: W:\2010Projects\103484 - Loop 303 Outfall Drainage\Project Support\Hydro\Rational\Lateral Inflow Rational Flows.rat

Author: Frank M. Koo, P.E.
Email: gufrank@engsoftwarecenter.com
URL: http://www.engsoftwarecenter.com/rational.html

RATIONAL FOR WINDOWS

Flood Control District of Maricopa County Rational Method

Project Information

Project Name: Loop 303 Outfall Channel

Project Description: Lateral Inflow Hydrology

Drainage Point: 15

Location: Basin 15

Drainage Basin Data

Water Course Length: 1187.00 ft

Basin Area: 27.000 acres

High Elevation: 937.30 ft

Low Elevation: 928.00 ft

Average Slope: 0.0078 ft/ft

Roughness, Kb: 0.0311 (A)

10-Year Runoff Coefficient: 0.200

10-Year 6 Hour Rainfall Depth: 1.70 inches

Hydrological Summary Table

Parameter	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Q (cfs)	12	16	20	28	35	42
C	0.200	0.200	0.200	0.220	0.240	0.250
Tc (min)	12.5	11.0	10.3	9.4	8.9	8.4
i (in/hr)	2.2	3.0	3.6	4.6	5.3	6.2

Computed by: SMS, Wood/Patel
Monday, April 18, 2011 1:03:28 p

File: W:\2010Projects\103484 - Loop 303 Outfall Drainage\Project Support\Hydro\Rational\Lateral Inflow Rational Flows.rat

Author: Frank M. Koo, P.E.
Email: gufrank@engsoftwarecenter.com
URL: http://www.engsoftwarecenter.com/rational.html

RATIONAL FOR WINDOWS

Flood Control District of Maricopa County Rational Method

Project Information

Project Name: Loop 303 Outfall Channel

Project Description: Lateral Inflow Hydrology

Drainage Point: 16

Location: Basin 16

Drainage Basin Data

Water Course Length: 1611.00 ft

Basin Area: 16.200 acres

High Elevation: 943.00 ft

Low Elevation: 935.00 ft

Average Slope: 0.0050 ft/ft

Roughness, Kb: 0.0324 (A)

10-Year Runoff Coefficient: 0.200

10-Year 6 Hour Rainfall Depth: 1.70 inches

Hydrological Summary Table

Parameter	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Q (cfs)	6	8	10	14	18	21
C	0.200	0.200	0.200	0.220	0.240	0.250
Tc (min)	18.5	16.3	15.1	13.7	13.0	12.3
i (in/hr)	1.8	2.5	3.0	3.9	4.6	5.3

Computed by: SMS, Wood/Patel
Monday, April 18, 2011 1:03:28 p

File: W:\2010Projects\103484 - Loop 303 Outfall Drainage\Project Support\Hydro\Rational\Lateral Inflow Rational Flows.rat

Author: Frank M. Koo, P.E.
Email: gufrank@engsoftwarecenter.com
URL: http://www.engsoftwarecenter.com/rational.html

RATIONAL FOR WINDOWS

Flood Control District of Maricopa County Rational Method

Project Information

Project Name: Loop 303 Outfall Channel

Project Description: Lateral Inflow Hydrology

Drainage Point: 18

Location: Basin 18

Drainage Basin Data

Water Course Length: 1433.00 ft

Basin Area: 24.900 acres

High Elevation: 973.00 ft

Low Elevation: 967.00 ft

Average Slope: 0.0042 ft/ft

Roughness, Kb: 0.0313 (A)

10-Year Runoff Coefficient: 0.200

10-Year 6 Hour Rainfall Depth: 1.70 inches

Hydrological Summary Table

Parameter	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Q (cfs)	9	13	15	22	28	33
C	0.200	0.200	0.200	0.220	0.240	0.250
Tc (min)	18.0	15.8	14.7	13.3	12.6	11.9
i (in/hr)	1.8	2.6	3.1	4.0	4.6	5.4

Computed by: SMS, Wood/Patel
Monday, April 18, 2011 1:03:28 p

File: W:\2010Projects\103484 - Loop 303 Outfall Drainage\Project Support\Hydro\Rational\Lateral Inflow Rational Flows.rat

Author: Frank M. Koo, P.E.
Email: gufrank@engsoftwarecenter.com
URL: http://www.engsoftwarecenter.com/rational.html

RATIONAL FOR WINDOWS

Flood Control District of Maricopa County Rational Method

Project Information

Project Name: Loop 303 Outfall Channel

Project Description: Lateral Inflow Hydrology

Drainage Point: 19

Location: Basin 19

Drainage Basin Data

Water Course Length: 1133.00 ft

Basin Area: 14.300 acres

High Elevation: 979.00 ft

Low Elevation: 973.00 ft

Average Slope: 0.0053 ft/ft

Roughness, Kb: 0.0328 (A)

10-Year Runoff Coefficient: 0.200

10-Year 6 Hour Rainfall Depth: 1.70 inches

Hydrological Summary Table

Parameter	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Q (cfs)	6	8	10	14	17	21
C	0.200	0.200	0.200	0.220	0.240	0.250
Tc (min)	14.6	12.9	12.0	10.9	10.3	9.8
i (in/hr)	2.0	2.8	3.4	4.4	5.0	5.8

Computed by: SMS, Wood/Patel
Monday, April 18, 2011 1:03:28 p

File: W:\2010Projects\103484 - Loop 303 Outfall Drainage\Project Support\Hydro\Rational\Lateral Inflow Rational Flows.rat

Author: Frank M. Koo, P.E.
Email: gufrank@engsoftwarecenter.com
URL: http://www.engsoftwarecenter.com/rational.html

RATIONAL FOR WINDOWS

Flood Control District of Maricopa County Rational Method

Project Information

Project Name: Loop 303 Outfall Channel

Project Description: Lateral Inflow Hydrology

Drainage Point: 20

Location: Basin 20

Drainage Basin Data

Water Course Length: 2652.00 ft

Basin Area: 42.400 acres

High Elevation: 992.00 ft

Low Elevation: 981.00 ft

Average Slope: 0.0042 ft/ft

Roughness, Kb: 0.0298 (A)

10-Year Runoff Coefficient: 0.200

10-Year 6 Hour Rainfall Depth: 1.70 inches

Hydrological Summary Table

Parameter	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Q (cfs)	13	18	22	31	40	49
C	0.200	0.200	0.200	0.220	0.240	0.250
Tc (min)	25.6	22.6	20.9	19.0	17.8	16.8
i (in/hr)	1.5	2.1	2.6	3.3	3.9	4.6

Computed by: SMS, Wood/Patel
Monday, April 18, 2011 1:03:28 p

File: W:\2010Projects\103484 - Loop 303 Outfall Drainage\Project Support\Hydro\Rational\Lateral Inflow Rational Flows.rat

Author: Frank M. Koo, P.E.
Email: gufrank@engsoftwarecenter.com
URL: http://www.engsoftwarecenter.com/rational.html

RATIONAL FOR WINDOWS

Flood Control District of Maricopa County Rational Method

Project Information

Project Name: Loop 303 Outfall Channel

Project Description: Lateral Inflow Hydrology

Drainage Point: 21

Location: Basin 21

Drainage Basin Data

Water Course Length: 2151.00 ft

Basin Area: 32.000 acres

High Elevation: 950.00 ft

Low Elevation: 937.00 ft

Average Slope: 0.0060 ft/ft

Roughness, Kb: 0.0306 (A)

10-Year Runoff Coefficient: 0.550

10-Year 6 Hour Rainfall Depth: 1.70 inches

Hydrological Summary Table

Parameter	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Q (cfs)	30	43	52	73	93	113
C	0.550	0.550	0.550	0.605	0.660	0.688
Tc (min)	19.8	17.4	16.1	14.7	13.8	13.1
i (in/hr)	1.7	2.4	2.9	3.8	4.4	5.1

Computed by: SMS, Wood/Patel
Monday, April 18, 2011 1:03:28 p

File: W:\2010Projects\103484 - Loop 303 Outfall Drainage\Project Support\Hydro\Rational\Lateral Inflow Rational Flows.rat

Author: Frank M. Koo, P.E.
Email: gufrank@engsoftwarecenter.com
URL: http://www.engsoftwarecenter.com/rational.html

RATIONAL FOR WINDOWS

Flood Control District of Maricopa County Rational Method

Project Information

Project Name: Loop 303 Outfall Channel

Project Description: Lateral Inflow Hydrology

Drainage Point: 22

Location: Basin 22

Drainage Basin Data

Water Course Length: 1932.00 ft

Basin Area: 18.600 acres

High Elevation: 954.00 ft

Low Elevation: 946.00 ft

Average Slope: 0.0041 ft/ft

Roughness, Kb: 0.0321 (A)

10-Year Runoff Coefficient: 0.550

10-Year 6 Hour Rainfall Depth: 1.70 inches

Hydrological Summary Table

Parameter	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Q (cfs)	17	23	29	40	52	63
C	0.550	0.550	0.550	0.605	0.660	0.688
Tc (min)	22.1	19.4	18.0	16.4	15.4	14.5
i (in/hr)	1.6	2.3	2.8	3.6	4.2	4.9

Computed by: SMS, Wood/Patel
Monday, April 18, 2011 1:03:28 p

File: W:\2010Projects\103484 - Loop 303 Outfall Drainage\Project Support\Hydro\Rational\Lateral Inflow Rational Flows.rat

Author: Frank M. Koo, P.E.
Email: gufrank@engsoftwarecenter.com
URL: http://www.engsoftwarecenter.com/rational.html

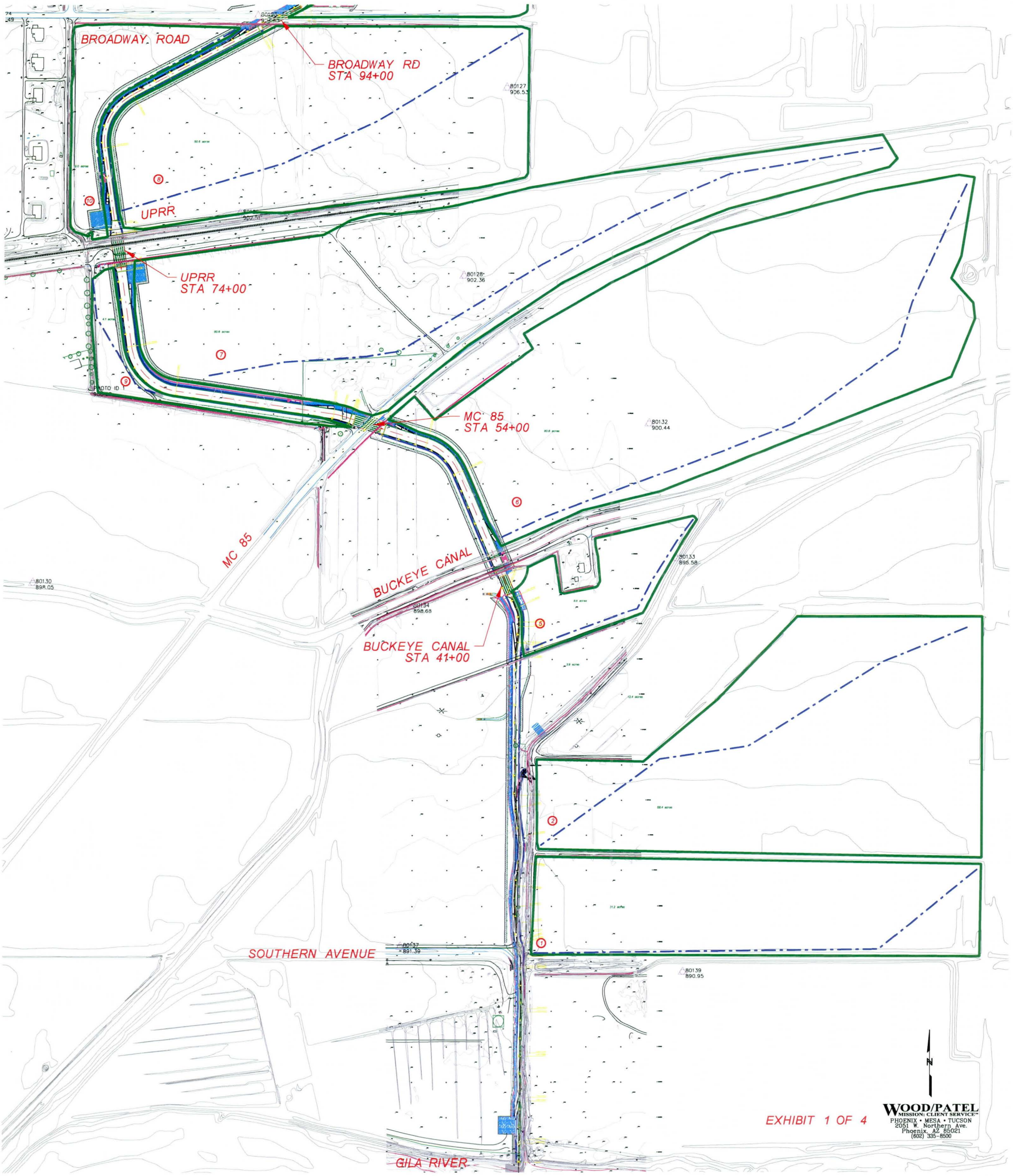


EXHIBIT 1 OF 4

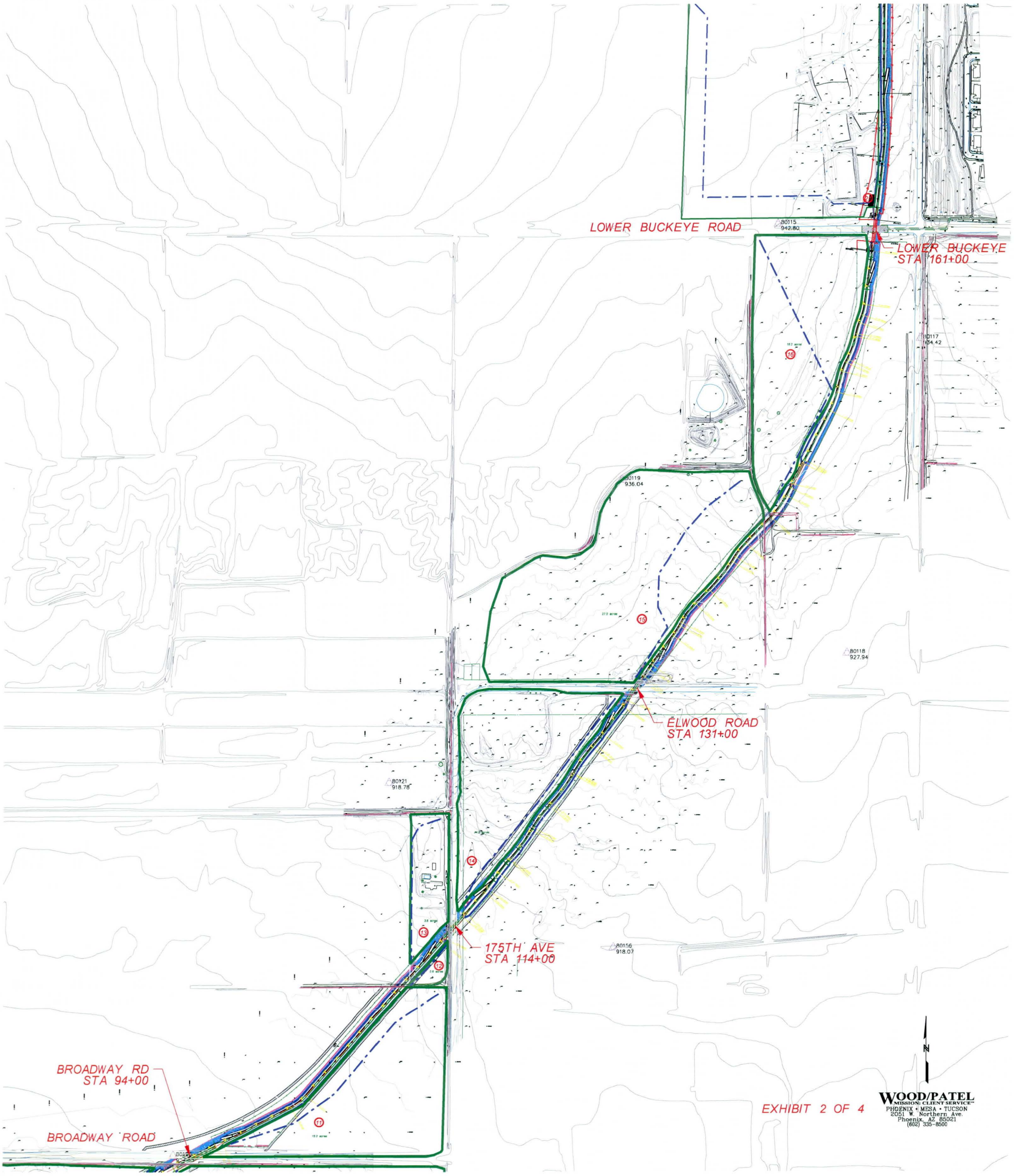


EXHIBIT 2 OF 4

WOOD/PATEL
MISSION: CLIENT SERVICE
PHOENIX • MESA • TUCSON
2051 W. Northern Ave.
Phoenix, AZ 85021
(602) 335-8500

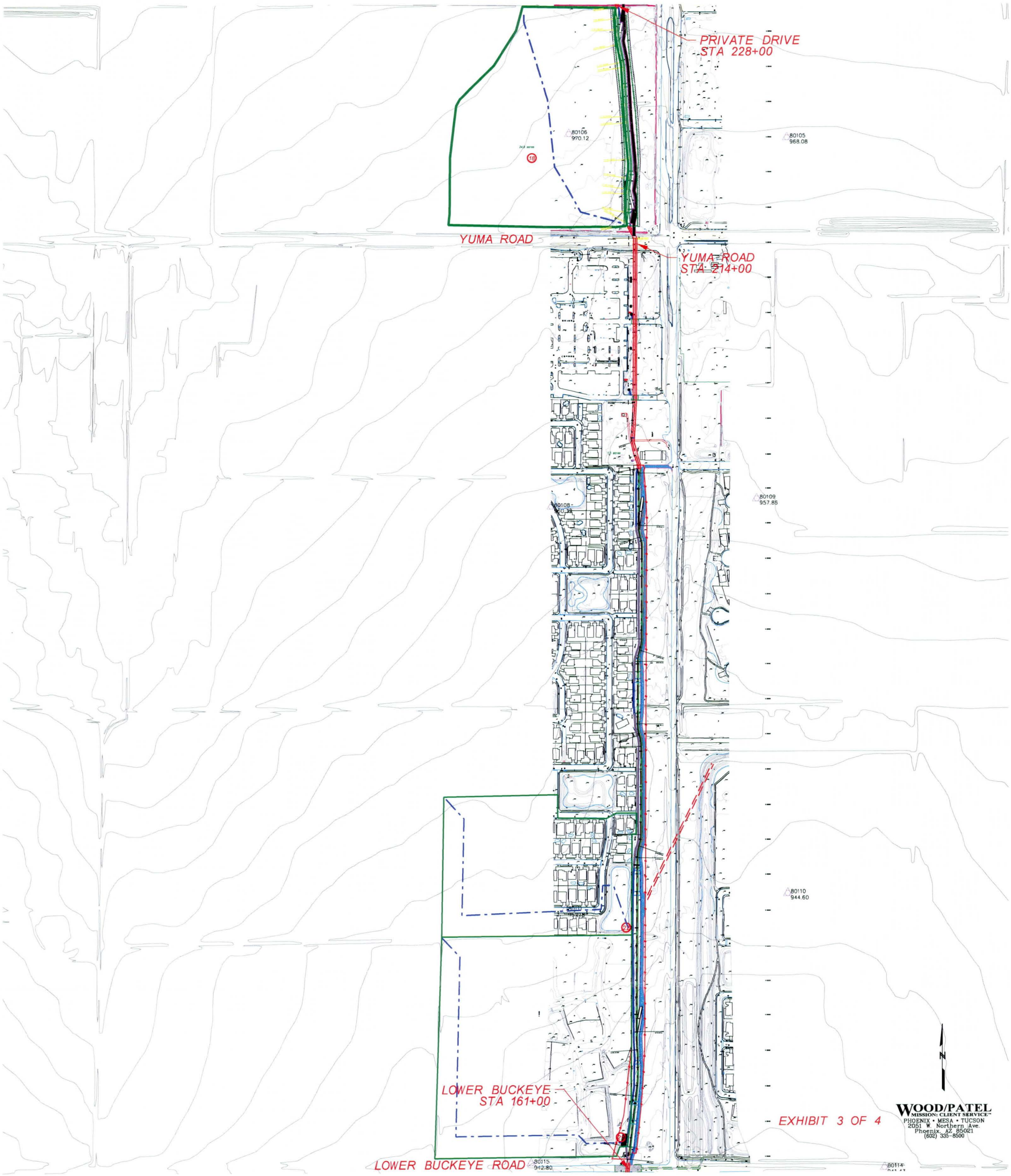


EXHIBIT 3 OF 4

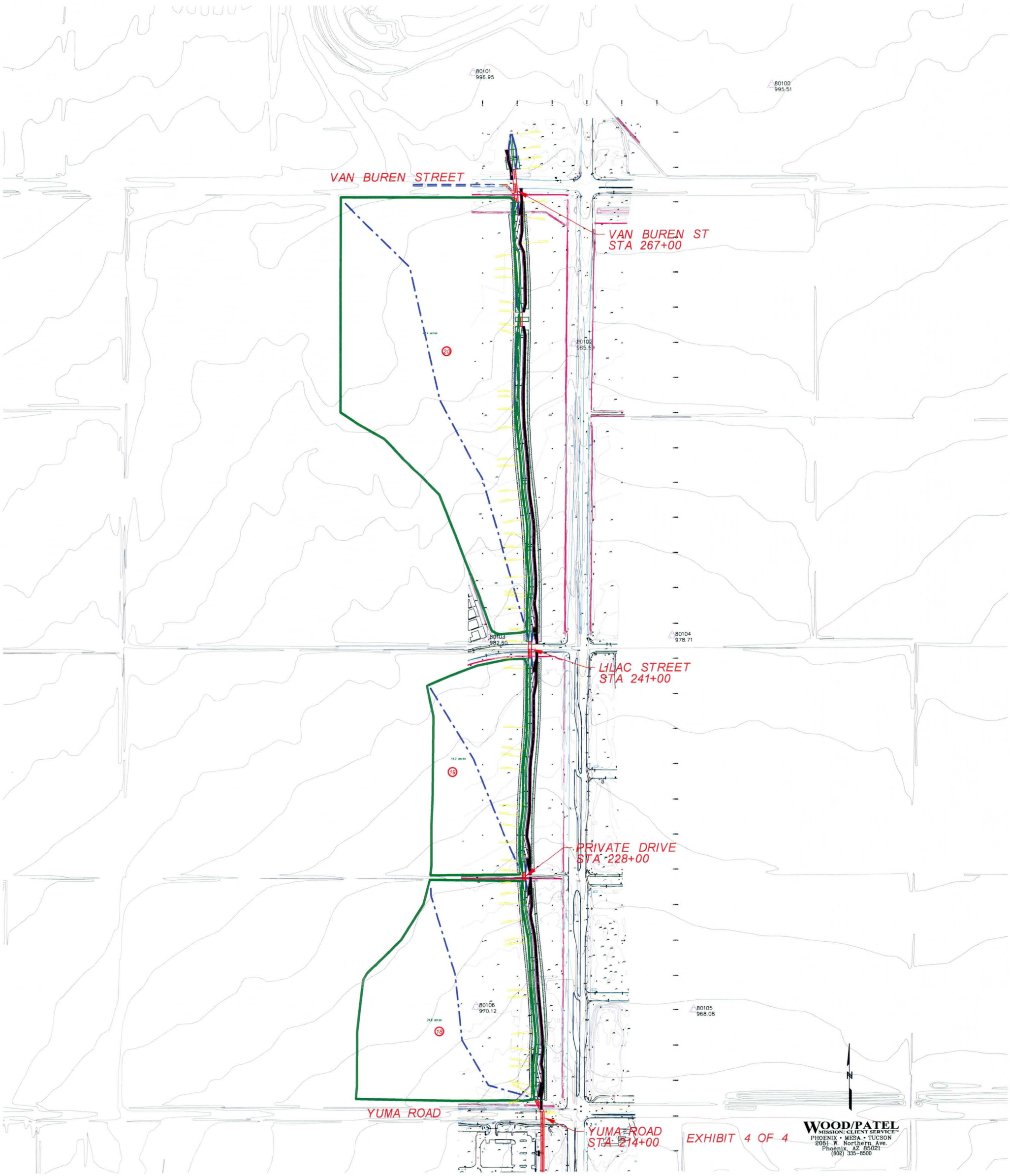


EXHIBIT 4 OF 4

WOOD/PATEL
MISSION: CLIENT SERVICE™
PHOENIX • MESA • TUCSON
2051 W. Northern Ave.
Phoenix, AZ 85021
(602) 335-8500

APPENDIX A3

Peak Flow Estimation for Adjacent Loop 303 Freeway

MEMO TO PROJECT FILE

PROJECT: Loop 303 Outfall Drainage System

SUBJECT: Estimate of flows from the future adjacent freeway

DATE: September 17, 2010 FROM: Mike Duncan, Project Manager

ASSUMPTIONS

Spacing of drain pipes for freeway on-site drainage: from 300 to 500 ft., with an average of 400 ft.

Width of impervious area: 150 ft.

Slope of natural terrain: 0.0046 ft/ft (from Candidate Assessment Report)

Slope of freeway crown: 0.02 ft/ft

Rational Method and its synthetic hydrograph are applicable.

10-year / 6-hour rainfall depth: 1.64 in. (from NOAA 14 website, 33.43 deg N and 112.43 deg W)

Channel Velocity: approx. 7 fps; then time interval for 400-ft drain spacing is 57 sec. or ~1 minute

RESULTS

100-year discharge for each drain pipe -- 9 cfs

Combination of synthetic rational hydrographs yields a steady flow -- 72 cfs
(from 16 adjacent drains)

Rational method for an area 6,400 ft. long (or 16 x 400 ft. or 1.21 mi.) yields -- 67 cfs

CONCLUSION

On-site drainage from the future freeway would produce approx. **75 cfs**

in the adjacent channel for a 100-year storm event.

Rational calc. for 150 ft. wide by 400 ft. long segment of freeway -- Q-100yr = 9 cfs Tc = 6.0 min.

Rational WorkSheet - 1/ 1

Drainage Point:	FWY	Location:	Avg length - 400 ft
Area:	1.3800	acres	
Rainfall Depth:	1.6400	Inches (10 Year 6 Hour)	
Drainage Length:	475.0000	ft	
High Elevation:	953.340	ft	
Low Elevation:	950.000	ft	
Runoff Coefficient:	0.850	(10 Year)	Look Up
Land Type:	◉ A ○ B ○ C ○ D		Look Up
Kb:	0.03913	Slope:	0.00703

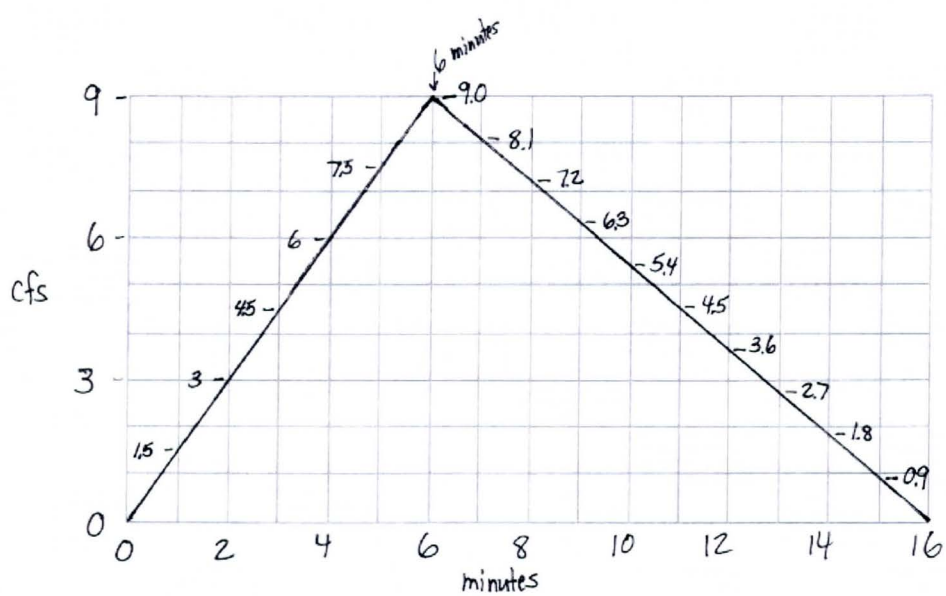
New
Next
Previous
Delete
Project Info

Parameter	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Q (cfs)	3	4	5	7	8	9
C	0.850	0.850	0.850	0.935	0.950	0.950
Tc (min)	8.8	7.8	7.3	6.7	6.3	6.0
i (in/hr)	2.4	3.4	4.1	5.1	5.8	6.7

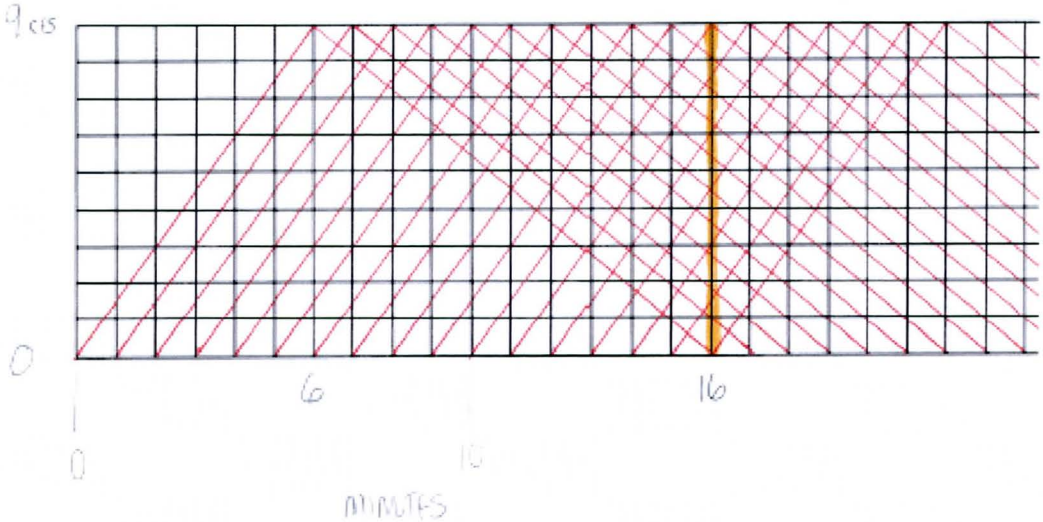
For a triangular synthetic hydrograph of the FCDMC manual, the time interval from Tc to end of hydrograph is

1.67 x Tc, which for this case is 1.67 x 6.0 min. = 10.0 min.

Then the hydrograph looks like this:



COMBINING HYDROGRAPHS FROM FREEWAY DRAINS



After 16 minutes, a steady combined flow is achieved and is made up of contributions from 15 hydrographs:

Total Q =1.5 + 3 + 4.5 + 6 + 7.5 + 9 + 8.1 + 7.2 + 6.3 + 5.4 + 4.5 + 3.6 + 2.7 + 1.8 +0.9 = 72.0 cfs

Rational calculation for 150 ft. wide by 6,400 ft. long segment of freeway -- Q-100yr = 67 cfs

Rational WorkSheet - 1/ 1

Drainage Point:	FWY	Location:	1.2 mi. segment
Area:	22.0400	acres	
Rainfall Depth:	1.6400	Inches	(10 Year 6 Hour)
Drainage Length:	6550.0000	ft	
High Elevation:	130.940	ft	
Low Elevation:	100.000	ft	
Runoff Coefficient:	0.850	(10 Year)	Look Up
Land Type:	◉ A ○ B ○ C ○ D		Look Up
Kb:	0.03160	Slope:	0.00472

New
Next
Previous
Delete
Project Info

Parameter	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Q (cfs)	17	26	32	47	57	67
C	0.850	0.850	0.850	0.935	0.950	0.950
Tc (min)	48.6	41.1	38.0	34.0	31.8	30.0
i (in/hr)	0.9	1.4	1.7	2.3	2.7	3.2

[1]

Date: March 1, 2011

From: Mike Duncan, P.E., CFM, Project Manager

Project: Loop 303 Outfall Drainage System

Subject: Combining results of two HEC-1 Models

(1) Existing with CIP model by J2 for I-10/SR303 S.T.I. – "ECIPJ2" run of 01OCT10 08:48

(2) 24-hr/100 yr model by Wood Patel for White Tanks FRS #4 – "FC24P05A" run of 25JAN11 17:53

Modifications:

Model (2) used NOAA-2 rainfall -- 4.03 in.; changed it to NOAA-14 rainfall -- 3.87 in.

Added JD records to model (2) to increase the areal reduction results from 60 sq. mi. to 100 sq. mi., and changed to the Depth-Area Reduction Factors of Table 2.2 of the new Volume I – Hydrology (updated February 10, 2011).

Assumption:

The worst case scenario was assumed: at each location, the times-of-peak-flow of both models occur at the same time.

Three concentration points of interest were chosen: Van Buren St., Lower Buckeye Rd., and the Union Pacific Railroad. The watershed boundaries and the three concentration points are shown on page 2. The total contributing areas were combined at the upper part of the table of page3. Then the related discharges were taken from the Areal Reduction Curves of pages 4 to 7.

The estimated capacities of at the bottom of the table of page 3 are based on flowing at minimum channel depth (which is 6 ft., 6 ft., and 3 ft. for the 3 locations) for the channels; and for the culverts, are based on inlet head water heights that are 1 foot greater than the box heights. The channels and box culverts of the 30% plans were used here.

LOOP 303 / WHITE TANKS WATERSHED

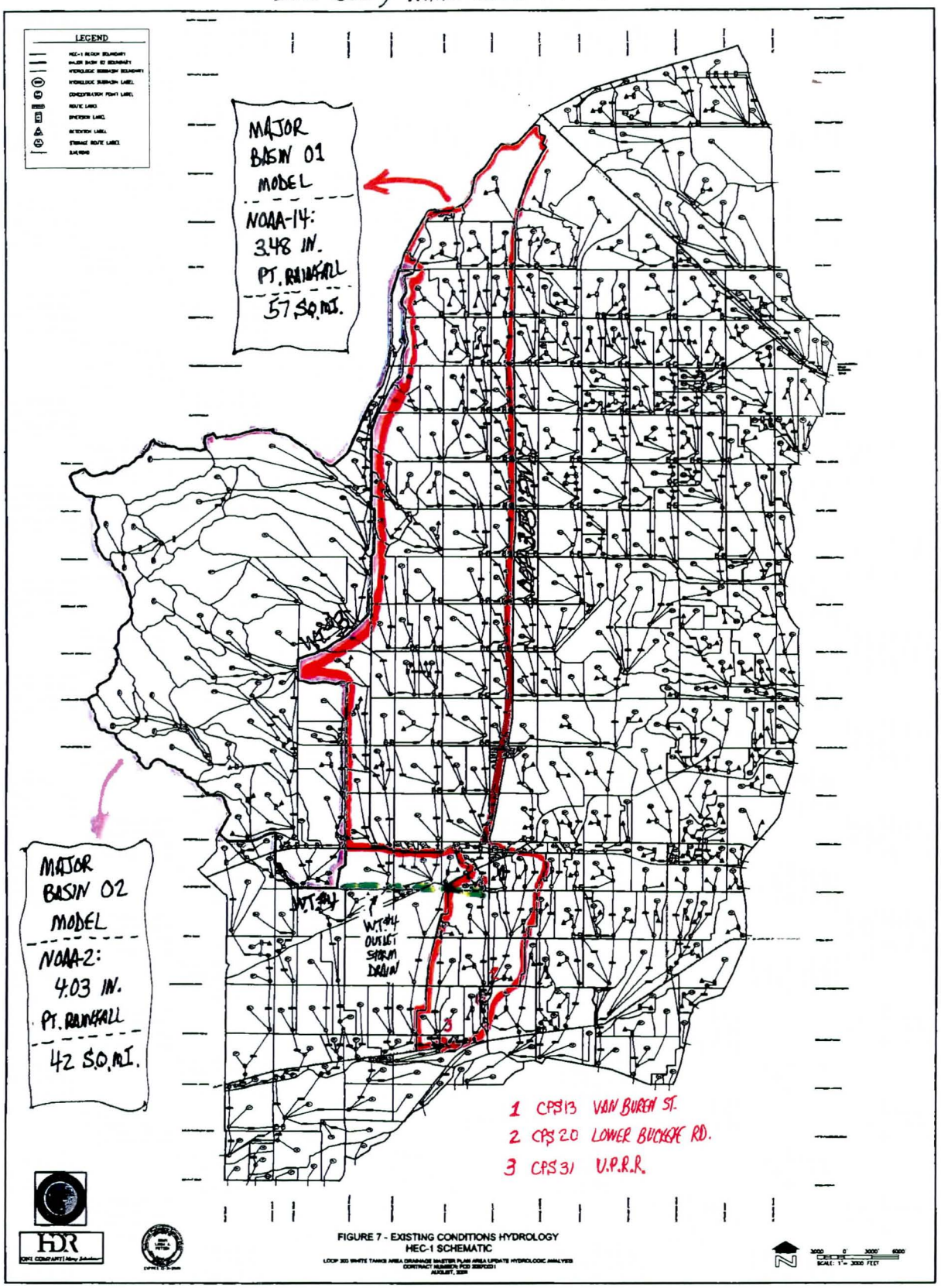


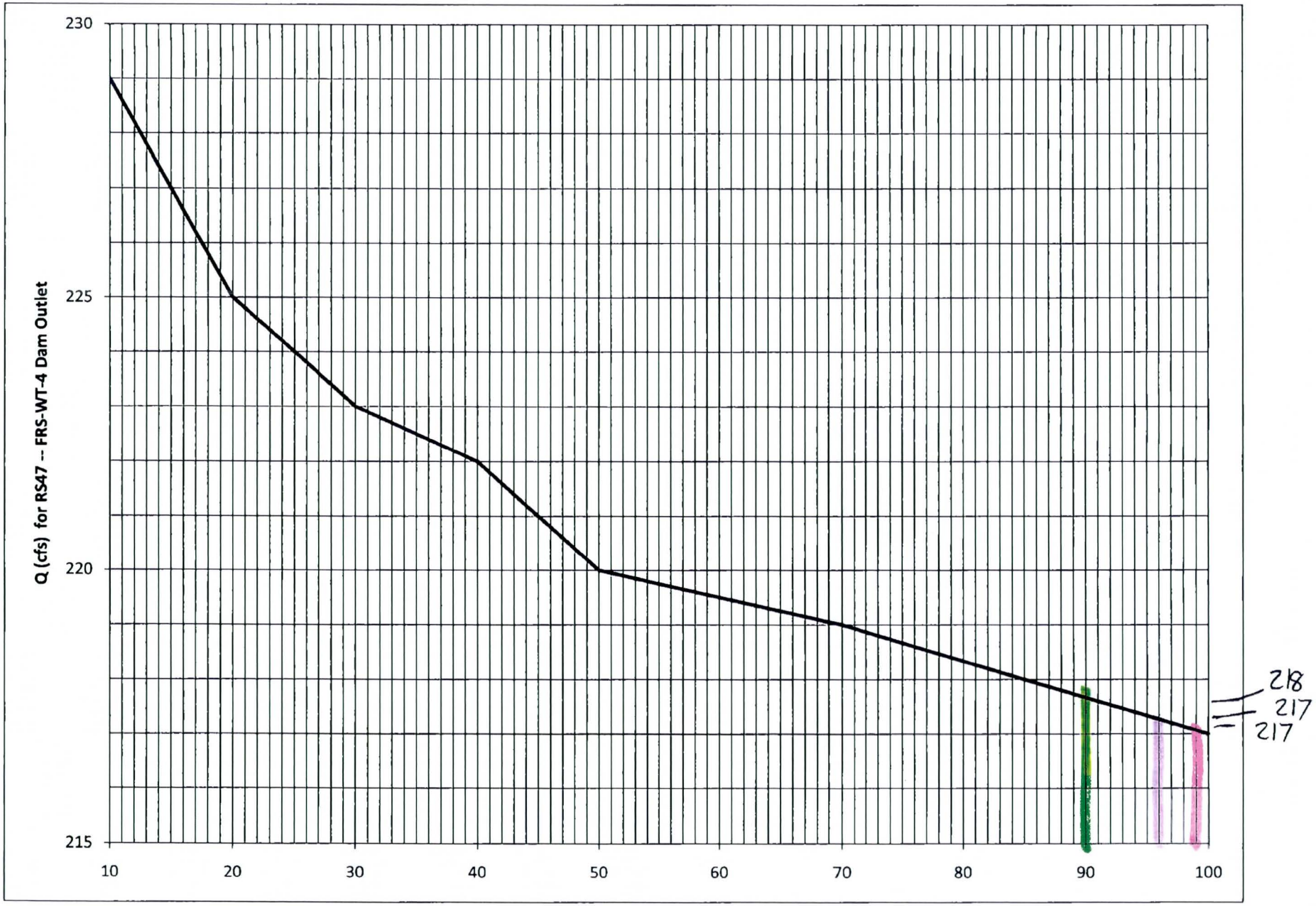
FIGURE 7 - EXISTING CONDITIONS HYDROLOGY
HEC-1 SCHEMATIC

LOOP 303 WHITE TANKS AREA DRAINAGE MASTER PLAN AREA UPDATE HYDROLOGIC ANALYSIS
CONTRACT NUMBER FCD 2002F031
AUGUST, 2003

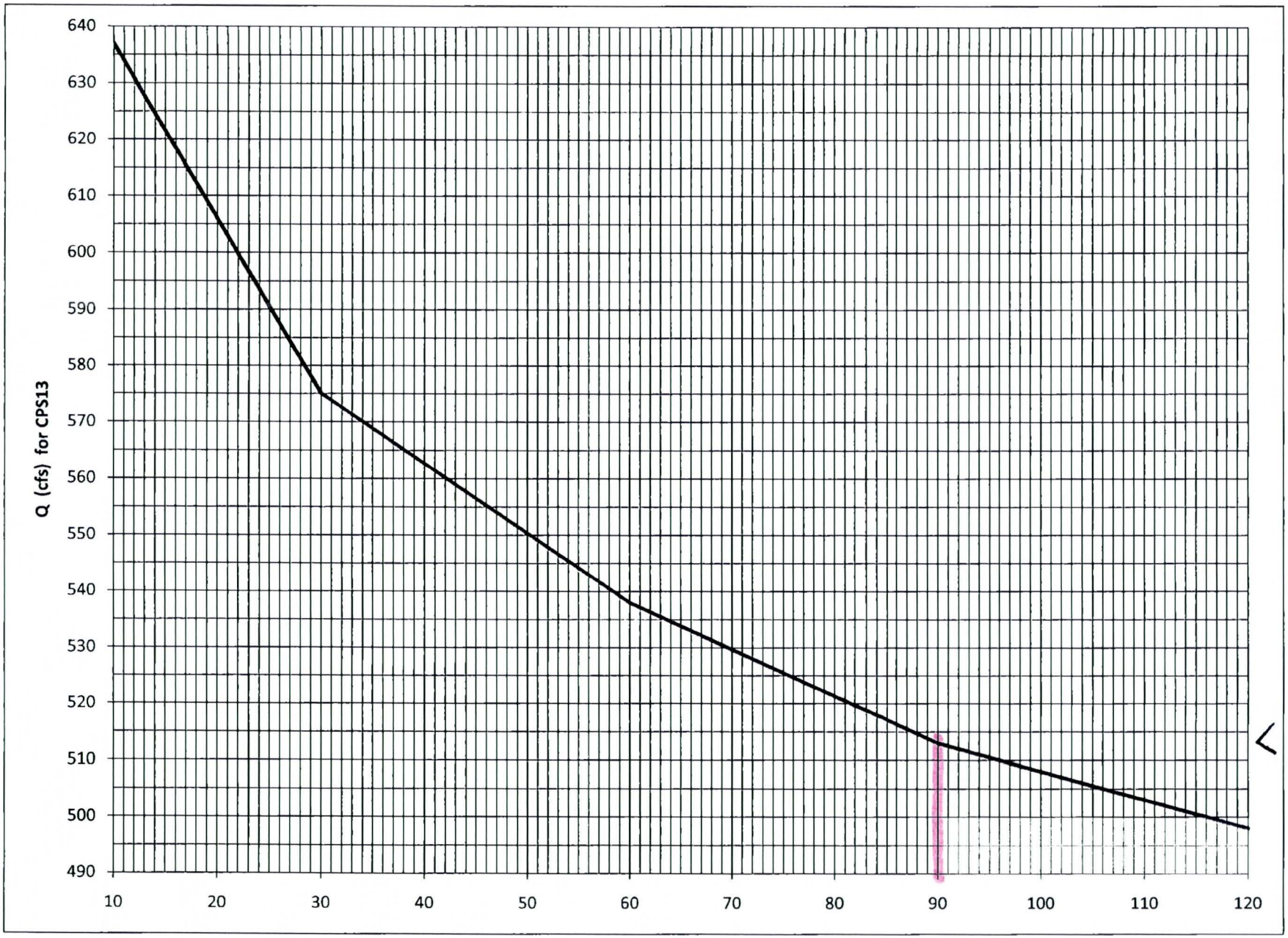
LOOP 303 OUTFALL
COMBINING RESULTS OF HEC-1 MODELS -- I-10 / SR303 S.T. I. and White Tanks FRS #4

	LOCATION	South of Van Buren St.	Lower Buckeye Rd.	Union Pacific R.R.
	CONC. POINT	CPS 13	CPS20	CPS31
CUMULATIVE AREAS	J2-EXIST-CIP model	48 sq. mi.	54 sq. mi.	57 sq. mi.
	Modified Wood Patel WT-4 model	42 sq. mi.	42 sq. mi.	42 sq. mi.
	TOTAL	90 sq. mi.	96 sq. mi.	99 sq. mi.
DISCHARGES from areal reduction	J2-EXIST-CIP model	513 cfs	475 cfs	960 cfs
	Modified Wood Patel WT-4 model	218 cfs	217 cfs	217 cfs
	TOTAL	731 cfs	692 cfs	1,177 cfs
ESTIMATED CAPACITIES	Channel	983 cfs	1,106 cfs	1,210 cfs
	Culvert	** 745 cfs	745 cfs	1,230 cfs

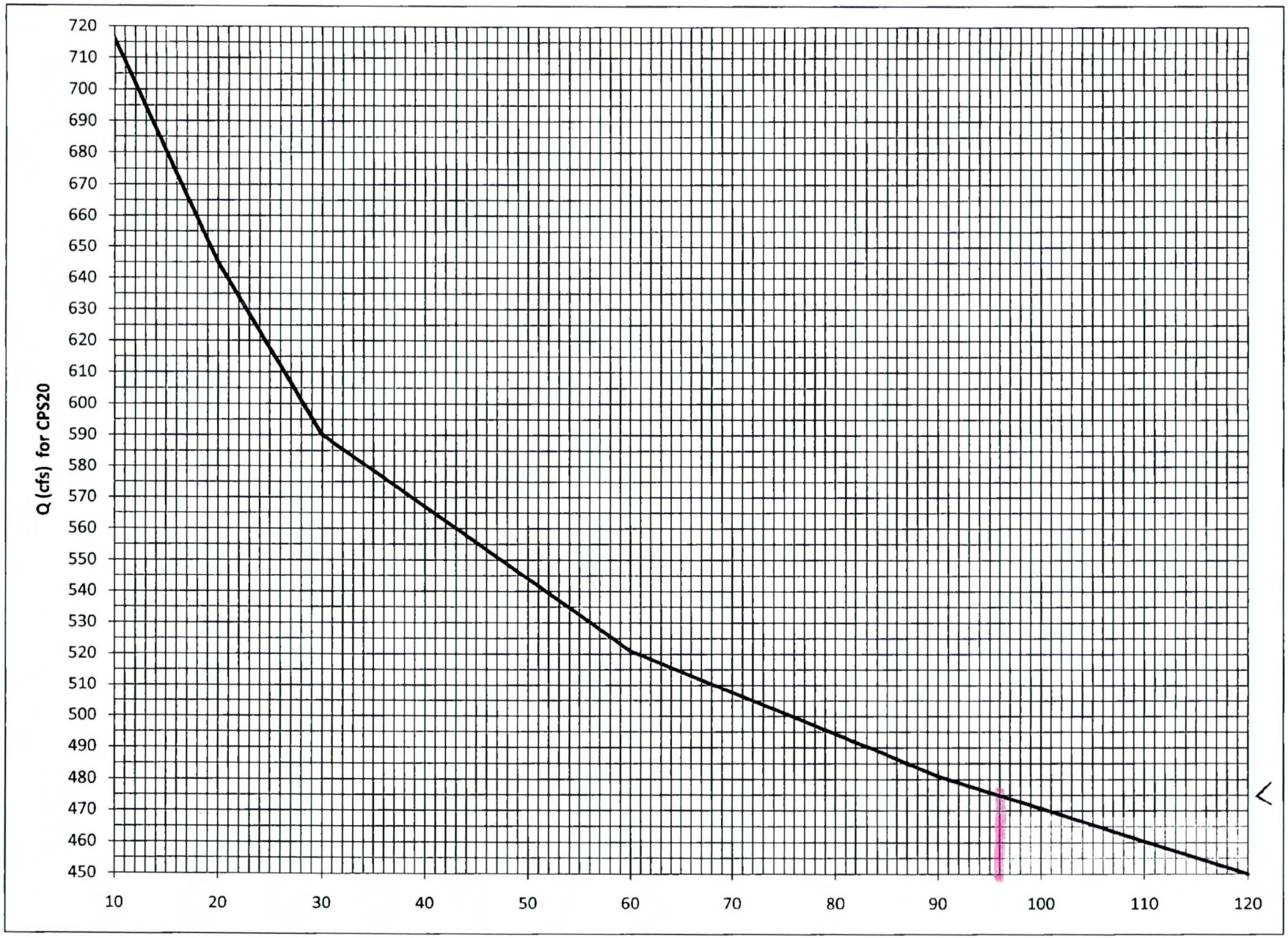
** - For next downstream culvert


Q (cfs) for RS47 -- FRS-WT-4 Dam Outlet
230
225
220
215
10
20
30
40
50
60
70
80
90
100
218
217
217

[4]

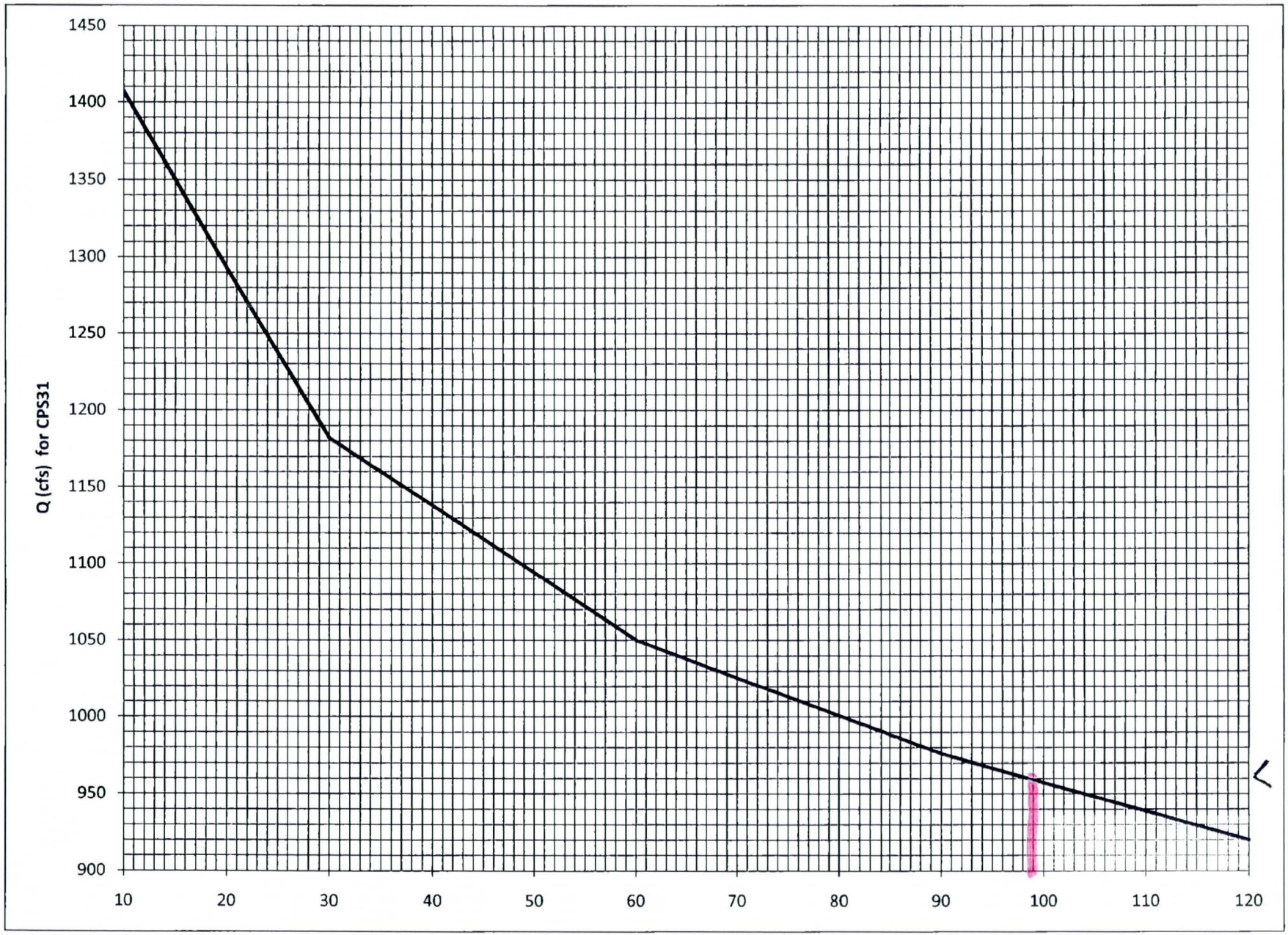

Q (cfs) for CPS13
640
630
620
610
600
590
580
570
560
550
540
530
520
510
500
490
10
20
30
40
50
60
70
80
90
100
110
120
513 cfs

[5]


Q (cfs) for CPS20
720
710
700
690
680
670
660
650
640
630
620
610
600
590
580
570
560
550
540
530
520
510
500
490
480
470
460
450
10
20
30
40
50
60
70
80
90
100
110
120

< 475 cfs

[6]


Q (cfs) for CPS31
1450
1400
1350
1300
1250
1200
1150
1100
1050
1000
950
900
10
20
30
40
50
60
70
80
90
100
110
120
< 960 cfs

[7]

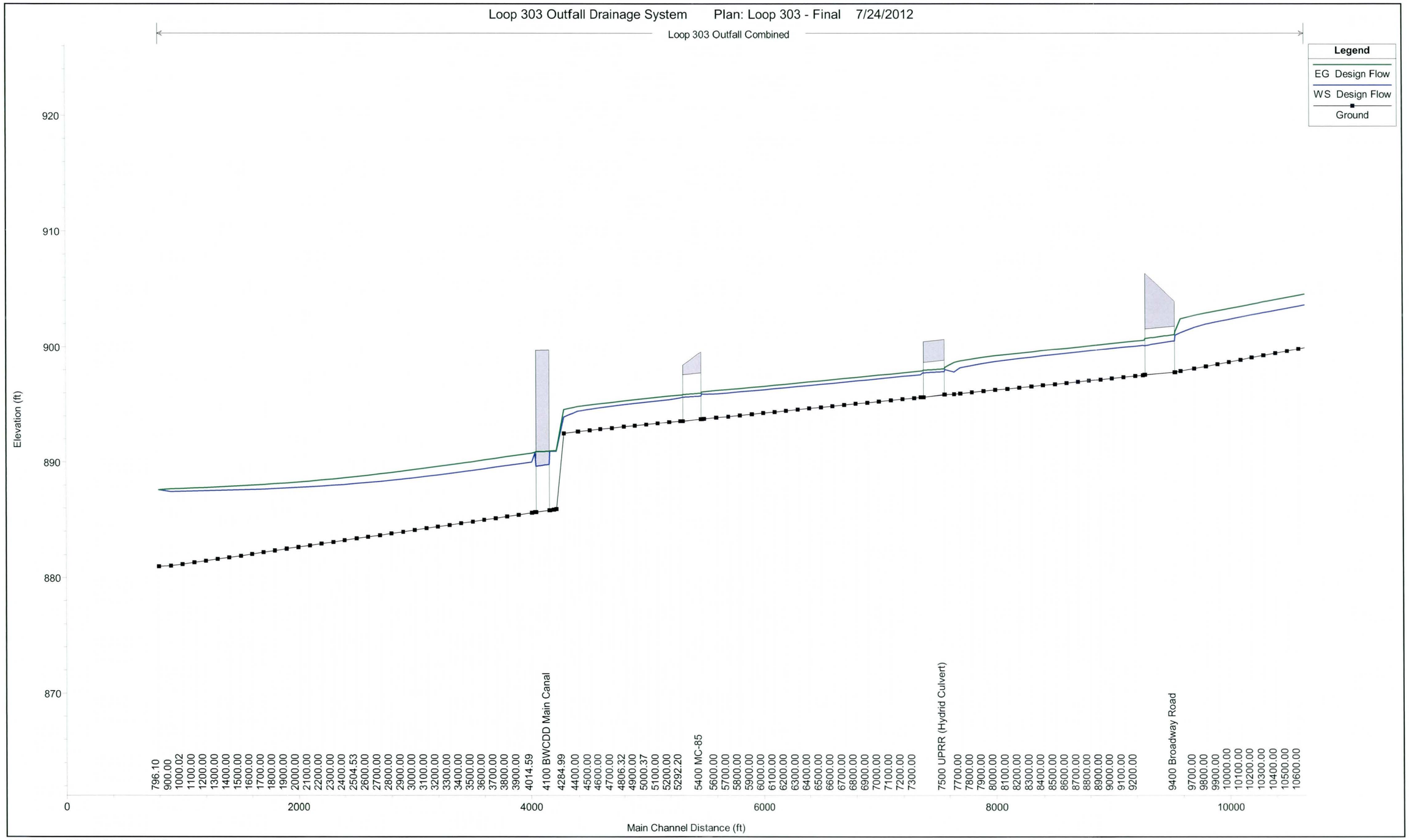
APPENDIX B

Supporting Data for Hydraulics

APPENDIX B1

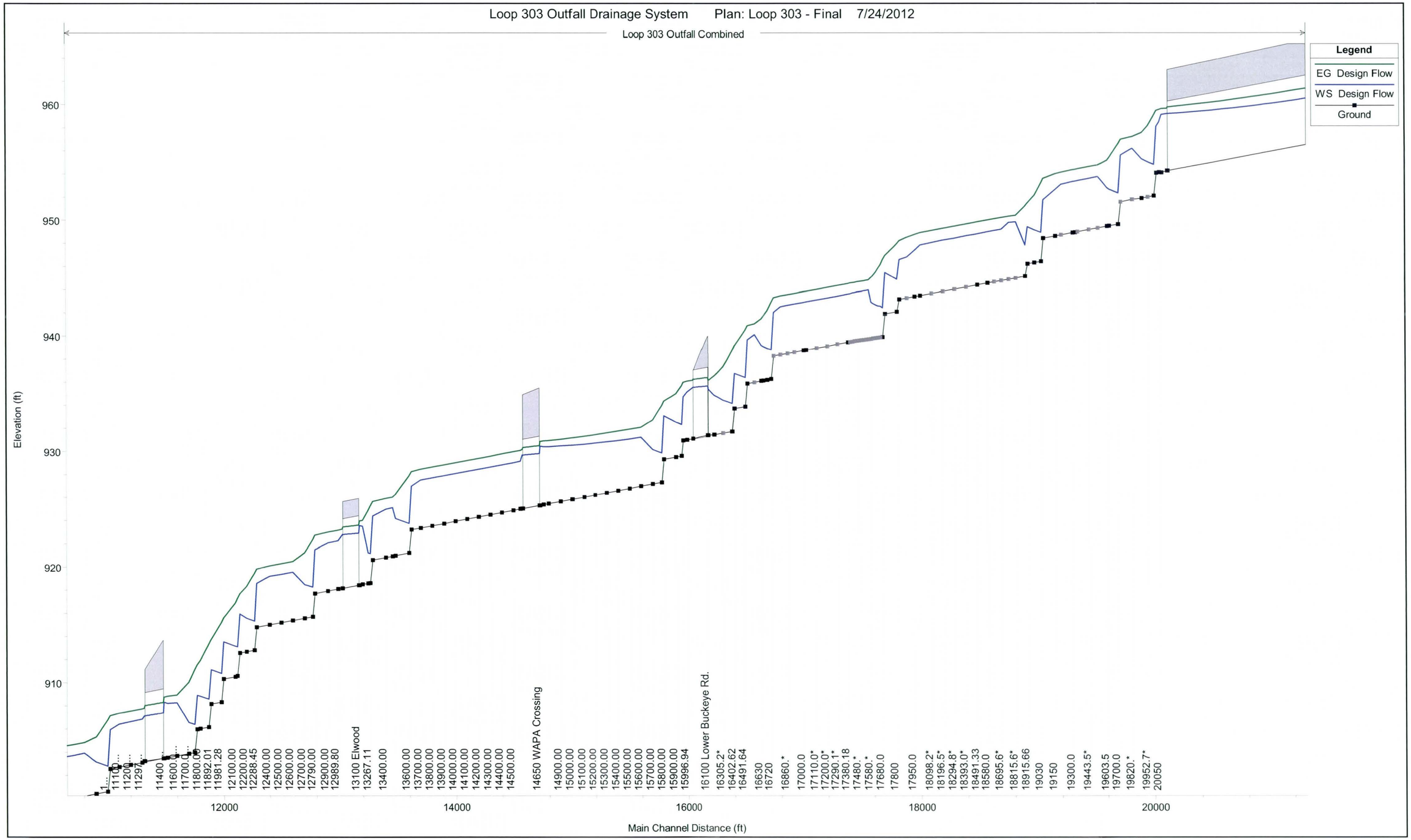
Channel Profiles and Freeboard Calculations

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012



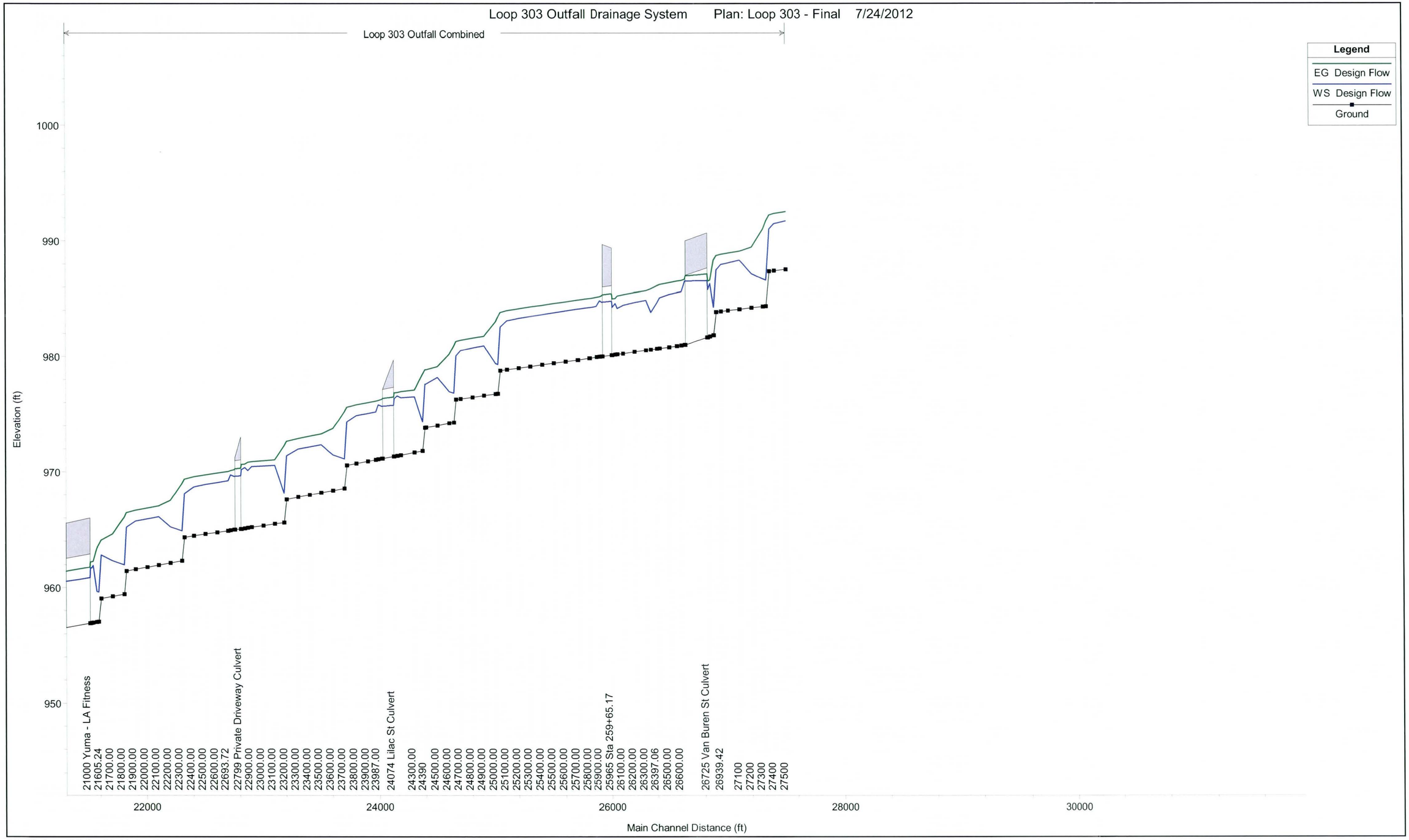
1 in Horiz. = 800 ft 1 in Vert. = 8 ft

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012



1 in Horiz. = 800 ft 1 in Vert. = 8 ft

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012



1 in Horiz. = 800 ft 1 in Vert. = 8 ft

Loop 303 Outfall Channel Profiles and Freeboard Calculation Table

HEC-RAS Plan: Loop303 Final River: Loop 303 Outfall Reach: Combined Profile: Design Flow

River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Total	Flow Area	Top Width	Hydr Radius	Froude # Chl	LOB Elev	ROB Elev	Channel Curve Radius	Super-elevation	W.S. Elev (w/Superelev.)	Freeboard Required	Freeboard Provided	Freeboard Check
		(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	(ft)		(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	
27400	Design Flow	480	987.40	991.47	991.06	992.35	0.00173	7.52	63.85	23.97	2.47	0.81	995.90	995.90	0.00	0.00	991.47	1.24	4.43	OK
27355.8	Design Flow	480	987.35	991.01	991.01	992.22	0.00268	8.84	54.32	22.33	2.26	1.00	995.85	995.85	0.00	0.00	991.01	2.00	4.84	OK
27325.8	Design Flow	480	984.35	986.58	988.01	991.67	0.01937	18.10	26.52	16.62	1.50	2.52	992.85	992.85	0.00	0.00	986.58	2.00	6.27	OK
27300	Design Flow	480	984.32	986.69	987.98	991.00	0.01535	16.65	28.83	17.16	1.58	2.26	992.82	992.82	0.00	0.00	986.69	2.00	6.13	OK
27200	Design Flow	480	984.20	987.15	987.86	989.45	0.00642	12.16	39.49	19.49	1.89	1.50	992.70	992.70	0.00	0.00	987.15	2.00	5.55	OK
27100	Design Flow	480	984.08	988.32	987.74	989.09	0.00147	7.08	67.82	24.63	2.55	0.75	992.58	992.58	0.00	0.00	988.32	1.25	4.26	OK
27000	Design Flow	480	983.97	988.08		988.94	0.00166	7.40	64.84	24.14	2.49	0.80	992.47	992.47	0.00	0.00	988.08	1.24	4.39	OK
26939.42	Design Flow	480	983.89	987.94	987.55	988.83	0.00177	7.59	63.26	23.87	2.46	0.82	992.39	992.39	0.00	0.00	987.94	1.24	4.45	OK
26899.42	Design Flow	480	983.84	987.50	987.50	988.71	0.00269	8.85	54.23	22.31	2.26	1.00	992.84	992.86	0.00	0.00	987.50	2.00	5.34	OK
26879.42	Design Flow	480	981.84	984.26	985.50	988.32	0.01413	16.16	29.70	17.36	1.61	2.18	990.84	990.86	0.00	0.00	984.26	2.00	6.58	OK
26850	Design Flow	480	981.74	986.28	984.65	986.58	0.00044	4.34	110.54	32.75	3.05	0.42	990.61	990.61	0.00	0.00	986.28	1.21	4.33	OK
26830.63	Design Flow	480	981.66	985.80	984.57	986.52	0.00120	6.80	70.55	17.09	2.79	0.59	990.66	990.66	0.00	0.00	985.80	1.21	4.86	OK
26725		Culvert																		
26630.12	Design Flow	480	981.00	986.51		986.65	0.00015	3.06	156.83	28.51	3.99	0.23	990.00	990.00	0.00	0.00	986.51	1.41	3.49	OK
26600	Design Flow	480	980.95	985.60		986.56	0.00176	7.86	61.05	17.95	2.60	0.75	989.95	989.95	0.00	0.00	985.60	1.40	4.35	OK
26564.36	Design Flow	480	980.90	985.53		986.50	0.00180	7.92	60.62	17.90	2.59	0.76	989.90	989.90	0.00	0.00	985.53	1.40	4.37	OK
26500	Design Flow	480	980.81	985.37		986.38	0.00191	8.09	59.36	17.76	2.55	0.78	989.81	989.81	0.00	0.00	985.37	1.39	4.44	OK
26420	Design Flow	480	980.70	985.07	984.66	986.21	0.00225	8.55	56.14	17.39	2.45	0.84	989.70	989.70	0.00	0.00	985.07	1.38	4.63	OK
26397.06	Design Flow	480	980.67	984.63	984.63	986.11	0.00315	9.77	49.12	16.56	2.33	1.00	989.67	989.67	0.00	0.00	984.63	2.00	5.04	OK
26342.41	Design Flow	480	980.59	983.82	984.37	985.84	0.00528	11.39	42.13	19.65	1.99	1.37	989.59	989.59	0.00	0.00	983.82	2.00	5.77	OK
26300	Design Flow	480	980.53	984.85	984.31	985.67	0.00157	7.29	65.83	23.99	2.53	0.78	989.53	989.53	0.00	0.00	984.85	1.29	4.68	OK
26200	Design Flow	480	980.39	984.66		985.51	0.00165	7.43	64.64	23.79	2.51	0.79	989.39	989.39	0.00	0.00	984.66	1.28	4.73	OK
26100	Design Flow	480	980.25	984.41		985.34	0.00183	7.72	62.16	23.37	2.46	0.83	989.25	989.25	0.00	0.00	984.41	1.27	4.84	OK
26051.93	Design Flow	480	980.19	984.17	983.97	985.24	0.00222	8.28	57.94	22.64	2.37	0.91	989.19	989.19	0.00	0.00	984.17	1.26	5.02	OK
26032	Design Flow	480	980.16	984.58		985.03	0.00069	5.36	89.54	26.11	2.97	0.51	989.16	989.16	0.00	0.00	984.58	1.22	4.58	OK
26006.79	Design Flow	480	980.11	984.26	983.01	984.97	0.00120	6.79	70.67	17.08	2.79	0.59	990.69	990.69	0.00	0.00	984.26	1.22	6.43	OK
25965		Culvert																		
25916.79	Design Flow	480	980.00	984.70		985.26	0.00083	5.99	80.15	17.10	3.03	0.49	989.68	989.68	0.00	0.00	984.70	1.31	4.98	OK
25900	Design Flow	480	979.97	984.84		985.19	0.00048	4.74	101.23	26.13	3.26	0.42	989.47	989.47	0.00	0.00	984.84	1.30	4.63	OK
25871.73	Design Flow	480	979.94	984.34		985.12	0.00144	7.07	67.90	24.33	2.57	0.75	989.44	989.44	0.00	0.00	984.34	1.29	5.10	OK
25800	Design Flow	480	979.83	984.24		985.01	0.00143	7.05	68.07	24.36	2.58	0.74	989.33	989.33	0.00	0.00	984.24	1.30	5.09	OK
25700	Design Flow	480	979.69	984.09		984.87	0.00144	7.07	67.90	24.33	2.57	0.75	989.19	989.19	0.00	0.00	984.09	1.29	5.10	OK
25600	Design Flow	480	979.55	983.94		984.73	0.00146	7.09	67.66	24.29	2.57	0.75	988.43	988.74	0.00	0.00	983.94	1.29	4.49	OK
25500	Design Flow	480	979.41	983.79		984.58	0.00148	7.13	67.35	24.24	2.56	0.75	987.91	987.98	0.00	0.00	983.79	1.29	4.12	OK
25400	Design Flow	480	979.27	983.64		984.43	0.00150	7.17	66.98	24.18	2.56	0.76	987.52	987.21	1200.00	0.02	983.66	1.29	3.55	OK
25300	Design Flow	480	979.13	983.47		984.28	0.00153	7.22	66.46	24.09	2.54	0.77	986.63	986.63	0.00	0.00	983.47	1.29	3.16	OK
25200	Design Flow	480	978.99	983.30		984.13	0.00158	7.31	65.70	23.97	2.53	0.78	986.24	986.24	0.00	0.00	983.30	1.28	2.94	OK
25100	Design Flow	480	978.85	983.09	982.64	983.96	0.00170	7.51	63.94	23.67	2.49	0.80	985.85	985.85	0.00	0.00	983.09	1.28	2.76	OK
25040	Design Flow	480	978.77	982.55	982.55	983.80	0.00274	8.95	53.60	21.86	2.27	1.01	985.27	985.77	0.00	0.00	982.55	2.00	2.72	OK
25020	Design Flow	480	976.77	979.31	980.55	983.41	0.01395	16.25	29.54	16.89	1.64	2.16	983.27	983.77	0.00	0.00	979.31	2.00	3.96	OK
25000	Design Flow	480	976.74	979.39	980.53	983.02	0.01182	15.30	31.38	17.32	1.69	2.00	983.24	983.74	0.00	0.00	979.39	2.00	3.85	OK
24900	Design Flow	480	976.60	980.93	980.39	981.75	0.00155	7.25	66.20	24.05	2.54	0.77	982.85	982.94	500.00	0.04	980.97	1.29	1.88	OK
24800	Design Flow	480	976.46	980.76		981.59	0.00161	7.35	65.30	23.90	2.52	0.78	982.71	982.46	500.00	0.04	980.80	1.28	1.66	OK
24700	Design Flow	480	976.33	980.49	980.11	981.42	0.00183	7.72	62.21	23.38	2.46	0.83	982.58	982.33	0.00	0.00	980.49	1.27	1.84	OK
24660	Design Flow	480	976.27	980.06	980.06	981.30	0.00274	8.95	53.62	21.86	2.27	1.01	982.52	982.27	0.00	0.00	980.06	2.00	2.21	OK
24640	Design Flow	480	974.27	976.81	978.05	980.91	0.01395	16.25	29.55	16.89	1.64	2.16	981.27	981.02	0.00	0.00	976.81	2.00	4.21	OK
24600	Design Flow	480	974.20	976.96	977.98	980.18	0.00999	14.39	33.36	17.77	1.75	1.85	981.20	980.95	500.00	0.23	977.19	2.00	3.76	OK
24500	Design Flow	480	974.01	978.19	977.80	979.11	0.00180	7.66	62.63	23.44	2.47	0.83	980.39	980.35	0.00	0.00	978.19	1.27	2.16	OK
24400	Design Flow	480	973.83	977.62	977.61	978.86	0.00272	8.93	53.77	21.89	2.27	1.00	980.08	980.08	500.00	0.11	977.73	2.00	2.35	OK
24390	Design Flow	480	973.81	977.59	977.59	978.84	0.00274	8.95	53.61	21.86	2.27	1.01	980.06	980.06	0.00	0.00	977.59	2.00	2.47	OK
24370	Design Flow	480	971.81	974.35	975.59	978.45	0.01395	16.25	29.55	16.89	1.64	2.16	978.06	978.06	500.00	0.28	974.63	2.00	3.43	OK
24300	Design Flow	480	971.68	976.50	975.47	977.08	0.00098	6.12	78.40	26.00	2.78	0.62	977.93	977.93	0.00	0.00	976.50	1.35	1.43	OK
24182.16	Design Flow	480	971.45	976.43		976.96	0.00085	5.80	82.72	26.66	2.85	0.58	977.70	977.70	0.00	0.00	976.43	1.38	1.27	CHECK

Loop 303 Outfall Channel Profiles and Freeboard Calculation Table

HEC-RAS Plan: Loop303 Final River: Loop 303 Outfall Reach: Combined Profile: Design Flow

River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Total	Flow Area	Top Width	Hydr Radius	Froude # Chl	LOB Elev	ROB Elev	Channel Curve Radius	Super-elevation	W.S. Elev (w/Superelev.)	Freeboard Required	Freeboard Provided	Freeboard Check
		(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	(ft)		(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	
24152.31	Design Flow	480	971.39	976.58		976.87	0.00037	4.38	109.58	26.15	3.46	0.38	979.70	979.70	0.00	0.00	976.58	1.37	3.12	OK
24126.95	Design Flow	480	971.34	976.35	974.24	976.84	0.00069	5.61	85.51	17.12	3.17	0.44	979.70	979.70	0.00	0.00	976.35	1.37	3.35	OK
24074		Culvert																		
24020.95	Design Flow	480	971.15	975.69		976.28	0.00092	6.20	77.47	17.15	2.97	0.51	977.15	977.15	0.00	0.00	975.69	1.28	1.46	OK
23987	Design Flow	480	971.08	975.80		976.20	0.00059	5.06	94.83	27.25	3.04	0.48	977.08	977.08	0.00	0.00	975.80	1.28	1.28	OK
23965.73	Design Flow	480	971.04	975.19		976.12	0.00186	7.76	61.83	23.32	2.45	0.84	977.04	977.04	0.00	0.00	975.19	1.27	1.85	OK
23900	Design Flow	480	970.91	975.07		976.00	0.00184	7.74	62.04	23.35	2.45	0.84	976.91	976.91	0.00	0.00	975.07	1.27	1.84	OK
23800	Design Flow	480	970.72	974.88	974.51	975.81	0.00184	7.73	62.13	23.37	2.46	0.83	976.72	976.72	500.00	0.04	974.92	1.27	1.80	OK
23720	Design Flow	480	970.57	974.35	974.35	975.60	0.00274	8.95	53.61	21.86	2.27	1.01	976.57	976.57	0.00	0.00	974.35	2.00	2.22	OK
23700	Design Flow	480	968.57	971.11	972.36	975.21	0.01395	16.25	29.55	16.89	1.64	2.16	974.82	974.82	0.00	0.00	971.11	2.00	3.71	OK
23600	Design Flow	480	968.38	971.47	972.16	973.77	0.00630	12.16	39.48	19.10	1.92	1.49	974.63	974.63	1000.00	0.09	971.56	2.00	3.07	OK
23500	Design Flow	480	968.19	972.33	971.98	973.27	0.00187	7.78	61.70	23.29	2.45	0.84	974.44	974.19	0.00	0.00	972.33	1.27	1.86	OK
23400	Design Flow	480	967.99	972.16		973.08	0.00183	7.72	62.21	23.38	2.46	0.83	974.24	973.99	500.00	0.04	972.20	1.27	1.79	OK
23300	Design Flow	480	967.80	971.97	971.59	972.89	0.00181	7.69	62.43	23.42	2.46	0.83	973.80	973.80	0.00	0.00	971.97	1.27	1.83	OK
23200	Design Flow	480	967.61	971.39	971.39	972.64	0.00274	8.96	53.60	21.86	2.27	1.01	973.61	973.61	0.00	0.00	971.39	2.00	2.22	OK
23180	Design Flow	480	965.61	968.15	969.40	972.25	0.01395	16.25	29.55	16.89	1.64	2.16	971.86	971.86	0.00	0.00	968.15	2.00	3.71	OK
23100	Design Flow	480	965.49	970.55	969.27	971.05	0.00079	5.67	84.73	26.96	2.89	0.56	971.74	971.74	0.00	0.00	970.55	1.39	1.19	CHECK
23000	Design Flow	480	965.34	970.49		970.96	0.00073	5.50	87.27	27.33	2.94	0.54	971.59	971.59	500.00	0.03	970.52	1.40	1.07	CHECK
22900	Design Flow	480	965.19	970.44		970.88	0.00068	5.33	90.00	27.73	2.98	0.52	971.44	971.44	0.00	0.00	970.44	1.42	1.00	CHECK
22864.34	Design Flow	480	965.14	970.10		970.82	0.00117	6.82	70.40	21.78	2.85	0.67	973.39	973.39	0.00	0.00	970.10	1.42	3.29	OK
22839.49	Design Flow	480	965.10	970.38		970.68	0.00037	4.34	110.49	27.28	3.42	0.38	973.39	973.39	0.00	0.00	970.38	1.39	3.01	OK
22809.03	Design Flow	480	965.05	970.18	967.95	970.65	0.00065	5.49	87.50	17.12	3.21	0.43	973.39	973.39	0.00	0.00	970.18	1.40	3.21	OK
22799		Culvert																		
22749.01	Design Flow	480	964.98	969.61		970.18	0.00087	6.07	79.04	17.15	3.01	0.50	971.22	971.22	0.00	0.00	969.61	1.30	1.61	OK
22717.12	Design Flow	480	964.92	969.72		970.10	0.00056	4.95	97.05	27.25	3.09	0.46	971.17	971.17	0.00	0.00	969.72	1.30	1.45	OK
22693.72	Design Flow	480	964.89	969.22		970.04	0.00155	7.26	66.11	24.04	2.54	0.77	971.14	971.14	0.00	0.00	969.22	1.29	1.92	OK
22600	Design Flow	480	964.75	969.07		969.89	0.00157	7.29	65.82	23.99	2.53	0.78	971.64	972.00	500.00	0.04	969.11	1.29	2.53	OK
22500	Design Flow	480	964.60	968.90		969.74	0.00160	7.34	65.38	23.92	2.52	0.78	970.60	970.60	0.00	0.00	968.90	1.28	1.70	OK
22400	Design Flow	480	964.45	968.69	968.24	969.56	0.00169	7.50	64.02	23.69	2.50	0.80	970.45	970.45	0.00	0.00	968.69	1.28	1.76	OK
22320	Design Flow	480	964.33	968.11	968.11	969.36	0.00274	8.95	53.60	21.86	2.27	1.01	970.33	970.33	0.00	0.00	968.11	2.00	2.22	OK
22300	Design Flow	480	962.33	964.87	966.11	968.97	0.01395	16.25	29.55	16.89	1.64	2.16	970.08	969.58	0.00	0.00	964.87	2.00	4.71	OK
22200	Design Flow	480	962.14	965.23	965.93	967.53	0.00630	12.16	39.48	19.10	1.92	1.49	968.39	968.89	0.00	0.00	965.23	2.00	3.16	OK
22100	Design Flow	480	961.95	966.10	965.73	967.04	0.00185	7.75	61.91	23.33	2.45	0.84	968.45	968.45	0.00	0.00	966.10	1.27	2.35	OK
22000	Design Flow	480	961.76	965.92		966.85	0.00184	7.74	62.04	23.35	2.45	0.84	968.26	968.26	0.00	0.00	965.92	1.27	2.34	OK
21900	Design Flow	480	961.57	965.73	965.35	966.66	0.00184	7.73	62.13	23.37	2.46	0.83	967.57	967.57	0.00	0.00	965.73	1.27	1.84	OK
21820	Design Flow	480	961.42	965.20	965.20	966.45	0.00274	8.96	53.60	21.86	2.27	1.01	967.92	967.92	500.00	0.11	965.31	2.00	2.61	OK
21800	Design Flow	480	959.42	961.96	963.20	966.06	0.01395	16.25	29.55	16.89	1.64	2.16	967.92	967.67	500.00	0.28	962.24	2.00	5.43	OK
21700	Design Flow	480	959.23	962.32	963.01	964.62	0.00630	12.16	39.48	19.10	1.92	1.49	968.15	967.48	200.00	0.44	962.76	2.00	4.72	OK
21605.24	Design Flow	480	959.05	962.84	962.84	964.08	0.00274	8.95	53.62	21.86	2.27	1.01	967.05	967.05	0.00	0.00	962.84	2.00	4.21	OK
21585.24	Design Flow	480	957.05	959.59	960.83	963.69	0.01395	16.25	29.54	16.89	1.64	2.16	966.77	966.77	0.00	0.00	959.59	2.00	7.18	OK
21570.24	Design Flow	480	957.02	959.64	960.80	963.40	0.01239	15.56	30.85	17.20	1.68	2.05	966.77	965.52	0.00	0.00	959.64	2.00	5.88	OK
21536.66	Design Flow	480	956.96	961.93	960.11	962.26	0.00043	4.61	104.19	25.93	3.33	0.41	966.77	966.77	0.00	0.00	961.93	1.33	4.84	OK
21524.85	Design Flow	480	956.94	961.68		962.23	0.00082	5.94	80.75	17.05	3.03	0.48	966.77	966.77	0.00	0.00	961.68	1.32	5.09	OK
21511.83	Design Flow	480	956.91	961.72	959.72	962.20	0.00070	5.59	85.81	17.91	3.13	0.45	966.00	966.00	0.00	0.00	961.72	1.32	4.28	OK
21000		Culvert																		
20119.61	Design Flow	480	954.28	959.20		959.67	0.00067	5.51	87.07	17.83	3.17	0.44	963.00	963.00	0.00	0.00	959.20	1.35	3.80	OK
20070.01	Design Flow	480	954.12	959.14		959.63	0.00067	5.64	85.14	18.33	3.27	0.46	960.97	960.99	0.00	0.00	959.14	1.38	1.83	OK
20050	Design Flow	480	954.13	958.49	958.16	959.55	0.00200	8.30	57.86	20.01	2.56	0.86	960.13	960.13	0.00	0.00	958.49	1.36	1.64	OK
20025.5	Design Flow	480	954.09	958.12	958.12	959.47	0.00275	9.32	51.49	19.01	2.41	1.00	960.09	960.09	0.00	0.00	958.12	2.00	1.97	CHECK
20005.5	Design Flow	480	952.11	954.82	956.14	959.07	0.01327	16.56	28.99	15.00	1.75	2.10	958.11	958.11	0.00	0.00	954.82	2.00	3.29	OK
19952.7*	Design Flow	480	952.01	955.02	956.04	958.18	0.00880	14.27	33.63	15.91	1.90	1.73	958.01	958.01	0.00	0.00	955.02	2.00	2.99	OK
19900	Design Flow	480	951.91	955.29	955.94	957.55	0.00557	12.08	39.72	17.03	2.09	1.39	957.91	957.91	0.00	0.00	955.29	2.00	2.62	OK
19820.*	Design Flow	480	951.78	956.18	955.81	957.22	0.00192	8.17	58.79	20.15	2.58	0.84	957.78	957.78	0.00	0.00	956.18	1.36	1.60	OK

Loop 303 Outfall Channel Profiles and Freeboard Calculation Table

HEC-RAS Plan: Loop303 Final River: Loop 303 Outfall Reach: Combined Profile: Design Flow

River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Total	Flow Area	Top Width	Hydr Radius	Froude # Chl	LOB Elev	ROB Elev	Channel Curve Radius	Super-elevation	W.S. Elev (w/Superelev.)	Freeboard Required	Freeboard Provided	Freeboard Check
		(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	(ft)		(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	
19720.*	Design Flow	480	951.58	955.61	955.61	956.96	0.00275	9.33	51.47	19.01	2.41	1.00	957.58	957.58	216.50	0.24	955.85	2.00	1.73	CHECK
19700	Design Flow	480	949.64	952.36	953.67	956.57	0.01307	16.47	29.14	15.03	1.75	2.08	955.64	955.64	0.00	0.00	952.36	2.00	3.28	OK
19623.5	Design Flow	480	949.50	952.66	953.53	955.40	0.00722	13.28	36.15	16.38	1.98	1.58	955.50	955.50	0.00	0.00	952.66	2.00	2.84	OK
19603.5	Design Flow	480	949.47	952.79	953.50	955.16	0.00592	12.35	38.86	16.88	2.06	1.43	955.47	955.47	0.00	0.00	952.79	2.00	2.68	OK
19523.5*	Design Flow	480	949.32	953.75	953.35	954.77	0.00186	8.08	59.43	20.24	2.60	0.83	955.32	955.32	0.00	0.00	953.75	1.36	1.57	OK
19443.5*	Design Flow	480	949.17	953.60		954.62	0.00186	8.07	59.46	20.25	2.60	0.83	955.17	955.17	0.00	0.00	953.60	1.36	1.57	OK
19343.5*	Design Flow	480	948.98	953.42		954.43	0.00185	8.06	59.57	20.26	2.60	0.83	954.98	954.98	0.00	0.00	953.42	1.36	1.56	OK
19320	Design Flow	480	948.94	953.37		954.39	0.00186	8.08	59.43	20.24	2.60	0.83	954.94	954.94	0.00	0.00	953.37	1.36	1.57	OK
19300	Design Flow	480	948.91	953.33		954.35	0.00188	8.11	59.16	20.20	2.59	0.84	954.91	954.91	0.00	0.00	953.33	1.36	1.58	OK
19200.*	Design Flow	480	948.72	953.11	952.75	954.15	0.00194	8.20	58.54	20.11	2.58	0.85	954.72	954.72	0.00	0.00	953.11	1.36	1.61	OK
19150	Design Flow	480	948.63	952.65	952.65	954.01	0.00276	9.34	51.41	19.00	2.41	1.00	954.63	954.63	216.50	0.24	952.89	2.00	1.74	CHECK
19050	Design Flow	480	948.44	951.76	952.23	953.60	0.00469	10.89	44.09	20.15	2.03	1.30	954.44	954.44	216.50	0.34	952.10	2.00	2.34	OK
19030	Design Flow	480	946.44	948.95	950.23	953.20	0.01478	16.56	28.99	16.84	1.61	2.22	952.44	952.44	0.00	0.00	948.95	2.00	3.49	OK
18971.64	Design Flow	480	946.33	949.15	950.12	952.15	0.00915	13.91	34.51	18.12	1.78	1.78	952.33	952.33	0.00	0.00	949.15	2.00	3.18	OK
18915.66	Design Flow	480	946.23	949.43	950.01	951.49	0.00547	11.52	41.66	19.65	1.97	1.39	952.23	952.23	0.00	0.00	949.43	2.00	2.80	OK
18895.66	Design Flow	480	945.14	947.85	948.92	951.21	0.01065	14.70	32.65	17.70	1.72	1.91	951.14	951.14	0.00	0.00	947.85	2.00	3.29	OK
18815.6*	Design Flow	480	944.99	949.84	948.76	950.40	0.00095	6.03	79.61	26.33	2.79	0.61	950.99	950.99	0.00	0.00	949.84	1.35	1.15	CHECK
18755.6*	Design Flow	480	944.88	949.80		950.34	0.00089	5.89	81.56	26.63	2.82	0.59	950.88	950.88	0.00	0.00	949.80	1.36	1.08	CHECK
18695.6*	Design Flow	480	944.77	949.21		950.22	0.00185	8.06	59.57	20.26	2.60	0.83	950.77	950.77	0.00	0.00	949.21	1.36	1.56	OK
18635.6*	Design Flow	480	944.66	949.10		950.11	0.00185	8.06	59.52	20.26	2.60	0.83	950.66	950.66	216.50	0.09	949.19	1.36	1.47	OK
18580	Design Flow	480	944.56	948.99		950.01	0.00186	8.08	59.39	20.24	2.60	0.83	950.56	950.56	216.50	0.09	949.08	1.36	1.48	OK
18491.33	Design Flow	480	944.40	948.82		949.84	0.00188	8.11	59.15	20.20	2.59	0.84	950.40	950.40	0.00	0.00	948.82	1.36	1.58	OK
18393.0*	Design Flow	480	944.21	948.64		949.65	0.00187	8.10	59.27	20.22	2.60	0.83	950.21	950.21	0.00	0.00	948.64	1.36	1.57	OK
18294.8*	Design Flow	480	944.03	948.45		949.47	0.00189	8.12	59.09	20.19	2.59	0.84	950.03	950.03	0.00	0.00	948.45	1.36	1.58	OK
18196.5*	Design Flow	480	943.84	948.26		949.28	0.00188	8.11	59.20	20.21	2.59	0.83	949.84	949.84	0.00	0.00	948.26	1.36	1.58	OK
18098.2*	Design Flow	480	943.66	948.07		949.10	0.00190	8.14	58.94	20.17	2.59	0.84	949.66	949.66	0.00	0.00	948.07	1.36	1.59	OK
18000	Design Flow	480	943.47	947.86	947.50	948.90	0.00194	8.20	58.54	20.11	2.58	0.85	949.47	949.47	216.50	0.10	947.96	1.36	1.51	OK
17950	Design Flow	480	943.38	947.40	947.40	948.76	0.00276	9.34	51.40	19.00	2.40	1.00	949.38	949.38	216.50	0.24	947.64	2.00	1.74	CHECK
17885.*	Design Flow	480	943.26	946.80	947.14	948.51	0.00401	10.50	45.71	19.32	2.16	1.20	949.26	949.26	0.00	0.00	946.80	2.00	2.46	OK
17820	Design Flow	480	943.14	946.59	946.92	948.22	0.00396	10.24	46.88	20.70	2.10	1.20	949.14	949.14	0.00	0.00	946.59	2.00	2.55	OK
17800	Design Flow	480	942.09	944.89	945.87	947.96	0.00945	14.07	34.11	18.03	1.77	1.80	948.09	948.09	0.00	0.00	944.89	2.00	3.20	OK
17700	Design Flow	480	941.90	945.46	945.68	946.94	0.00349	9.77	49.13	21.13	2.16	1.13	947.90	947.90	0.00	0.00	945.46	2.00	2.44	OK
17680	Design Flow	480	939.90	942.43	943.68	946.56	0.01416	16.31	29.44	16.95	1.63	2.18	945.90	945.90	0.00	0.00	942.43	2.00	3.47	OK
17660.*	Design Flow	480	939.87	942.57	943.68	946.13	0.01162	15.16	31.67	17.52	1.69	1.99	945.87	945.87	0.00	0.00	942.57	2.00	3.30	OK
17640.*	Design Flow	480	939.84	942.59	943.62	945.83	0.01015	14.45	33.22	17.83	1.74	1.87	945.84	945.84	0.00	0.00	942.59	2.00	3.25	OK
17620.*	Design Flow	480	939.81	942.68	943.58	945.53	0.00851	13.55	35.43	18.32	1.80	1.72	945.81	945.81	0.00	0.00	942.68	2.00	3.13	OK
17600.*	Design Flow	480	939.78	942.78	943.56	945.27	0.00705	12.65	37.95	18.87	1.87	1.57	945.78	945.78	0.00	0.00	942.78	2.00	3.00	OK
17580.*	Design Flow	480	939.75	942.91	943.53	945.04	0.00570	11.70	41.02	19.52	1.96	1.42	945.75	945.75	0.00	0.00	942.91	2.00	2.84	OK
17560.*	Design Flow	480	939.72	943.97	943.49	944.83	0.00167	7.44	64.53	23.90	2.50	0.80	945.72	945.72	0.00	0.00	943.97	1.28	1.75	OK
17540.*	Design Flow	480	939.69	943.93		944.79	0.00168	7.46	64.38	23.88	2.49	0.80	945.69	945.69	0.00	0.00	943.93	1.28	1.76	OK
17520.*	Design Flow	480	939.66	943.89		944.76	0.00169	7.47	64.23	23.85	2.49	0.80	945.66	945.66	0.00	0.00	943.89	1.27	1.77	OK
17500.*	Design Flow	480	939.63	943.86		944.73	0.00170	7.49	64.07	23.82	2.49	0.81	945.63	945.63	0.00	0.00	943.86	1.28	1.77	OK
17480.*	Design Flow	480	939.60	943.82		944.70	0.00171	7.51	63.90	23.79	2.48	0.81	945.60	945.60	0.00	0.00	943.82	1.27	1.78	OK
17460.*	Design Flow	480	939.57	943.78		944.66	0.00172	7.53	63.71	23.76	2.48	0.81	945.57	945.57	0.00	0.00	943.78	1.27	1.79	OK
17440.*	Design Flow	480	939.54	943.74		944.63	0.00174	7.56	63.53	23.73	2.48	0.81	945.54	945.54	0.00	0.00	943.74	1.27	1.80	OK
17420.*	Design Flow	480	939.51	943.72		944.59	0.00170	7.49	64.07	23.79	2.49	0.80	945.50	945.51	0.00	0.00	943.72	1.27	1.78	OK
17400.*	Design Flow	480	939.48	943.64		944.56	0.00182	7.69	62.42	23.54	2.45	0.83	945.48	945.48	0.00	0.00	943.64	1.27	1.84	OK
17380.18	Design Flow	480	939.45	943.60		944.52	0.00184	7.72	62.15	23.50	2.45	0.84	945.45	945.45	0.00	0.00	943.60	1.27	1.85	OK
17290.1*	Design Flow	480	939.28	943.43		944.35	0.00184	7.71	62.26	23.51	2.45	0.83	945.28	945.28	0.00	0.00	943.43	1.27	1.85	OK
17200.0*	Design Flow	480	939.11	943.27		944.19	0.00182	7.69	62.40	23.54	2.45	0.83	945.11	945.11	0.00	0.00	943.27	1.27	1.84	OK
17110.0*	Design Flow	480	938.94	943.10		944.02	0.00181	7.67	62.56	23.57	2.46	0.83	944.94	944.94	0.00	0.00	943.10	1.27	1.84	OK
17020	Design Flow	480	938.77	942.94		943.85	0.00180	7.65	62.76	23.60	2.46	0.83	944.77	944.77	0.00	0.00	942.94	1.27	1.83	OK
17000	Design Flow	480	938.74	942.89		943.82	0.00186	7.74	62.02	23.49	2.44	0.84	944.74	944.74	0.00	0.00	942.89	1.27	1.85	OK

Loop 303 Outfall Channel Profiles and Freeboard Calculation Table

HEC-RAS Plan: Loop303 Final River: Loop 303 Outfall Reach: Combined Profile: Design Flow

River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Total	Flow Area	Top Width	Hydr Radius	Froude # Chl	LOB Elev	ROB Elev	Channel Curve Radius	Super-elevation	W.S. Elev (w/Superelev.)	Freeboard Required	Freeboard Provided	Freeboard Check
		(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	(ft)		(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	
16920.*	Design Flow	480	938.59	942.74		943.66	0.00183	7.70	62.36	23.53	2.45	0.83	944.59	944.59	0.00	0.00	942.74	1.27	1.85	OK
16860.*	Design Flow	480	938.48	942.63		943.55	0.00183	7.70	62.36	23.53	2.45	0.83	944.48	944.48	0.00	0.00	942.63	1.27	1.85	OK
16800.*	Design Flow	480	938.37	942.51	942.15	943.44	0.00186	7.75	61.91	23.45	2.44	0.84	944.37	944.37	1416.50	0.02	942.53	1.27	1.84	OK
16740.*	Design Flow	480	938.26	942.04	942.04	943.28	0.00274	8.94	53.71	21.99	2.26	1.01	944.26	944.26	1416.50	0.04	942.08	2.00	2.18	OK
16720	Design Flow	480	936.26	938.80	940.04	942.89	0.01398	16.23	29.57	16.98	1.63	2.17	942.26	942.26	1416.50	0.10	938.90	2.00	3.36	OK
16683.21	Design Flow	480	936.19	938.92	939.97	942.20	0.01032	14.53	33.03	17.78	1.74	1.88	942.19	942.19	1416.50	0.08	939.00	2.00	3.19	OK
16650	Design Flow	480	936.13	939.07	939.90	941.72	0.00773	13.08	36.69	18.60	1.84	1.64	942.13	942.13	1416.50	0.07	939.14	2.00	2.99	OK
16630	Design Flow	480	936.10	939.18	939.88	941.48	0.00634	12.17	39.45	19.19	1.92	1.50	942.10	942.10	1416.50	0.06	939.24	2.00	2.86	OK
16570.8*	Design Flow	480	935.99	940.12	939.77	941.06	0.00188	7.77	61.76	23.43	2.44	0.84	941.99	941.99	1416.50	0.02	940.14	1.27	1.85	OK
16511.64	Design Flow	480	935.88	939.66	939.66	940.90	0.00274	8.93	53.72	22.00	2.26	1.01	941.88	941.88	0.00	0.00	939.66	2.00	2.22	OK
16491.64	Design Flow	480	933.88	936.42	937.66	940.51	0.01398	16.23	29.57	16.98	1.63	2.17	939.88	939.88	0.00	0.00	936.42	2.00	3.46	OK
16402.62	Design Flow	480	933.72	936.75	937.49	939.17	0.00678	12.46	38.51	18.99	1.89	1.54	939.72	939.72	0.00	0.00	936.75	2.00	2.97	OK
16382.62	Design Flow	480	931.72	934.16	935.50	938.74	0.01636	17.18	27.94	16.58	1.58	2.33	937.72	937.72	0.00	0.00	934.16	2.00	3.56	OK
16380.42	Design Flow	480	931.72	934.17	935.49	938.69	0.01603	17.06	28.14	16.63	1.59	2.31	937.72	937.72	0.00	0.00	934.17	2.00	3.55	OK
16305.2*	Design Flow	480	931.58	934.43	935.36	937.34	0.00879	13.71	35.02	18.23	1.79	1.74	937.58	937.58	0.00	0.00	934.43	2.00	3.15	OK
16230	Design Flow	480	931.44	934.86	935.22	936.54	0.00412	10.39	46.20	20.56	2.09	1.22	937.44	937.44	0.00	0.00	934.86	2.00	2.58	OK
16180.76	Design Flow	480	931.38	935.38	934.28	936.15	0.00132	7.04	68.19	17.08	2.73	0.62	941.28	941.28	0.00	0.00	935.38	1.19	5.90	OK
16100		Culvert																		
16050	Design Flow	480	931.10	935.54		936.17	0.00095	6.37	75.30	18.20	3.02	0.55	937.50	937.50	0.00	0.00	935.54	1.27	1.96	OK
15996.94	Design Flow	480	931.00	935.15	934.78	936.08	0.00182	7.70	62.32	23.37	2.46	0.83	937.00	937.00	0.00	0.00	935.15	1.27	1.85	OK
15963.3	Design Flow	480	930.94	934.73	934.73	935.97	0.00272	8.93	53.74	21.88	2.27	1.00	936.84	936.69	0.00	0.00	934.73	2.00	1.96	CHECK
15950	Design Flow	480	929.61	932.33	933.39	935.69	0.01064	14.72	32.61	17.60	1.73	1.91	936.77	936.29	0.00	0.00	932.33	2.00	3.96	OK
15900	Design Flow	480	929.51	932.54	933.30	935.00	0.00692	12.58	38.14	18.81	1.89	1.56	936.34	935.86	0.00	0.00	932.54	2.00	3.32	OK
15800	Design Flow	480	929.32	933.10	933.10	934.35	0.00274	8.96	53.57	21.85	2.27	1.01	935.48	936.16	0.00	0.00	933.10	2.00	2.38	OK
15780	Design Flow	480	927.32	929.86	931.11	933.96	0.01395	16.25	29.54	16.89	1.64	2.16	935.97	936.32	0.00	0.00	929.86	2.00	6.11	OK
15700	Design Flow	480	927.17	930.16	930.96	932.71	0.00730	12.83	37.41	18.66	1.87	1.60	935.84	936.32	0.00	0.00	930.16	2.00	5.68	OK
15600	Design Flow	480	926.98	931.22	930.76	932.09	0.00169	7.49	64.07	23.70	2.50	0.80	935.66	936.13	0.00	0.00	931.22	1.28	4.44	OK
15500	Design Flow	480	926.79	931.08		931.92	0.00162	7.37	65.10	23.87	2.52	0.79	935.50	934.96	500.00	0.04	931.12	1.28	3.84	OK
15400	Design Flow	480	926.60	930.94		931.75	0.00153	7.22	66.46	24.09	2.55	0.77	935.69	935.72	0.00	0.00	930.94	1.29	4.75	OK
15300	Design Flow	480	926.41	930.82		931.59	0.00143	7.04	68.15	24.37	2.58	0.74	935.86	935.85	0.00	0.00	930.82	1.29	5.03	OK
15200	Design Flow	480	926.22	930.72		931.44	0.00132	6.84	70.16	24.70	2.62	0.72	935.77	936.23	0.00	0.00	930.72	1.31	5.05	OK
15100	Design Flow	480	926.03	930.62		931.30	0.00121	6.61	72.60	25.09	2.67	0.69	935.68	936.00	500.00	0.03	930.65	1.32	5.03	OK
15000	Design Flow	480	925.84	930.54		931.17	0.00109	6.37	75.37	25.53	2.72	0.65	935.59	936.03	0.00	0.00	930.54	1.33	5.05	OK
14900	Design Flow	480	925.65	930.47		931.06	0.00098	6.12	78.49	26.02	2.78	0.62	935.50	935.95	0.00	0.00	930.47	1.35	5.03	OK
14800	Design Flow	480	925.46	930.42		930.95	0.00087	5.86	81.88	26.53	2.84	0.59	935.42	935.70	0.00	0.00	930.42	1.37	5.00	OK
14757.73	Design Flow	480	925.38	930.40		930.91	0.00080	5.70	84.16	26.70	2.89	0.57	935.46	935.13	0.00	0.00	930.40	1.38	4.73	OK
14727.75	Design Flow	480	925.31	930.47	928.03	930.85	0.00050	4.93	97.27	18.90	3.34	0.38	935.49	935.49	0.00	0.00	930.47	1.38	5.02	OK
14650		Culvert																		
14579.51	Design Flow	480	925.05	929.69		930.16	0.00068	5.49	87.42	18.89	3.11	0.45	934.91	934.91	0.00	0.00	929.69	1.28	5.22	OK
14561.53	Design Flow	480	925.01	929.14		930.09	0.00189	7.81	61.48	23.26	2.44	0.85	934.87	933.41	0.00	0.00	929.14	1.27	4.27	OK
14500	Design Flow	480	924.89	929.03		929.97	0.00188	7.80	61.56	23.26	2.44	0.84	935.36	935.17	500.00	0.04	929.07	1.27	6.10	OK
14400	Design Flow	480	924.70	928.84		929.78	0.00189	7.80	61.51	23.26	2.44	0.85	936.14	934.83	500.00	0.04	928.88	1.27	5.95	OK
14300	Design Flow	480	924.51	928.65		929.59	0.00187	7.78	61.66	23.29	2.45	0.84	935.29	934.46	0.00	0.00	928.65	1.27	5.81	OK
14200	Design Flow	480	924.32	928.46		929.40	0.00187	7.77	61.76	23.31	2.45	0.84	934.15	933.63	0.00	0.00	928.46	1.27	5.17	OK
14100	Design Flow	480	924.13	928.28		929.21	0.00186	7.76	61.83	23.31	2.45	0.84	933.01	932.90	500.00	0.04	928.32	1.27	4.58	OK
14000	Design Flow	480	923.94	928.09		929.03	0.00185	7.75	61.93	23.33	2.45	0.84	931.88	931.63	0.00	0.00	928.09	1.27	3.54	OK
13900	Design Flow	480	923.75	927.91		928.84	0.00185	7.74	62.00	23.34	2.45	0.84	931.17	930.43	1000.00	0.02	927.93	1.27	2.50	OK
13800	Design Flow	480	923.56	927.73		928.65	0.00183	7.71	62.23	23.38	2.46	0.83	930.46	930.21	0.00	0.00	927.73	1.27	2.48	OK
13700	Design Flow	480	923.37	927.53	927.16	928.46	0.00184	7.73	62.06	23.35	2.45	0.84	929.75	929.32	0.00	0.00	927.53	1.27	1.79	OK
13620	Design Flow	480	923.22	927.01	927.01	928.25	0.00274	8.95	53.62	21.86	2.27	1.01	929.19	929.17	0.00	0.00	927.01	2.00	2.16	OK
13600	Design Flow	480	921.22	923.76	925.00	927.86	0.01396	16.25	29.54	16.89	1.64	2.17	929.08	929.08	500.00	0.28	924.04	2.00	5.04	OK
13482.55	Design Flow	480	921.00	924.19	924.79	926.28	0.00553	11.60	41.40	19.50	1.97	1.40	928.52	928.39	0.00	0.00	924.19	2.00	4.20	OK
13459.34	Design Flow	480	920.95	925.12	924.73	926.04	0.00181	7.69	62.45	23.42	2.46	0.83	928.41	928.12	0.00	0.00	925.12	1.27	3.00	OK

Loop 303 Outfall Channel Profiles and Freeboard Calculation Table

HEC-RAS Plan: Loop303 Final River: Loop 303 Outfall Reach: Combined Profile: Design Flow

River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Total	Flow Area	Top Width	Hydr Radius	Froude # Chl	LOB Elev	ROB Elev	Channel Curve Radius	Super-elevation	W.S. Elev (w/Superelev.)	Freeboard Required	Freeboard Provided	Freeboard Check
		(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	(ft)		(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	
13400	Design Flow	480	920.84	925.00	924.62	925.93	0.00184	7.74	62.03	23.35	2.45	0.84	928.13	927.81	0.00	0.00	925.00	1.27	2.81	OK
13287.11	Design Flow	480	920.62	924.41	924.41	925.65	0.00274	8.95	53.62	21.86	2.27	1.01	927.60	927.75	500.00	0.11	924.52	2.00	3.08	OK
13267.11	Design Flow	480	918.62	921.17	922.41	925.26	0.01393	16.24	29.56	16.89	1.64	2.16	926.73	927.78	500.00	0.28	921.45	2.00	5.28	OK
13247.44	Design Flow	480	918.59	921.24	922.37	924.88	0.01188	15.32	31.33	17.31	1.69	2.01	926.49	927.28	0.00	0.00	921.24	2.00	5.25	OK
13199.46	Design Flow	480	918.50	923.52	922.26	924.02	0.00080	5.68	84.50	26.96	2.88	0.57	926.06	925.80	0.00	0.00	923.52	1.38	2.28	OK
13172.24	Design Flow	480	918.43	923.59	921.15	923.97	0.00050	4.93	97.34	18.94	3.34	0.38	925.93	925.93	0.00	0.00	923.59	1.38	2.34	OK
13100		Culvert																		
13025.42	Design Flow	480	918.17	922.81		923.27	0.00068	5.49	87.46	18.92	3.12	0.45	925.67	925.67	0.00	0.00	922.81	1.28	2.86	OK
12989.8	Design Flow	480	918.10	922.27		923.19	0.00183	7.71	62.26	23.39	2.46	0.83	923.78	923.74	0.00	0.00	922.27	1.27	1.47	OK
12900	Design Flow	480	917.93	922.10	921.72	923.02	0.00183	7.71	62.28	23.40	2.46	0.83	923.07	924.39	0.00	0.00	922.10	1.27	0.97	CHECK
12790	Design Flow	480	917.72	921.50	921.50	922.75	0.00274	8.95	53.63	22.40	2.22	1.01	922.89	922.89	0.00	0.00	921.50	2.00	1.39	CHECK
12770	Design Flow	480	915.72	918.27	919.51	922.36	0.01390	16.23	29.58	16.89	1.64	2.16	922.52	922.58	0.00	0.00	918.27	2.00	4.25	OK
12700	Design Flow	480	915.58	918.50	919.36	921.24	0.00802	13.28	36.14	18.39	1.83	1.67	922.21	922.46	0.00	0.00	918.50	2.00	3.71	OK
12600	Design Flow	480	915.39	919.56	919.18	920.48	0.00183	7.72	62.19	23.37	2.46	0.83	921.78	922.51	0.00	0.00	919.56	1.27	2.22	OK
12500	Design Flow	480	915.20	919.37		920.29	0.00182	7.71	62.28	23.39	2.46	0.83	921.05	922.83	1000.00	0.02	919.39	1.27	1.66	OK
12400	Design Flow	480	915.01	919.19	918.80	920.11	0.00180	7.67	62.59	23.45	2.47	0.83	920.82	921.28	1000.00	0.02	919.21	1.27	1.61	OK
12288.45	Design Flow	480	914.80	918.58	918.58	919.83	0.00274	8.96	53.60	21.85	2.27	1.01	920.56	921.10	750.00	0.07	918.65	2.00	1.91	CHECK
12268.53	Design Flow	480	912.81	915.35	916.59	919.44	0.01391	16.23	29.57	16.88	1.64	2.16	920.33	921.04	750.00	0.18	915.53	2.00	4.80	OK
12200	Design Flow	480	912.67	915.58	916.46	918.34	0.00808	13.32	36.04	18.37	1.83	1.68	919.48	919.90	750.00	0.13	915.71	2.00	3.77	OK
12140.56	Design Flow	480	912.56	915.95	916.34	917.69	0.00431	10.58	45.37	20.30	2.07	1.25	918.74	919.07	0.00	0.00	915.95	2.00	2.79	OK
12120.77	Design Flow	480	910.58	913.10	914.36	917.30	0.01444	16.45	29.18	16.81	1.62	2.20	918.55	918.66	0.00	0.00	913.10	2.00	5.45	OK
12100	Design Flow	480	910.52	913.14	914.31	916.88	0.01230	15.52	30.94	17.22	1.68	2.04	918.18	918.38	1000.00	0.13	913.27	2.00	4.91	OK
12001.28	Design Flow	480	910.33	913.53	914.11	915.61	0.00549	11.56	41.51	19.52	1.98	1.40	916.43	917.08	1000.00	0.08	913.61	2.00	2.82	OK
11981.28	Design Flow	480	908.33	910.81	912.12	915.20	0.01532	16.80	28.56	16.66	1.60	2.26	916.29	916.83	1000.00	0.15	910.96	2.00	5.33	OK
11892.01	Design Flow	480	908.16	911.12	911.95	913.74	0.00755	12.99	36.95	18.56	1.85	1.62	915.44	915.70	0.00	0.00	911.12	2.00	4.32	OK
11872.01	Design Flow	480	906.16	908.58	909.95	913.31	0.01699	17.45	27.51	16.40	1.57	2.37	915.25	915.25	0.00	0.00	908.58	2.00	6.67	OK
11800	Design Flow	480	906.03	908.82	909.81	911.93	0.00954	14.15	33.93	17.91	1.77	1.81	914.59	914.59	0.00	0.00	908.82	2.00	5.77	OK
11772	Design Flow	480	905.97	908.93	909.76	911.56	0.00760	13.02	36.86	18.54	1.85	1.63	914.33	914.31	0.00	0.00	908.93	2.00	5.38	OK
11752.02	Design Flow	480	903.98	906.40	907.76	911.13	0.01699	17.45	27.51	16.41	1.57	2.37	914.16	913.75	0.00	0.00	906.40	2.00	7.35	OK
11700	Design Flow	480	903.88	906.58	907.67	910.03	0.01102	14.91	32.19	17.50	1.72	1.94	913.69	913.49	0.00	0.00	906.58	2.00	6.91	OK
11600	Design Flow	480	903.69	908.27	907.48	908.95	0.00122	6.65	72.22	24.93	2.67	0.69	913.34	913.09	0.00	0.00	908.27	1.32	4.82	OK
11516.69	Design Flow	480	903.53	908.22		908.84	0.00106	6.31	76.13	25.73	2.73	0.65	913.05	912.34	0.00	0.00	908.22	1.33	4.12	OK
11488.44	Design Flow	480	903.47	908.33	906.18	908.76	0.00059	5.24	91.62	18.90	3.21	0.42	913.69	913.69	0.00	0.00	908.33	1.32	5.36	OK
11400		Culvert																		
11317.74	Design Flow	480	903.23	907.14		907.80	0.00112	6.52	73.60	18.88	2.77	0.58	912.47	912.47	0.00	0.00	907.14	1.14	5.33	OK
11297.45	Design Flow	480	903.11	906.85		907.74	0.00184	7.60	63.15	24.72	2.39	0.84	910.86	910.86	0.00	0.00	906.85	1.16	4.01	OK
11200	Design Flow	480	902.92	906.65		907.56	0.00187	7.65	62.72	24.52	2.39	0.84	910.02	909.45	0.00	0.00	906.65	1.16	2.80	OK
11100	Design Flow	480	902.73	906.44	906.13	907.37	0.00191	7.71	62.25	24.44	2.38	0.85	909.47	909.47	0.00	0.00	906.44	1.16	3.03	OK
11020.21	Design Flow	480	902.57	905.96	905.96	907.16	0.00273	8.77	54.70	23.19	2.21	1.01	909.04	908.98	0.00	0.00	905.96	2.00	3.02	OK
11000.21	Design Flow	480	900.59	902.80	903.99	906.77	0.01462	16.00	30.00	18.43	1.54	2.21	909.05	909.05	0.00	0.00	902.80	2.00	6.25	OK
10900	Design Flow	480	900.40	903.15	903.79	905.32	0.00623	11.81	40.63	20.61	1.86	1.48	908.12	907.99	0.00	0.00	903.15	2.00	4.84	OK
10800	Design Flow	480	900.20	903.92	903.59	904.84	0.00190	7.69	62.38	24.47	2.38	0.85	907.19	906.45	0.00	0.00	903.92	1.16	2.53	OK
10700	Design Flow	480	900.01	903.73		904.65	0.00190	7.70	62.31	24.46	2.38	0.85	906.83	906.67	0.00	0.00	903.73	1.16	2.94	OK
10600	Design Flow	480	899.82	903.54	903.22	904.46	0.00190	7.71	62.29	24.45	2.38	0.85	906.48	905.87	0.00	0.00	903.54	1.16	2.33	OK
10500	Design Flow	480	899.63	903.35		904.27	0.00190	7.70	62.35	24.47	2.38	0.85	906.12	906.01	0.00	0.00	903.35	1.16	2.66	OK
10400	Design Flow	480	899.44	903.16		904.08	0.00190	7.70	62.37	24.48	2.38	0.85	905.76	905.76	0.00	0.00	903.16	1.16	2.60	OK
10300	Design Flow	480	899.25	902.96	902.65	903.89	0.00191	7.71	62.24	24.45	2.38	0.85	905.41	905.41	0.00	0.00	902.96	1.16	2.45	OK
10200	Design Flow	480	899.06	902.77		903.70	0.00191	7.71	62.26	24.45	2.38	0.85	905.13	905.13	0.00	0.00	902.77	1.16	2.36	OK
10100	Design Flow	480	898.87	902.58		903.51	0.00191	7.71	62.22	24.45	2.38	0.85	904.85	904.85	300.00	0.08	902.66	1.16	2.19	OK
10000	Design Flow	480	898.68	902.39		903.31	0.00191	7.72	62.17	24.44	2.38	0.85	904.56	904.35	0.00	0.00	902.39	1.16	1.96	OK
9900	Design Flow	480	898.49	902.19		903.12	0.00193	7.75	61.96	24.41	2.37	0.86	904.28	904.28	0.00	0.00	902.19	1.16	2.09	OK
9800	Design Flow	480	898.30	901.98		902.93	0.00198	7.82	61.40	24.31	2.36	0.87	904.20	904.00	0.00	0.00	901.98	1.16	2.02	OK
9700	Design Flow	480	898.11	901.68	901.51	902.71	0.00224	8.18	58.70	23.87	2.30	0.92	903.73	903.73	0.00	0.00	901.68	1.15	2.05	OK

Loop 303 Outfall Channel Profiles and Freeboard Calculation Table

HEC-RAS Plan: Loop303 Final River: Loop 303 Outfall Reach: Combined Profile: Design Flow

River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Total	Flow Area	Top Width	Hydr Radius	Froude # Chl	LOB Elev	ROB Elev	Channel Curve Radius	Super-elevation	W.S. Elev (w/Superelev.)	Freeboard Required	Freeboard Provided	Freeboard Check
		(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	(ft)		(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	
9587.18	Design Flow	480	897.90	901.24	901.24	902.42	0.00271	8.72	55.02	23.46	2.20	1.00	903.94	903.94	0.00	0.00	901.24	2.00	2.70	OK
9541.48	Design Flow	480	897.80	901.03	899.64	901.33	0.00052	4.39	109.22	33.91	2.71	0.43	903.94	903.94	0.00	0.00	901.03	1.00	2.91	OK
9400		Culvert																		
9277.83	Design Flow	480	897.57	900.11		900.60	0.00110	5.58	86.04	33.87	2.21	0.62	904.89	904.89	0.00	0.00	900.11	1.00	4.78	OK
9262.83	Design Flow	480	897.53	900.13		900.56	0.00101	5.26	91.25	41.12	2.16	0.62	903.67	903.66	0.00	0.00	900.13	1.00	3.53	OK
9200	Design Flow	480	897.46	900.07		900.50	0.00101	5.26	91.22	41.12	2.16	0.62	902.51	902.51	0.00	0.00	900.07	1.00	2.44	OK
9100	Design Flow	480	897.36	899.97		900.40	0.00101	5.26	91.24	41.13	2.16	0.62	902.17	902.17	0.00	0.00	899.97	1.00	2.20	OK
9000	Design Flow	480	897.26	899.86		900.30	0.00102	5.27	91.00	41.11	2.15	0.62	901.84	901.84	0.00	0.00	899.86	1.00	1.98	OK
8900	Design Flow	480	897.16	899.76		900.19	0.00103	5.29	90.73	41.09	2.15	0.63	901.51	901.51	0.00	0.00	899.76	1.00	1.75	OK
8800	Design Flow	480	897.06	899.66		900.09	0.00103	5.29	90.66	41.07	2.15	0.63	901.17	901.17	0.00	0.00	899.66	1.00	1.51	OK
8700	Design Flow	480	896.96	899.55		899.99	0.00104	5.31	90.47	41.03	2.14	0.63	901.03	901.04	0.00	0.00	899.55	1.00	1.48	OK
8600	Design Flow	480	896.86	899.44		899.88	0.00105	5.33	90.03	41.00	2.13	0.63	900.87	900.89	0.00	0.00	899.44	1.00	1.43	OK
8500	Design Flow	480	896.76	899.33		899.78	0.00106	5.35	89.74	40.97	2.13	0.64	900.72	900.74	0.00	0.00	899.33	1.00	1.39	OK
8400	Design Flow	480	896.66	899.22		899.67	0.00108	5.37	89.40	40.93	2.12	0.64	900.57	900.60	300.00	0.06	899.28	1.00	1.29	OK
8300	Design Flow	480	896.56	899.11		899.56	0.00110	5.40	88.83	40.87	2.11	0.65	900.41	900.45	300.00	0.06	899.17	1.00	1.24	OK
8200	Design Flow	480	896.46	898.99		899.45	0.00114	5.46	87.84	40.78	2.09	0.66	900.26	900.31	300.00	0.06	899.05	1.00	1.21	OK
8100	Design Flow	480	896.36	898.86		899.34	0.00118	5.54	86.69	40.68	2.07	0.67	900.03	900.08	300.00	0.06	898.92	1.00	1.11	OK
8000	Design Flow	480	896.26	898.73		899.22	0.00124	5.62	85.40	40.55	2.05	0.68	899.97	900.01	0.00	0.00	898.73	1.00	1.24	OK
7900	Design Flow	480	896.16	898.57		899.09	0.00134	5.77	83.26	40.34	2.01	0.71	899.85	899.87	0.00	0.00	898.57	1.00	1.28	OK
7800	Design Flow	480	896.06	898.38		898.95	0.00154	6.05	79.40	39.96	1.94	0.76	899.71	899.71	0.00	0.00	898.38	1.00	1.33	OK
7700	Design Flow	480	895.96	898.18	897.88	898.78	0.00171	6.20	77.37	40.41	1.87	0.79	899.61	899.45	0.00	0.00	898.18	1.00	1.27	OK
7649.1	Design Flow	480	895.91	897.81	897.81	898.64	0.00290	7.33	65.45	39.71	1.61	1.01	899.56	899.58	0.00	0.00	897.81	2.00	1.75	CHECK
7567.6	Design Flow	480	895.87	898.03	897.04	898.20	0.00044	3.32	144.62	66.90	2.03	0.40	900.37	900.37	0.00	0.00	898.03	1.00	2.34	OK
7500		Culvert																		
7375.48	Design Flow	480	895.64	897.74		897.92	0.00048	3.42	140.49	66.89	1.98	0.42	900.15	900.15	0.00	0.00	897.74	1.00	2.41	OK
7357.5	Design Flow	480	895.62	897.59	897.07	897.90	0.00100	4.46	107.69	62.36	1.70	0.60	898.93	898.93	0.00	0.00	897.59	1.00	1.34	OK
7300	Design Flow	480	895.56	897.53	897.01	897.84	0.00100	4.46	107.68	62.35	1.70	0.60	898.66	898.62	0.00	0.00	897.53	1.00	1.09	OK
7200	Design Flow	480	895.46	897.43		897.74	0.00099	4.45	107.77	62.35	1.70	0.60	898.55	898.55	0.00	0.00	897.43	1.00	1.12	OK
7100	Design Flow	480	895.36	897.33		897.64	0.00099	4.45	107.87	62.35	1.71	0.60	898.47	898.47	0.00	0.00	897.33	1.00	1.14	OK
7000	Design Flow	480	895.26	897.24	896.72	897.54	0.00099	4.44	108.01	62.36	1.71	0.60	898.39	898.39	0.00	0.00	897.24	1.00	1.15	OK
6900	Design Flow	480	895.16	897.14	896.61	897.44	0.00099	4.45	107.89	62.37	1.71	0.60	898.30	898.30	300.00	0.06	897.20	1.00	1.10	OK
6800	Design Flow	480	895.06	897.04	896.51	897.34	0.00099	4.44	108.02	62.36	1.71	0.60	898.17	898.17	300.00	0.06	897.10	1.00	1.07	OK
6700	Design Flow	480	894.96	896.94	896.40	897.24	0.00098	4.43	108.29	62.38	1.71	0.59	898.04	898.04	300.00	0.06	897.00	1.00	1.04	OK
6600	Design Flow	480	894.86	896.84		897.15	0.00097	4.43	108.46	62.37	1.71	0.59	897.92	897.92	0.00	0.00	896.84	1.00	1.08	OK
6500	Design Flow	480	894.76	896.75	896.21	897.05	0.00097	4.42	108.58	62.39	1.72	0.59	897.85	897.85	0.00	0.00	896.75	1.00	1.10	OK
6400	Design Flow	480	894.66	896.65		896.95	0.00096	4.41	108.83	62.41	1.72	0.59	897.79	897.79	0.00	0.00	896.65	1.00	1.14	OK
6300	Design Flow	480	894.56	896.55		896.85	0.00095	4.40	109.14	62.43	1.72	0.59	897.72	897.72	0.00	0.00	896.55	1.00	1.17	OK
6200	Design Flow	480	894.46	896.46		896.76	0.00094	4.38	109.51	62.46	1.73	0.58	897.66	897.66	0.00	0.00	896.46	1.00	1.20	OK
6100	Design Flow	480	894.36	896.37		896.66	0.00093	4.37	109.93	62.47	1.74	0.58	897.59	897.59	0.00	0.00	896.37	1.00	1.22	OK
6000	Design Flow	480	894.26	896.27	895.71	896.57	0.00092	4.34	110.48	62.51	1.74	0.58	897.53	897.42	0.00	0.00	896.27	1.00	1.15	OK
5900	Design Flow	480	894.16	896.19	895.61	896.48	0.00090	4.32	111.16	62.55	1.75	0.57	897.46	897.46	0.00	0.00	896.19	1.00	1.27	OK
5800	Design Flow	480	894.06	896.10		896.38	0.00088	4.29	112.01	62.60	1.76	0.56	897.40	897.40	0.00	0.00	896.10	1.00	1.30	OK
5700	Design Flow	480	893.96	896.02		896.30	0.00085	4.25	113.07	62.68	1.78	0.56	897.33	897.33	0.00	0.00	896.02	1.00	1.31	OK
5600	Design Flow	480	893.86	895.93		896.21	0.00082	4.20	114.29	62.76	1.79	0.55	897.26	897.25	0.00	0.00	895.93	1.00	1.32	OK
5498.4	Design Flow	480	893.76	895.89		896.12	0.00066	3.86	124.24	64.45	1.87	0.49	897.20	897.47	0.00	0.00	895.89	1.00	1.31	OK
5479.89	Design Flow	480	893.75	895.91	894.94	896.10	0.00046	3.41	140.60	64.99	2.03	0.41	898.75	898.75	0.00	0.00	895.91	1.00	2.84	OK
5400		Culvert																		
5310.18	Design Flow	480	893.55	895.63		895.83	0.00052	3.53	136.05	65.40	1.96	0.43	897.85	897.85	0.00	0.00	895.63	1.00	2.22	OK
5292.2	Design Flow	480	893.55	895.58		895.81	0.00070	3.85	124.65	68.58	1.78	0.50	898.04	898.26	0.00	0.00	895.58	1.00	2.46	OK
5200	Design Flow	480	893.46	895.41		895.72	0.00104	4.52	106.19	62.25	1.68	0.61	897.80	897.80	0.00	0.00	895.41	1.00	2.39	OK
5100	Design Flow	480	893.36	895.30		895.62	0.00105	4.54	105.80	62.22	1.68	0.61	897.69	897.69	0.00	0.00	895.30	1.00	2.39	OK
5000.37	Design Flow	480	893.25	895.20		895.51	0.00104	4.50	106.66	62.78	1.68	0.61	897.36	897.35	300.00	0.07	895.27	1.00	2.08	OK
4900	Design Flow	480	893.15	895.09		895.41	0.00107	4.56	105.31	62.18	1.67	0.62	897.50	897.39	300.00	0.07	895.16	1.00	2.23	OK

Loop 303 Outfall Channel Profiles and Freeboard Calculation Table

HEC-RAS Plan: Loop303 Final River: Loop 303 Outfall Reach: Combined Profile: Design Flow

River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Total	Flow Area	Top Width	Hydr Radius	Froude # Chl	LOB Elev	ROB Elev	Channel Curve Radius	Super-elevation	W.S. Elev (w/Superelev.)	Freeboard Required	Freeboard Provided	Freeboard Check
		(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	(ft)		(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	
4806.32	Design Flow	480	893.06	894.98		895.31	0.00109	4.59	104.59	62.15	1.66	0.62	897.63	897.43	300.00	0.07	895.05	1.00	2.38	OK
4700	Design Flow	480	892.95	894.86		895.19	0.00111	4.62	103.92	62.09	1.65	0.63	897.77	896.37	0.00	0.00	894.86	1.00	1.51	OK
4600	Design Flow	480	892.85	894.74		895.08	0.00116	4.68	102.50	62.01	1.63	0.64	897.51	896.75	0.00	0.00	894.74	1.00	2.01	OK
4500	Design Flow	480	892.75	894.60		894.96	0.00125	4.79	100.28	61.86	1.60	0.66	897.25	897.24	0.00	0.00	894.60	1.00	2.64	OK
4400	Design Flow	480	892.64	894.44	894.08	894.82	0.00139	4.95	96.95	61.64	1.55	0.70	897.00	897.61	0.00	0.00	894.44	1.00	2.56	OK
4284.99	Design Flow	480	892.49	893.93	893.93	894.57	0.00313	6.38	75.18	60.22	1.24	1.01	898.49	898.33	0.00	0.00	893.93	2.00	4.40	OK
4219.24	Design Flow	480	885.92	890.94	887.36	890.98	0.00004	1.52	316.72	74.54	4.12	0.13	897.06	897.06	0.00	0.00	890.94	1.26	6.12	OK
4196.77	Design Flow	480	885.88	890.94		890.98	0.00003	1.50	319.66	74.70	4.15	0.13	897.06	897.06	0.00	0.00	890.94	1.27	6.12	OK
4165.71	Design Flow	480	885.82	890.93	887.17	890.98	0.00004	1.75	275.07	53.87	4.30	0.14	899.74	899.74	0.00	0.00	890.93	1.29	8.81	OK
4100		Culvert																		
4040.78	Design Flow	480	885.66	890.81		890.86	0.00004	1.73	277.35	53.87	4.33	0.13	899.70	899.70	0.00	0.00	890.81	1.30	8.89	OK
4014.59	Design Flow	480	885.60	890.01		890.78	0.00142	7.03	68.24	24.39	2.58	0.74	897.29	897.35	0.00	0.00	890.01	1.29	7.28	OK
3900	Design Flow	480	885.43	889.85		890.62	0.00142	7.03	68.27	24.40	2.58	0.74	896.99	896.99	200.00	0.09	889.94	1.30	7.05	OK
3800	Design Flow	480	885.28	889.71		890.47	0.00141	7.00	68.56	24.44	2.59	0.74	896.69	895.99	500.00	0.04	889.75	1.30	6.24	OK
3700	Design Flow	480	885.13	889.57		890.33	0.00140	6.99	68.66	24.45	2.59	0.74	896.85	896.41	500.00	0.04	889.61	1.30	6.80	OK
3600	Design Flow	480	884.99	889.43		890.18	0.00139	6.97	68.84	24.49	2.59	0.73	894.23	890.90	0.00	0.00	889.43	1.30	1.47	OK
3500	Design Flow	480	884.84	889.29		890.04	0.00138	6.94	69.14	24.54	2.60	0.73	893.60	892.53	0.00	0.00	889.29	1.30	3.24	OK
3400	Design Flow	480	884.70	889.16		889.90	0.00137	6.93	69.26	24.56	2.60	0.73	893.82	892.12	0.00	0.00	889.16	1.30	2.96	OK
3300	Design Flow	480	884.55	889.03		889.76	0.00135	6.89	69.69	24.63	2.61	0.72	893.98	893.79	0.00	0.00	889.03	1.30	4.76	OK
3200	Design Flow	480	884.40	888.90		889.62	0.00132	6.85	70.11	24.69	2.62	0.72	893.47	892.94	0.00	0.00	888.90	1.31	4.04	OK
3100	Design Flow	480	884.26	888.77		889.49	0.00130	6.80	70.63	24.78	2.63	0.71	892.94	892.98	0.00	0.00	888.77	1.31	4.17	OK
3000	Design Flow	480	884.11	888.65		889.36	0.00126	6.72	71.38	24.91	2.64	0.70	892.79	892.96	0.00	0.00	888.65	1.31	4.14	OK
2900	Design Flow	480	883.96	888.54		889.23	0.00122	6.64	72.25	25.04	2.66	0.69	892.59	892.16	0.00	0.00	888.54	1.32	3.62	OK
2800	Design Flow	480	883.82	888.43		889.10	0.00118	6.56	73.19	25.18	2.68	0.68	892.38	892.22	0.00	0.00	888.43	1.32	3.79	OK
2700	Design Flow	480	883.67	888.33		888.98	0.00113	6.46	74.32	25.37	2.70	0.67	892.18	891.73	0.00	0.00	888.33	1.33	3.40	OK
2600	Design Flow	480	883.52	888.24		888.86	0.00107	6.33	75.78	25.60	2.73	0.65	891.12	890.60	500.00	0.03	888.27	1.34	2.33	OK
2504.53	Design Flow	480	883.38	888.16		888.76	0.00102	6.22	77.21	25.82	2.75	0.63	890.87	890.42	0.00	0.00	888.16	1.35	2.26	OK
2400	Design Flow	480	883.23	888.07		888.64	0.00096	6.09	78.85	26.07	2.78	0.62	890.70	890.19	0.00	0.00	888.07	1.35	2.12	OK
2300	Design Flow	480	883.08	887.99		888.54	0.00090	5.94	80.80	26.36	2.82	0.60	890.53	890.50	500.00	0.03	888.02	1.36	2.48	OK
2200	Design Flow	480	882.94	887.93		888.45	0.00085	5.80	82.76	26.68	2.85	0.58	890.35	890.04	0.00	0.00	887.93	1.38	2.11	OK
2100	Design Flow	480	882.79	887.86		888.36	0.00079	5.64	85.06	27.01	2.90	0.56	890.17	890.24	200.00	0.07	887.93	1.39	2.24	OK
2000	Design Flow	480	882.64	887.81		888.27	0.00073	5.48	87.60	27.38	2.94	0.54	890.00	890.25	200.00	0.06	887.87	1.41	2.13	OK
1900	Design Flow	480	882.50	887.76		888.20	0.00067	5.33	90.14	27.75	2.98	0.52	889.50	890.09	0.00	0.00	887.76	1.43	1.74	OK
1800	Design Flow	480	882.35	887.71		888.12	0.00062	5.17	92.92	28.14	3.03	0.50	889.31	889.61	0.00	0.00	887.71	1.44	1.60	OK
1700	Design Flow	480	882.21	887.67		888.06	0.00057	5.00	95.91	28.58	3.08	0.48	889.67	889.85	0.00	0.00	887.67	1.46	2.00	OK
1600	Design Flow	480	882.06	887.63		888.00	0.00052	4.85	99.07	29.02	3.13	0.46	890.04	890.40	0.00	0.00	887.63	1.48	2.41	OK
1500	Design Flow	480	881.91	887.60		887.94	0.00048	4.69	102.38	29.46	3.19	0.44	890.41	890.12	0.00	0.00	887.60	1.51	2.52	OK
1400	Design Flow	480	881.77	887.57		887.89	0.00044	4.54	105.72	29.92	3.24	0.43	890.76	890.78	300.00	0.03	887.60	1.53	3.16	OK
1300	Design Flow	480	881.62	887.54		887.84	0.00040	4.39	109.44	30.41	3.30	0.41	890.39	890.38	300.00	0.03	887.57	1.55	2.81	OK
1200	Design Flow	480	881.47	887.51		887.79	0.00037	4.24	113.17	30.89	3.36	0.39	890.02	890.19	300.00	0.03	887.54	1.58	2.48	OK
1100	Design Flow	480	881.33	887.49		887.75	0.00033	4.10	116.93	31.37	3.41	0.37	889.65	889.80	300.00	0.03	887.52	1.61	2.13	OK
1000.02	Design Flow	480	881.18	887.47		887.72	0.00031	3.97	121.04	31.90	3.47	0.36	889.28	889.28	0.00	0.00	887.47	1.63	1.81	OK
900	Design Flow	480	881.03	887.45		887.68	0.00028	3.84	125.04	32.39	3.53	0.34	888.23	888.24	0.00	0.00	887.45	1.66	0.78	CHECK
796.1	Design Flow	480	881.00	887.61	881.91	887.61	0.00000	0.51	903.19	154.29	5.53	0.04	881.00	885.00	0.00	0.00	887.61	1.65	-6.61	CHECK

Flood Control District
of Maricopa County

INTEROFFICE MEMORANDUM

Date: January 20, 2012
From: Michael Duncan, P.E., CFM, Project Manager
Project: Loop 303 Outfall Drainage System
File: FCD2010 C002

Subject: WAIVER OF DESIGN CRITERIA AT SPECIFIC LOCATIONS

Criteria Reference: FCDMC Drainage Design Manual, Volume II Hydraulics, 1996
Section 6.3.3.2 and Equation 6.10

PARAMETER	LOCATION	CRITERIA VALUE	ACTUAL VALUE	DEFICIT AMOUNT	RELATED PARAMETERS	FOOTNOTES
Channel freeboard	Sta. 827.09	1.72 ft	-0.61 ft	2.33 ft	6.66 ft flow depth	(1)
Channel freeboard	Sta. 901.96	1.69 ft	0.66 ft	1.03 ft	6.56 ft flow depth	
Channel freeboard	Sta. 911.55	1.69 ft	0.84 ft	0.85 ft	6.55 ft flow depth	
Channel freeboard	Sta. 990.12	1.67 ft	1.65	0.02 ft	6.46 ft flow depth	
Channel freeboard	Sta. 12790	2 ft	1.33 ft	0.67 ft	Froude No. = 1.01	(2)
Channel freeboard	Sta. 12792.47	2 ft	1.33 ft	0.67 ft	Froude No. = 1.01	

Footnote (1)
These four cross-sections are the last four of the RAS model, at the Gila River bank. The related plan sheet is attached with the cross-section locations highlighted in yellow. The RAS model assumes that a 100-year project channel flow coincides with a 10-year flow of the Gila River. This situation would be rare. Most project channel flows would occur with little or no flow in the Gila River. In which case, the channel geometry and flow would meet the freeboard criteria at these four cross-sections, just as it does just upstream of these four cross-sections in the model, where the effects of the artificially high Gila River boundary condition have no effect on the model's computed water surfaces.

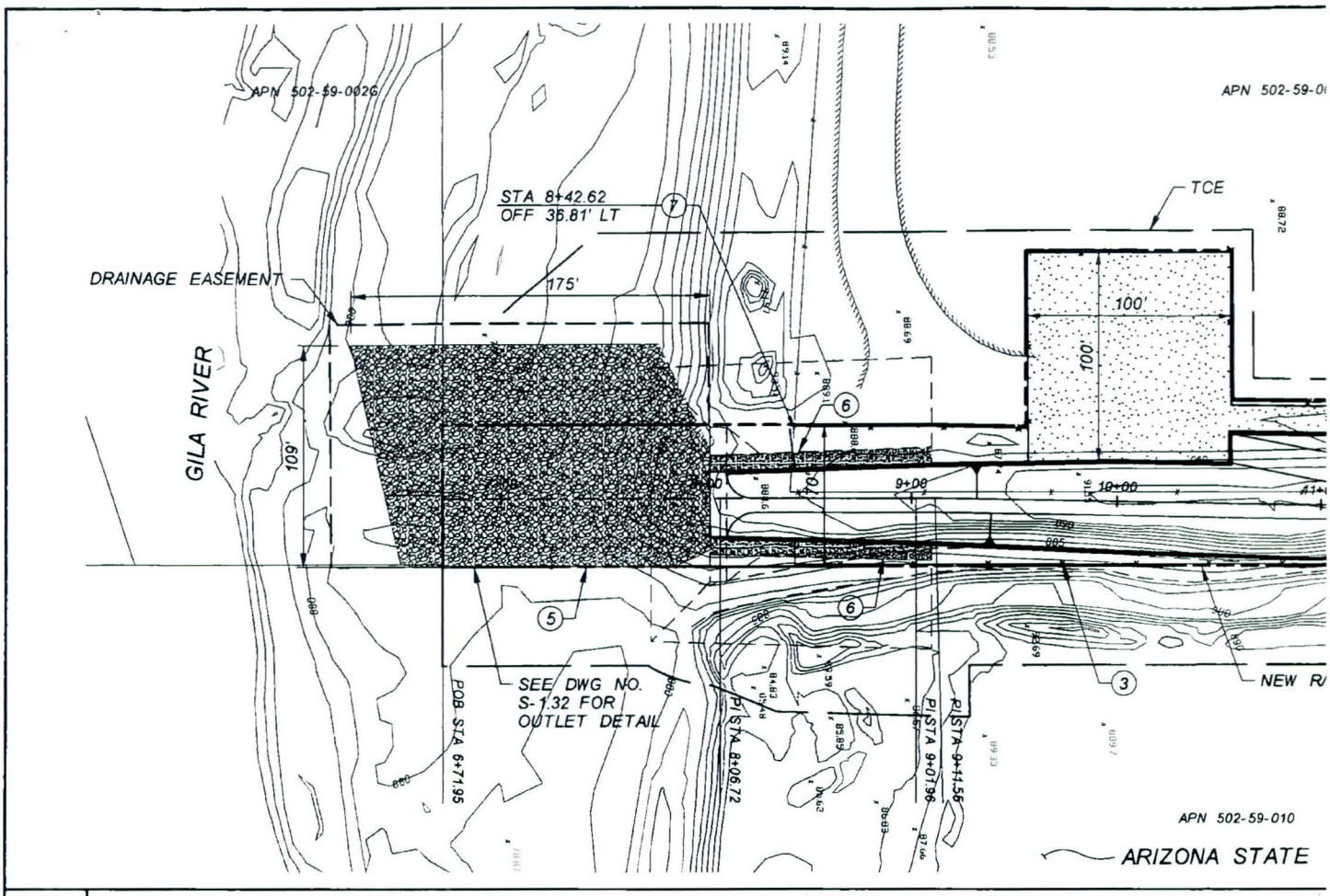
Thus, the major factor for the related model water surface elevations of these four cross-sections is the boundary condition of a 10-year water surface for the Gila River. Widening the channel would not change the freeboard situation. Deepening the channel would not change the freeboard situation. To meet the freeboard criteria, would require levee-type berms at the top of each channel bank, which would block stormwater flows from entering the channel. This would not be compatible with the project goals of this flood control channel, which collects and conveys stormwater flows.

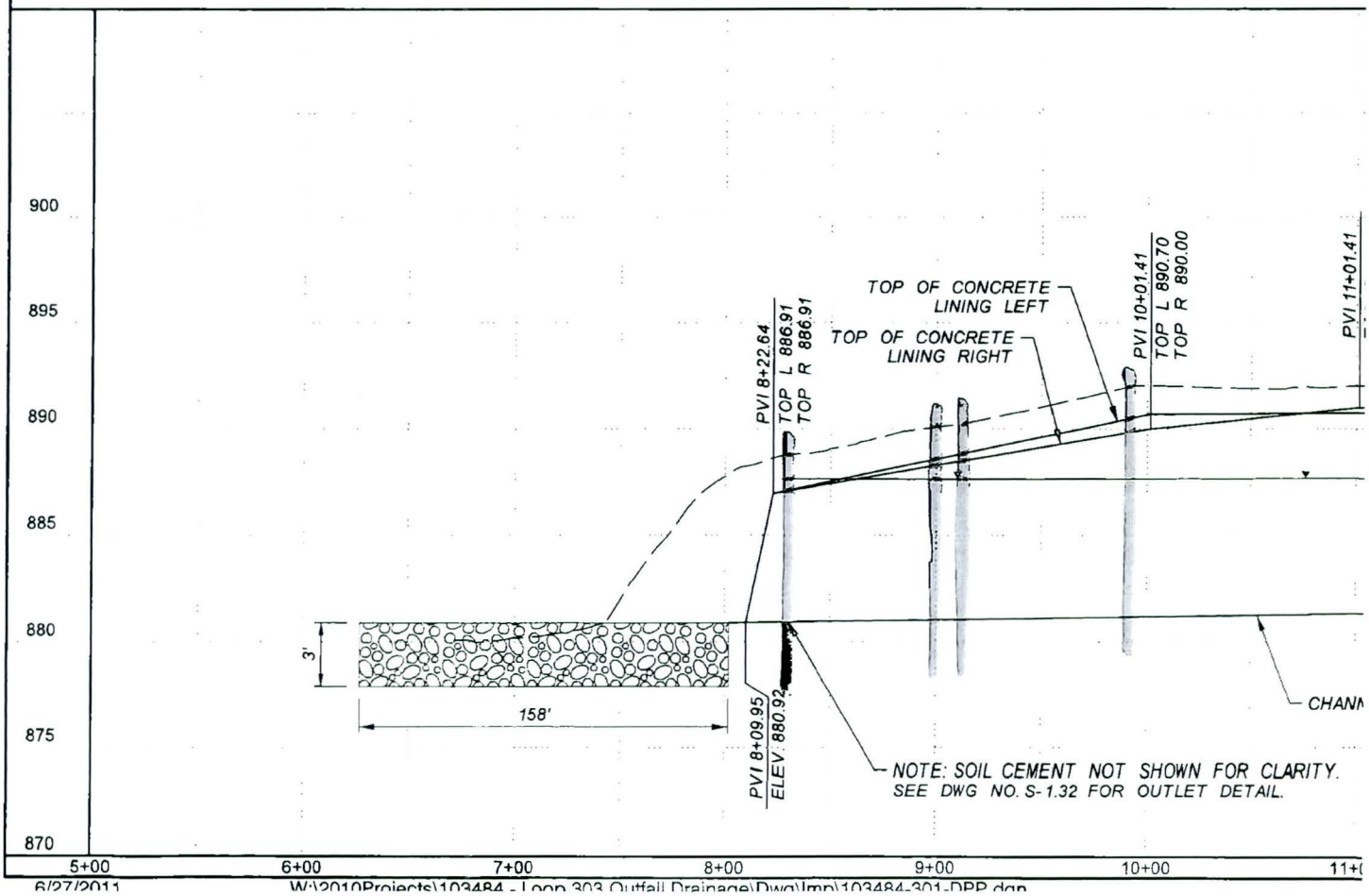
Footnote (2)
These two cross-sections, just 2.47 ft. apart, are located at the top break point of a drop structure (2 ft. high by 20 ft. long). The related plan sheet is attached with the cross-section locations highlighted in yellow. The flow is passing through critical depth, as it transitions from subcritical to supercritical flow regimes. The channel geometry at this location is constrained vertically by an adjacent sanitary sewer that changes from a force-main pressure flow to a gravity flow condition. One mitigating factor is that immediately downstream (at the toe of the drop structure) the provided freeboard is 4.1 ft. (versus a criteria of 2 ft.).

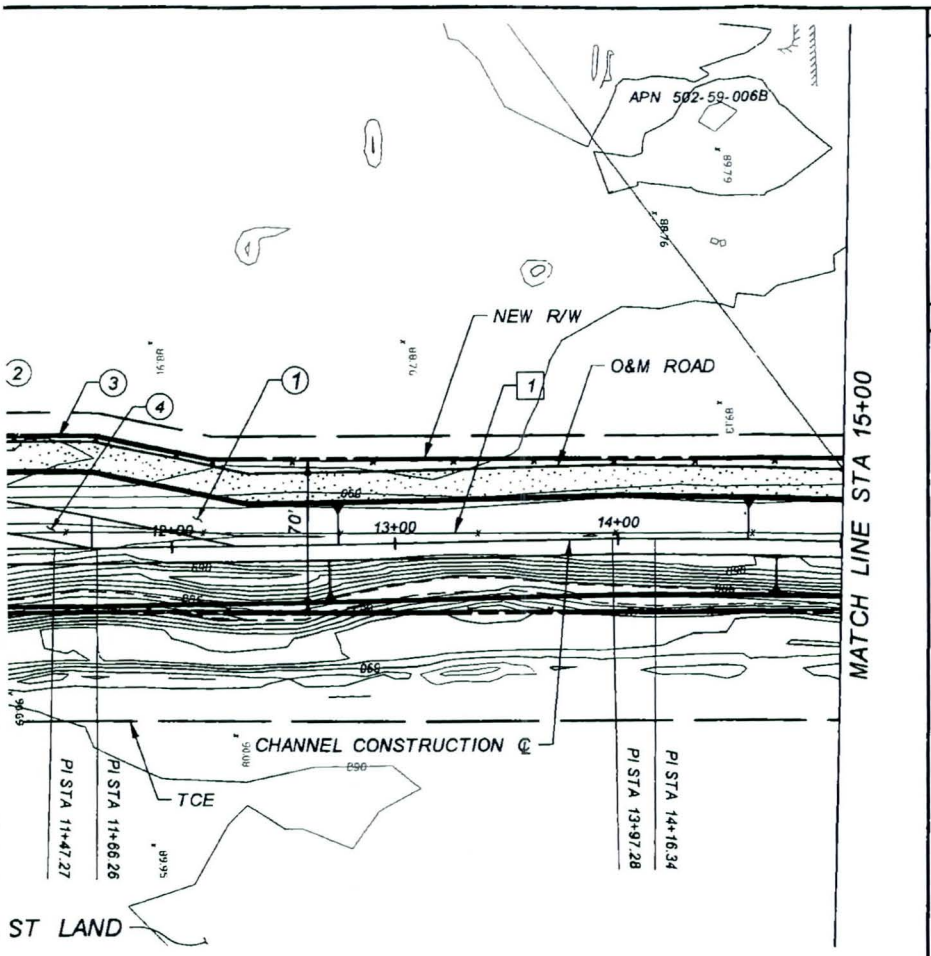
To expand on the freeboard criteria, the design manual states that the minimum freeboard for supercritical flow (Froude No. > 1) is 2 feet, and that for subcritical flow (Froude No. < 1) the minimum is 1 ft. The design manual does not specifically have a criteria for critical flow (Froude No. = 1). At these two cross-sections, the Froude numbers are 1.01 and 1.01. One could argue that these locations have critical flow (very close to 1) and that a reasonable criteria might be 1.5 ft. Then comparing the provided freeboards of 1.33 and 1.33 ft. would indicate that the freeboard deficits are only 0.17 ft., or 2.0 inches, which is quite small.

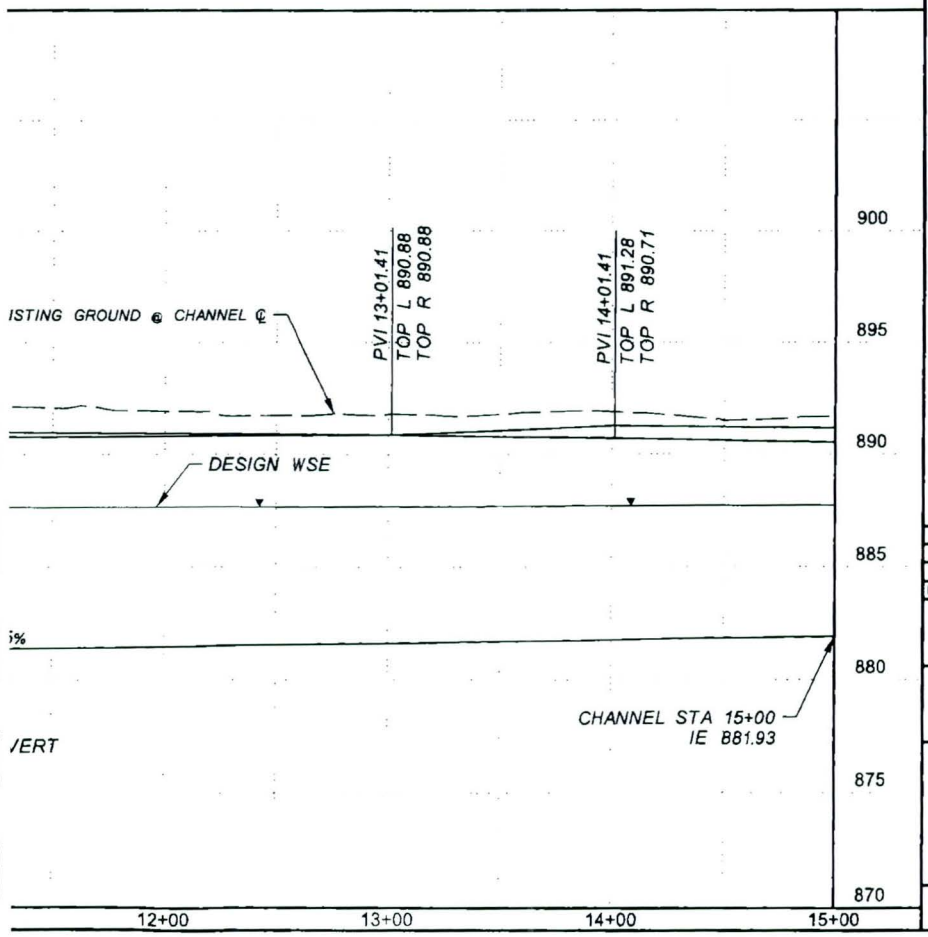
Waiver of Criteria Concurrence:

Michael Duncan 1-20-12	Michael Duncan, P.E., CFM, Project Manager
Shimin Li	Dr. Shimin Li, PhD, P.E., Reviewer
Bing Zhao	Dr. Bing Zhao, PhD, P.E., Branch Manager
Jeff Riddle	JEFF RIDDLE, CIVIL STRUCTURES BRANCH MGR.
Amir M.	Amir M. (We should Note in Report) AMIR MOTAMEDI, HYDROLOGY/HYDRAULICS BRANCH MGR.
Edward Raleigh 1/27/12	Edward Raleigh, P.E., Engineering Division Manager
C. Scott Vogel 2/1/12	C. Scott Vogel, P.E., Project Management Branch Manager
Don Rerick 2/2/12	Don Rerick, P.E., PPM Division Manager


APN 502-59-002G
APN 502-59-0
STA 8+42.62
OFF 35.81' LT
TCE
DRAINAGE EASEMENT
175'
100'
100'
GILA RIVER
109'
9+00
10+00
SEE DWG NO.
S-1.32 FOR
OUTLET DETAIL
POB STA 6+71.95
PI STA 8+06.72
PI STA 9+01.96
PI STA 9+11.56
NEW R
APN 502-59-010
ARIZONA STATE


900
895
890
885
880
875
870
TOP OF CONCRETE
LINING LEFT
TOP OF CONCRETE
LINING RIGHT
PVI 8+22.64
TOP L 886.91
TOP R 886.91
PVI 10+01.41
TOP L 890.70
TOP R 890.00
PVI 11+01.41
3'
158'
PVI 8+09.95
ELEV. 880.92
CHANN
NOTE: SOIL CEMENT NOT SHOWN FOR CLARITY.
SEE DWG NO. S-1.32 FOR OUTLET DETAIL.
5+00
6+00
7+00
8+00
9+00
10+00
11+0





REMOVE

1	REMOVE EXISTING FENCE	700 LF

CONSTRUCT

1	CONSTRUCT CONCRETE CHANNEL PER TYPICAL SECTION 1W, SEE DWG NO. G-1.09	3550 SY
2	CONSTRUCT MAINTENANCE ROAD PER STRUCTURAL SECTION DETAIL D2, SEE DWG NO. G-2.01	1115 SY
3	INSTALL NEW CHAIN LINK FENCE PER DETAIL D3, SEE DWG NO. G-2.01	1403 LF
4	CONSTRUCT ACCESS RAMP PER DETAIL D6, SEE DWG NO. G-2.02	1 EA
5	CONSTRUCT RIPRAP PROTECTION WITH FILTER FABRIC PER DETAIL D4, SEE DWG NO. G-2.06. D_{50}=18", DEPTH=3'	1889 CY
6	CONSTRUCT SOIL CEMENT OUTLET PROTECTION PER DWG S-1.32	2100 CY
7	MOVE EXISTING 20' WIDE GATE	1 EA

N

20 0 20 40
Scale: Horiz: 1"=40'
Vert: 1"=4'

TWO WORKING DAYS BEFORE YOU DIG, CALL
602-263-1100
BLUE STAKE

NO.	REVISION	BY	DATE
3			
2			
1			

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
ENGINEERING DIVISION

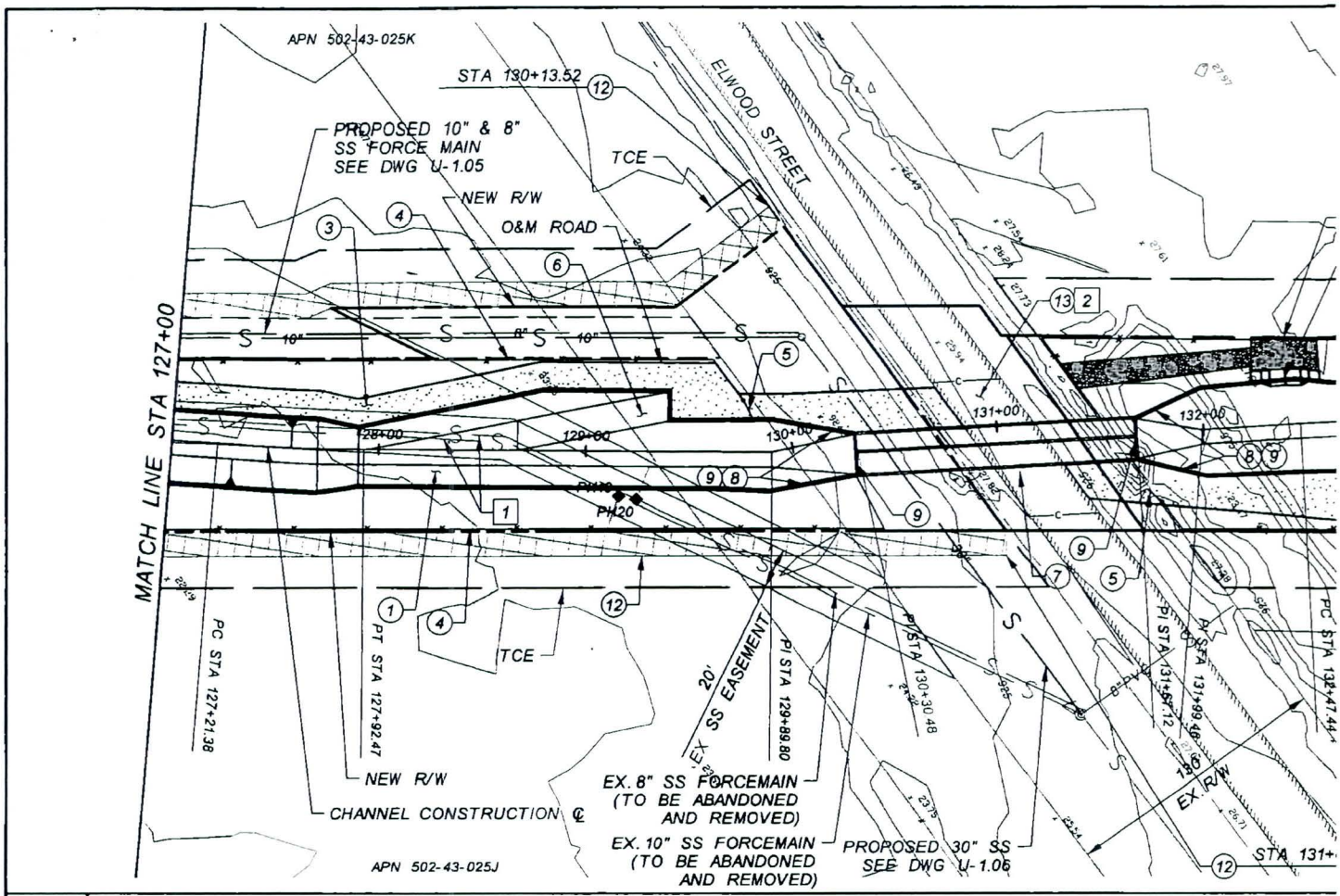
LOOP 303 OUTFALL DRAINAGE SYSTEM
FCD NO. 2011C015

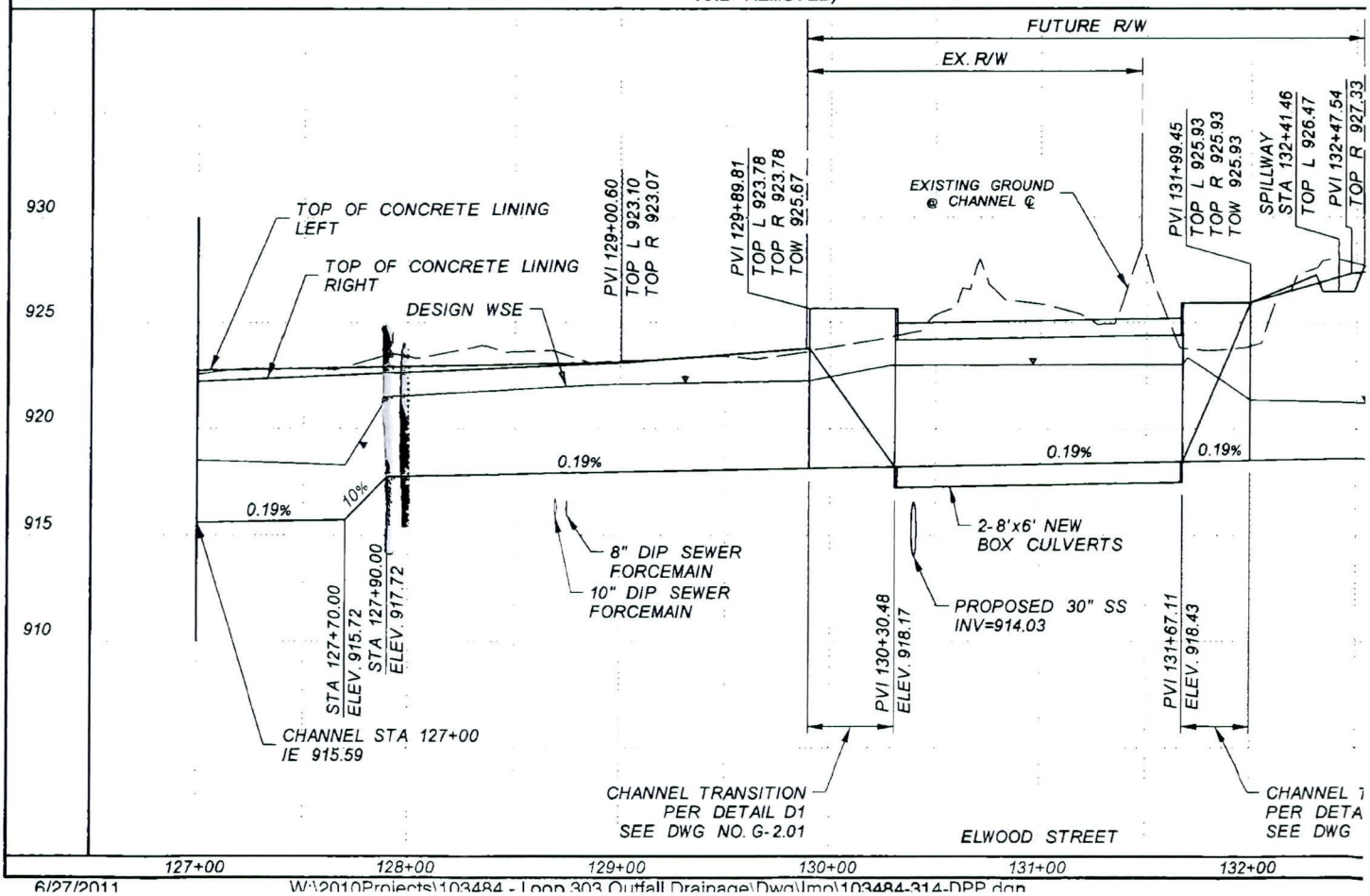
90%
PRELIMINARY NOT FOR CONSTRUCTION

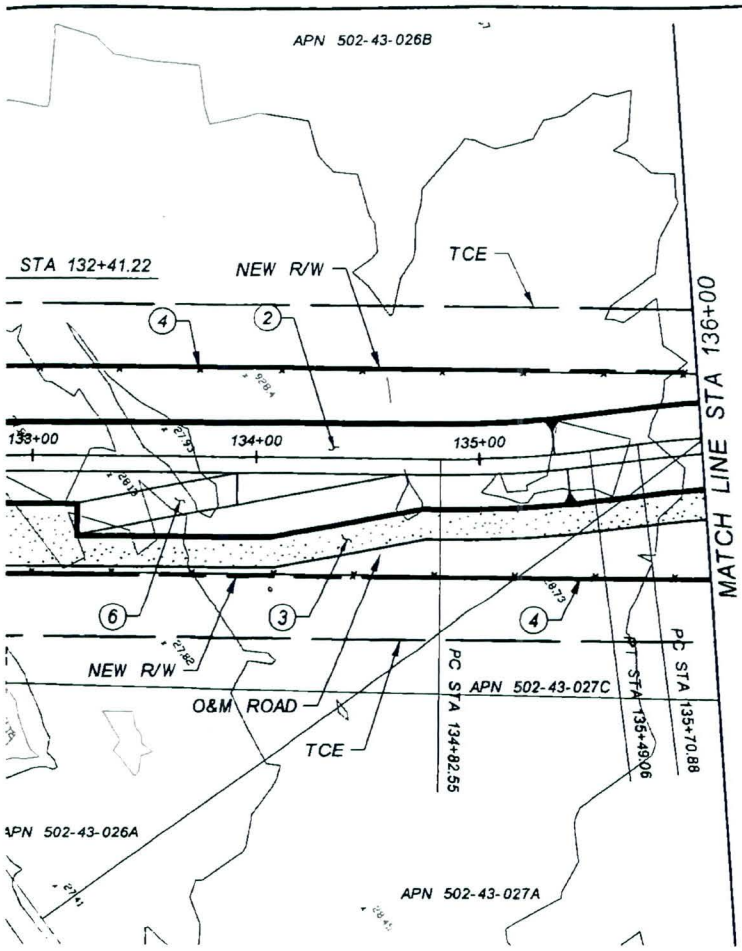
	BY	DATE
DESIGNED	S. SCINTO	6/2011
DRAWN	D. BURMEISTER	6/2011
CHECKED	J. MINCH	6/2011

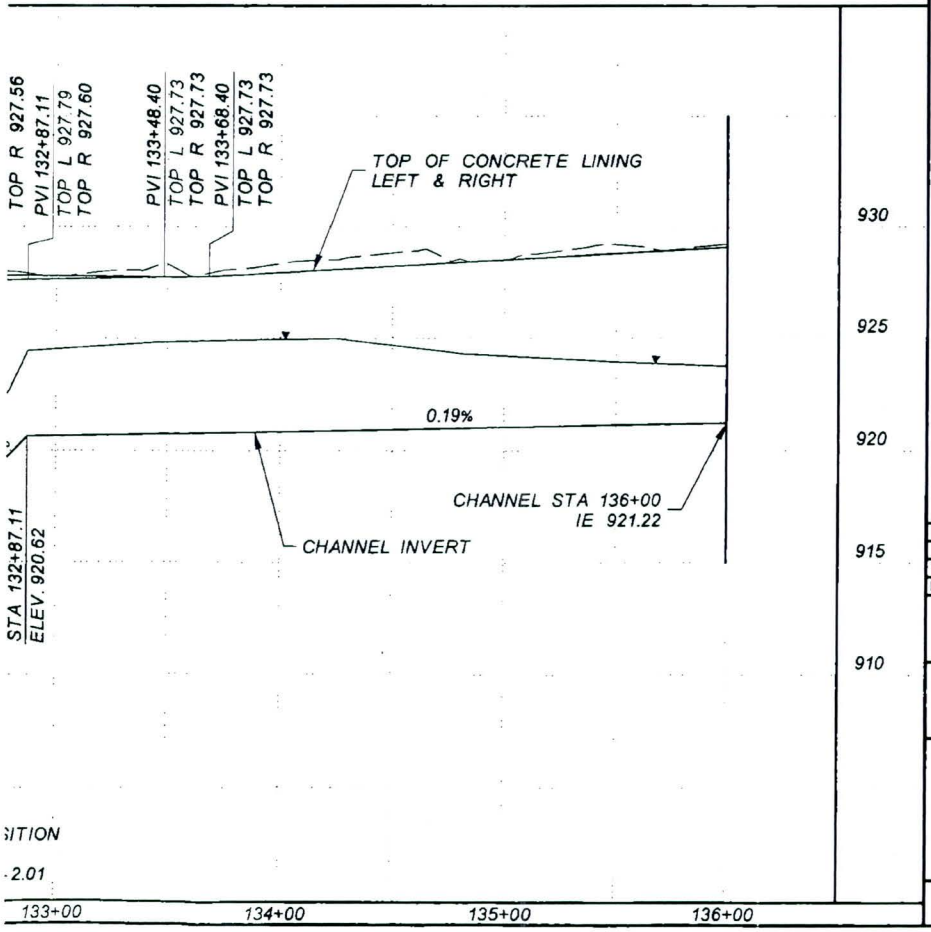
WOOD/PATEL
MISSION: CLIENT SERVICE™
PHOENIX · MESA · TUCSON
2051 W Northern Ave
Phoenix, AZ 85021
(602) 335-8500

DRAWING NO.		SHEET OF
D-1.01	CHANNEL PLAN & PROFILE	24 180


APN 502-43-025K
STA 130+13.52
ELWOOD STREET
PROPOSED 10" & 8" SS FORCE MAIN SEE DWG U-1.05
TCE
NEW R/W
O&M ROAD
MATCH LINE STA 127+00
128+00
129+00
130+00
131+00
132+00
PH19
PH20
PC STA 127+21.38
PT STA 127+92.47
TCE
20' EX SS EASEMENT
PI STA 129+89.80
PI STA 130+30.48
PI STA 131+99.45
PC STA 132+47.44
NEW R/W
CHANNEL CONSTRUCTION ℄
EX. 8" SS FORCEMAIN (TO BE ABANDONED AND REMOVED)
EX. 10" SS FORCEMAIN (TO BE ABANDONED AND REMOVED)
PROPOSED 30" SS SEE DWG U-1.06
EX. R/W
APN 502-43-025J


FUTURE R/W
EX. R/W
930
925
920
915
910
TOP OF CONCRETE LINING LEFT
TOP OF CONCRETE LINING RIGHT
DESIGN WSE
PVI 129+00.60
TOP L 923.10
TOP R 923.07
PVI 129+89.81
TOP L 923.78
TOP R 923.78
TOW 925.67
EXISTING GROUND @ CHANNEL ℄
PVI 131+99.45
TOP L 925.93
TOP R 925.93
TOW 925.93
SPILLWAY
STA 132+41.46
TOP L 926.47
PVI 132+47.54
TOP R 927.33
0.19%
10%
0.19%
0.19%
0.19%
STA 127+70.00
ELEV. 915.72
STA 127+90.00
ELEV. 917.72
8" DIP SEWER FORCEMAIN
10" DIP SEWER FORCEMAIN
2-8'x6' NEW BOX CULVERTS
PROPOSED 30" SS INV=914.03
PVI 130+30.48
ELEV. 918.17
PVI 131+67.11
ELEV. 918.43
CHANNEL STA 127+00 IE 915.59
CHANNEL TRANSITION PER DETAIL D1 SEE DWG NO. G-2.01
ELWOOD STREET
127+00
128+00
129+00
130+00
131+00
132+00





REMOVE

1	REMOVE EXISTING FORCE MAIN	NPI
2	REMOVE AND REPLACE AC PAVEMENT	126 SY

CONSTRUCT

1	CONSTRUCT CONCRETE CHANNEL PER TYPICAL SECTION 1W, SEE DWG NO. G-1.09	1300 SY
2	CONSTRUCT CONCRETE CHANNEL PER TYPICAL SECTION 1E, SEE DWG NO. G-1.09	2000 SY
3	CONSTRUCT MAINTENANCE ROAD PER STRUCTURAL SECTION DETAIL D2, SEE DWG NO. G-2.01	912 SY
4	INSTALL NEW CHAIN LINK FENCE PER DETAIL D3, SEE DWG NO. G-2.01	1390 LF
5	INSTALL 14' WIDE SINGLE SWING GATE PER ADOT STD DETAIL C-12.20	2 EA
6	CONSTRUCT ACCESS RAMP PER DETAIL D6, SEE DWG NO. G-2.02	305 SY
7	CONSTRUCT 2 BARREL 8'x6' CONCRETE BOX CULVERT PER ADOT DWG B-2.30	137 LF
8	CONSTRUCT RETAINING WALL PER ADOT STD DET. B-18.10, CASE1. SEE DWG NO. S-1.11	145 SY
9	CONSTRUCT HANDRAIL PER MAG DETAIL 145, TYPE 4, AS SHOWN ON DETAIL D7	354 LF
10	INSTALL CONCRETE SPILLWAY PER DETAIL D21, SEE DWG NO. G-2.06	1 EA
11	CONSTRUCT RIPRAP PROTECTION WITH FILTER FABRIC PER DETAIL D4, SEE DWG NO. G-2.01. D_{50}=12", DEPTH=2'	107 CY
12	GRADE FARM ACCESS ROAD	NPI
13	REPLACE EXISTING STRIPING	NPI
◆	INDICATES POTHOLE ELEVATION AND LOCATION	

N

20 0 20 40

Scale: Horiz: 1"=40'
Vert: 1"=4'

TWO WORKING DAYS BEFORE YOU DIG, CALL
602-263-1100
BLUE STAKE

NO.	REVISION	BY	DATE
3			
2			
1			

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
ENGINEERING DIVISION

LOOP 303 OUTFALL DRAINAGE SYSTEM
FCD NO. 2011C015

90%
PRELIMINARY NOT FOR CONSTRUCTION

	BY	DATE
DESIGNED	S. SCINTO	6/2011
DRAWN	D. BURMEISTER	6/2011
CHECKED	J. MINCH	6/2011

WOOD/PATEL
MISSION: CLIENT SERVICE™
PHOENIX • MESA • TUCSON
2051 W. Northern Ave
Phoenix, AZ 85021
(602) 335-8500

DRAWING NO.		SHEET OF
D-1.14	CHANNEL PLAN & PROFILE	37 180

APPENDIX B2

HEC-RAS Modeling Results for the 100-Year Flow

HEC-RAS Plan: Loop 303 Final River: Loop 303 Outfall Reach: Combined Profile: Design Flow

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Hydr Radius	Froude # Chl	LOB Elev	ROB Elev
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	(ft)		(ft)	(ft)
Combined	27500	Design Flow	480.00	987.52	991.71	991.18	992.52	0.001529	7.19	66.76	24.45	2.53	0.77	996.02	996.02
Combined	27400	Design Flow	480.00	987.40	991.47	991.06	992.35	0.001726	7.52	63.85	23.97	2.47	0.81	995.90	995.90
Combined	27355.80	Design Flow	480.00	987.35	991.01	991.01	992.22	0.002681	8.84	54.32	22.33	2.26	1.00	995.85	995.85
Combined	27325.80	Design Flow	480.00	984.35	986.58	988.01	991.67	0.019371	18.10	26.52	16.62	1.50	2.52	992.85	992.85
Combined	27300	Design Flow	480.00	984.32	986.69	987.98	991.00	0.015352	16.65	28.83	17.16	1.58	2.26	992.82	992.82
Combined	27200	Design Flow	480.00	984.20	987.15	987.86	989.45	0.006424	12.16	39.49	19.49	1.89	1.50	992.70	992.70
Combined	27100	Design Flow	480.00	984.08	988.32	987.74	989.09	0.001465	7.08	67.82	24.63	2.55	0.75	992.58	992.58
Combined	27000	Design Flow	480.00	983.97	988.08		988.94	0.001655	7.40	64.84	24.14	2.49	0.80	992.47	992.47
Combined	26939.42	Design Flow	480.00	983.89	987.94	987.55	988.83	0.001770	7.59	63.26	23.87	2.46	0.82	992.39	992.39
Combined	26899.42	Design Flow	480.00	983.84	987.50	987.50	988.71	0.002692	8.85	54.23	22.31	2.26	1.00	992.84	992.86
Combined	26879.42	Design Flow	480.00	981.84	984.26	985.50	988.32	0.014127	16.16	29.70	17.36	1.61	2.18	990.84	990.86
Combined	26850.00	Design Flow	480.00	981.74	986.28	984.65	986.58	0.000435	4.34	110.54	32.75	3.05	0.42	990.61	990.61
Combined	26830.63	Design Flow	480.00	981.66	985.80	984.57	986.52	0.001201	6.80	70.55	17.09	2.79	0.59	990.66	990.66
Combined	26725		Culvert												
Combined	26630.12	Design Flow	480.00	981.00	986.51		986.65	0.000151	3.06	156.83	28.51	3.99	0.23	990.00	990.00
Combined	26600.00	Design Flow	480.00	980.95	985.60		986.56	0.001764	7.86	61.05	17.95	2.60	0.75	989.95	989.95
Combined	26564.36	Design Flow	480.00	980.90	985.53		986.50	0.001800	7.92	60.62	17.90	2.59	0.76	989.90	989.90
Combined	26500.00	Design Flow	480.00	980.81	985.37		986.38	0.001913	8.09	59.36	17.76	2.55	0.78	989.81	989.81
Combined	26420.00	Design Flow	480.00	980.70	985.07	984.66	986.21	0.002250	8.55	56.14	17.39	2.45	0.84	989.70	989.70
Combined	26397.06	Design Flow	480.00	980.67	984.63	984.63	986.11	0.003146	9.77	49.12	16.56	2.33	1.00	989.67	989.67
Combined	26342.41	Design Flow	480.00	980.59	983.82	984.37	985.84	0.005275	11.39	42.13	19.65	1.99	1.37	989.59	989.59
Combined	26300.00	Design Flow	480.00	980.53	984.85	984.31	985.67	0.001570	7.29	65.83	23.99	2.53	0.78	989.53	989.53
Combined	26200.00	Design Flow	480.00	980.39	984.66		985.51	0.001649	7.43	64.64	23.79	2.51	0.79	989.39	989.39
Combined	26100.00	Design Flow	480.00	980.25	984.41		985.34	0.001833	7.72	62.16	23.37	2.46	0.83	989.25	989.25
Combined	26051.93	Design Flow	480.00	980.19	984.17	983.97	985.24	0.002218	8.28	57.94	22.64	2.37	0.91	989.19	989.19
Combined	26032.00	Design Flow	480.00	980.16	984.58		985.03	0.000686	5.36	89.54	26.11	2.97	0.51	989.16	989.16
Combined	26006.79	Design Flow	480.00	980.11	984.26	983.01	984.97	0.001195	6.79	70.67	17.08	2.79	0.59	990.69	990.69
Combined	25965		Culvert												
Combined	25916.79	Design Flow	480.00	980.00	984.70		985.26	0.000833	5.99	80.15	17.10	3.03	0.49	989.68	989.68
Combined	25900.00	Design Flow	480.00	979.97	984.84		985.19	0.000475	4.74	101.23	26.13	3.26	0.42	989.47	989.47
Combined	25871.73	Design Flow	480.00	979.94	984.34		985.12	0.001444	7.07	67.90	24.33	2.57	0.75	989.44	989.44
Combined	25800.00	Design Flow	480.00	979.83	984.24		985.01	0.001434	7.05	68.07	24.36	2.58	0.74	989.33	989.33
Combined	25700.00	Design Flow	480.00	979.69	984.09		984.87	0.001444	7.07	67.90	24.33	2.57	0.75	989.19	989.19
Combined	25600.00	Design Flow	480.00	979.55	983.94		984.73	0.001458	7.09	67.66	24.29	2.57	0.75	988.43	988.74
Combined	25500.00	Design Flow	480.00	979.41	983.79		984.58	0.001475	7.13	67.35	24.24	2.56	0.75	987.91	987.98
Combined	25400.00	Design Flow	480.00	979.27	983.64		984.43	0.001498	7.17	66.98	24.18	2.56	0.76	987.52	987.21
Combined	25300.00	Design Flow	480.00	979.13	983.47		984.28	0.001530	7.22	66.46	24.09	2.54	0.77	986.63	986.63
Combined	25200.00	Design Flow	480.00	978.99	983.30		984.13	0.001578	7.31	65.70	23.97	2.53	0.78	986.24	986.24
Combined	25100.00	Design Flow	480.00	978.85	983.09	982.64	983.96	0.001698	7.51	63.94	23.67	2.49	0.80	985.85	985.85
Combined	25040	Design Flow	480.00	978.77	982.55	982.55	983.80	0.002739	8.95	53.60	21.86	2.27	1.01	985.27	985.77
Combined	25020	Design Flow	480.00	976.77	979.31	980.55	983.41	0.013952	16.25	29.54	16.89	1.64	2.16	983.27	983.77
Combined	25000.00	Design Flow	480.00	976.74	979.39	980.53	983.02	0.011818	15.30	31.38	17.32	1.69	2.00	983.24	983.74
Combined	24900.00	Design Flow	480.00	976.60	980.93	980.39	981.75	0.001546	7.25	66.20	24.05	2.54	0.77	982.85	982.94
Combined	24800.00	Design Flow	480.00	976.46	980.76		981.59	0.001605	7.35	65.30	23.90	2.52	0.78	982.71	982.46
Combined	24700.00	Design Flow	480.00	976.33	980.49	980.11	981.42	0.001829	7.72	62.21	23.38	2.46	0.83	982.58	982.33
Combined	24660.00	Design Flow	480.00	976.27	980.06	980.06	981.30	0.002737	8.95	53.62	21.86	2.27	1.01	982.52	982.27
Combined	24640.00	Design Flow	480.00	974.27	976.81	978.05	980.91	0.013951	16.25	29.55	16.89	1.64	2.16	981.27	981.02
Combined	24600.00	Design Flow	480.00	974.20	976.96	977.98	980.18	0.009990	14.39	33.36	17.77	1.75	1.85	981.20	980.95

HEC-RAS Plan: Loop 303 Final River: Loop 303 Outfall Reach: Combined Profile: Design Flow (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Hydr Radius	Froude # Chl	LOB Elev	ROB Elev
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	(ft)		(ft)	(ft)
Combined	24500.00	Design Flow	480.00	974.01	978.19	977.80	979.11	0.001796	7.66	62.63	23.44	2.47	0.83	980.39	980.35
Combined	24400.00	Design Flow	480.00	973.83	977.62	977.61	978.86	0.002716	8.93	53.77	21.89	2.27	1.00	980.08	980.08
Combined	24390	Design Flow	480.00	973.81	977.59	977.59	978.84	0.002738	8.95	53.61	21.86	2.27	1.01	980.06	980.06
Combined	24370	Design Flow	480.00	971.81	974.35	975.59	978.45	0.013951	16.25	29.55	16.89	1.64	2.16	978.06	978.06
Combined	24300.00	Design Flow	480.00	971.68	976.50	975.47	977.08	0.000979	6.12	78.40	26.00	2.78	0.62	977.93	977.93
Combined	24182.16	Design Flow	480.00	971.45	976.43		976.96	0.000848	5.80	82.72	26.66	2.85	0.58	977.70	977.70
Combined	24152.31	Design Flow	480.00	971.39	976.58		976.87	0.000374	4.38	109.58	26.15	3.46	0.38	979.70	979.70
Combined	24126.95	Design Flow	480.00	971.34	976.35	974.24	976.84	0.000690	5.61	85.51	17.12	3.17	0.44	979.70	979.70
Combined	24074		Culvert												
Combined	24020.95	Design Flow	480.00	971.15	975.69		976.28	0.000915	6.20	77.47	17.15	2.97	0.51	977.15	977.15
Combined	23987.00	Design Flow	480.00	971.08	975.80		976.20	0.000594	5.06	94.83	27.25	3.04	0.48	977.08	977.08
Combined	23965.73	Design Flow	480.00	971.04	975.19		976.12	0.001860	7.76	61.83	23.32	2.45	0.84	977.04	977.04
Combined	23900.00	Design Flow	480.00	970.91	975.07		976.00	0.001843	7.74	62.04	23.35	2.45	0.84	976.91	976.91
Combined	23800.00	Design Flow	480.00	970.72	974.88	974.51	975.81	0.001836	7.73	62.13	23.37	2.46	0.83	976.72	976.72
Combined	23720.00	Design Flow	480.00	970.57	974.35	974.35	975.60	0.002738	8.95	53.61	21.86	2.27	1.01	976.57	976.57
Combined	23700.00	Design Flow	480.00	968.57	971.11	972.36	975.21	0.013950	16.25	29.55	16.89	1.64	2.16	974.82	974.82
Combined	23600.00	Design Flow	480.00	968.38	971.47	972.16	973.77	0.006297	12.16	39.48	19.10	1.92	1.49	974.63	974.63
Combined	23500.00	Design Flow	480.00	968.19	972.33	971.98	973.27	0.001870	7.78	61.70	23.29	2.45	0.84	974.44	974.19
Combined	23400.00	Design Flow	480.00	967.99	972.16		973.08	0.001829	7.72	62.21	23.38	2.46	0.83	974.24	973.99
Combined	23300.00	Design Flow	480.00	967.80	971.97	971.59	972.89	0.001812	7.69	62.43	23.42	2.46	0.83	973.80	973.80
Combined	23200.00	Design Flow	480.00	967.61	971.39	971.39	972.64	0.002740	8.96	53.60	21.86	2.27	1.01	973.61	973.61
Combined	23180.00	Design Flow	480.00	965.61	968.15	969.40	972.25	0.013950	16.25	29.55	16.89	1.64	2.16	971.86	971.86
Combined	23100.00	Design Flow	480.00	965.49	970.55	969.27	971.05	0.000794	5.67	84.73	26.96	2.89	0.56	971.74	971.74
Combined	23000.00	Design Flow	480.00	965.34	970.49		970.96	0.000734	5.50	87.27	27.33	2.94	0.54	971.59	971.59
Combined	22900.00	Design Flow	480.00	965.19	970.44		970.88	0.000675	5.33	90.00	27.73	2.98	0.52	971.44	971.44
Combined	22864.34	Design Flow	480.00	965.14	970.10		970.82	0.001174	6.82	70.40	21.78	2.85	0.67	973.39	973.39
Combined	22839.49	Design Flow	480.00	965.10	970.38		970.68	0.000373	4.34	110.49	27.28	3.42	0.38	973.39	973.39
Combined	22809.03	Design Flow	480.00	965.05	970.18	967.95	970.65	0.000648	5.49	87.50	17.12	3.21	0.43	973.39	973.39
Combined	22799		Culvert												
Combined	22749.01	Design Flow	480.00	964.98	969.61		970.18	0.000866	6.07	79.04	17.15	3.01	0.50	971.22	971.22
Combined	22717.12	Design Flow	480.00	964.92	969.72		970.10	0.000555	4.95	97.05	27.25	3.09	0.46	971.17	971.17
Combined	22693.72	Design Flow	480.00	964.89	969.22		970.04	0.001552	7.26	66.11	24.04	2.54	0.77	971.14	971.14
Combined	22600.00	Design Flow	480.00	964.75	969.07		969.89	0.001570	7.29	65.82	23.99	2.53	0.78	971.64	972.00
Combined	22500.00	Design Flow	480.00	964.60	968.90		969.74	0.001599	7.34	65.38	23.92	2.52	0.78	970.60	970.60
Combined	22400.00	Design Flow	480.00	964.45	968.69	968.24	969.56	0.001693	7.50	64.02	23.69	2.50	0.80	970.45	970.45
Combined	22320.00	Design Flow	480.00	964.33	968.11	968.11	969.36	0.002739	8.95	53.60	21.86	2.27	1.01	970.33	970.33
Combined	22300.00	Design Flow	480.00	962.33	964.87	966.11	968.97	0.013951	16.25	29.55	16.89	1.64	2.16	970.08	969.58
Combined	22200.00	Design Flow	480.00	962.14	965.23	965.93	967.53	0.006299	12.16	39.48	19.10	1.92	1.49	968.39	968.89
Combined	22100.00	Design Flow	480.00	961.95	966.10	965.73	967.04	0.001854	7.75	61.91	23.33	2.45	0.84	968.45	968.45
Combined	22000.00	Design Flow	480.00	961.76	965.92		966.85	0.001843	7.74	62.04	23.35	2.45	0.84	968.26	968.26
Combined	21900.00	Design Flow	480.00	961.57	965.73	965.35	966.66	0.001836	7.73	62.13	23.37	2.46	0.83	967.57	967.57
Combined	21820.00	Design Flow	480.00	961.42	965.20	965.20	966.45	0.002739	8.96	53.60	21.86	2.27	1.01	967.92	967.92
Combined	21800.00	Design Flow	480.00	959.42	961.96	963.20	966.06	0.013951	16.25	29.55	16.89	1.64	2.16	967.92	967.67
Combined	21700.00	Design Flow	480.00	959.23	962.32	963.01	964.62	0.006301	12.16	39.48	19.10	1.92	1.49	968.15	967.48
Combined	21605.24	Design Flow	480.00	959.05	962.84	962.84	964.08	0.002736	8.95	53.62	21.86	2.27	1.01	967.05	967.05
Combined	21585.24	Design Flow	480.00	957.05	959.59	960.83	963.69	0.013953	16.25	29.54	16.89	1.64	2.16	966.77	966.77
Combined	21570.24	Design Flow	480.00	957.02	959.64	960.80	963.40	0.012388	15.56	30.85	17.20	1.68	2.05	966.77	965.52
Combined	21536.66	Design Flow	480.00	956.96	961.93	960.11	962.26	0.000434	4.61	104.19	25.93	3.33	0.41	966.77	966.77

HEC-RAS Plan: Loop 303 Final River: Loop 303 Outfall Reach: Combined Profile: Design Flow (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Hydr Radius	Froude # Chl	LOB Elev	ROB Elev
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	(ft)		(ft)	(ft)
Combined	21524.85	Design Flow	480.00	956.94	961.68		962.23	0.000821	5.94	80.75	17.05	3.03	0.48	966.77	966.77
Combined	21511.83	Design Flow	480.00	956.91	961.72	959.72	962.20	0.000696	5.59	85.81	17.91	3.13	0.45	966.00	966.00
Combined	21000		Culvert												
Combined	20119.61	Design Flow	480.00	954.28	959.20		959.67	0.000665	5.51	87.07	17.83	3.17	0.44	963.00	963.00
Combined	20070.01	Design Flow	480.00	954.12	959.14		959.63	0.000668	5.64	85.14	18.33	3.27	0.46	960.97	960.99
Combined	20050	Design Flow	480.00	954.13	958.49	958.16	959.55	0.001999	8.30	57.86	20.01	2.56	0.86	960.13	960.13
Combined	20025.5	Design Flow	480.00	954.09	958.12	958.12	959.47	0.002745	9.32	51.49	19.01	2.41	1.00	960.09	960.09
Combined	20005.5	Design Flow	480.00	952.11	954.82	956.14	959.07	0.013266	16.56	28.99	15.00	1.75	2.10	958.11	958.11
Combined	19952.7*	Design Flow	480.00	952.01	955.02	956.04	958.18	0.008800	14.27	33.63	15.91	1.90	1.73	958.01	958.01
Combined	19900.0	Design Flow	480.00	951.91	955.29	955.94	957.55	0.005573	12.08	39.72	17.03	2.09	1.39	957.91	957.91
Combined	19820.*	Design Flow	480.00	951.78	956.18	955.81	957.22	0.001915	8.17	58.79	20.15	2.58	0.84	957.78	957.78
Combined	19720.*	Design Flow	480.00	951.58	955.61	955.61	956.96	0.002748	9.33	51.47	19.01	2.41	1.00	957.58	957.58
Combined	19700.0	Design Flow	480.00	949.64	952.36	953.67	956.57	0.013072	16.47	29.14	15.03	1.75	2.08	955.64	955.64
Combined	19623.50	Design Flow	480.00	949.50	952.66	953.53	955.40	0.007216	13.28	36.15	16.38	1.98	1.58	955.50	955.50
Combined	19603.5	Design Flow	480.00	949.47	952.79	953.50	955.16	0.005917	12.35	38.86	16.88	2.06	1.43	955.47	955.47
Combined	19523.5*	Design Flow	480.00	949.32	953.75	953.35	954.77	0.001859	8.08	59.43	20.24	2.60	0.83	955.32	955.32
Combined	19443.5*	Design Flow	480.00	949.17	953.60		954.62	0.001857	8.07	59.46	20.25	2.60	0.83	955.17	955.17
Combined	19343.5*	Design Flow	480.00	948.98	953.42		954.43	0.001848	8.06	59.57	20.26	2.60	0.83	954.98	954.98
Combined	19320.0	Design Flow	480.00	948.94	953.37		954.39	0.001859	8.08	59.43	20.24	2.60	0.83	954.94	954.94
Combined	19300.0	Design Flow	480.00	948.91	953.33		954.35	0.001883	8.11	59.16	20.20	2.59	0.84	954.91	954.91
Combined	19200.*	Design Flow	480.00	948.72	953.11	952.75	954.15	0.001938	8.20	58.54	20.11	2.58	0.85	954.72	954.72
Combined	19150	Design Flow	480.00	948.63	952.65	952.65	954.01	0.002757	9.34	51.41	19.00	2.41	1.00	954.63	954.63
Combined	19050	Design Flow	480.00	948.44	951.76	952.23	953.60	0.004685	10.89	44.09	20.15	2.03	1.30	954.44	954.44
Combined	19030	Design Flow	480.00	946.44	948.95	950.23	953.20	0.014781	16.56	28.99	16.84	1.61	2.22	952.44	952.44
Combined	18971.64	Design Flow	480.00	946.33	949.15	950.12	952.15	0.009152	13.91	34.51	18.12	1.78	1.78	952.33	952.33
Combined	18915.66	Design Flow	480.00	946.23	949.43	950.01	951.49	0.005467	11.52	41.66	19.65	1.97	1.39	952.23	952.23
Combined	18895.66	Design Flow	480.00	945.14	947.85	948.92	951.21	0.010649	14.70	32.65	17.70	1.72	1.91	951.14	951.14
Combined	18815.6*	Design Flow	480.00	944.99	949.84	948.76	950.40	0.000945	6.03	79.61	26.33	2.79	0.61	950.99	950.99
Combined	18755.6*	Design Flow	480.00	944.88	949.80		950.34	0.000885	5.89	81.56	26.63	2.82	0.59	950.88	950.88
Combined	18695.6*	Design Flow	480.00	944.77	949.21		950.22	0.001848	8.06	59.57	20.26	2.60	0.83	950.77	950.77
Combined	18635.6*	Design Flow	480.00	944.66	949.10		950.11	0.001852	8.06	59.52	20.26	2.60	0.83	950.66	950.66
Combined	18580.0	Design Flow	480.00	944.56	948.99		950.01	0.001863	8.08	59.39	20.24	2.60	0.83	950.56	950.56
Combined	18491.33	Design Flow	480.00	944.40	948.82		949.84	0.001883	8.11	59.15	20.20	2.59	0.84	950.40	950.40
Combined	18393.0*	Design Flow	480.00	944.21	948.64		949.65	0.001873	8.10	59.27	20.22	2.60	0.83	950.21	950.21
Combined	18294.8*	Design Flow	480.00	944.03	948.45		949.47	0.001889	8.12	59.09	20.19	2.59	0.84	950.03	950.03
Combined	18196.5*	Design Flow	480.00	943.84	948.26		949.28	0.001880	8.11	59.20	20.21	2.59	0.83	949.84	949.84
Combined	18098.2*	Design Flow	480.00	943.66	948.07		949.10	0.001902	8.14	58.94	20.17	2.59	0.84	949.66	949.66
Combined	18000.0	Design Flow	480.00	943.47	947.86	947.50	948.90	0.001937	8.20	58.54	20.11	2.58	0.85	949.47	949.47
Combined	17950.0	Design Flow	480.00	943.38	947.40	947.40	948.76	0.002758	9.34	51.40	19.00	2.40	1.00	949.38	949.38
Combined	17885.*	Design Flow	480.00	943.26	946.80	947.14	948.51	0.004012	10.50	45.71	19.32	2.16	1.20	949.26	949.26
Combined	17820	Design Flow	480.00	943.14	946.59	946.92	948.22	0.003962	10.24	46.88	20.70	2.10	1.20	949.14	949.14
Combined	17800	Design Flow	480.00	942.09	944.89	945.87	947.96	0.009445	14.07	34.11	18.03	1.77	1.80	948.09	948.09
Combined	17700.0	Design Flow	480.00	941.90	945.46	945.68	946.94	0.003487	9.77	49.13	21.13	2.16	1.13	947.90	947.90
Combined	17680.0	Design Flow	480.00	939.90	942.43	943.68	946.56	0.014163	16.31	29.44	16.95	1.63	2.18	945.90	945.90
Combined	17660.*	Design Flow	480.00	939.87	942.57	943.68	946.13	0.011618	15.16	31.67	17.52	1.69	1.99	945.87	945.87
Combined	17640.*	Design Flow	480.00	939.84	942.59	943.62	945.83	0.010154	14.45	33.22	17.83	1.74	1.87	945.84	945.84
Combined	17620.*	Design Flow	480.00	939.81	942.68	943.58	945.53	0.008512	13.55	35.43	18.32	1.80	1.72	945.81	945.81
Combined	17600.*	Design Flow	480.00	939.78	942.78	943.56	945.27	0.007054	12.65	37.95	18.87	1.87	1.57	945.78	945.78

HEC-RAS Plan: Loop 303 Final River: Loop 303 Outfall Reach: Combined Profile: Design Flow (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Hydr Radius	Froude # Chl	LOB Elev	ROB Elev
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	(ft)		(ft)	(ft)
Combined	17580.*	Design Flow	480.00	939.75	942.91	943.53	945.04	0.005702	11.70	41.02	19.52	1.96	1.42	945.75	945.75
Combined	17560.*	Design Flow	480.00	939.72	943.97	943.49	944.83	0.001666	7.44	64.53	23.90	2.50	0.80	945.72	945.72
Combined	17540.*	Design Flow	480.00	939.69	943.93		944.79	0.001676	7.46	64.38	23.88	2.49	0.80	945.69	945.69
Combined	17520.*	Design Flow	480.00	939.66	943.89		944.76	0.001686	7.47	64.23	23.85	2.49	0.80	945.66	945.66
Combined	17500.*	Design Flow	480.00	939.63	943.86		944.73	0.001698	7.49	64.07	23.82	2.49	0.81	945.63	945.63
Combined	17480.*	Design Flow	480.00	939.60	943.82		944.70	0.001710	7.51	63.90	23.79	2.48	0.81	945.60	945.60
Combined	17460.*	Design Flow	480.00	939.57	943.78		944.66	0.001724	7.53	63.71	23.76	2.48	0.81	945.57	945.57
Combined	17440.*	Design Flow	480.00	939.54	943.74		944.63	0.001737	7.56	63.53	23.73	2.48	0.81	945.54	945.54
Combined	17420.*	Design Flow	480.00	939.51	943.72		944.59	0.001696	7.49	64.07	23.79	2.49	0.80	945.50	945.51
Combined	17400.*	Design Flow	480.00	939.48	943.64		944.56	0.001822	7.69	62.42	23.54	2.45	0.83	945.48	945.48
Combined	17380.18	Design Flow	480.00	939.45	943.60		944.52	0.001844	7.72	62.15	23.50	2.45	0.84	945.45	945.45
Combined	17290.1*	Design Flow	480.00	939.28	943.43		944.35	0.001835	7.71	62.26	23.51	2.45	0.83	945.28	945.28
Combined	17200.0*	Design Flow	480.00	939.11	943.27		944.19	0.001824	7.69	62.40	23.54	2.45	0.83	945.11	945.11
Combined	17110.0*	Design Flow	480.00	938.94	943.10		944.02	0.001811	7.67	62.56	23.57	2.46	0.83	944.94	944.94
Combined	17020.0	Design Flow	480.00	938.77	942.94		943.85	0.001796	7.65	62.76	23.60	2.46	0.83	944.77	944.77
Combined	17000.0	Design Flow	480.00	938.74	942.89		943.82	0.001855	7.74	62.02	23.49	2.44	0.84	944.74	944.74
Combined	16920.*	Design Flow	480.00	938.59	942.74		943.66	0.001827	7.70	62.36	23.53	2.45	0.83	944.59	944.59
Combined	16860.*	Design Flow	480.00	938.48	942.63		943.55	0.001827	7.70	62.36	23.53	2.45	0.83	944.48	944.48
Combined	16800.*	Design Flow	480.00	938.37	942.51	942.15	943.44	0.001863	7.75	61.91	23.45	2.44	0.84	944.37	944.37
Combined	16740.*	Design Flow	480.00	938.26	942.04	942.04	943.28	0.002738	8.94	53.71	21.99	2.26	1.01	944.26	944.26
Combined	16720	Design Flow	480.00	936.26	938.80	940.04	942.89	0.013983	16.23	29.57	16.98	1.63	2.17	942.26	942.26
Combined	16683.21	Design Flow	480.00	936.19	938.92	939.97	942.20	0.010321	14.53	33.03	17.78	1.74	1.88	942.19	942.19
Combined	16650	Design Flow	480.00	936.13	939.07	939.90	941.72	0.007734	13.08	36.69	18.60	1.84	1.64	942.13	942.13
Combined	16630	Design Flow	480.00	936.10	939.18	939.88	941.48	0.006344	12.17	39.45	19.19	1.92	1.50	942.10	942.10
Combined	16570.8*	Design Flow	480.00	935.99	940.12	939.77	941.06	0.001875	7.77	61.76	23.43	2.44	0.84	941.99	941.99
Combined	16511.64	Design Flow	480.00	935.88	939.66	939.66	940.90	0.002736	8.93	53.72	22.00	2.26	1.01	941.88	941.88
Combined	16491.64	Design Flow	480.00	933.88	936.42	937.66	940.51	0.013983	16.23	29.57	16.98	1.63	2.17	939.88	939.88
Combined	16402.62	Design Flow	480.00	933.72	936.75	937.49	939.17	0.006776	12.46	38.51	18.99	1.89	1.54	939.72	939.72
Combined	16382.62	Design Flow	480.00	931.72	934.16	935.50	938.74	0.016362	17.18	27.94	16.58	1.58	2.33	937.72	937.72
Combined	16380.42	Design Flow	480.00	931.72	934.17	935.49	938.69	0.016034	17.06	28.14	16.63	1.59	2.31	937.72	937.72
Combined	16305.2*	Design Flow	480.00	931.58	934.43	935.36	937.34	0.008789	13.71	35.02	18.23	1.79	1.74	937.58	937.58
Combined	16230	Design Flow	480.00	931.44	934.86	935.22	936.54	0.004122	10.39	46.20	20.56	2.09	1.22	937.44	937.44
Combined	16180.76	Design Flow	480.00	931.38	935.38	934.28	936.15	0.001322	7.04	68.19	17.08	2.73	0.62	941.28	941.28
Combined	16100		Culvert												
Combined	16050	Design Flow	480.00	931.10	935.54		936.17	0.000949	6.37	75.30	18.20	3.02	0.55	937.50	937.50
Combined	15996.94	Design Flow	480.00	931.00	935.15	934.78	936.08	0.001818	7.70	62.32	23.37	2.46	0.83	937.00	937.00
Combined	15963.30	Design Flow	480.00	930.94	934.73	934.73	935.97	0.002720	8.93	53.74	21.88	2.27	1.00	936.84	936.69
Combined	15950.00	Design Flow	480.00	929.61	932.33	933.39	935.69	0.010636	14.72	32.61	17.60	1.73	1.91	936.77	936.29
Combined	15900.00	Design Flow	480.00	929.51	932.54	933.30	935.00	0.006918	12.58	38.14	18.81	1.89	1.56	936.34	935.86
Combined	15800.00	Design Flow	480.00	929.32	933.10	933.10	934.35	0.002743	8.96	53.57	21.85	2.27	1.01	935.48	936.16
Combined	15780.00	Design Flow	480.00	927.32	929.86	931.11	933.96	0.013952	16.25	29.54	16.89	1.64	2.16	935.97	936.32
Combined	15700.00	Design Flow	480.00	927.17	930.16	930.96	932.71	0.007297	12.83	37.41	18.66	1.87	1.60	935.84	936.32
Combined	15600.00	Design Flow	480.00	926.98	931.22	930.76	932.09	0.001690	7.49	64.07	23.70	2.50	0.80	935.66	936.13
Combined	15500.00	Design Flow	480.00	926.79	931.08		931.92	0.001618	7.37	65.10	23.87	2.52	0.79	935.50	934.96
Combined	15400.00	Design Flow	480.00	926.60	930.94		931.75	0.001530	7.22	66.46	24.09	2.55	0.77	935.69	935.72
Combined	15300.00	Design Flow	480.00	926.41	930.82		931.59	0.001429	7.04	68.15	24.37	2.58	0.74	935.86	935.85
Combined	15200.00	Design Flow	480.00	926.22	930.72		931.44	0.001322	6.84	70.16	24.70	2.62	0.72	935.77	936.23
Combined	15100.00	Design Flow	480.00	926.03	930.62		931.30	0.001205	6.61	72.60	25.09	2.67	0.69	935.68	936.00

HEC-RAS Plan: Loop 303 Final River: Loop 303 Outfall Reach: Combined Profile: Design Flow (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Hydr Radius	Froude # Chl	LOB Elev	ROB Elev
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	(ft)		(ft)	(ft)
Combined	15000.00	Design Flow	480.00	925.84	930.54		931.17	0.001089	6.37	75.37	25.53	2.72	0.65	935.59	936.03
Combined	14900.00	Design Flow	480.00	925.65	930.47		931.06	0.000976	6.12	78.49	26.02	2.78	0.62	935.50	935.95
Combined	14800.00	Design Flow	480.00	925.46	930.42		930.95	0.000871	5.86	81.88	26.53	2.84	0.59	935.42	935.70
Combined	14757.73	Design Flow	480.00	925.38	930.40		930.91	0.000804	5.70	84.16	26.70	2.89	0.57	935.46	935.13
Combined	14727.75	Design Flow	480.00	925.31	930.47	928.03	930.85	0.000497	4.93	97.27	18.90	3.34	0.38	935.49	935.49
Combined	14650		Culvert												
Combined	14579.51	Design Flow	480.00	925.05	929.69		930.16	0.000676	5.49	87.42	18.89	3.11	0.45	934.91	934.91
Combined	14561.53	Design Flow	480.00	925.01	929.14		930.09	0.001889	7.81	61.48	23.26	2.44	0.85	934.87	933.41
Combined	14500.00	Design Flow	480.00	924.89	929.03		929.97	0.001881	7.80	61.56	23.26	2.44	0.84	935.36	935.17
Combined	14400.00	Design Flow	480.00	924.70	928.84		929.78	0.001886	7.80	61.51	23.26	2.44	0.85	936.14	934.83
Combined	14300.00	Design Flow	480.00	924.51	928.65		929.59	0.001874	7.78	61.66	23.29	2.45	0.84	935.29	934.46
Combined	14200.00	Design Flow	480.00	924.32	928.46		929.40	0.001866	7.77	61.76	23.31	2.45	0.84	934.15	933.63
Combined	14100.00	Design Flow	480.00	924.13	928.28		929.21	0.001860	7.76	61.83	23.31	2.45	0.84	933.01	932.90
Combined	14000.00	Design Flow	480.00	923.94	928.09		929.03	0.001852	7.75	61.93	23.33	2.45	0.84	931.88	931.63
Combined	13900.00	Design Flow	480.00	923.75	927.91		928.84	0.001846	7.74	62.00	23.34	2.45	0.84	931.17	930.43
Combined	13800.00	Design Flow	480.00	923.56	927.73		928.65	0.001827	7.71	62.23	23.38	2.46	0.83	930.46	930.21
Combined	13700.00	Design Flow	480.00	923.37	927.53	927.16	928.46	0.001841	7.73	62.06	23.35	2.45	0.84	929.75	929.32
Combined	13620.00	Design Flow	480.00	923.22	927.01	927.01	928.25	0.002737	8.95	53.62	21.86	2.27	1.01	929.19	929.17
Combined	13600.00	Design Flow	480.00	921.22	923.76	925.00	927.86	0.013960	16.25	29.54	16.89	1.64	2.17	929.08	929.08
Combined	13482.55	Design Flow	480.00	921.00	924.19	924.79	926.28	0.005534	11.60	41.40	19.50	1.97	1.40	928.52	928.39
Combined	13459.34	Design Flow	480.00	920.95	925.12	924.73	926.04	0.001810	7.69	62.45	23.42	2.46	0.83	928.41	928.12
Combined	13400.00	Design Flow	480.00	920.84	925.00	924.62	925.93	0.001843	7.74	62.03	23.35	2.45	0.84	928.13	927.81
Combined	13287.11	Design Flow	480.00	920.62	924.41	924.41	925.65	0.002736	8.95	53.62	21.86	2.27	1.01	927.60	927.75
Combined	13267.11	Design Flow	480.00	918.62	921.17	922.41	925.26	0.013926	16.24	29.56	16.89	1.64	2.16	926.73	927.78
Combined	13247.44	Design Flow	480.00	918.59	921.24	922.37	924.88	0.011876	15.32	31.33	17.31	1.69	2.01	926.49	927.28
Combined	13199.46	Design Flow	480.00	918.50	923.52	922.26	924.02	0.000801	5.68	84.50	26.96	2.88	0.57	926.06	925.80
Combined	13172.24	Design Flow	480.00	918.43	923.59	921.15	923.97	0.000496	4.93	97.34	18.94	3.34	0.38	925.93	925.93
Combined	13100		Culvert												
Combined	13025.42	Design Flow	480.00	918.17	922.81		923.27	0.000675	5.49	87.46	18.92	3.12	0.45	925.67	925.67
Combined	12989.80	Design Flow	480.00	918.10	922.27		923.19	0.001825	7.71	62.26	23.39	2.46	0.83	923.78	923.74
Combined	12900.00	Design Flow	480.00	917.93	922.10	921.72	923.02	0.001825	7.71	62.28	23.40	2.46	0.83	923.07	924.39
Combined	12790.00	Design Flow	480.00	917.72	921.50	921.50	922.75	0.002738	8.95	53.63	22.40	2.22	1.01	922.89	922.89
Combined	12770.00	Design Flow	480.00	915.72	918.27	919.51	922.36	0.013900	16.23	29.58	16.89	1.64	2.16	922.52	922.58
Combined	12700.00	Design Flow	480.00	915.58	918.50	919.36	921.24	0.008024	13.28	36.14	18.39	1.83	1.67	922.21	922.46
Combined	12600.00	Design Flow	480.00	915.39	919.56	919.18	920.48	0.001831	7.72	62.19	23.37	2.46	0.83	921.78	922.51
Combined	12500.00	Design Flow	480.00	915.20	919.37		920.29	0.001824	7.71	62.28	23.39	2.46	0.83	921.05	922.83
Combined	12400.00	Design Flow	480.00	915.01	919.19	918.80	920.11	0.001800	7.67	62.59	23.45	2.47	0.83	920.82	921.28
Combined	12288.45	Design Flow	480.00	914.80	918.58	918.58	919.83	0.002739	8.96	53.60	21.85	2.27	1.01	920.56	921.10
Combined	12268.53	Design Flow	480.00	912.81	915.35	916.59	919.44	0.013905	16.23	29.57	16.88	1.64	2.16	920.33	921.04
Combined	12200.00	Design Flow	480.00	912.67	915.58	916.46	918.34	0.008083	13.32	36.04	18.37	1.83	1.68	919.48	919.90
Combined	12140.56	Design Flow	480.00	912.56	915.95	916.34	917.69	0.004310	10.58	45.37	20.30	2.07	1.25	918.74	919.07
Combined	12120.77	Design Flow	480.00	910.58	913.10	914.36	917.30	0.014440	16.45	29.18	16.81	1.62	2.20	918.55	918.66
Combined	12100.00	Design Flow	480.00	910.52	913.14	914.31	916.88	0.012295	15.52	30.94	17.22	1.68	2.04	918.18	918.38
Combined	12001.28	Design Flow	480.00	910.33	913.53	914.11	915.61	0.005493	11.56	41.51	19.52	1.98	1.40	916.43	917.08
Combined	11981.28	Design Flow	480.00	908.33	910.81	912.12	915.20	0.015317	16.80	28.56	16.66	1.60	2.26	916.29	916.83
Combined	11892.01	Design Flow	480.00	908.16	911.12	911.95	913.74	0.007546	12.99	36.95	18.56	1.85	1.62	915.44	915.70
Combined	11872.01	Design Flow	480.00	906.16	908.58	909.95	913.31	0.016988	17.45	27.51	16.40	1.57	2.37	915.25	915.25
Combined	11800.00	Design Flow	480.00	906.03	908.82	909.81	911.93	0.009541	14.15	33.93	17.91	1.77	1.81	914.59	914.59

HEC-RAS Plan: Loop 303 Final River: Loop 303 Outfall Reach: Combined Profile: Design Flow (Continued)

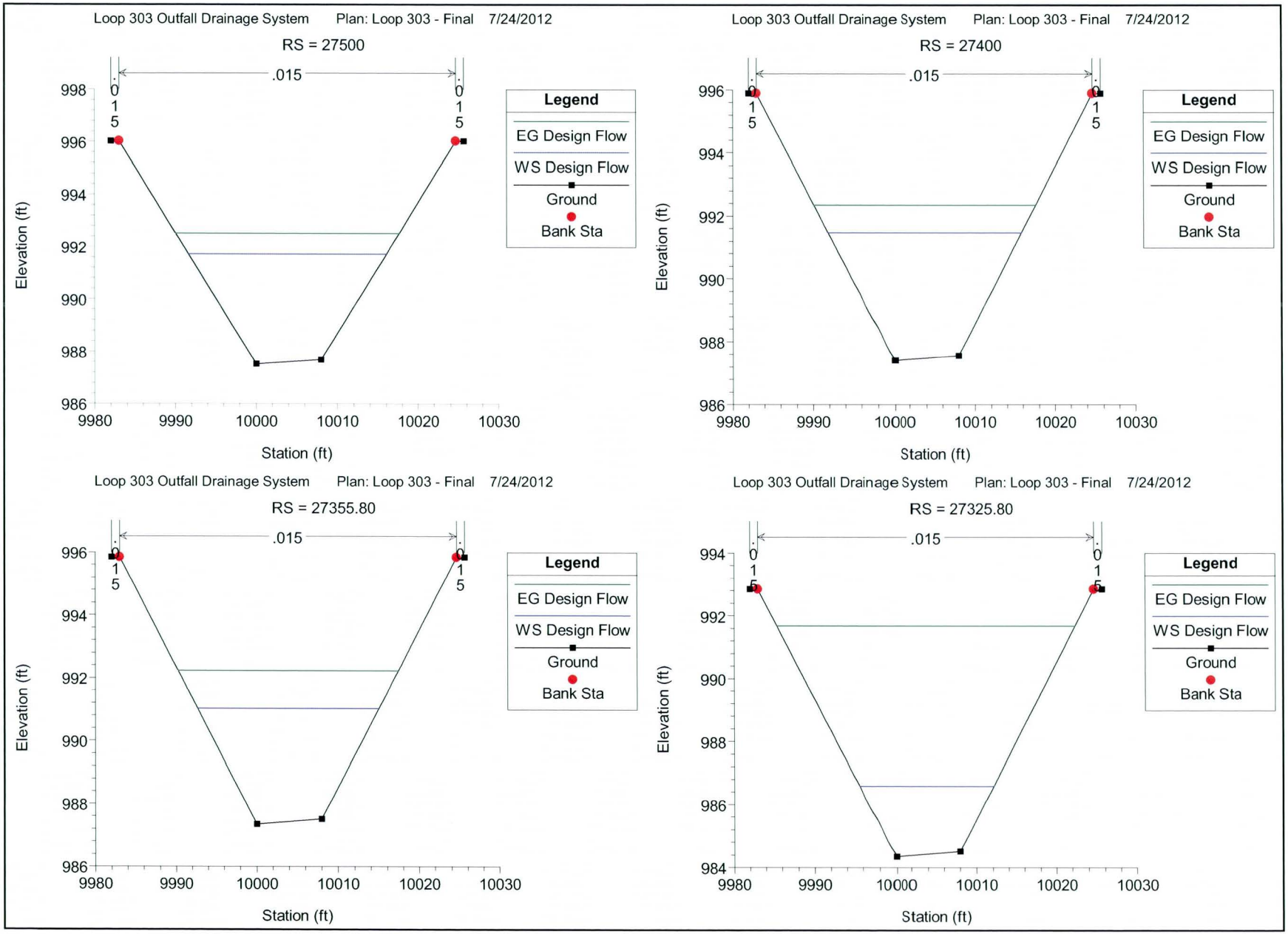
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Hydr Radius	Froude # Chl	LOB Elev	ROB Elev
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	(ft)		(ft)	(ft)
Combined	11772.00	Design Flow	480.00	905.97	908.93	909.76	911.56	0.007599	13.02	36.86	18.54	1.85	1.63	914.33	914.31
Combined	11752.02	Design Flow	480.00	903.98	906.40	907.76	911.13	0.016990	17.45	27.51	16.41	1.57	2.37	914.16	913.75
Combined	11700.00	Design Flow	480.00	903.88	906.58	907.67	910.03	0.011019	14.91	32.19	17.50	1.72	1.94	913.69	913.49
Combined	11600.00	Design Flow	480.00	903.69	908.27	907.48	908.95	0.001217	6.65	72.22	24.93	2.67	0.69	913.34	913.09
Combined	11516.69	Design Flow	480.00	903.53	908.22		908.84	0.001063	6.31	76.13	25.73	2.73	0.65	913.05	912.34
Combined	11488.44	Design Flow	480.00	903.47	908.33	906.18	908.76	0.000590	5.24	91.62	18.90	3.21	0.42	913.69	913.69
Combined	11400		Culvert												
Combined	11317.74	Design Flow	480.00	903.23	907.14		907.80	0.001117	6.52	73.60	18.88	2.77	0.58	912.47	912.47
Combined	11297.45	Design Flow	480.00	903.11	906.85		907.74	0.001842	7.60	63.15	24.72	2.39	0.84	910.86	910.86
Combined	11200.00	Design Flow	480.00	902.92	906.65		907.56	0.001868	7.65	62.72	24.52	2.39	0.84	910.02	909.45
Combined	11100.00	Design Flow	480.00	902.73	906.44	906.13	907.37	0.001906	7.71	62.25	24.44	2.38	0.85	909.47	909.47
Combined	11020.21	Design Flow	480.00	902.57	905.96	905.96	907.16	0.002725	8.77	54.70	23.19	2.21	1.01	909.04	908.98
Combined	11000.21	Design Flow	480.00	900.59	902.80	903.99	906.77	0.014615	16.00	30.00	18.43	1.54	2.21	909.05	909.05
Combined	10900.00	Design Flow	480.00	900.40	903.15	903.79	905.32	0.006226	11.81	40.63	20.61	1.86	1.48	908.12	907.99
Combined	10800.00	Design Flow	480.00	900.20	903.92	903.59	904.84	0.001896	7.69	62.38	24.47	2.38	0.85	907.19	906.45
Combined	10700.00	Design Flow	480.00	900.01	903.73		904.65	0.001902	7.70	62.31	24.46	2.38	0.85	906.83	906.67
Combined	10600.00	Design Flow	480.00	899.82	903.54	903.22	904.46	0.001903	7.71	62.29	24.45	2.38	0.85	906.48	905.87
Combined	10500.00	Design Flow	480.00	899.63	903.35		904.27	0.001899	7.70	62.35	24.47	2.38	0.85	906.12	906.01
Combined	10400.00	Design Flow	480.00	899.44	903.16		904.08	0.001898	7.70	62.37	24.48	2.38	0.85	905.76	905.76
Combined	10300.00	Design Flow	480.00	899.25	902.96	902.65	903.89	0.001907	7.71	62.24	24.45	2.38	0.85	905.41	905.41
Combined	10200.00	Design Flow	480.00	899.06	902.77		903.70	0.001906	7.71	62.26	24.45	2.38	0.85	905.13	905.13
Combined	10100.00	Design Flow	480.00	898.87	902.58		903.51	0.001910	7.71	62.22	24.45	2.38	0.85	904.85	904.85
Combined	10000.00	Design Flow	480.00	898.68	902.39		903.31	0.001913	7.72	62.17	24.44	2.38	0.85	904.56	904.35
Combined	9900.00	Design Flow	480.00	898.49	902.19		903.12	0.001932	7.75	61.96	24.41	2.37	0.86	904.28	904.28
Combined	9800.00	Design Flow	480.00	898.30	901.98		902.93	0.001981	7.82	61.40	24.31	2.36	0.87	904.20	904.00
Combined	9700.00	Design Flow	480.00	898.11	901.68	901.51	902.71	0.002243	8.18	58.70	23.87	2.30	0.92	903.73	903.73
Combined	9587.18	Design Flow	480.00	897.90	901.24	901.24	902.42	0.002708	8.72	55.02	23.46	2.20	1.00	903.94	903.94
Combined	9541.48	Design Flow	480.00	897.80	901.03	899.64	901.33	0.000520	4.39	109.22	33.91	2.71	0.43	903.94	903.94
Combined	9400		Culvert												
Combined	9277.83	Design Flow	480.00	897.57	900.11		900.60	0.001100	5.58	86.04	33.87	2.21	0.62	904.89	904.89
Combined	9262.83	Design Flow	480.00	897.53	900.13		900.56	0.001012	5.26	91.25	41.12	2.16	0.62	903.67	903.66
Combined	9200.00	Design Flow	480.00	897.46	900.07		900.50	0.001013	5.26	91.22	41.12	2.16	0.62	902.51	902.51
Combined	9100.00	Design Flow	480.00	897.36	899.97		900.40	0.001012	5.26	91.24	41.13	2.16	0.62	902.17	902.17
Combined	9000.00	Design Flow	480.00	897.26	899.86		900.30	0.001021	5.27	91.00	41.11	2.15	0.62	901.84	901.84
Combined	8900.00	Design Flow	480.00	897.16	899.76		900.19	0.001030	5.29	90.73	41.09	2.15	0.63	901.51	901.51
Combined	8800.00	Design Flow	480.00	897.06	899.66		900.09	0.001032	5.29	90.66	41.07	2.15	0.63	901.17	901.17
Combined	8700.00	Design Flow	480.00	896.96	899.55		899.99	0.001038	5.31	90.47	41.03	2.14	0.63	901.03	901.04
Combined	8600.00	Design Flow	480.00	896.86	899.44		899.88	0.001054	5.33	90.03	41.00	2.13	0.63	900.87	900.89
Combined	8500.00	Design Flow	480.00	896.76	899.33		899.78	0.001064	5.35	89.74	40.97	2.13	0.64	900.72	900.74
Combined	8400.00	Design Flow	480.00	896.66	899.22		899.67	0.001076	5.37	89.40	40.93	2.12	0.64	900.57	900.60
Combined	8300.00	Design Flow	480.00	896.56	899.11		899.56	0.001097	5.40	88.83	40.87	2.11	0.65	900.41	900.45
Combined	8200.00	Design Flow	480.00	896.46	898.99		899.45	0.001136	5.46	87.84	40.78	2.09	0.66	900.26	900.31
Combined	8100.00	Design Flow	480.00	896.36	898.86		899.34	0.001182	5.54	86.69	40.68	2.07	0.67	900.03	900.08
Combined	8000.00	Design Flow	480.00	896.26	898.73		899.22	0.001237	5.62	85.40	40.55	2.05	0.68	899.97	900.01
Combined	7900.00	Design Flow	480.00	896.16	898.57		899.09	0.001336	5.77	83.26	40.34	2.01	0.71	899.85	899.87
Combined	7800.00	Design Flow	480.00	896.06	898.38		898.95	0.001544	6.05	79.40	39.96	1.94	0.76	899.71	899.71
Combined	7700.00	Design Flow	480.00	895.96	898.18	897.88	898.78	0.001705	6.20	77.37	40.41	1.87	0.79	899.61	899.45
Combined	7649.10	Design Flow	480.00	895.91	897.81	897.81	898.64	0.002898	7.33	65.45	39.71	1.61	1.01	899.56	899.58

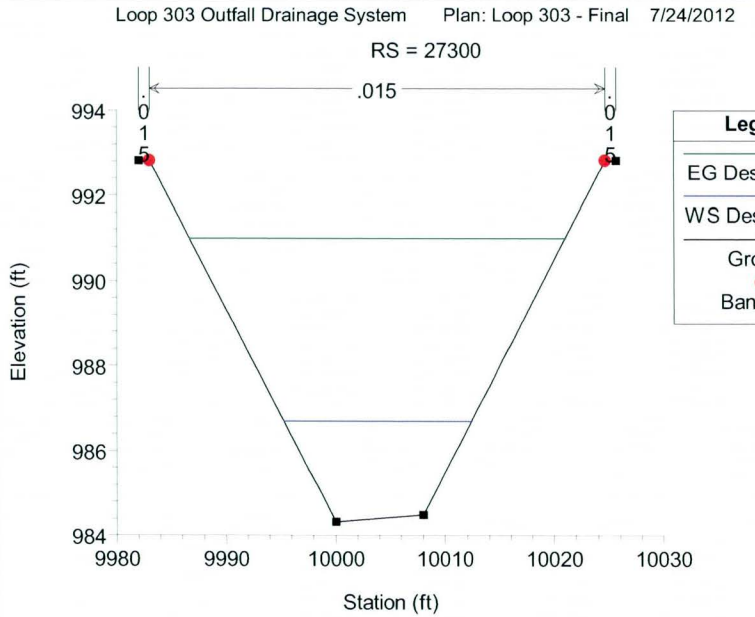
HEC-RAS Plan: Loop 303 Final River: Loop 303 Outfall Reach: Combined Profile: Design Flow (Continued)

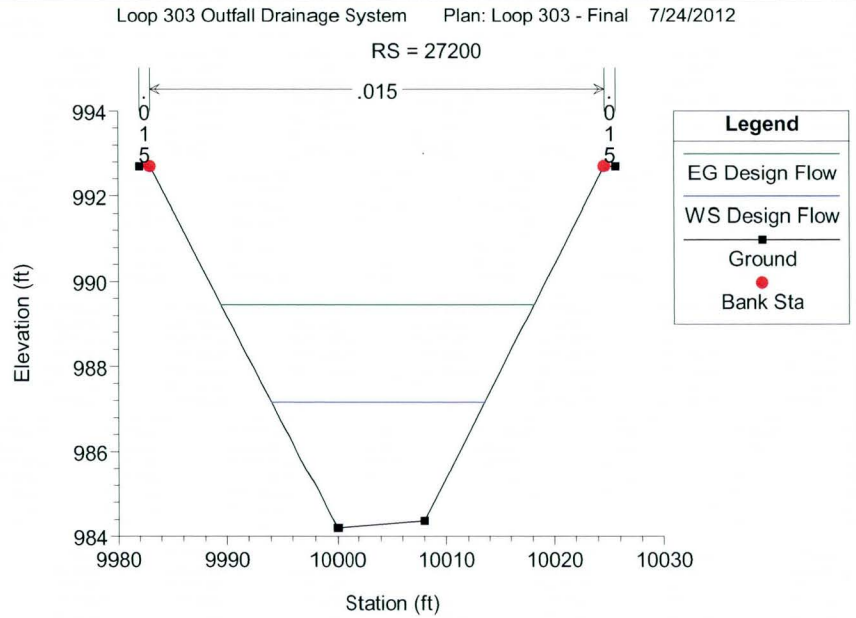
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Hydr Radius	Froude # Chl	LOB Elev	ROB Elev
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	(ft)		(ft)	(ft)
Combined	7567.60	Design Flow	480.00	895.87	898.03	897.04	898.20	0.000436	3.32	144.62	66.90	2.03	0.40	900.37	900.37
Combined	7500		Culvert												
Combined	7375.48	Design Flow	480.00	895.64	897.74		897.92	0.000479	3.42	140.49	66.89	1.98	0.42	900.15	900.15
Combined	7357.50	Design Flow	480.00	895.62	897.59	897.07	897.90	0.000995	4.46	107.69	62.36	1.70	0.60	898.93	898.93
Combined	7300.00	Design Flow	480.00	895.56	897.53	897.01	897.84	0.000995	4.46	107.68	62.35	1.70	0.60	898.66	898.62
Combined	7200.00	Design Flow	480.00	895.46	897.43		897.74	0.000993	4.45	107.77	62.35	1.70	0.60	898.55	898.55
Combined	7100.00	Design Flow	480.00	895.36	897.33		897.64	0.000990	4.45	107.87	62.35	1.71	0.60	898.47	898.47
Combined	7000.00	Design Flow	480.00	895.26	897.24	896.72	897.54	0.000986	4.44	108.01	62.36	1.71	0.60	898.39	898.39
Combined	6900.00	Design Flow	480.00	895.16	897.14	896.61	897.44	0.000990	4.45	107.89	62.37	1.71	0.60	898.30	898.30
Combined	6800.00	Design Flow	480.00	895.06	897.04	896.51	897.34	0.000985	4.44	108.02	62.36	1.71	0.60	898.17	898.17
Combined	6700.00	Design Flow	480.00	894.96	896.94	896.40	897.24	0.000978	4.43	108.29	62.38	1.71	0.59	898.04	898.04
Combined	6600.00	Design Flow	480.00	894.86	896.84		897.15	0.000972	4.43	108.46	62.37	1.71	0.59	897.92	897.92
Combined	6500.00	Design Flow	480.00	894.76	896.75	896.21	897.05	0.000969	4.42	108.58	62.39	1.72	0.59	897.85	897.66
Combined	6400.00	Design Flow	480.00	894.66	896.65		896.95	0.000962	4.41	108.83	62.41	1.72	0.59	897.79	897.79
Combined	6300.00	Design Flow	480.00	894.56	896.55		896.85	0.000954	4.40	109.14	62.43	1.72	0.59	897.72	897.72
Combined	6200.00	Design Flow	480.00	894.46	896.46		896.76	0.000944	4.38	109.51	62.46	1.73	0.58	897.66	897.30
Combined	6100.00	Design Flow	480.00	894.36	896.37		896.66	0.000932	4.37	109.93	62.47	1.74	0.58	897.59	897.31
Combined	6000.00	Design Flow	480.00	894.26	896.27	895.71	896.57	0.000917	4.34	110.48	62.51	1.74	0.58	897.53	897.42
Combined	5900.00	Design Flow	480.00	894.16	896.19	895.61	896.48	0.000899	4.32	111.16	62.55	1.75	0.57	897.46	897.46
Combined	5800.00	Design Flow	480.00	894.06	896.10		896.38	0.000878	4.29	112.01	62.60	1.76	0.56	897.40	897.40
Combined	5700.00	Design Flow	480.00	893.96	896.02		896.30	0.000853	4.25	113.07	62.68	1.78	0.56	897.33	897.33
Combined	5600.00	Design Flow	480.00	893.86	895.93		896.21	0.000824	4.20	114.29	62.76	1.79	0.55	897.26	897.25
Combined	5498.40	Design Flow	480.00	893.76	895.89		896.12	0.000659	3.86	124.24	64.45	1.87	0.49	897.20	897.47
Combined	5479.89	Design Flow	480.00	893.75	895.91	894.94	896.10	0.000462	3.41	140.60	64.99	2.03	0.41	898.75	898.75
Combined	5400		Culvert												
Combined	5310.18	Design Flow	480.00	893.55	895.63		895.83	0.000518	3.53	136.05	65.40	1.96	0.43	897.85	897.85
Combined	5292.20	Design Flow	480.00	893.55	895.58		895.81	0.000699	3.85	124.65	68.58	1.78	0.50	898.04	898.26
Combined	5200.00	Design Flow	480.00	893.46	895.41		895.72	0.001040	4.52	106.19	62.25	1.68	0.61	897.80	897.80
Combined	5100.00	Design Flow	480.00	893.36	895.30		895.62	0.001053	4.54	105.80	62.22	1.68	0.61	897.69	897.69
Combined	5000.37	Design Flow	480.00	893.25	895.20		895.51	0.001037	4.50	106.66	62.78	1.68	0.61	897.36	897.35
Combined	4900.00	Design Flow	480.00	893.15	895.09		895.41	0.001068	4.56	105.31	62.18	1.67	0.62	897.50	897.39
Combined	4806.32	Design Flow	480.00	893.06	894.98		895.31	0.001092	4.59	104.59	62.15	1.66	0.62	897.63	897.43
Combined	4700.00	Design Flow	480.00	892.95	894.86		895.19	0.001114	4.62	103.92	62.09	1.65	0.63	897.77	896.37
Combined	4600.00	Design Flow	480.00	892.85	894.74		895.08	0.001164	4.68	102.50	62.01	1.63	0.64	897.51	896.75
Combined	4500.00	Design Flow	480.00	892.75	894.60		894.96	0.001247	4.79	100.28	61.86	1.60	0.66	897.25	897.24
Combined	4400.00	Design Flow	480.00	892.64	894.44	894.08	894.82	0.001389	4.95	96.95	61.64	1.55	0.70	897.00	897.61
Combined	4284.99	Design Flow	480.00	892.49	893.93	893.93	894.57	0.003132	6.38	75.18	60.22	1.24	1.01	898.49	898.33
Combined	4219.24	Design Flow	480.00	885.92	890.94	887.36	890.98	0.000035	1.52	316.72	74.54	4.12	0.13	891.92	891.75
Combined	4196.77	Design Flow	480.00	885.88	890.94		890.98	0.000034	1.50	319.66	74.70	4.15	0.13	891.88	891.77
Combined	4165.71	Design Flow	480.00	885.82	890.93	887.17	890.98	0.000044	1.75	275.07	53.87	4.30	0.14	899.74	899.74
Combined	4100		Culvert												
Combined	4040.78	Design Flow	480.00	885.66	890.81		890.86	0.000043	1.73	277.35	53.87	4.33	0.13	899.70	899.70
Combined	4014.59	Design Flow	480.00	885.60	890.01		890.78	0.001424	7.03	68.24	24.39	2.58	0.74	897.29	897.35
Combined	3900.00	Design Flow	480.00	885.43	889.85		890.62	0.001423	7.03	68.27	24.40	2.58	0.74	896.99	896.99
Combined	3800.00	Design Flow	480.00	885.28	889.71		890.47	0.001406	7.00	68.56	24.44	2.59	0.74	896.69	895.99
Combined	3700.00	Design Flow	480.00	885.13	889.57		890.33	0.001400	6.99	68.66	24.45	2.59	0.74	896.85	896.41
Combined	3600.00	Design Flow	480.00	884.99	889.43		890.18	0.001391	6.97	68.84	24.49	2.59	0.73	894.23	890.90
Combined	3500.00	Design Flow	480.00	884.84	889.29		890.04	0.001375	6.94	69.14	24.54	2.60	0.73	893.60	892.53

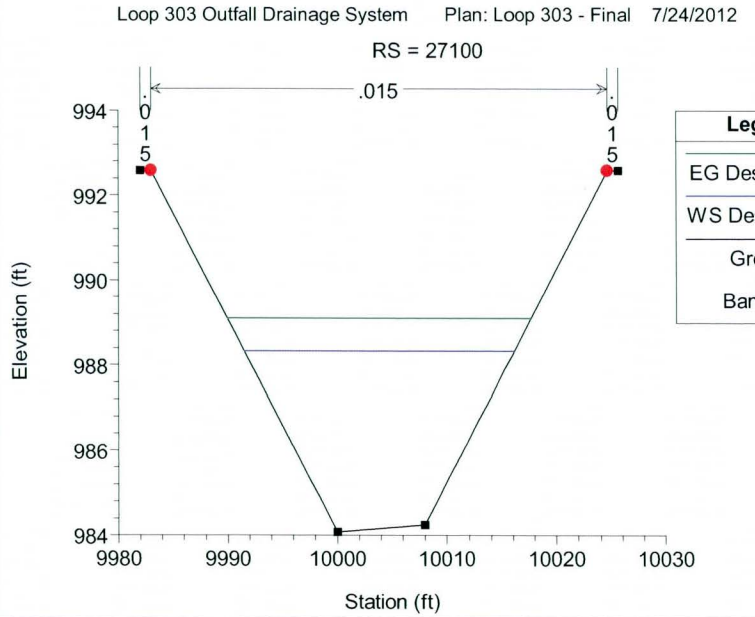
HEC-RAS Plan: Loop 303 Final River: Loop 303 Outfall Reach: Combined Profile: Design Flow (Continued)

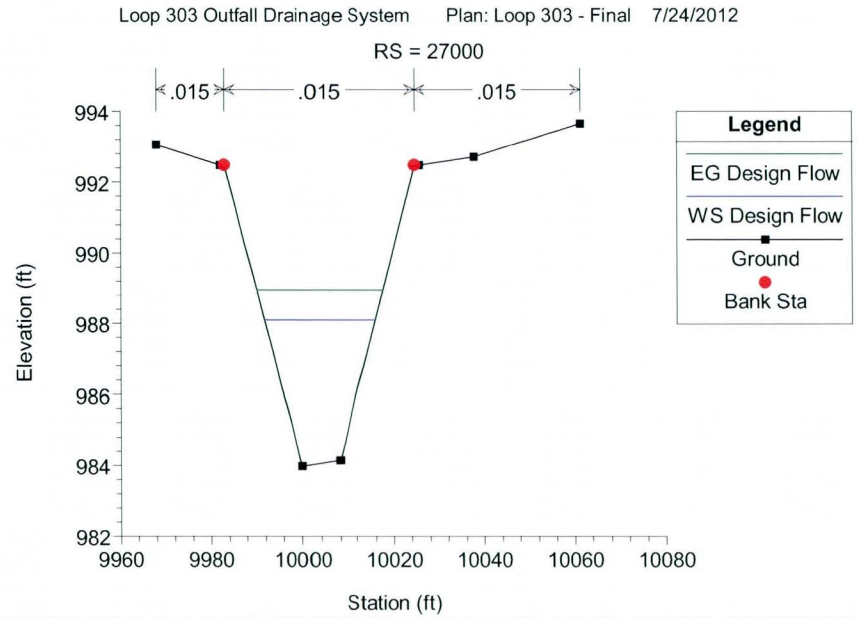
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Hydr Radius	Froude # Chl	LOB Elev	ROB Elev
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	(ft)		(ft)	(ft)
Combined	3400.00	Design Flow	480.00	884.70	889.16		889.90	0.001369	6.93	69.26	24.56	2.60	0.73	893.82	892.12
Combined	3300.00	Design Flow	480.00	884.55	889.03		889.76	0.001345	6.89	69.69	24.63	2.61	0.72	893.98	893.79
Combined	3200.00	Design Flow	480.00	884.40	888.90		889.62	0.001324	6.85	70.11	24.69	2.62	0.72	893.47	892.94
Combined	3100.00	Design Flow	480.00	884.26	888.77		889.49	0.001298	6.80	70.63	24.78	2.63	0.71	892.94	892.98
Combined	3000.00	Design Flow	480.00	884.11	888.65		889.36	0.001262	6.72	71.38	24.91	2.64	0.70	892.79	892.96
Combined	2900.00	Design Flow	480.00	883.96	888.54		889.23	0.001221	6.64	72.25	25.04	2.66	0.69	892.59	892.16
Combined	2800.00	Design Flow	480.00	883.82	888.43		889.10	0.001178	6.56	73.19	25.18	2.68	0.68	892.38	892.22
Combined	2700.00	Design Flow	480.00	883.67	888.33		888.98	0.001131	6.46	74.32	25.37	2.70	0.67	892.18	891.73
Combined	2600.00	Design Flow	480.00	883.52	888.24		888.86	0.001073	6.33	75.78	25.60	2.73	0.65	891.12	890.60
Combined	2504.53	Design Flow	480.00	883.38	888.16		888.76	0.001020	6.22	77.21	25.82	2.75	0.63	890.87	890.42
Combined	2400.00	Design Flow	480.00	883.23	888.07		888.64	0.000964	6.09	78.85	26.07	2.78	0.62	890.70	890.19
Combined	2300.00	Design Flow	480.00	883.08	887.99		888.54	0.000903	5.94	80.80	26.36	2.82	0.60	890.53	890.50
Combined	2200.00	Design Flow	480.00	882.94	887.93		888.45	0.000847	5.80	82.76	26.68	2.85	0.58	890.35	890.04
Combined	2100.00	Design Flow	480.00	882.79	887.86		888.36	0.000786	5.64	85.06	27.01	2.90	0.56	890.17	890.24
Combined	2000.00	Design Flow	480.00	882.64	887.81		888.27	0.000726	5.48	87.60	27.38	2.94	0.54	890.00	890.25
Combined	1900.00	Design Flow	480.00	882.50	887.76		888.20	0.000673	5.33	90.14	27.75	2.98	0.52	889.50	890.09
Combined	1800.00	Design Flow	480.00	882.35	887.71		888.12	0.000619	5.17	92.92	28.14	3.03	0.50	889.31	889.61
Combined	1700.00	Design Flow	480.00	882.21	887.67		888.06	0.000569	5.00	95.91	28.58	3.08	0.48	889.67	889.85
Combined	1600.00	Design Flow	480.00	882.06	887.63		888.00	0.000522	4.85	99.07	29.02	3.13	0.46	890.04	890.40
Combined	1500.00	Design Flow	480.00	881.91	887.60		887.94	0.000477	4.69	102.38	29.46	3.19	0.44	890.41	890.12
Combined	1400.00	Design Flow	480.00	881.77	887.57		887.89	0.000438	4.54	105.72	29.92	3.24	0.43	890.76	890.78
Combined	1300.00	Design Flow	480.00	881.62	887.54		887.84	0.000399	4.39	109.44	30.41	3.30	0.41	890.39	890.38
Combined	1200.00	Design Flow	480.00	881.47	887.51		887.79	0.000365	4.24	113.17	30.89	3.36	0.39	890.02	890.19
Combined	1100.00	Design Flow	480.00	881.33	887.49		887.75	0.000334	4.10	116.93	31.37	3.41	0.37	889.65	889.80
Combined	1000.02	Design Flow	480.00	881.18	887.47		887.72	0.000305	3.97	121.04	31.90	3.47	0.36	889.28	889.28
Combined	900.00	Design Flow	480.00	881.03	887.45		887.68	0.000279	3.84	125.04	32.39	3.53	0.34	888.23	888.24
Combined	796.10	Design Flow	480.00	881.00	887.61	881.91	887.61	0.000003	0.51	903.19	154.29	5.53	0.04	881.00	885.00

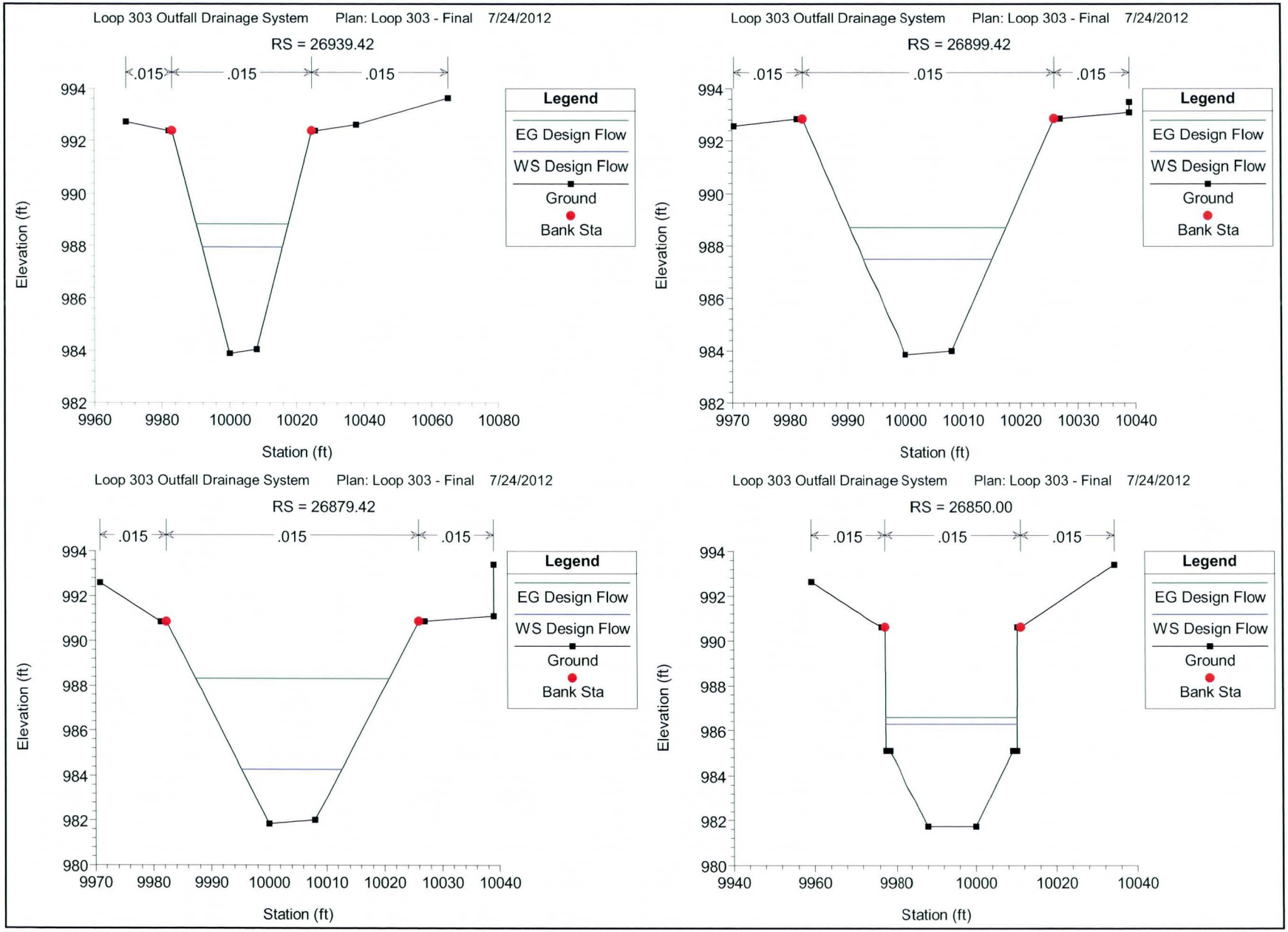

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 27500
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 27400
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 27355.80
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 27325.80
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

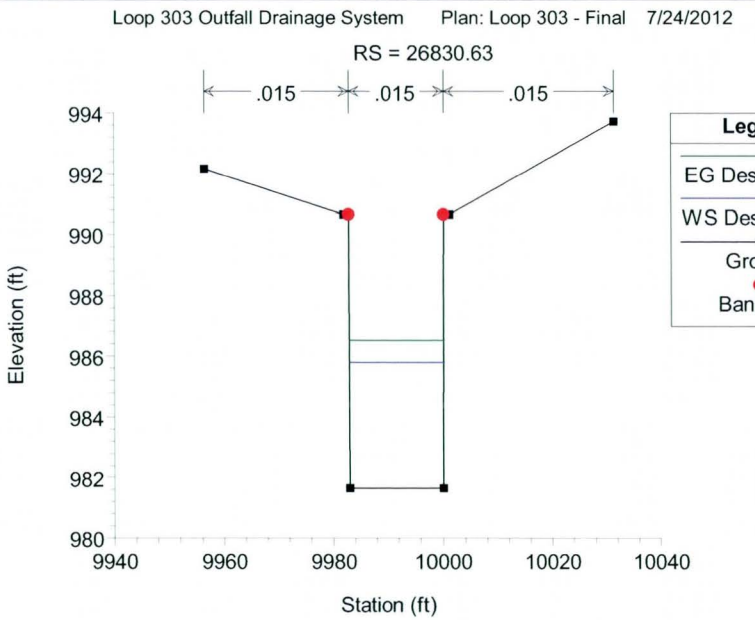

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 27300
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
994
992
990
988
986
984
9980
9990
10000
10010
10020
10030

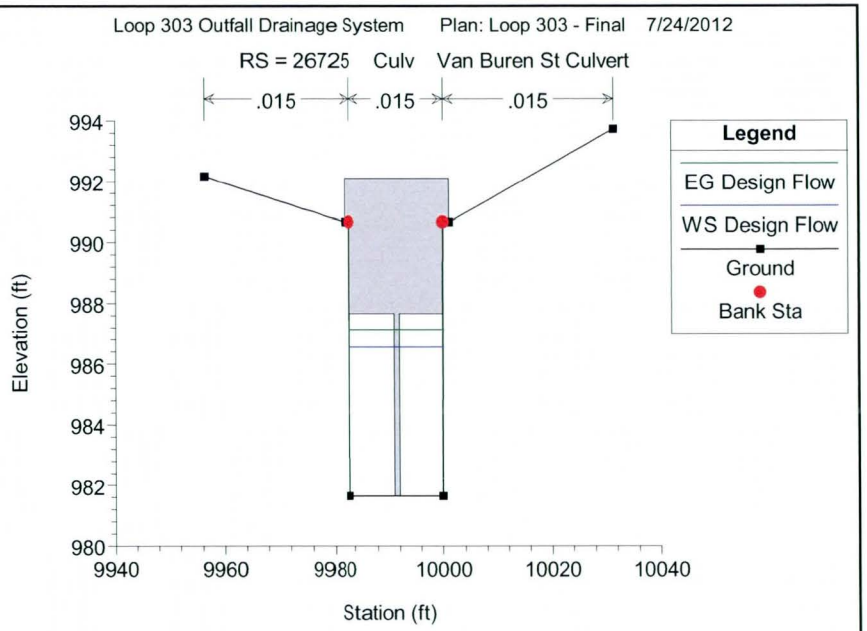

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 27200
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
994
992
990
988
986
984
9980
9990
10000
10010
10020
10030

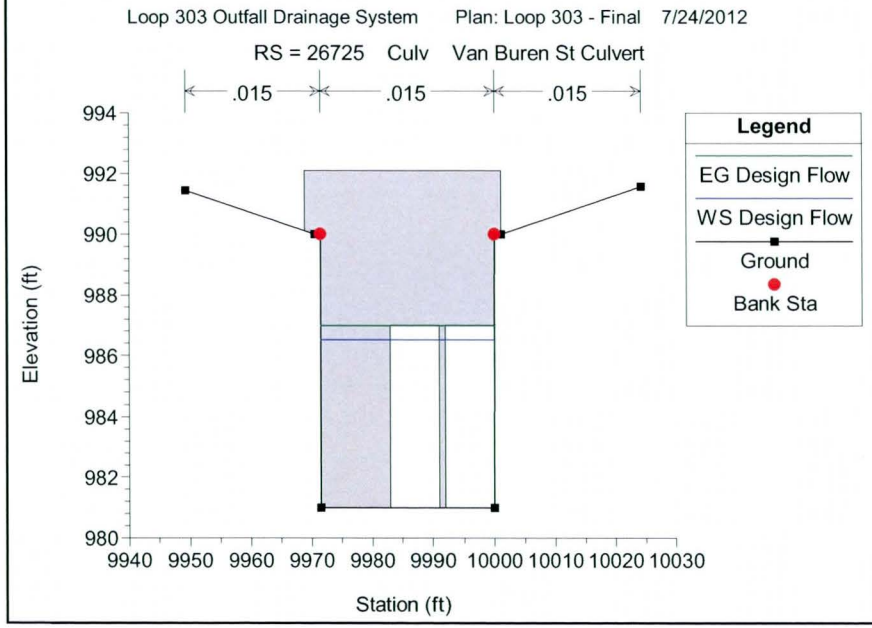

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 27100
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
994
992
990
988
986
984
9980
9990
10000
10010
10020
10030

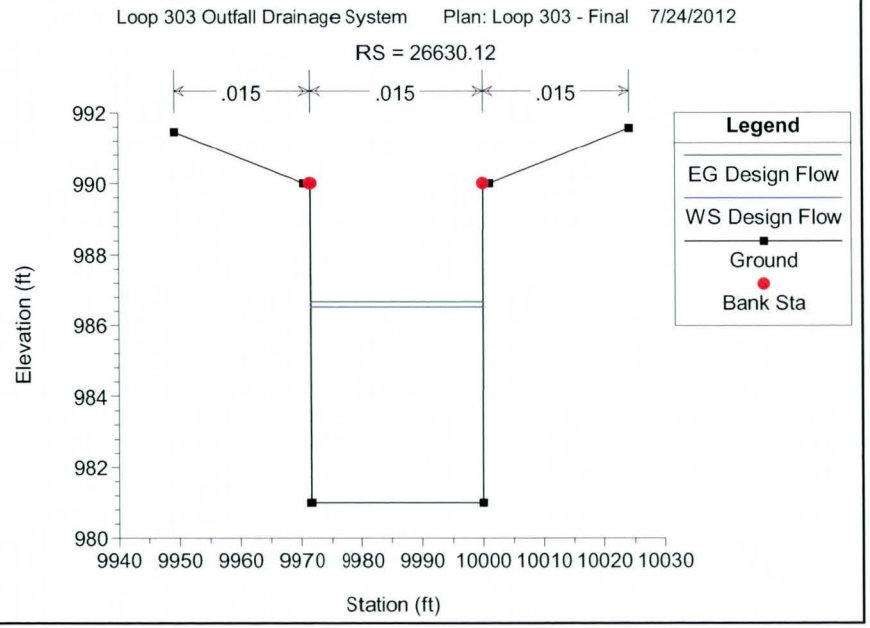

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 27000
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
994
992
990
988
986
984
982
9960
9980
10000
10020
10040
10060
10080

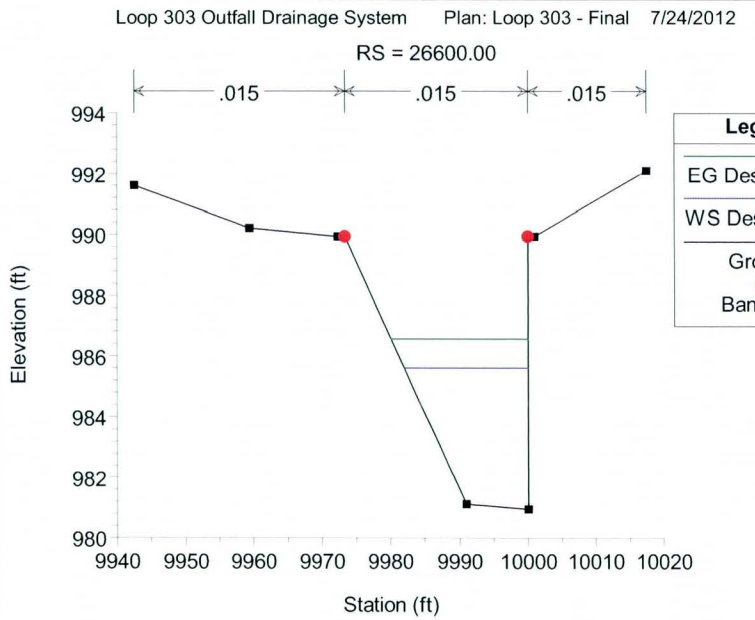

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 26939.42
.015 .015 .015
Elevation (ft)
Station (ft)
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 26899.42
.015 .015 .015
Elevation (ft)
Station (ft)
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 26879.42
.015 .015 .015
Elevation (ft)
Station (ft)
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 26850.00
.015 .015 .015
Elevation (ft)
Station (ft)
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta

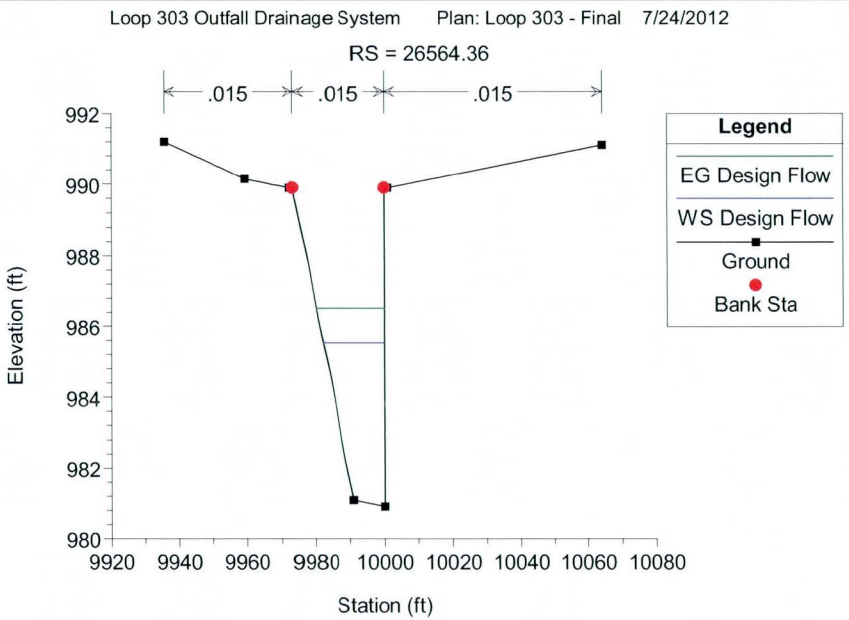

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 26830.63
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

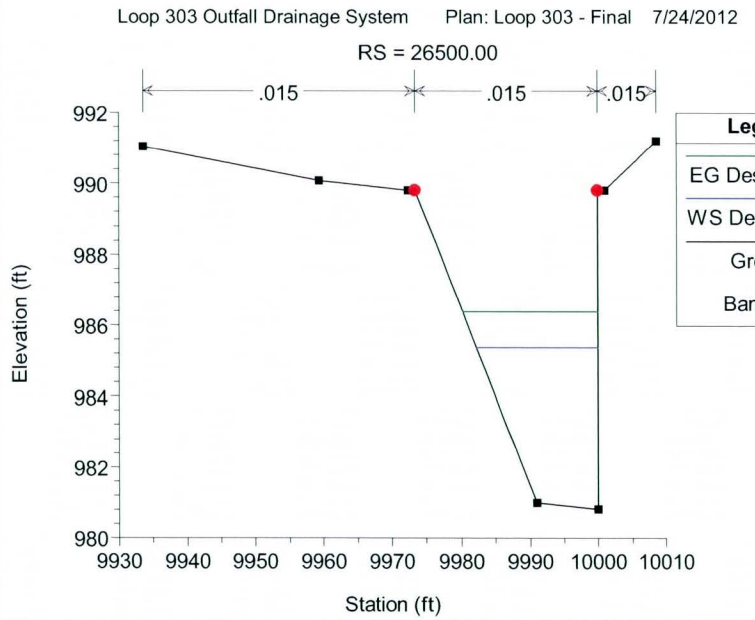

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 26725 Culv Van Buren St Culvert
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

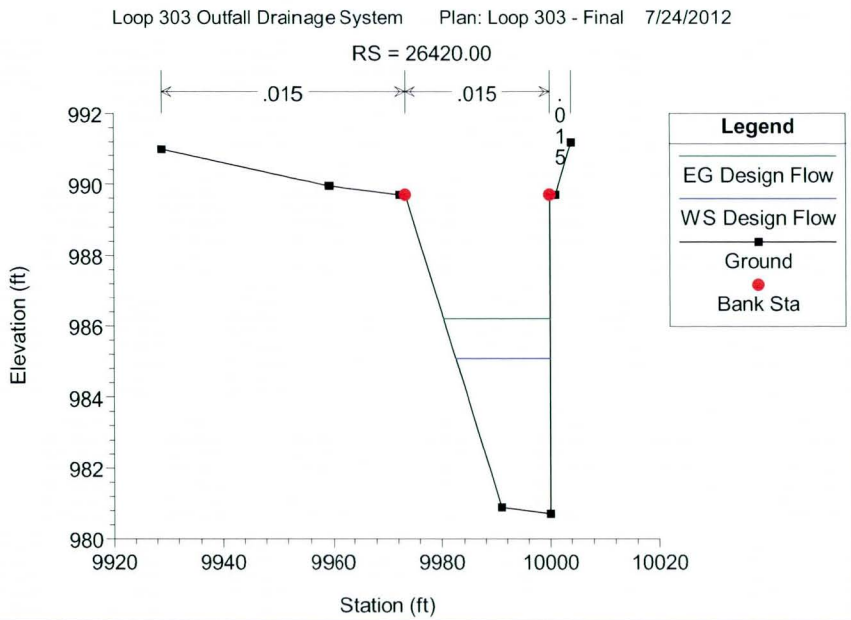

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 26725 Culv Van Buren St Culvert
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

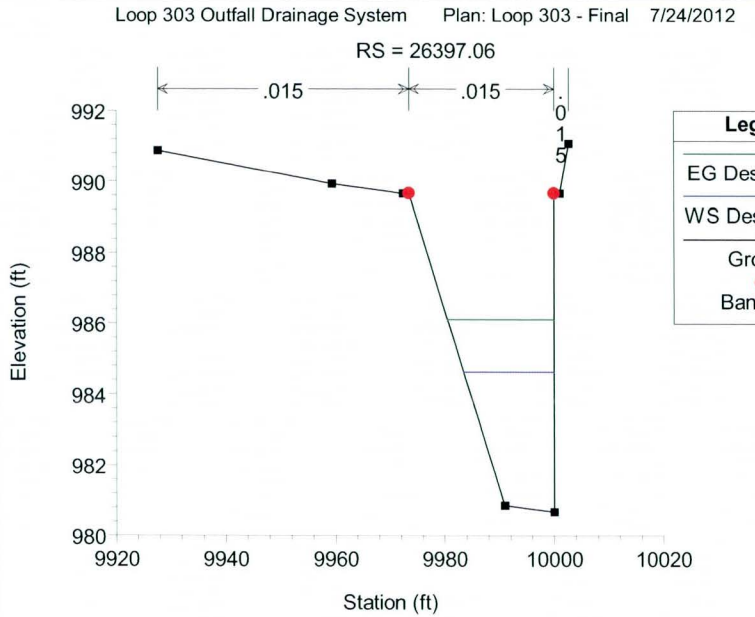

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 26630.12
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

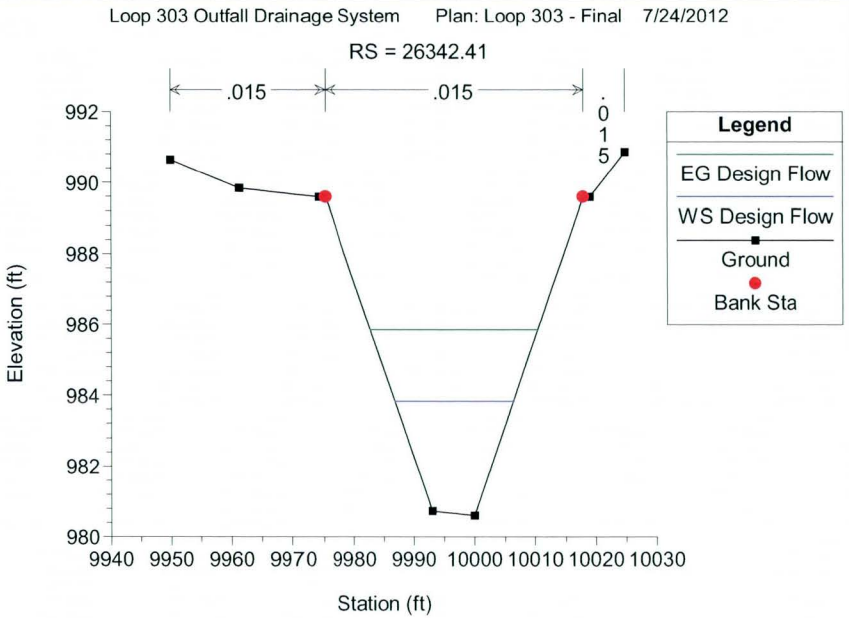

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 26600.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

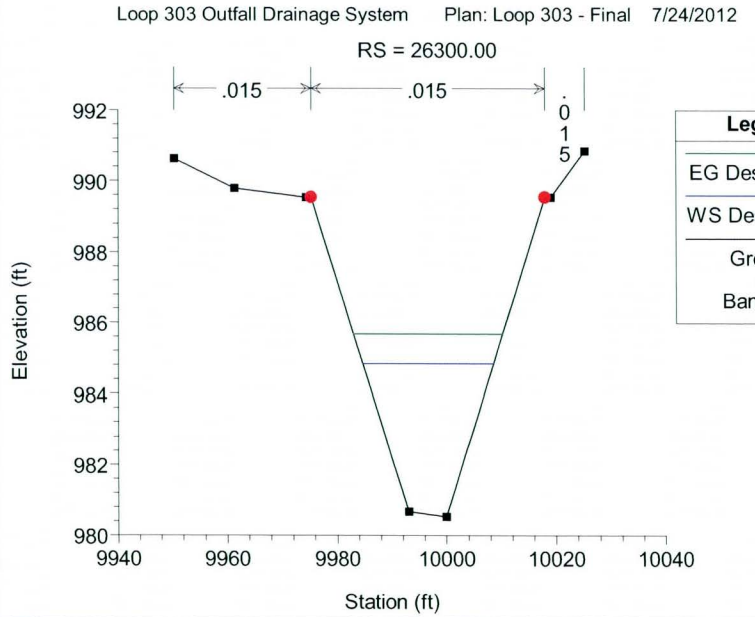

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 26564.36
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

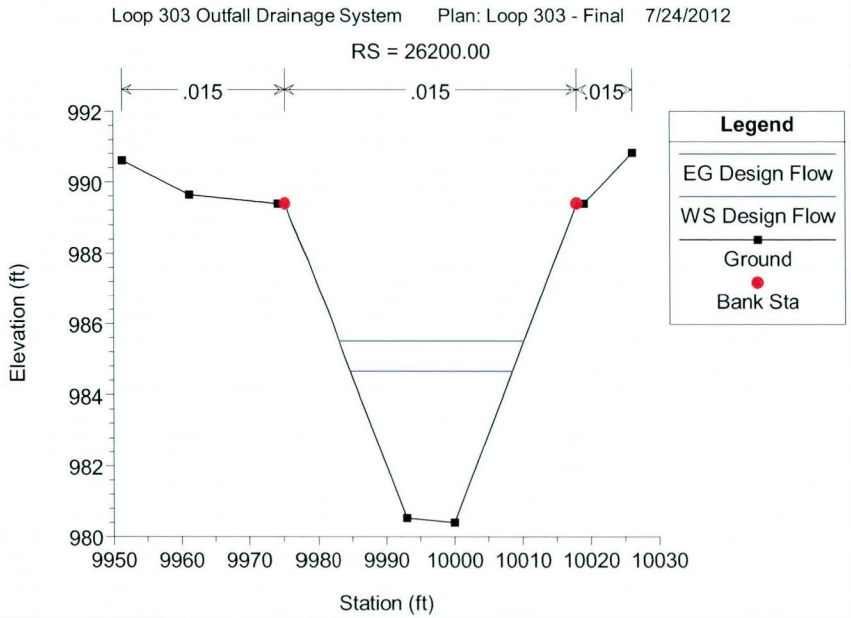

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 26500.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

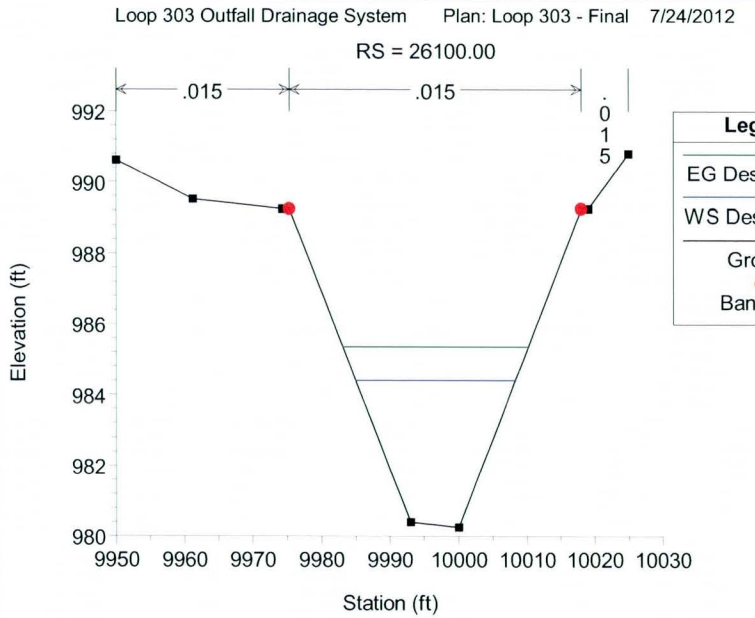

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 26420.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

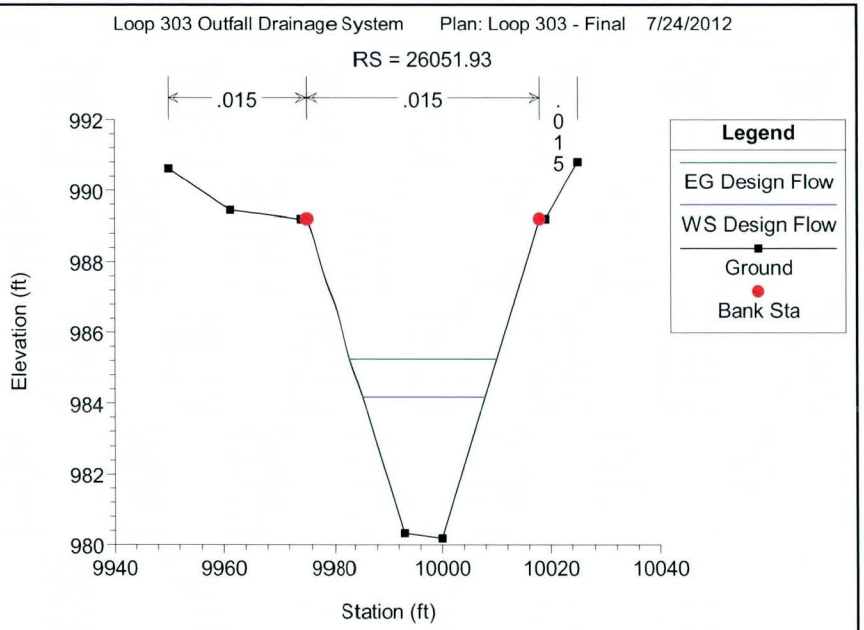

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 26397.06
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

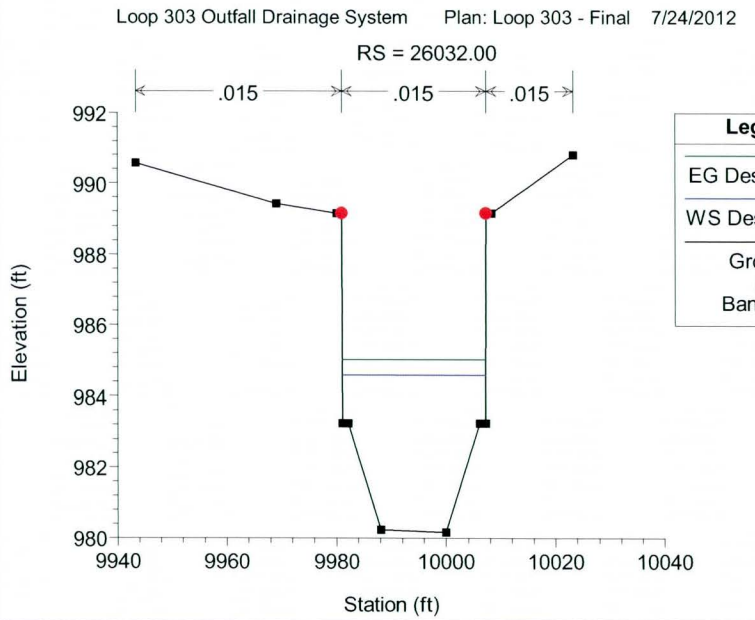

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 26342.41
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

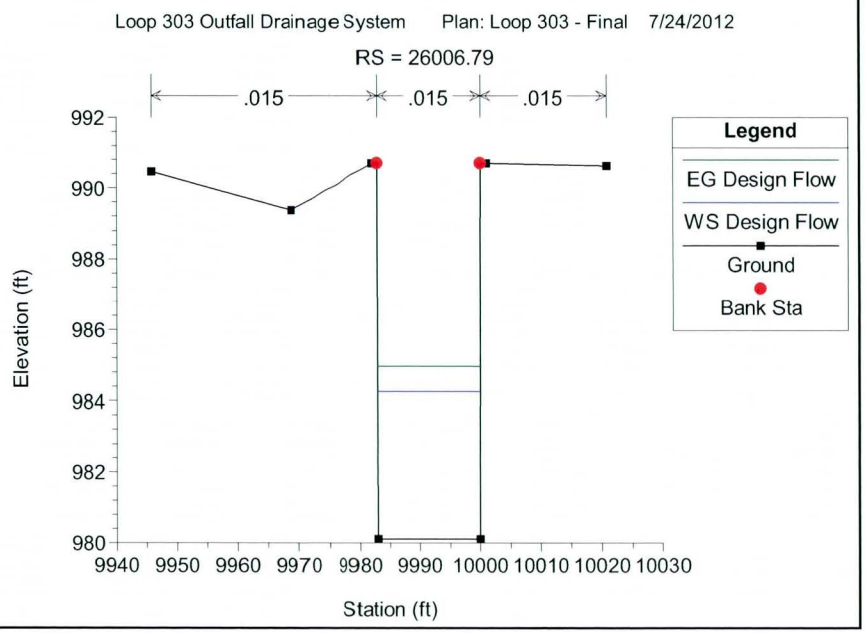

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 26300.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

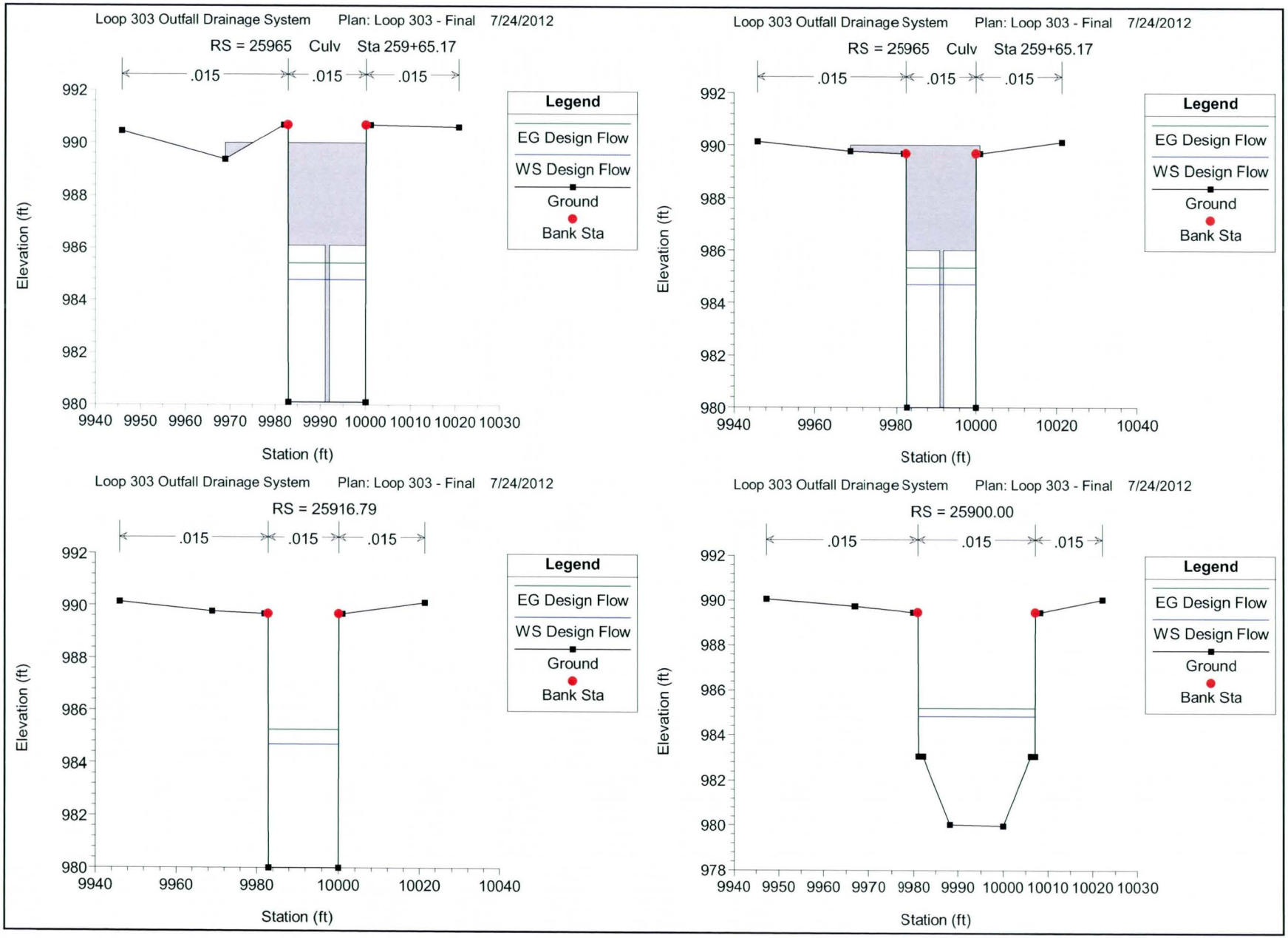

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 26200.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

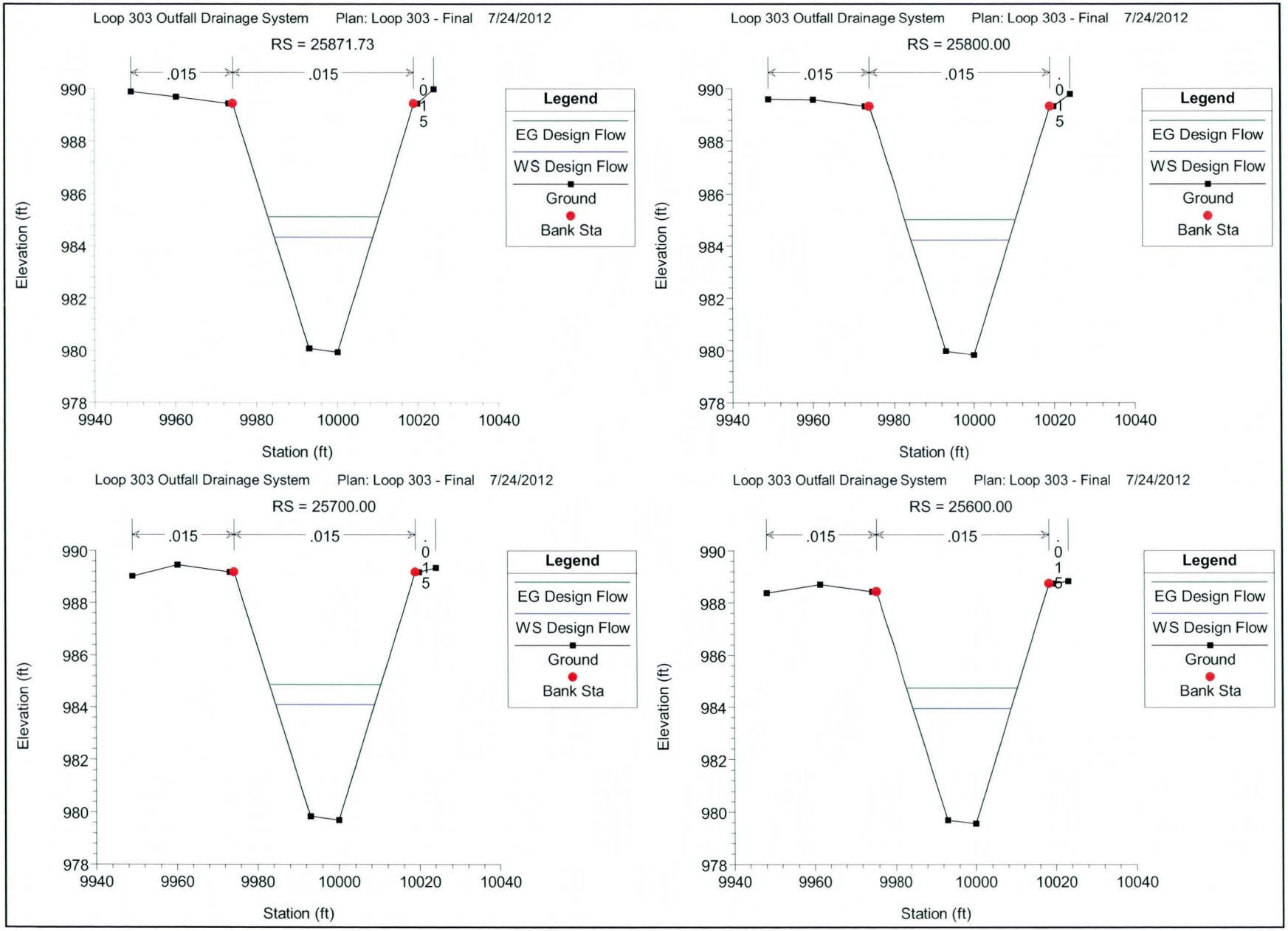

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 26100.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

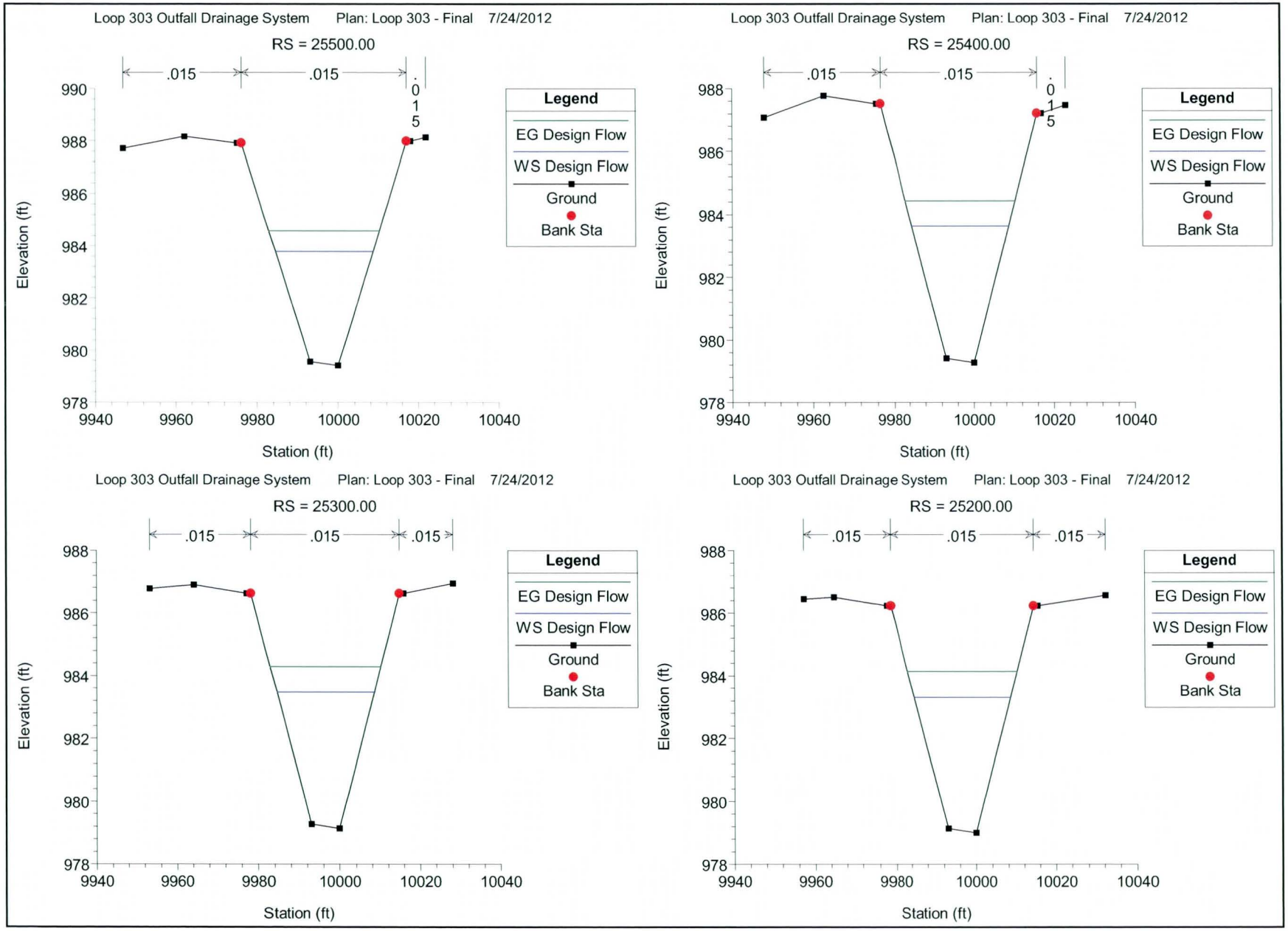

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 26051.93
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

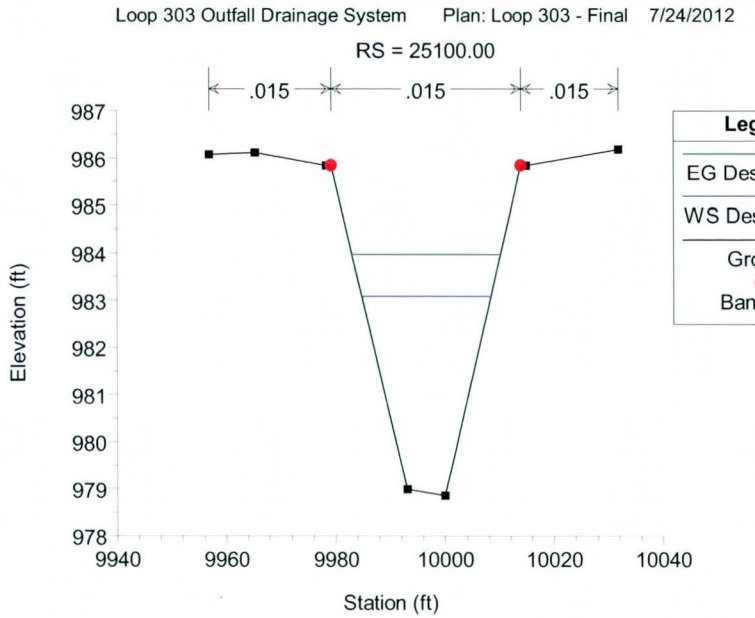

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 26032.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

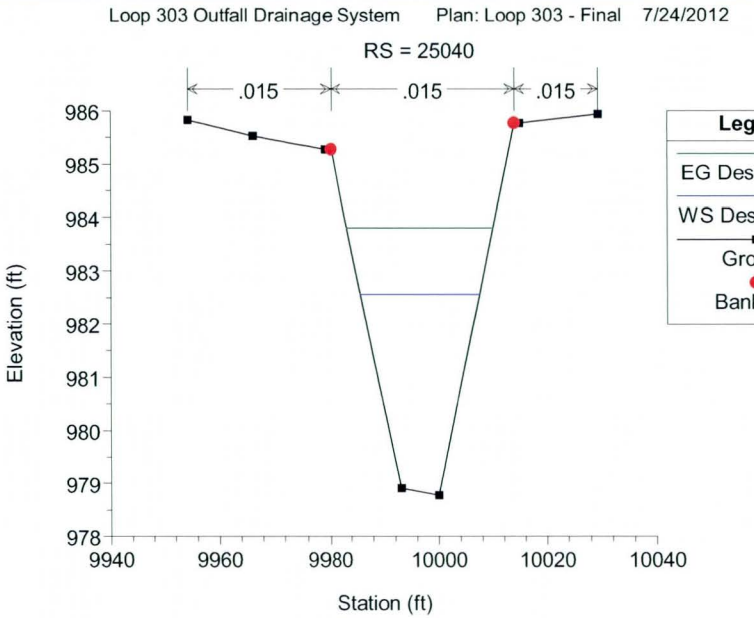

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 26006.79
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

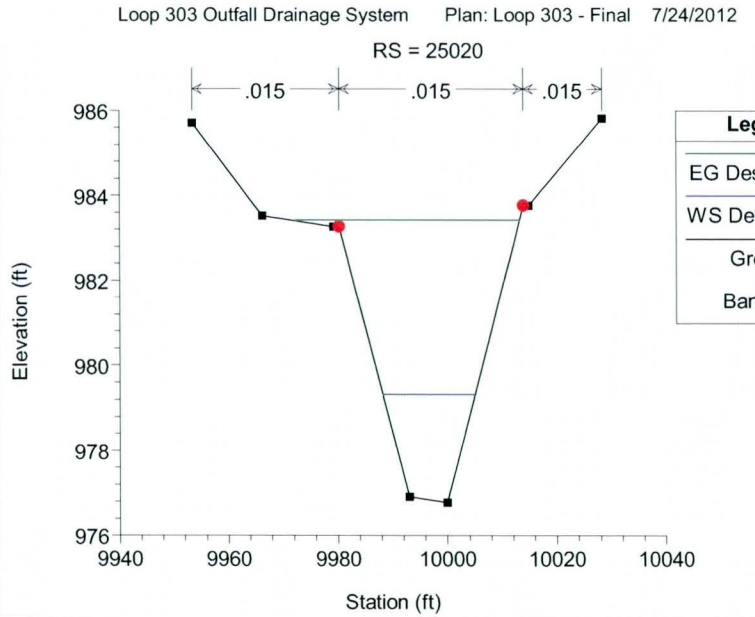

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 25965 Culv Sta 259+65.17
.015 .015 .015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 25965 Culv Sta 259+65.17
.015 .015 .015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 25916.79
.015 .015 .015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 25900.00
.015 .015 .015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

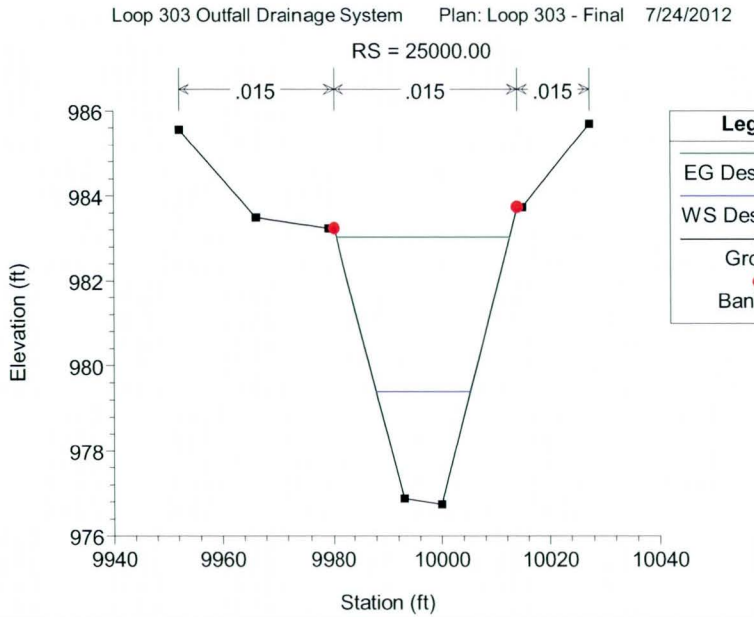

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 25871.73
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 25800.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 25700.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 25600.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

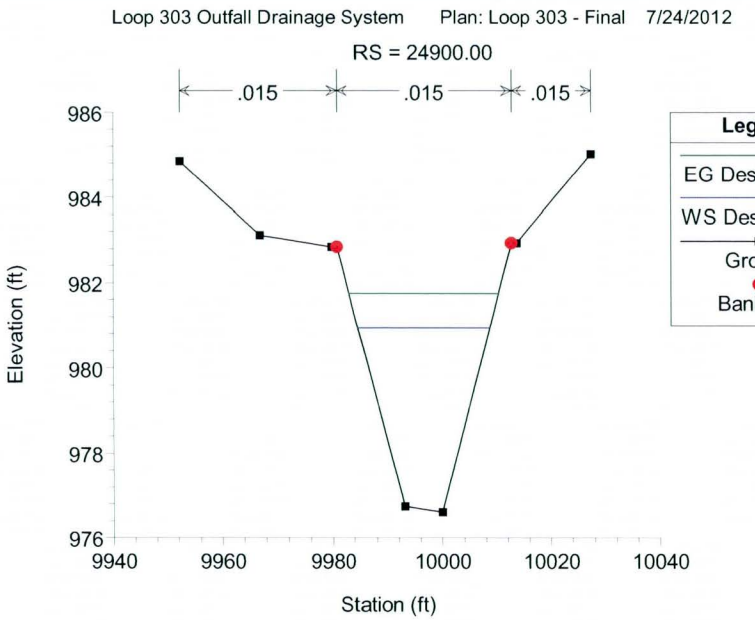

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 25500.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 25400.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 25300.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 25200.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

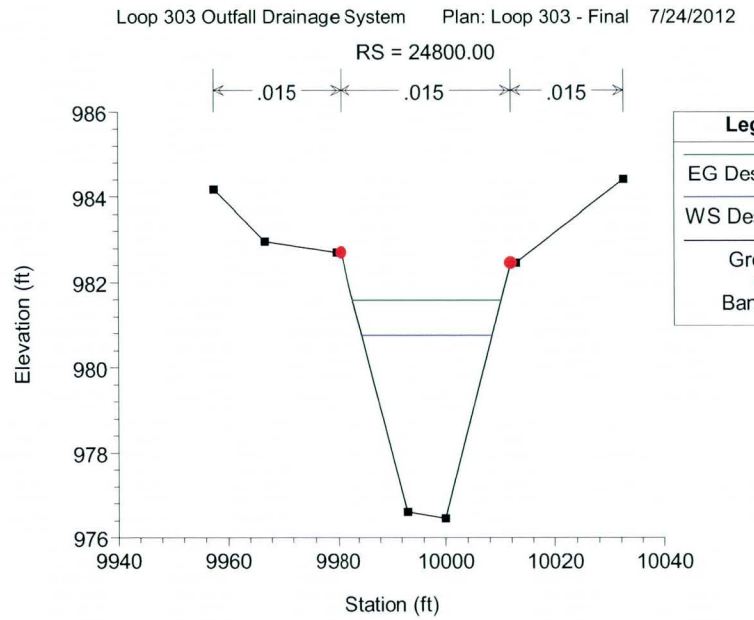

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 25100.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

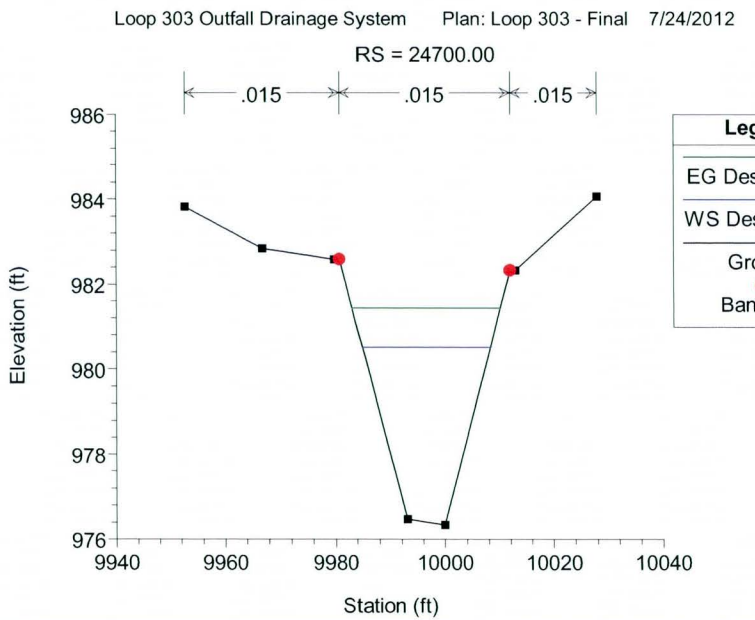

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 25040
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

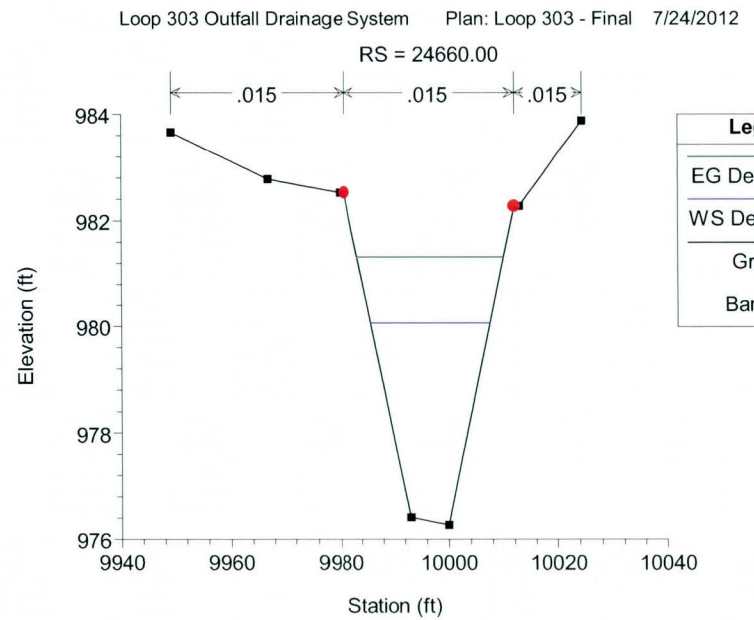

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 25020
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

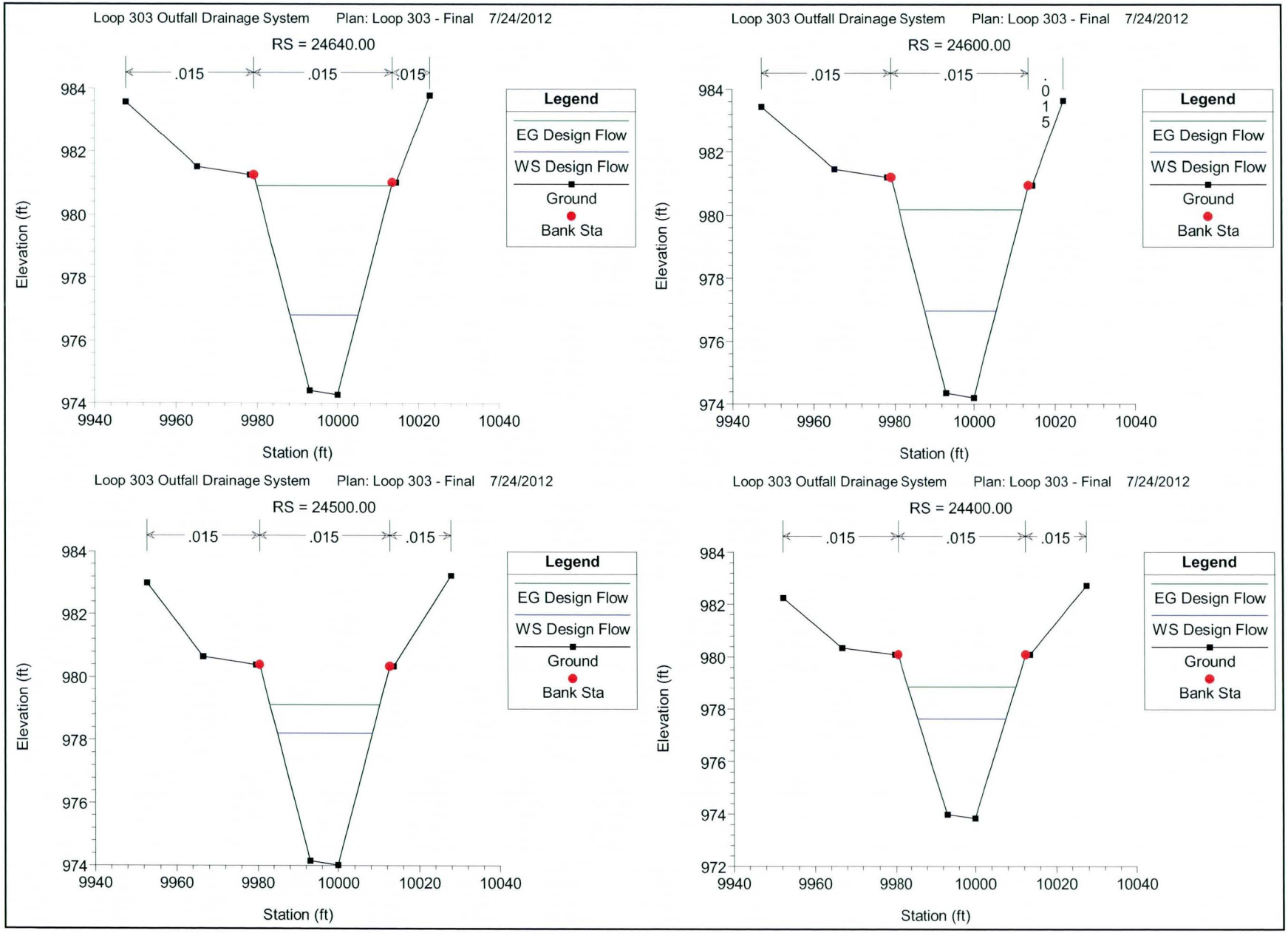

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 25000.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

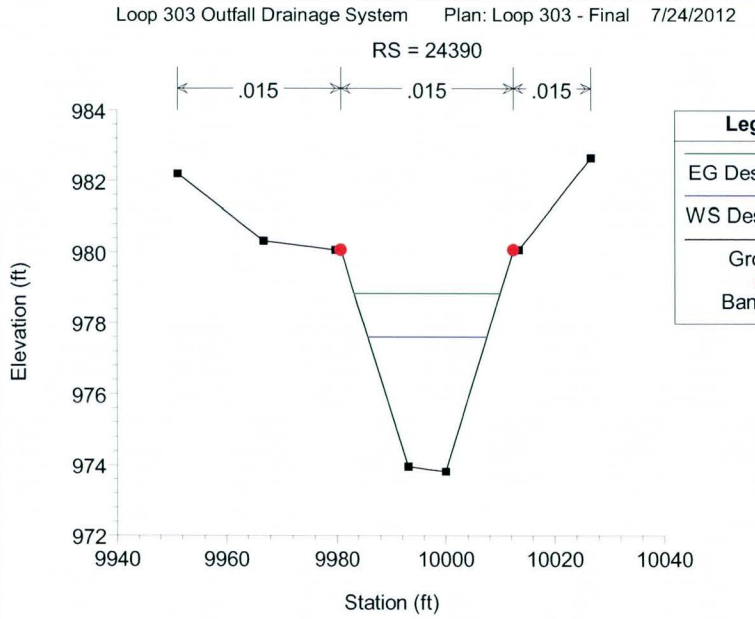

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 24900.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

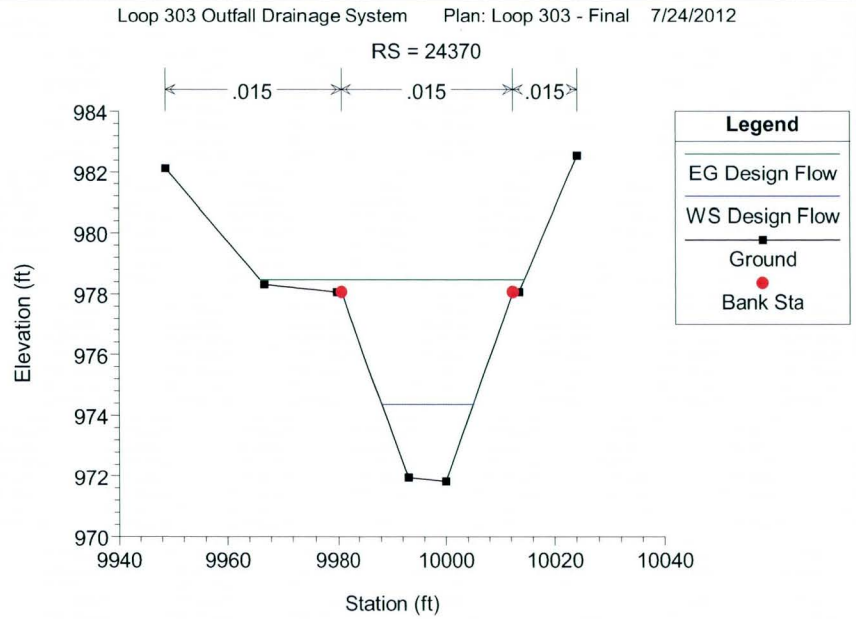

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 24800.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

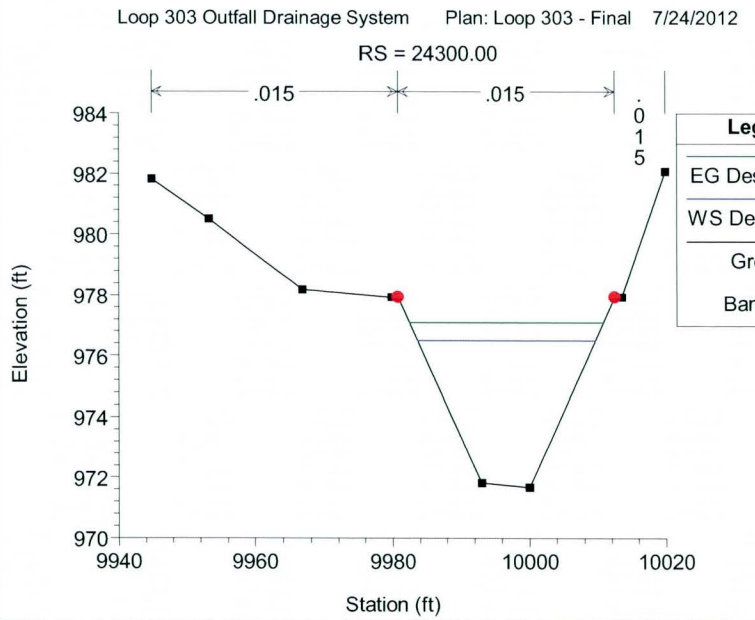

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 24700.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

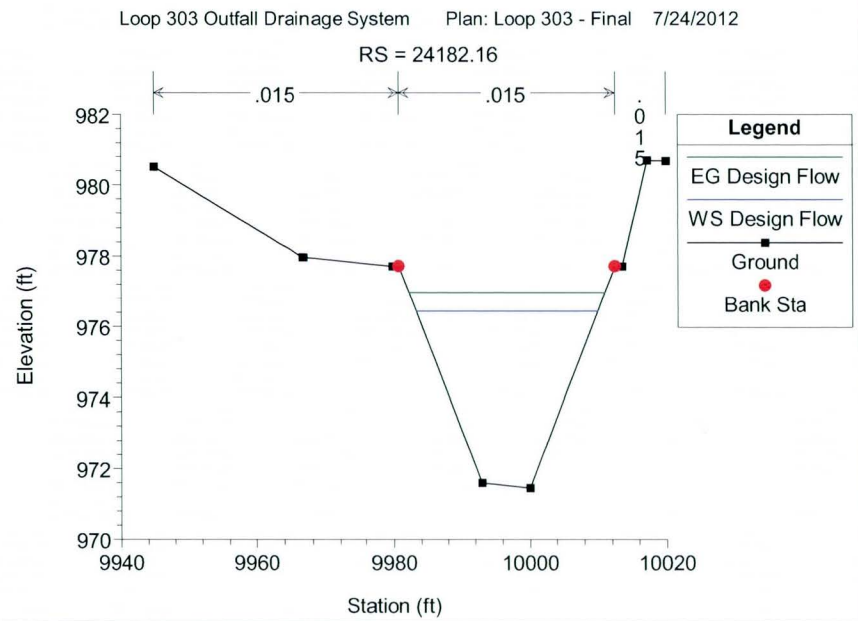

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 24660.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

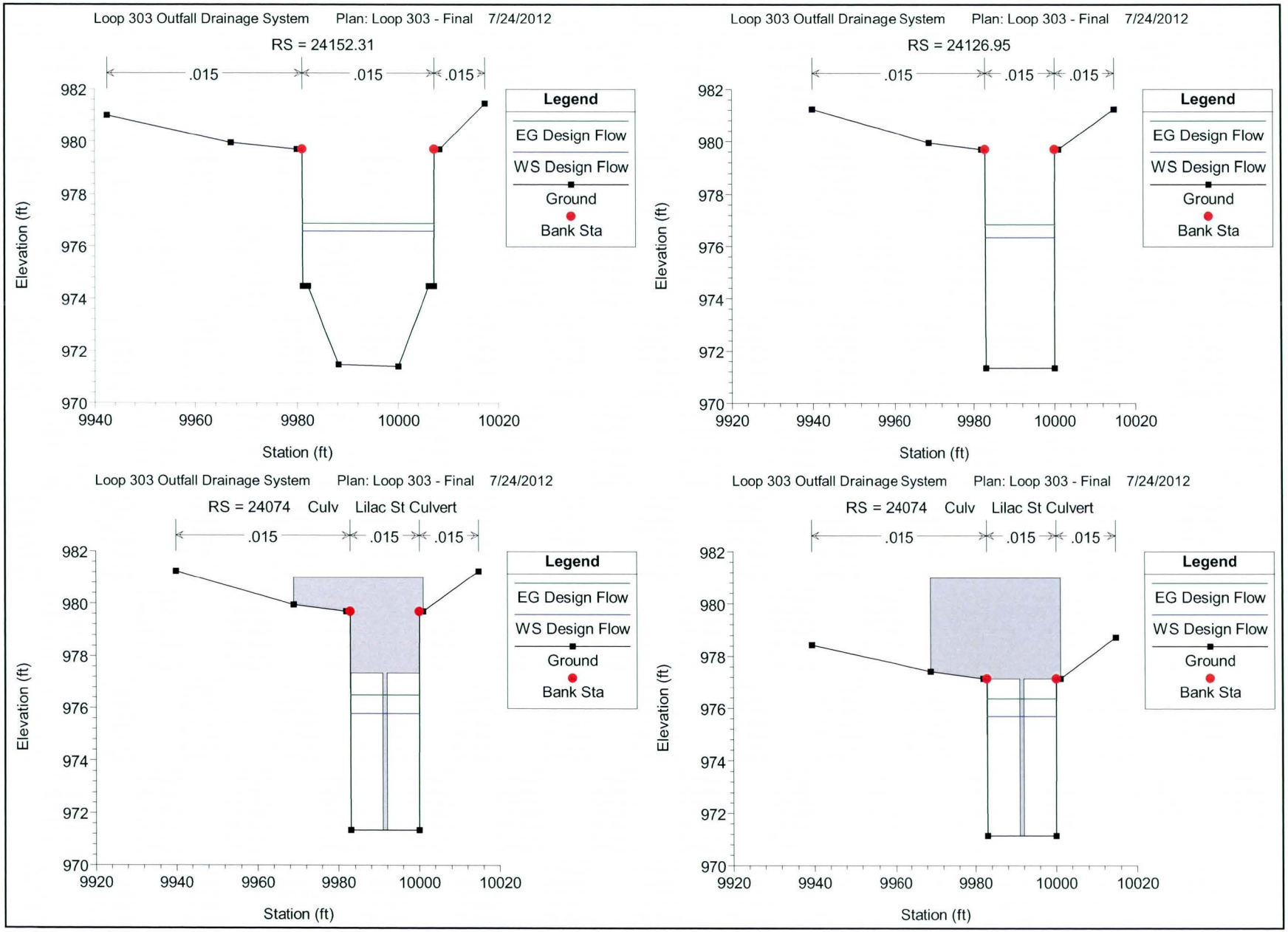

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 24640.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 24600.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 24500.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 24400.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

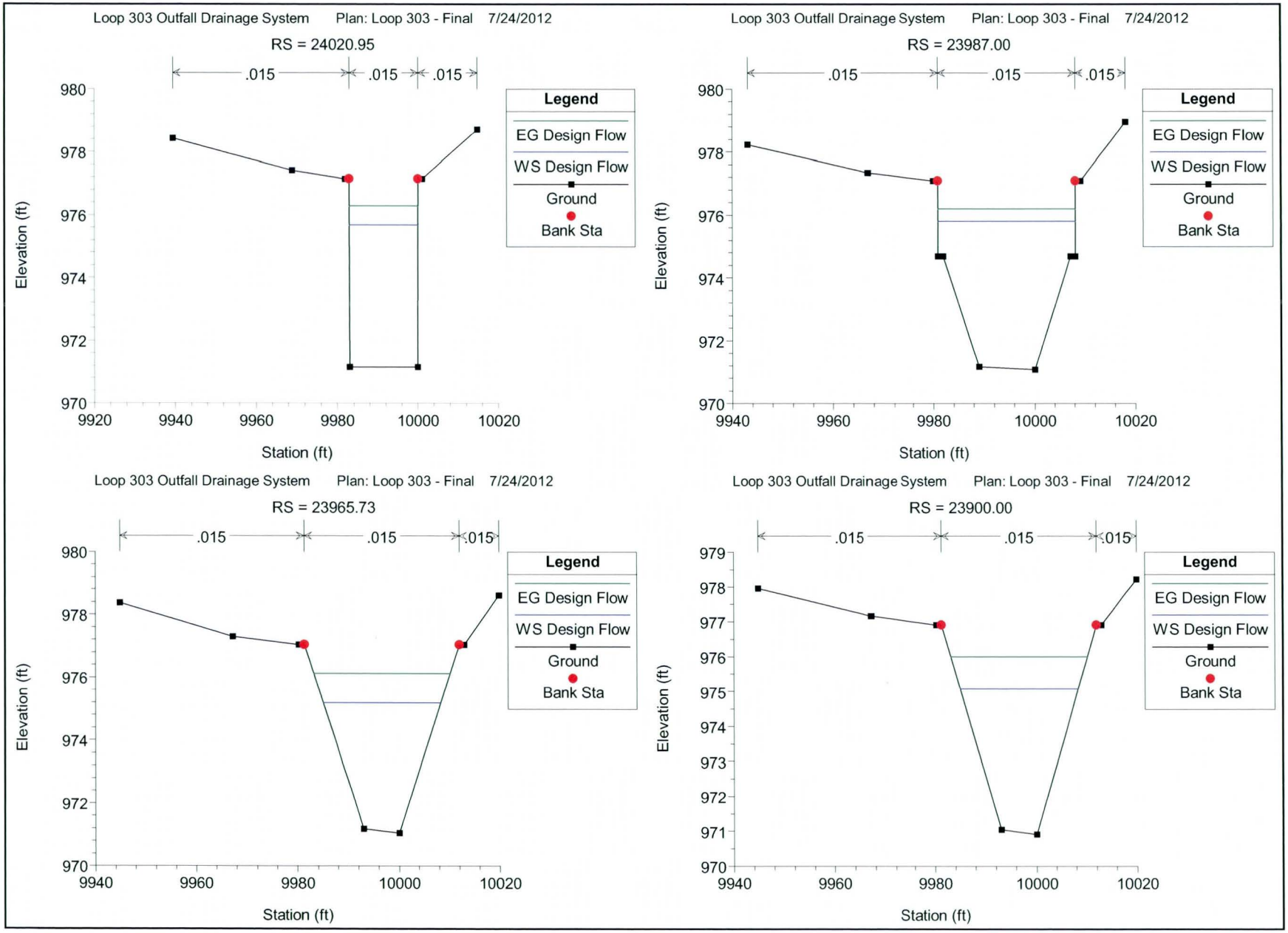

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 24390
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

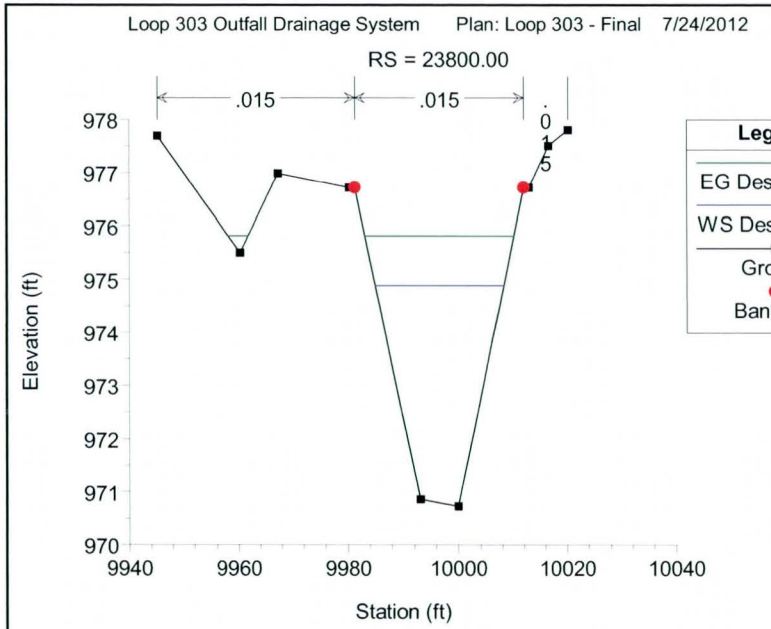

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 24370
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

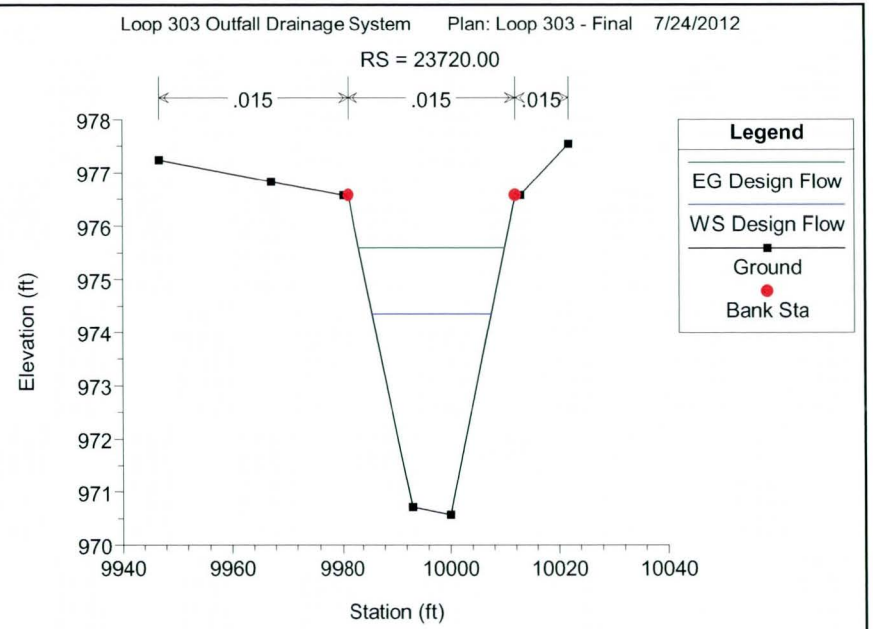

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 24300.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

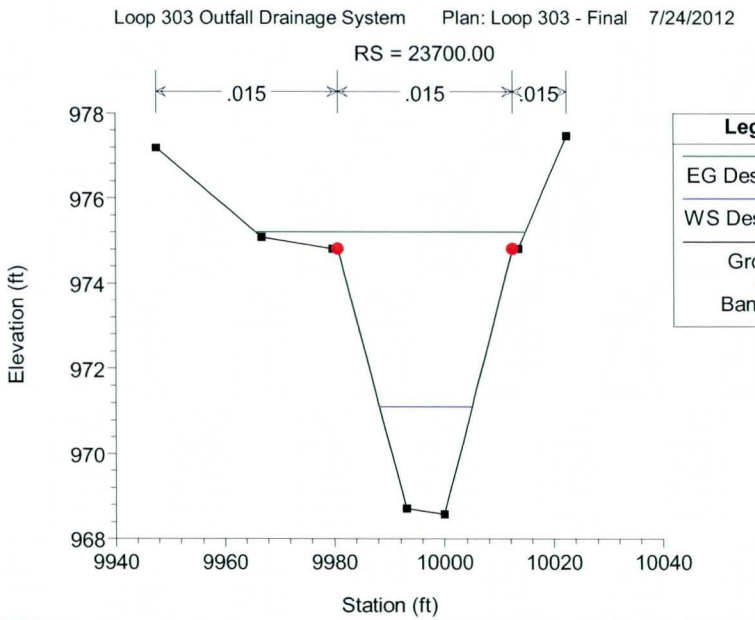

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 24182.16
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

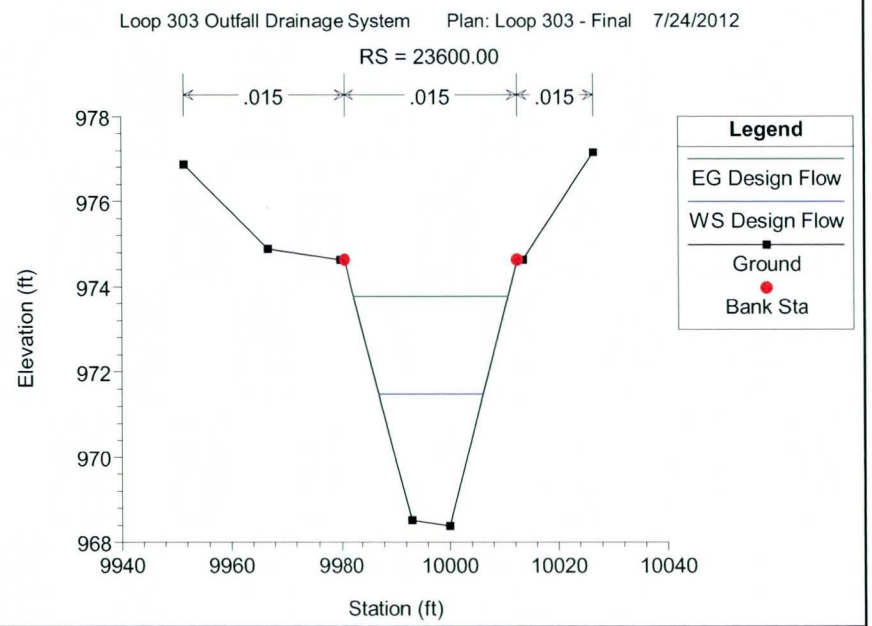

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 24152.31
.015 .015 .015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 24126.95
.015 .015 .015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 24074 Culv Lilac St Culvert
.015 .015 .015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 24074 Culv Lilac St Culvert
.015 .015 .015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

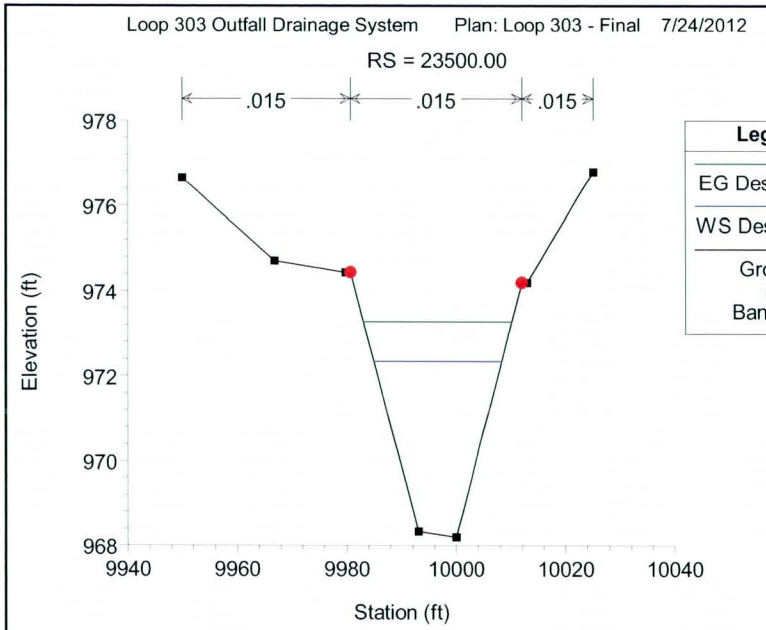

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 24020.95
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 23987.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 23965.73
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 23900.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

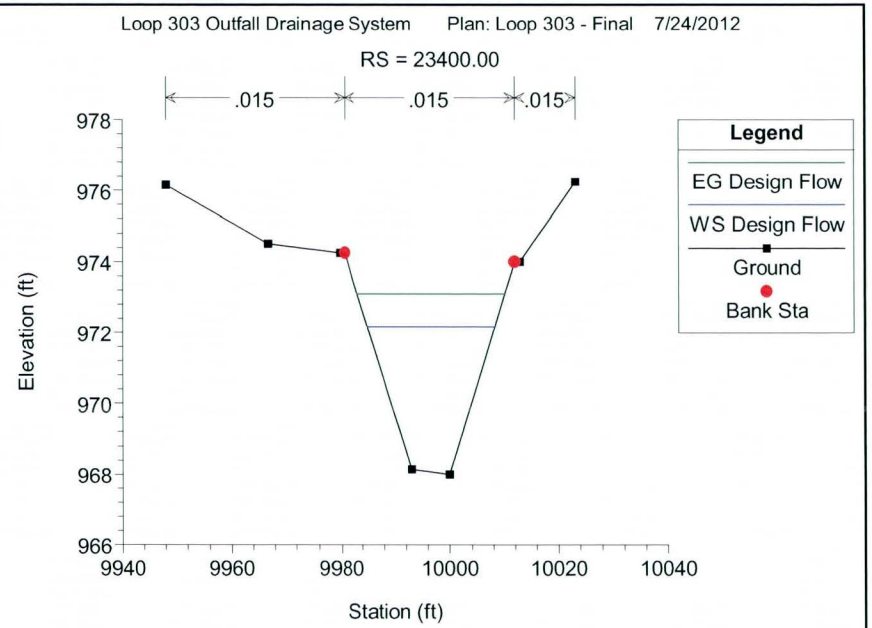

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 23800.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

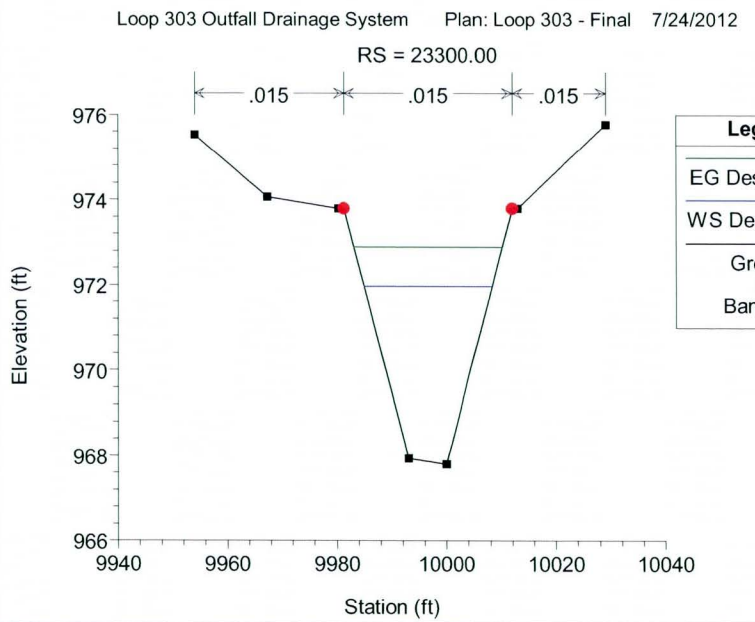

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 23720.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

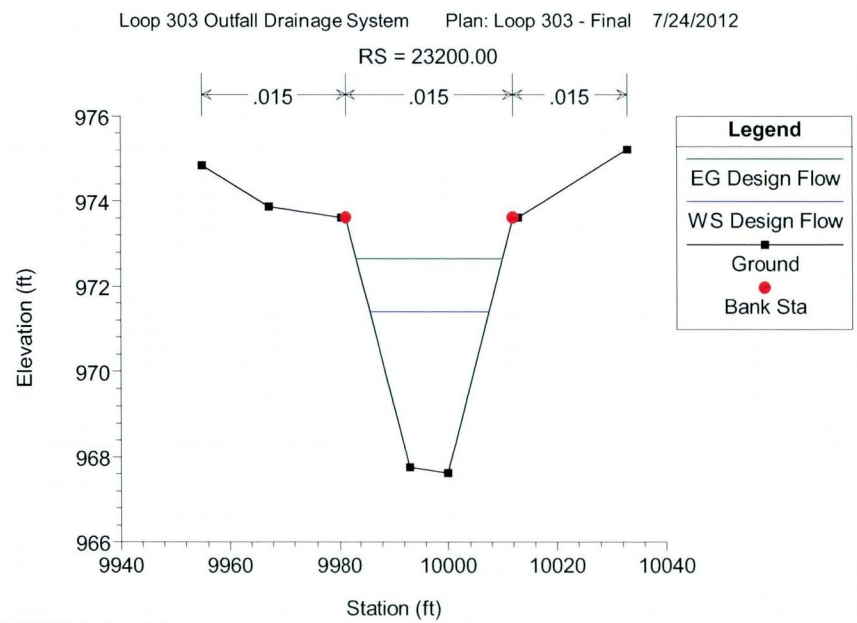

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 23700.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

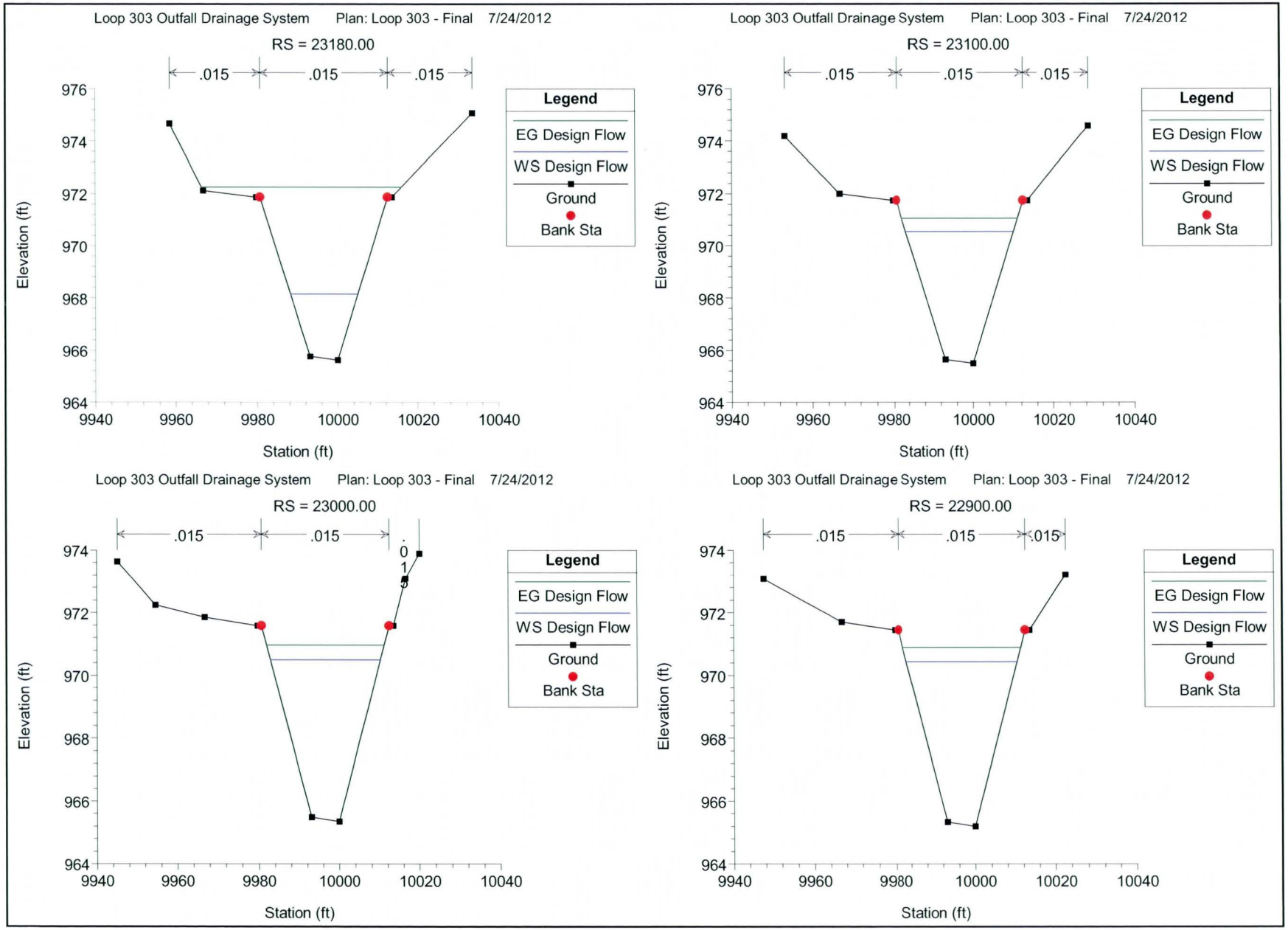

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 23600.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

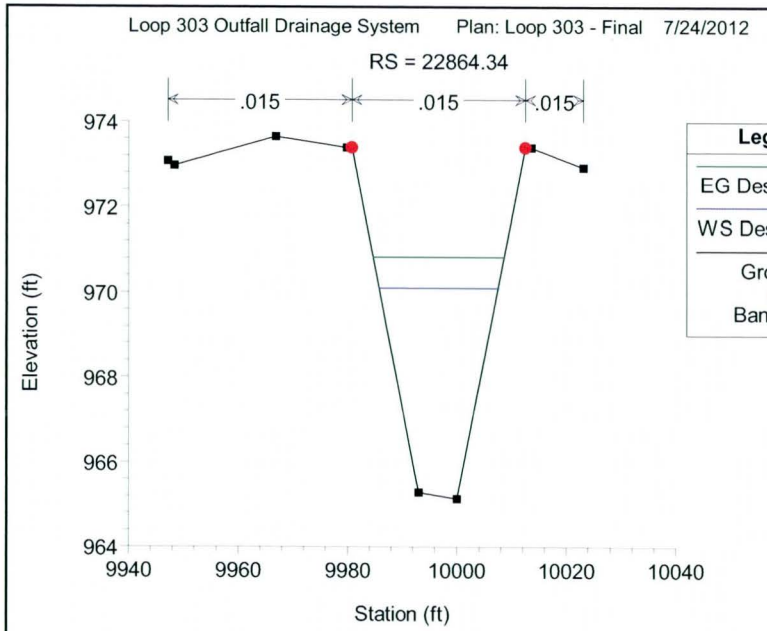

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 23500.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

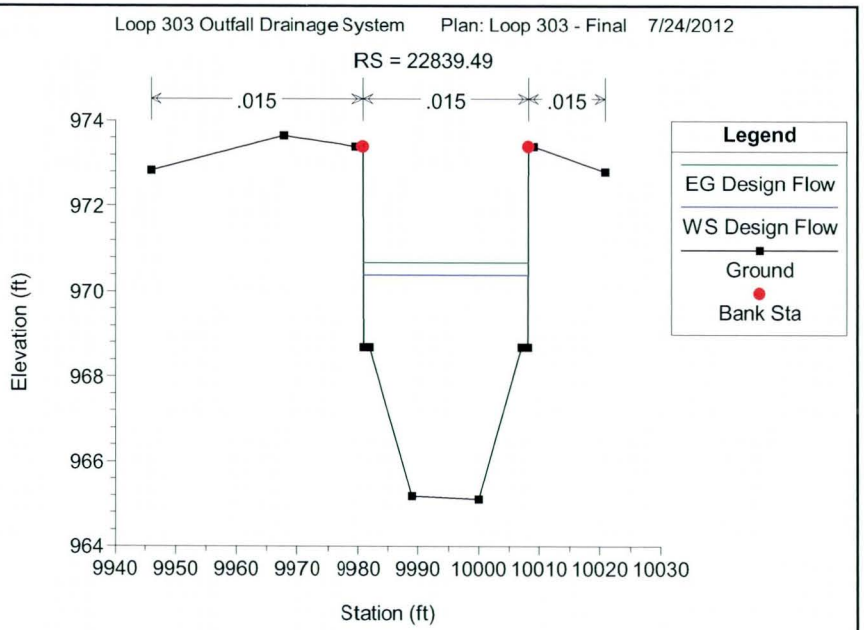

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 23400.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

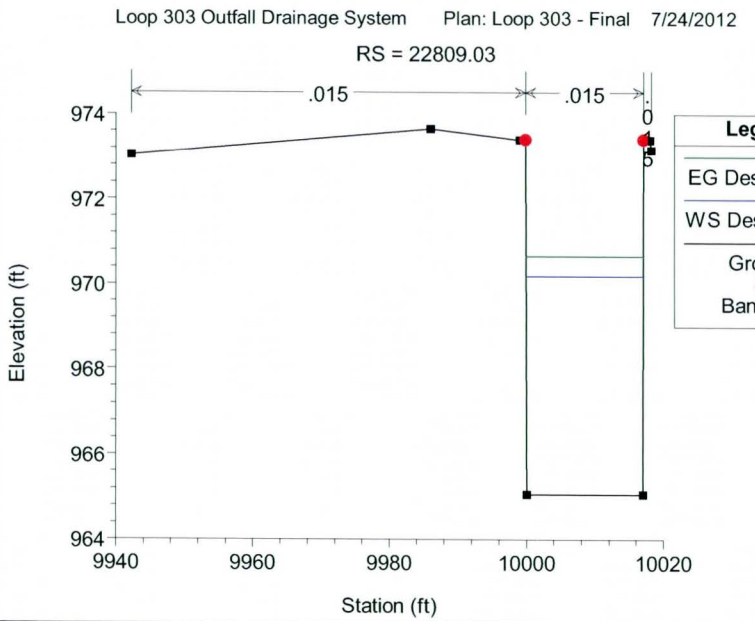

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 23300.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

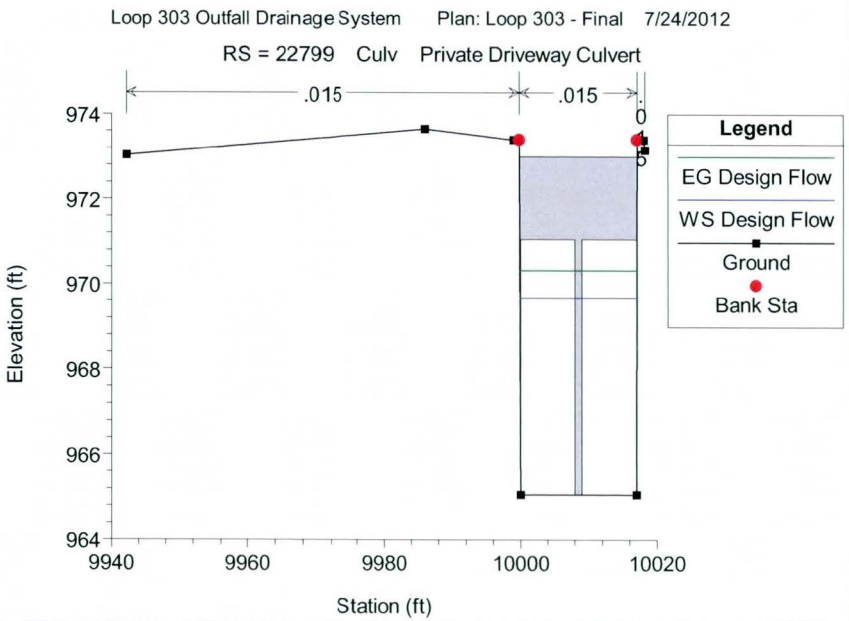

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 23200.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

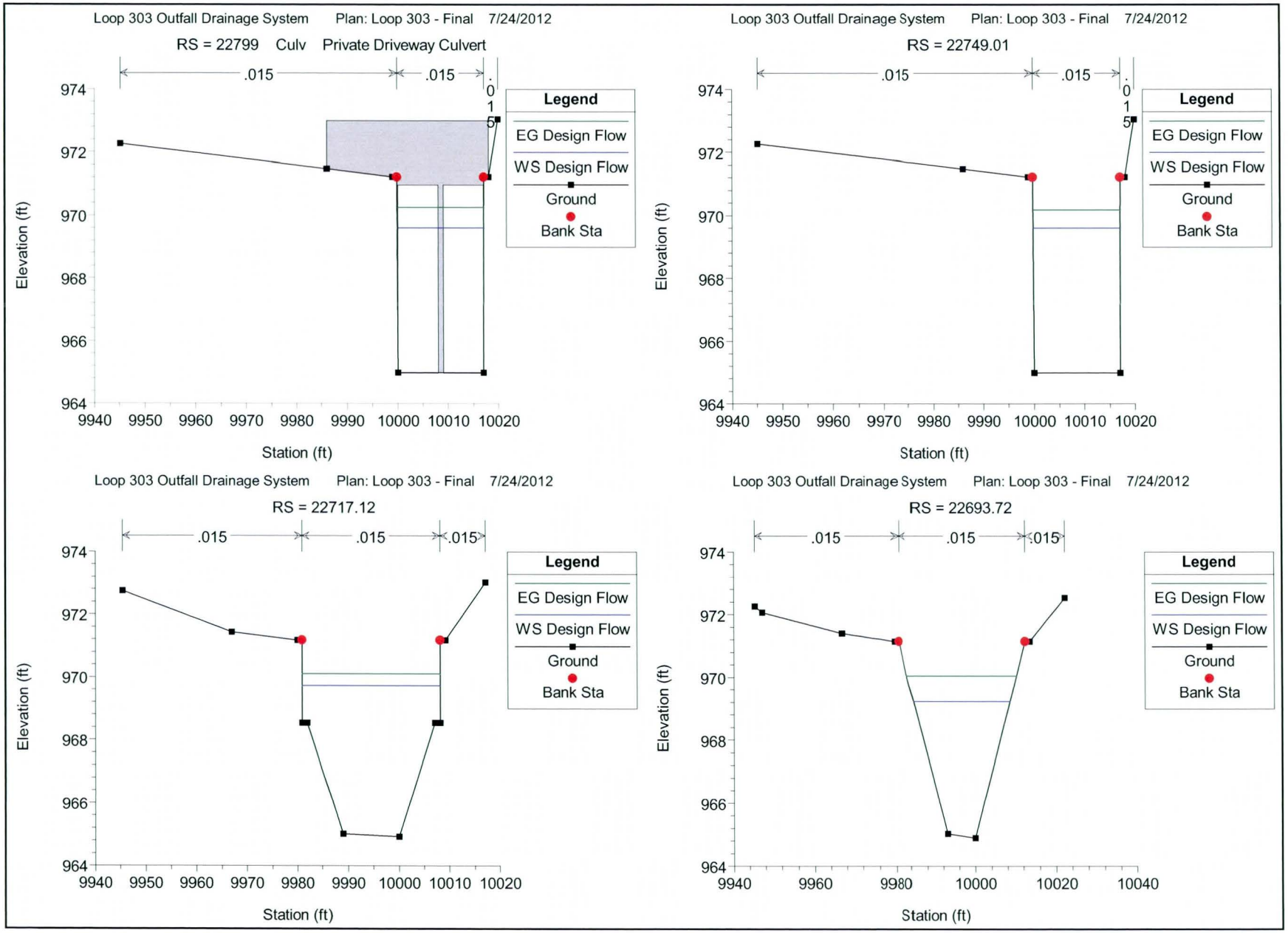

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 23180.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 23100.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 23000.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 22900.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

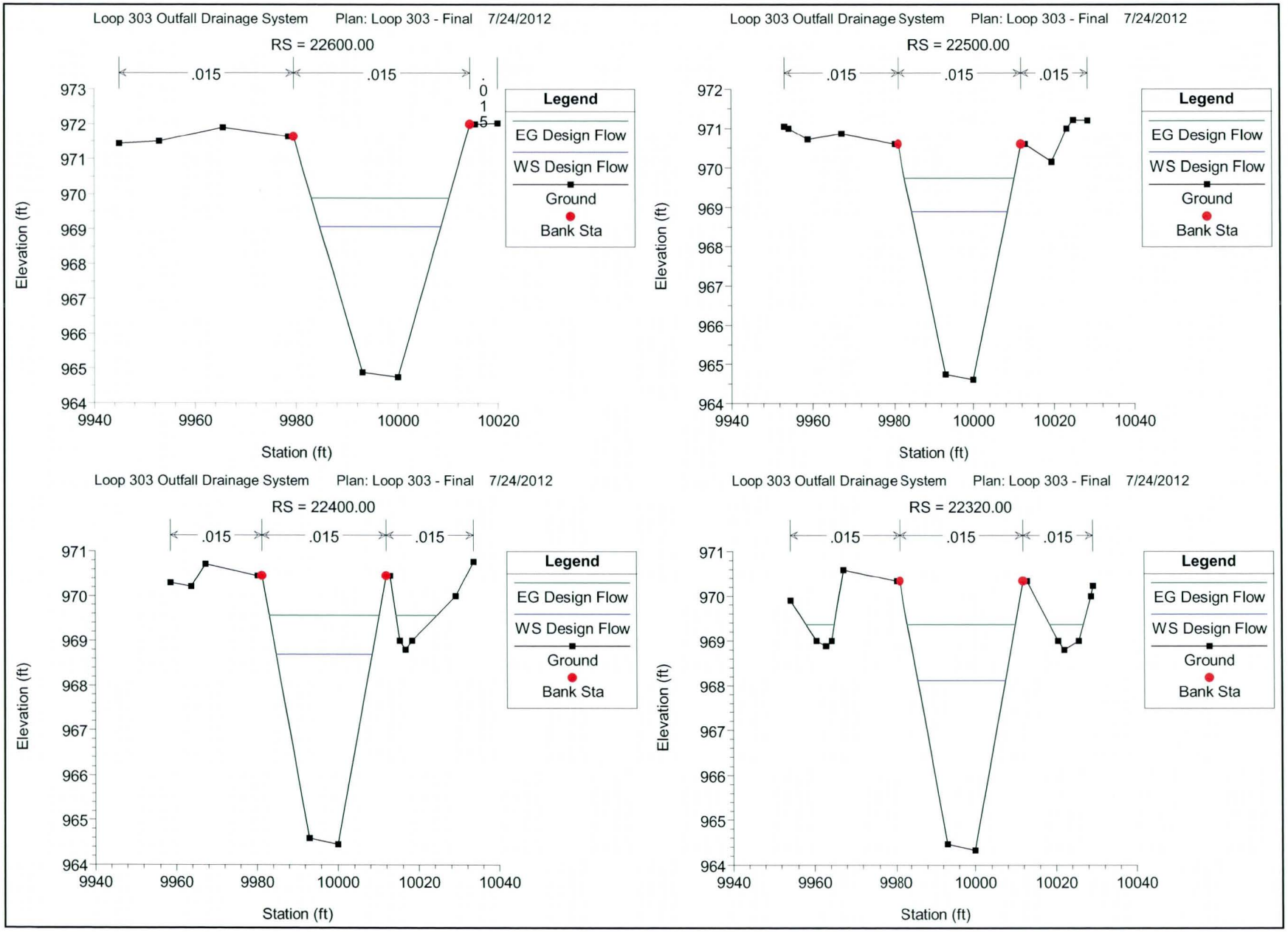

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 22864.34
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

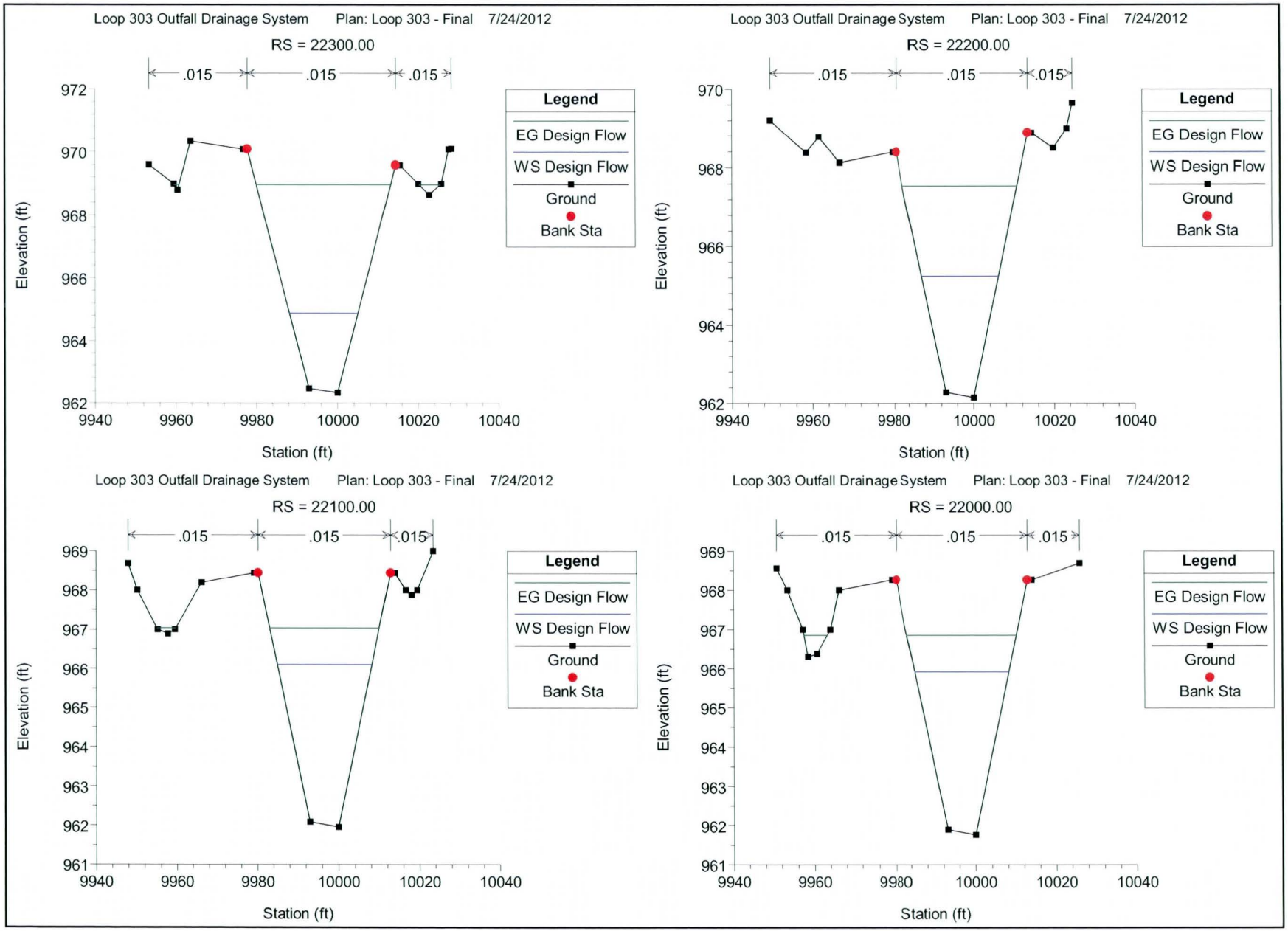

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 22839.49
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

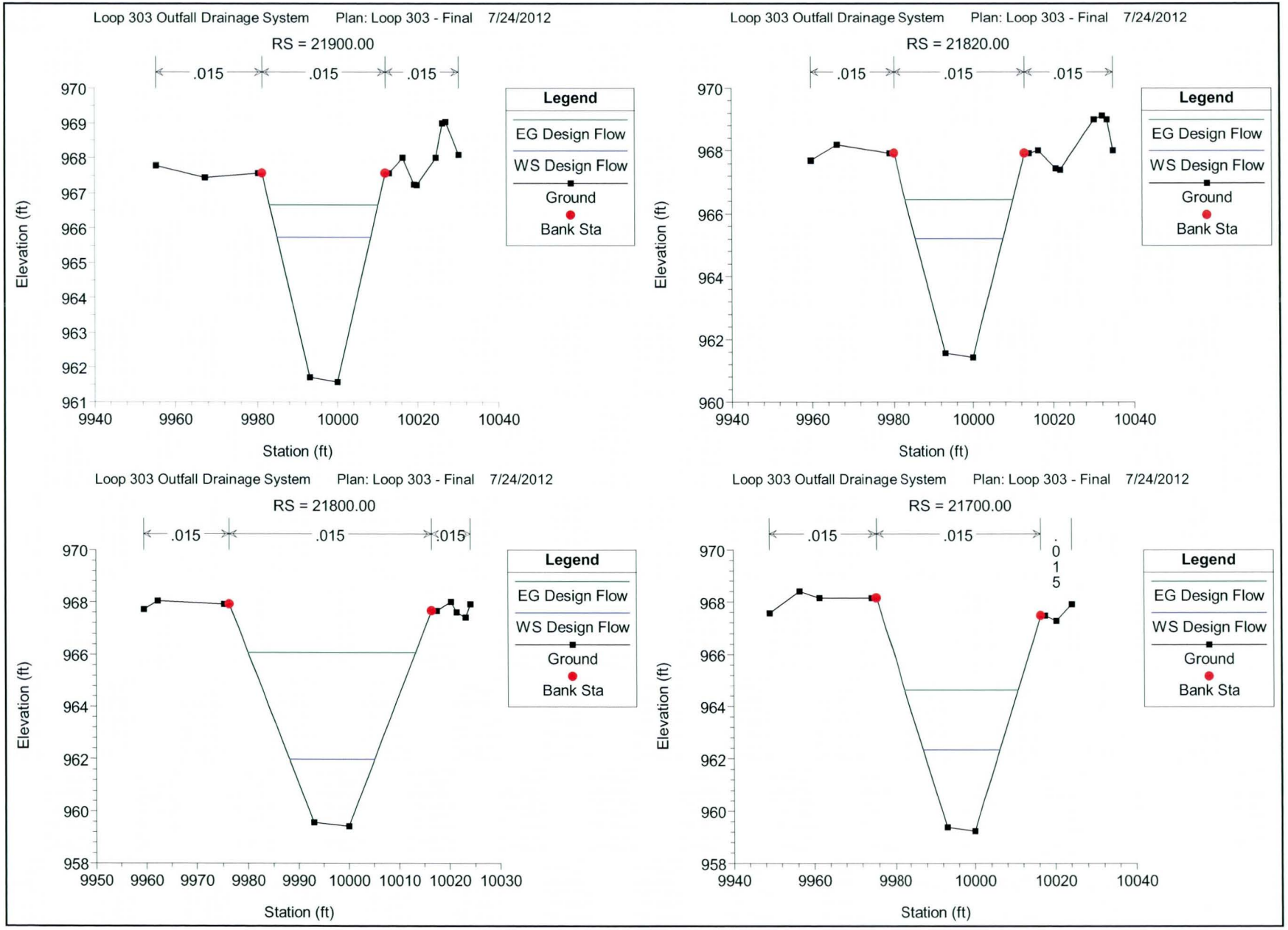

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 22809.03
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

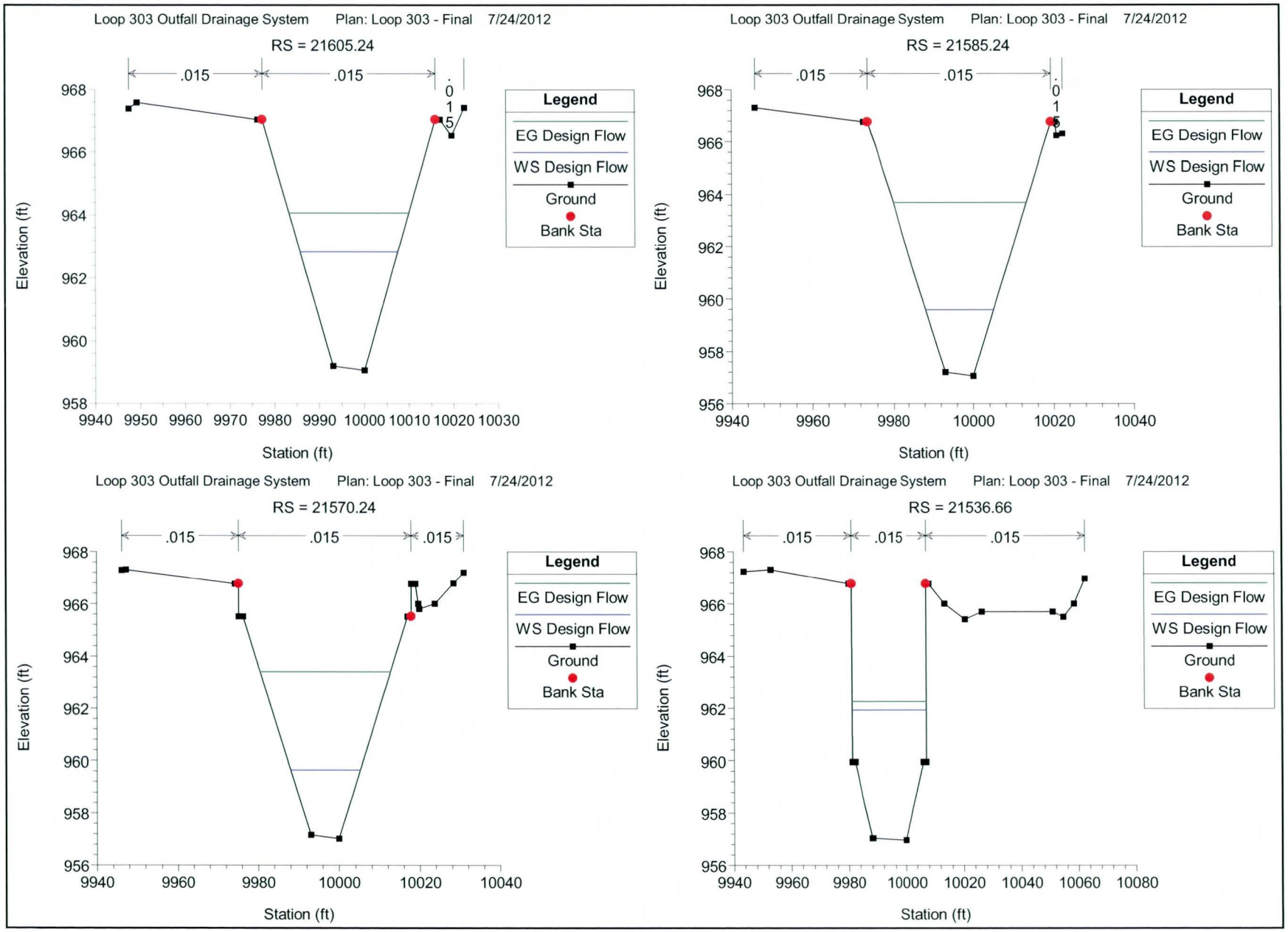

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 22799 Culv Private Driveway Culvert
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

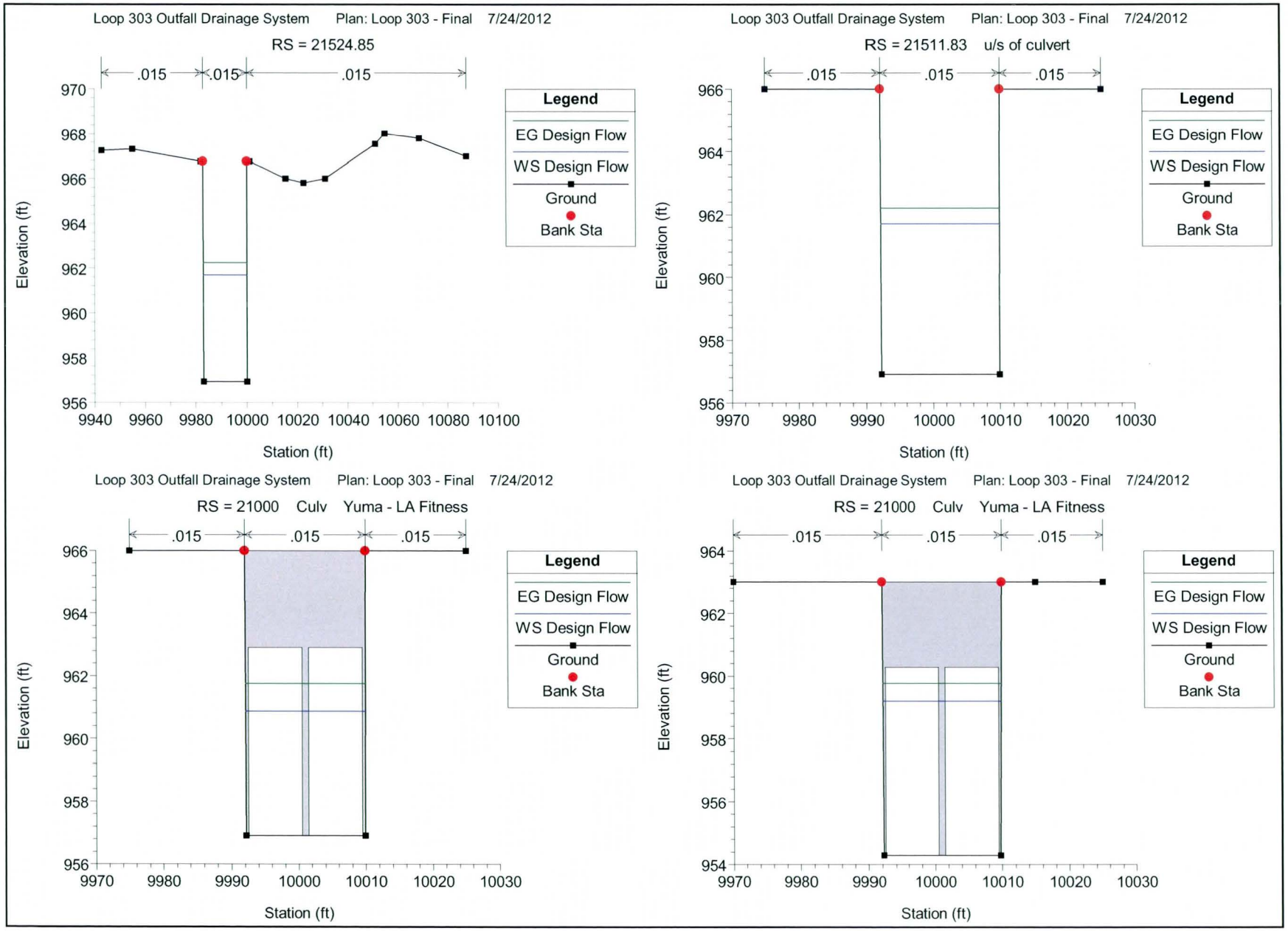

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 22799 Culv Private Driveway Culvert
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 22749.01
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 22717.12
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 22693.72
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

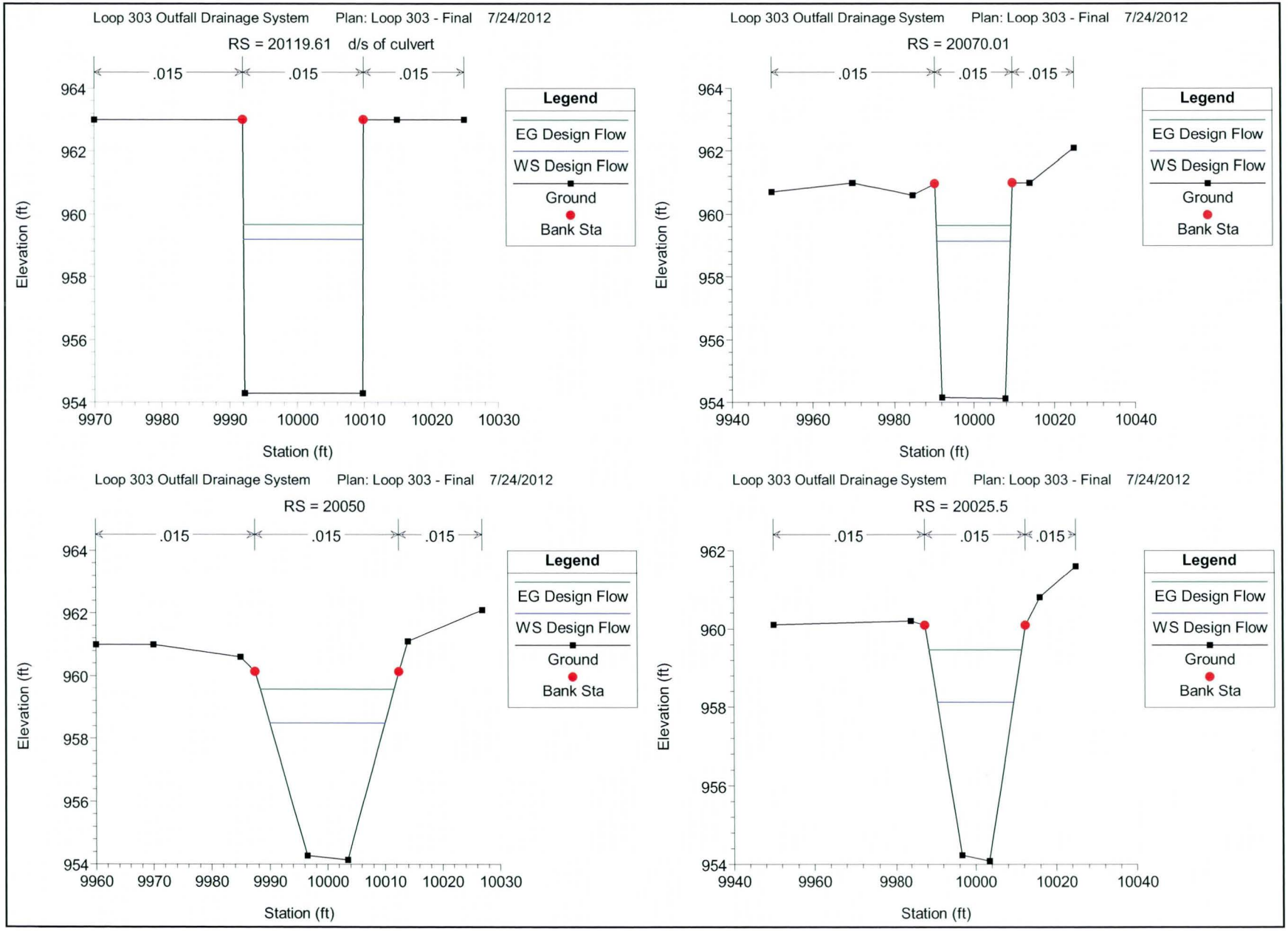

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 22600.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 22500.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 22400.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 22320.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

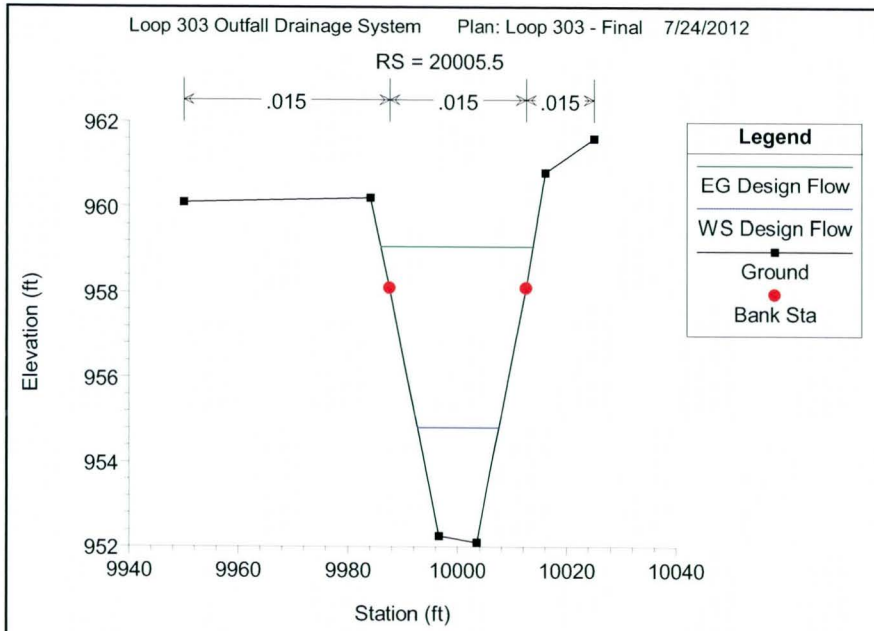

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 22300.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 22200.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 22100.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 22000.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

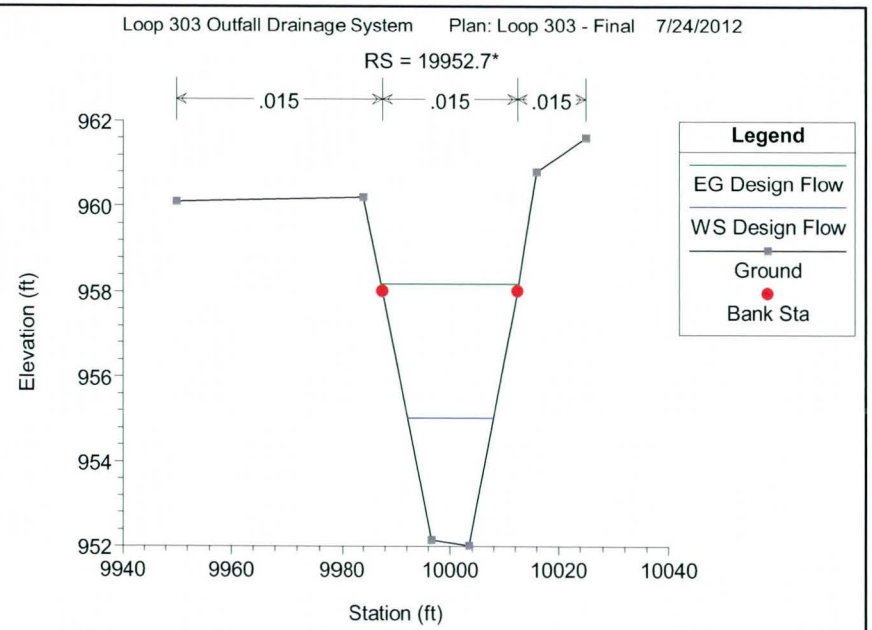

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 21900.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 21820.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 21800.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 21700.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

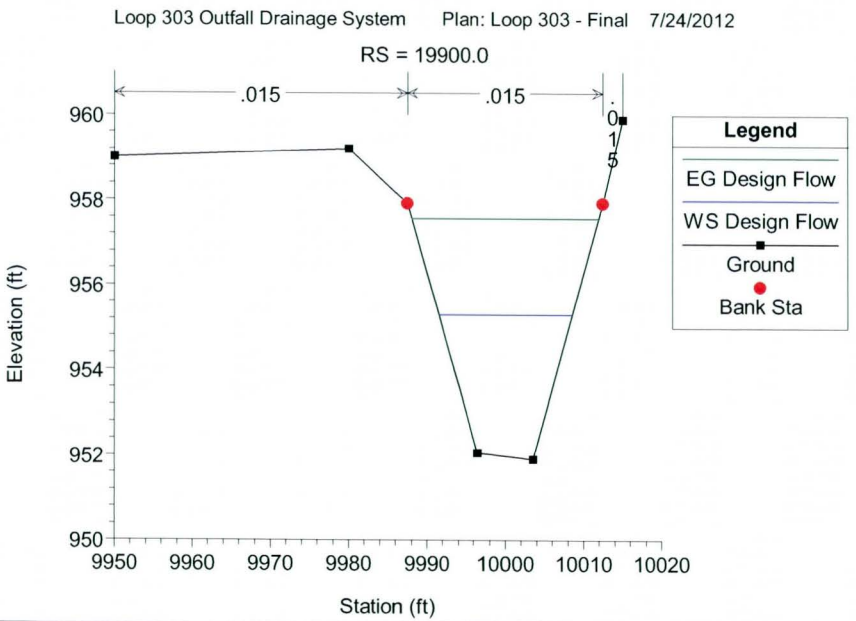

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 21605.24
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 21585.24
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 21570.24
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 21536.66
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

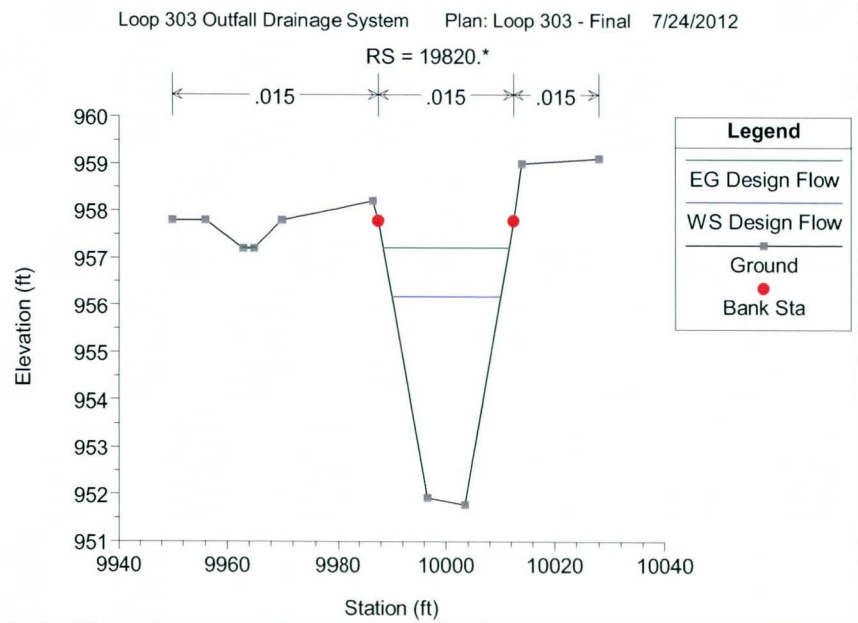

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 21524.85
.015 .015 .015
Elevation (ft)
Station (ft)
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 21511.83 u/s of culvert
.015 .015 .015
Elevation (ft)
Station (ft)
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 21000 Culv Yuma - LA Fitness
.015 .015 .015
Elevation (ft)
Station (ft)
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 21000 Culv Yuma - LA Fitness
.015 .015 .015
Elevation (ft)
Station (ft)
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta

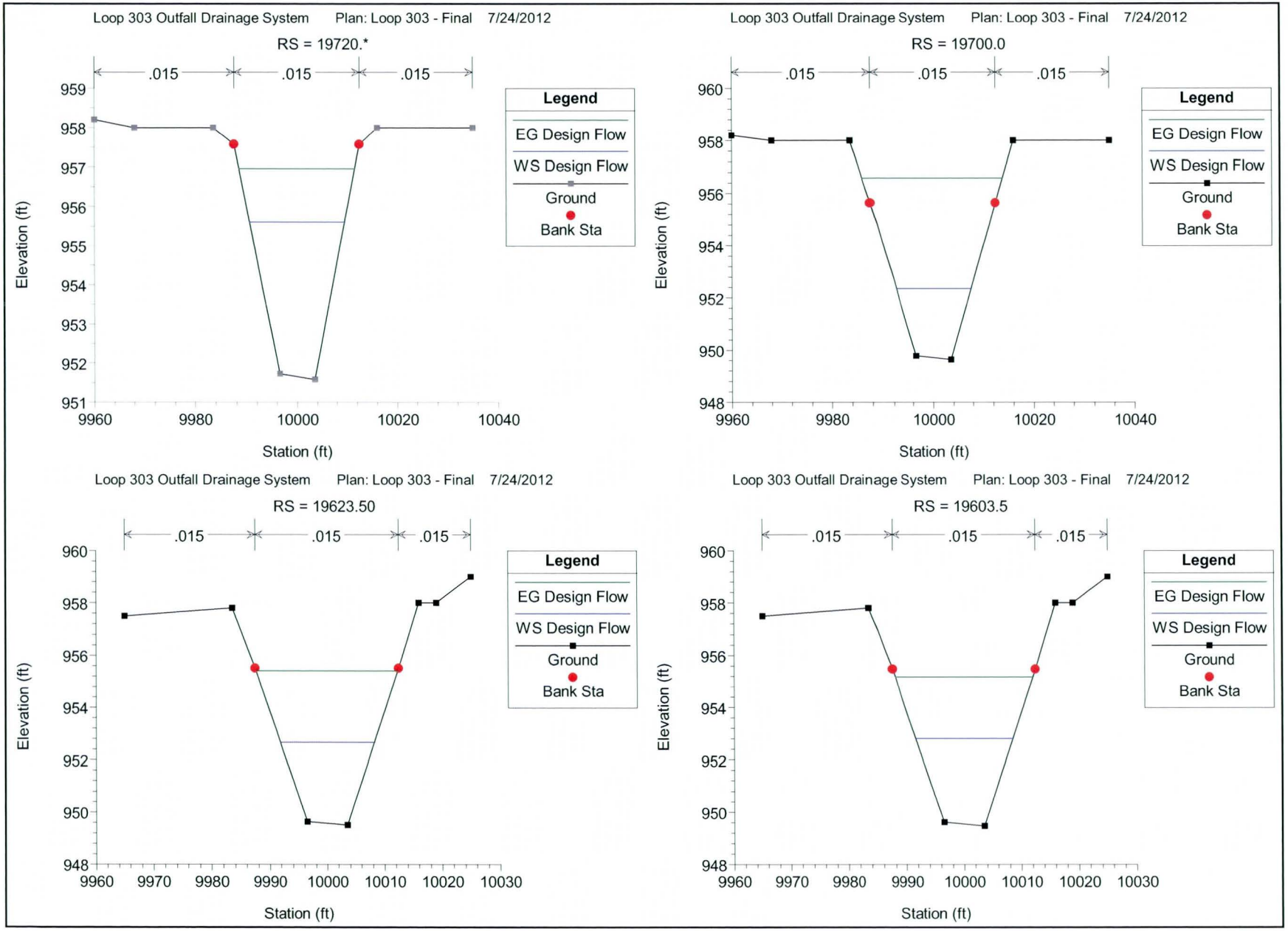

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 20119.61 d/s of culvert
.015 .015 .015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 20070.01
.015 .015 .015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 20050
.015 .015 .015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 20025.5
.015 .015 .015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

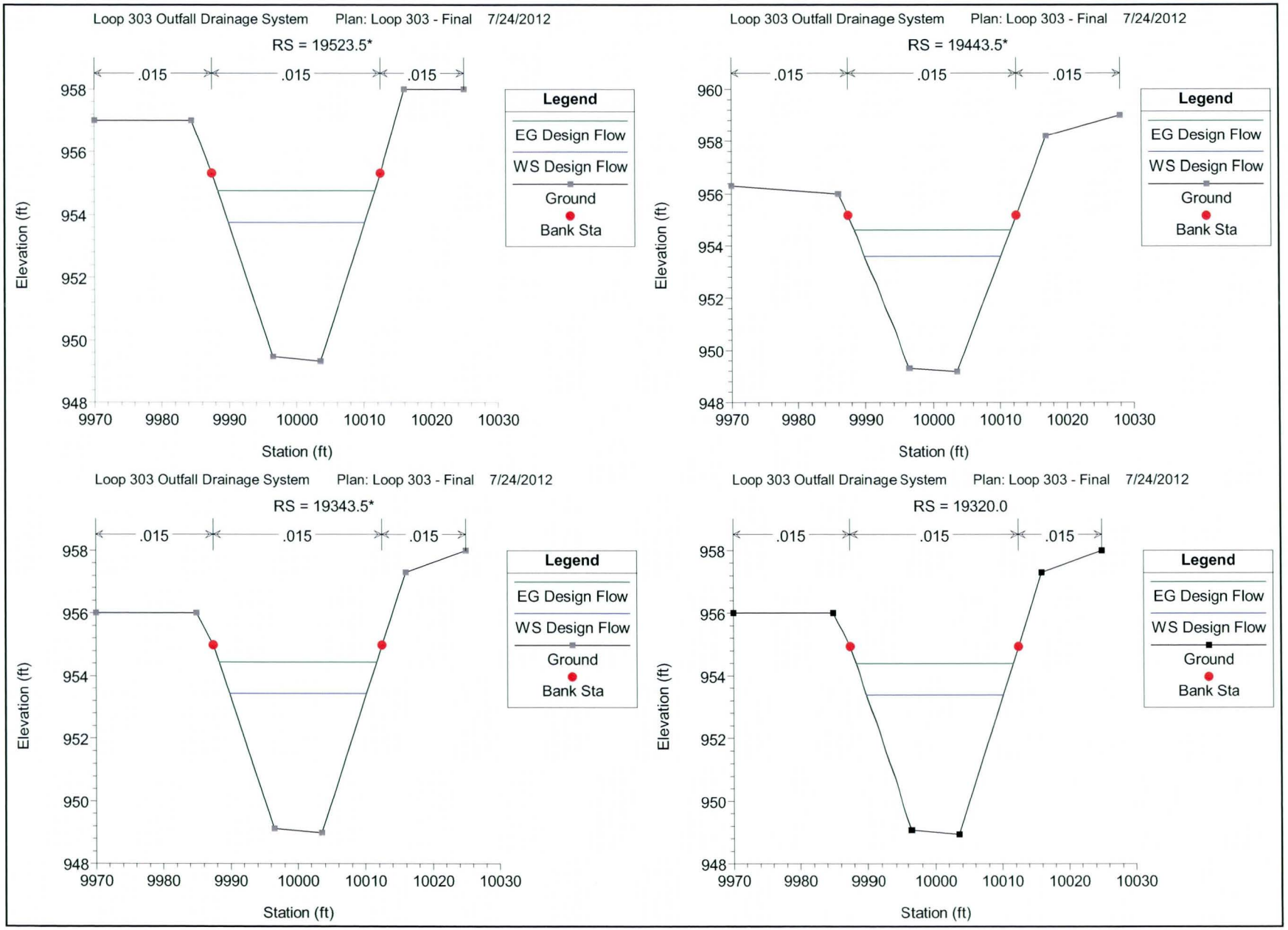

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 20005.5
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

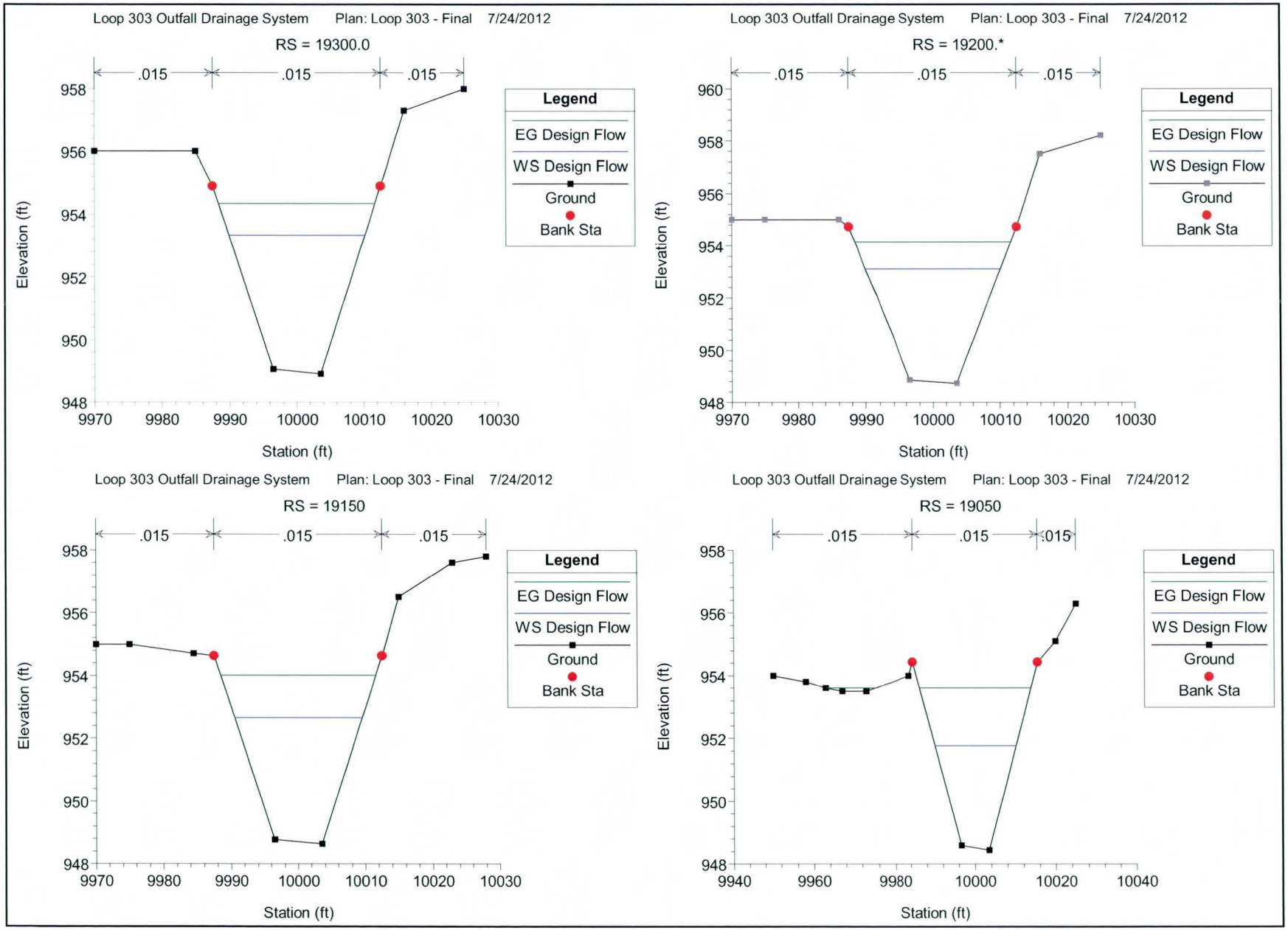

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 19952.7*
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

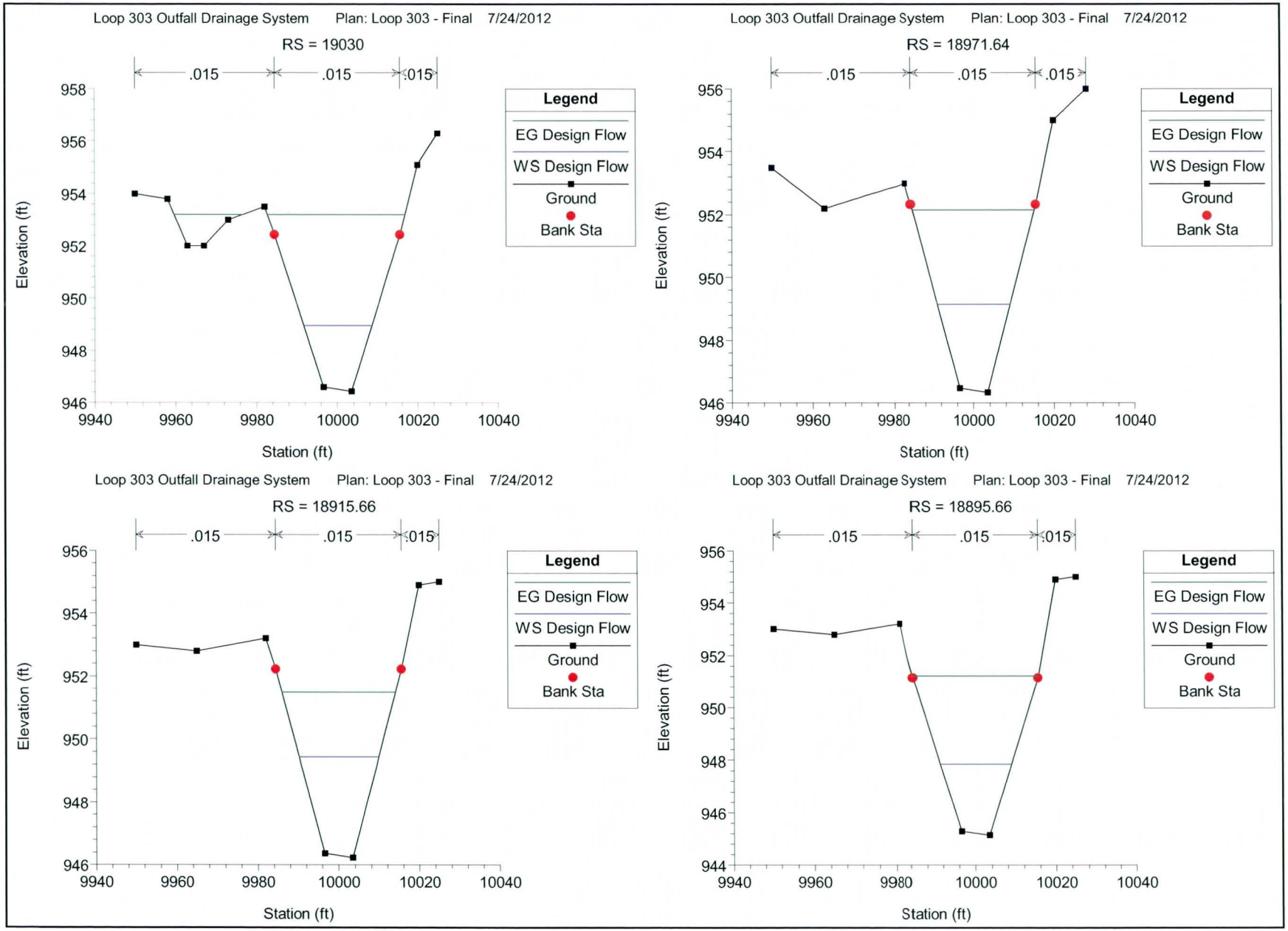

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 19900.0
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

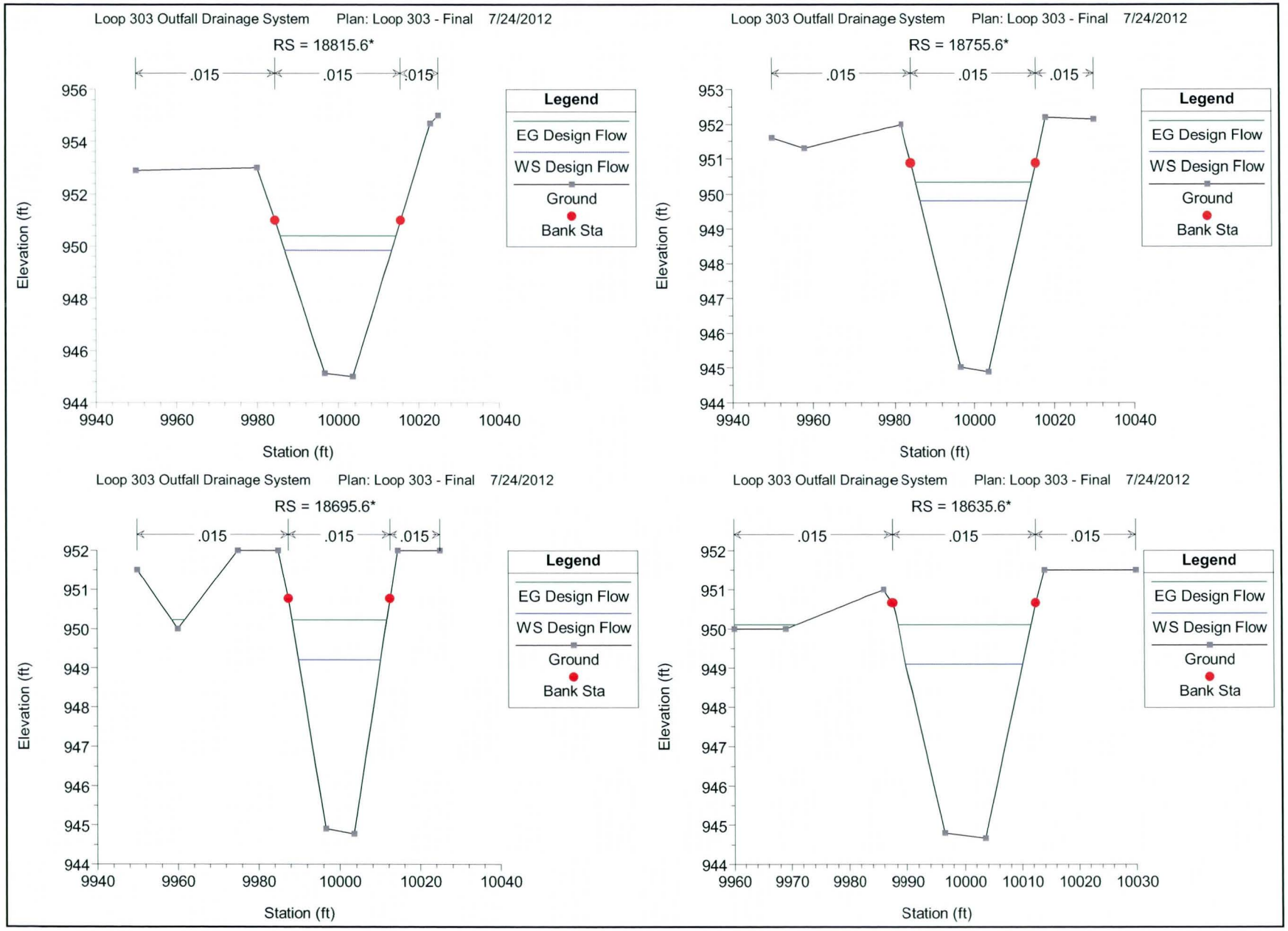

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 19820.*
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

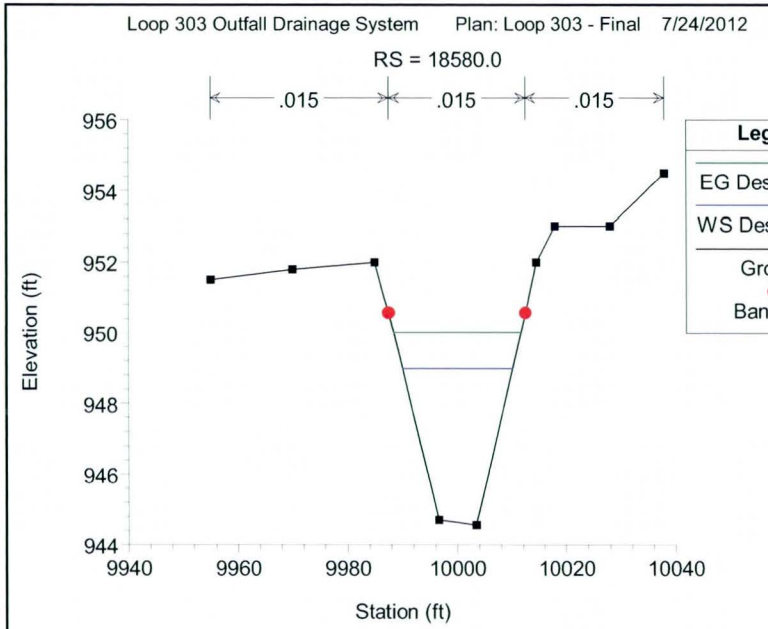

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 19720.*
.015 .015 .015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 19700.0
.015 .015 .015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 19623.50
.015 .015 .015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 19603.5
.015 .015 .015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

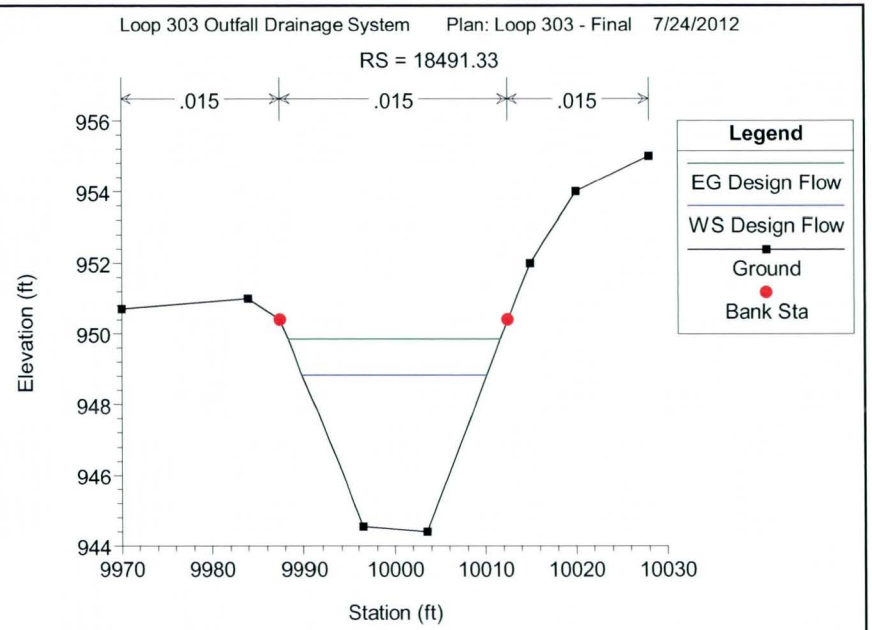

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 19523.5*
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 19443.5*
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 19343.5*
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 19320.0
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

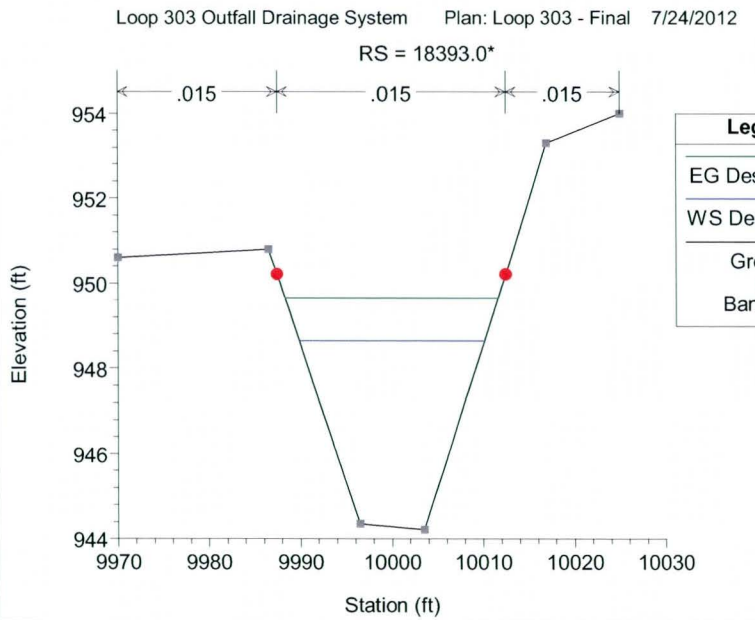

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 19300.0
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 19200.*
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 19150
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 19050
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

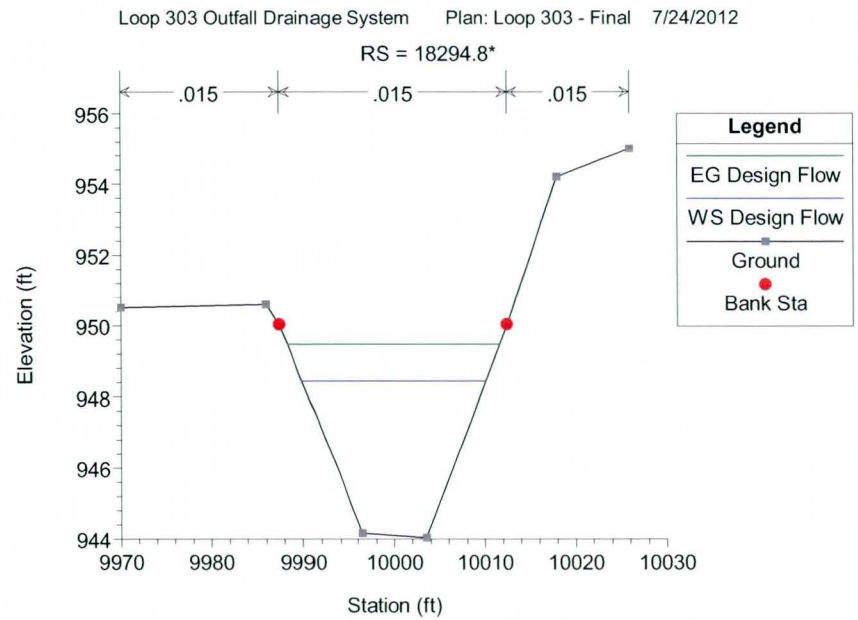

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 19030
.015 .015 .015
Elevation (ft)
Station (ft)
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 18971.64
.015 .015 .015
Elevation (ft)
Station (ft)
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 18915.66
.015 .015 .015
Elevation (ft)
Station (ft)
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 18895.66
.015 .015 .015
Elevation (ft)
Station (ft)
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta

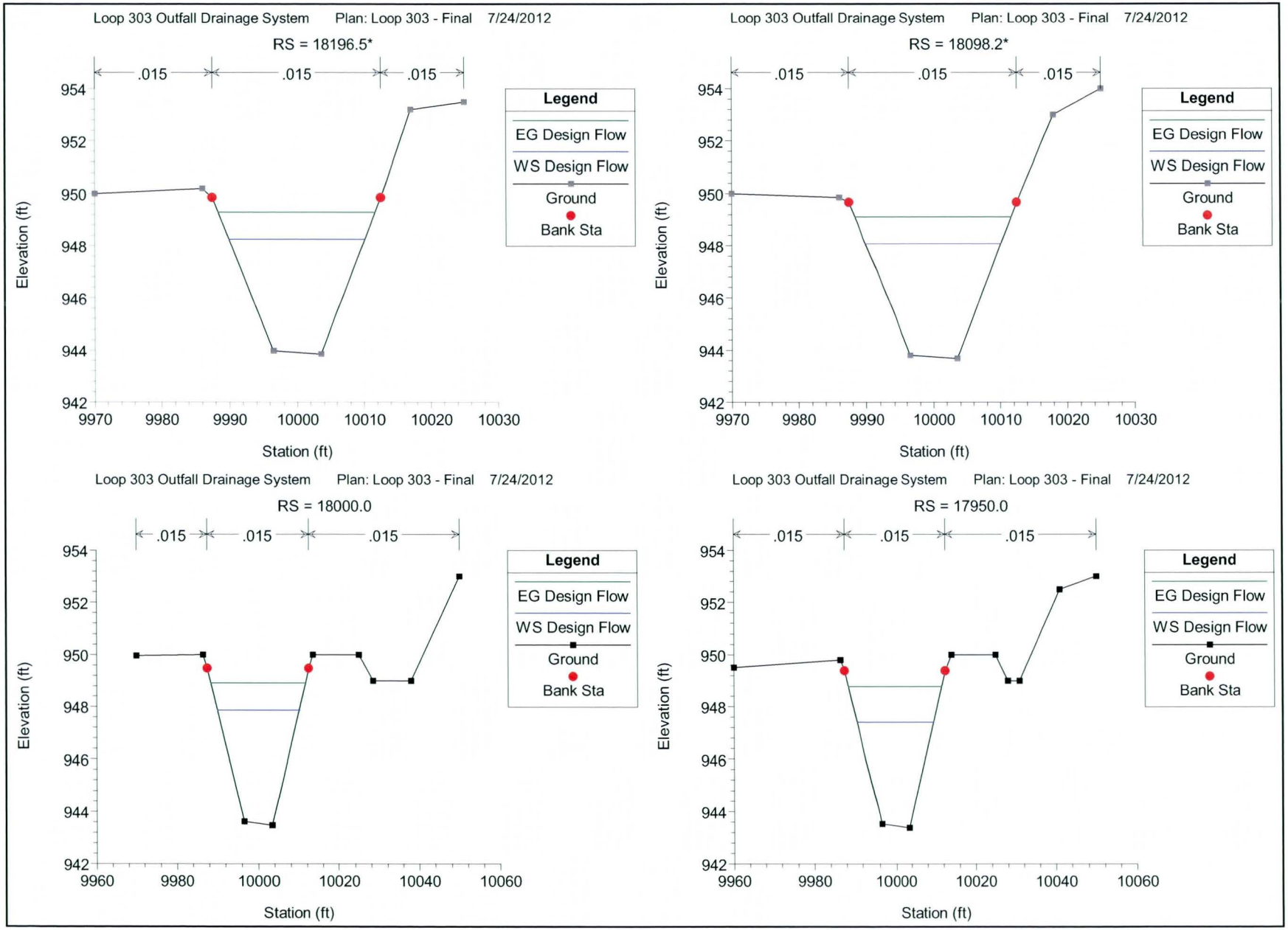

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 18815.6*
.015
.015
.015
Elevation (ft)
Station (ft)
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 18755.6*
.015
.015
.015
Elevation (ft)
Station (ft)
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 18695.6*
.015
.015
.015
Elevation (ft)
Station (ft)
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 18635.6*
.015
.015
.015
Elevation (ft)
Station (ft)
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta

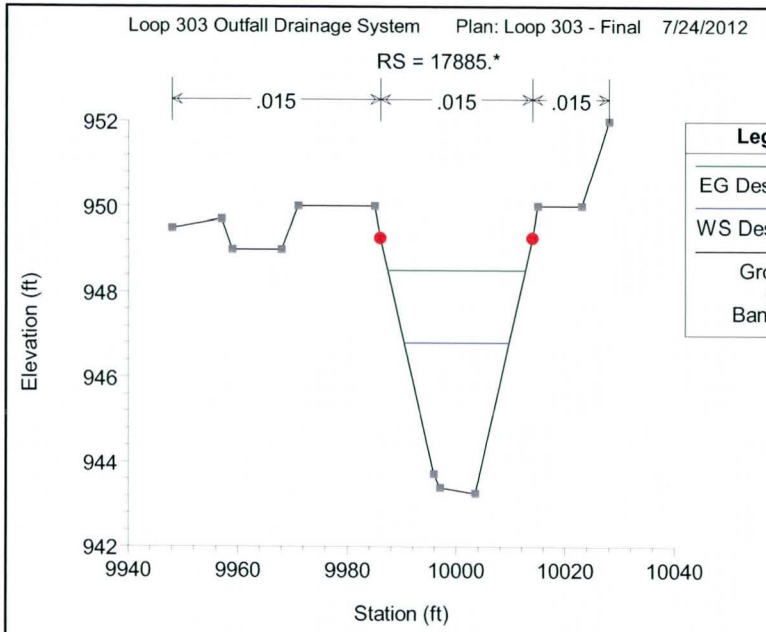

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 18580.0
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

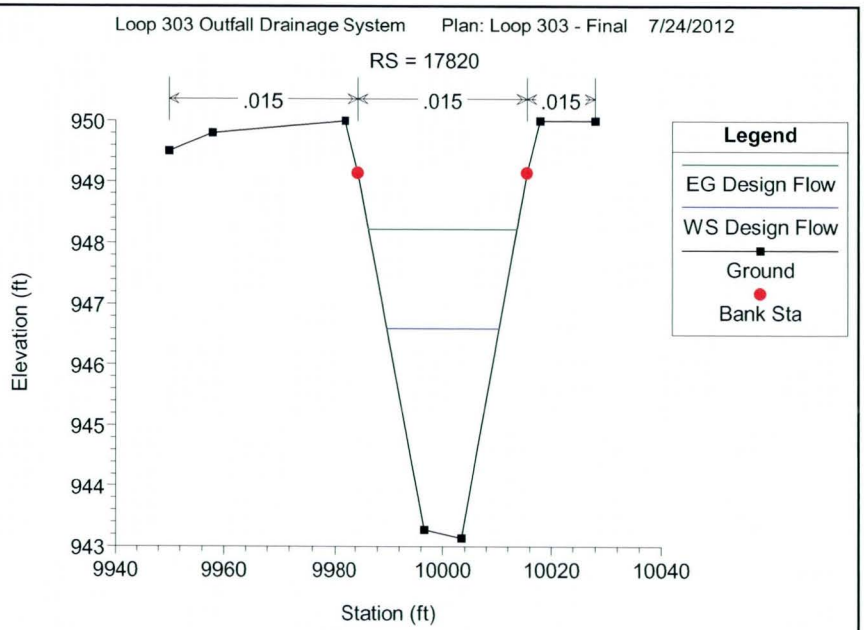

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 18491.33
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

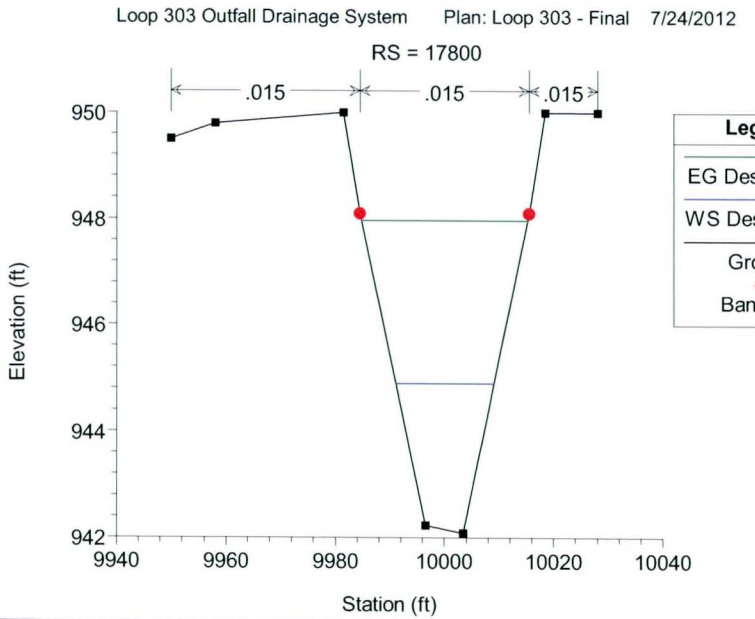

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 18393.0*
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

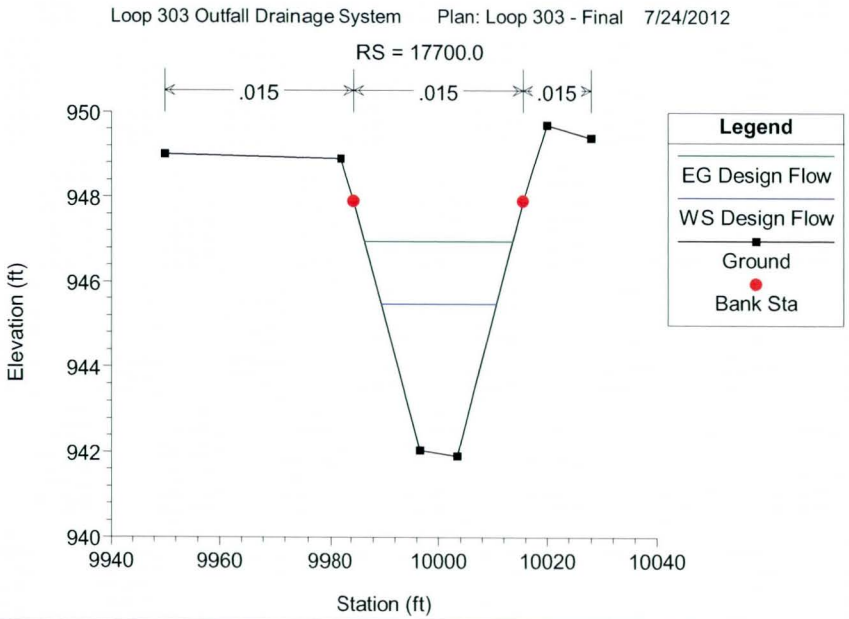

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 18294.8*
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

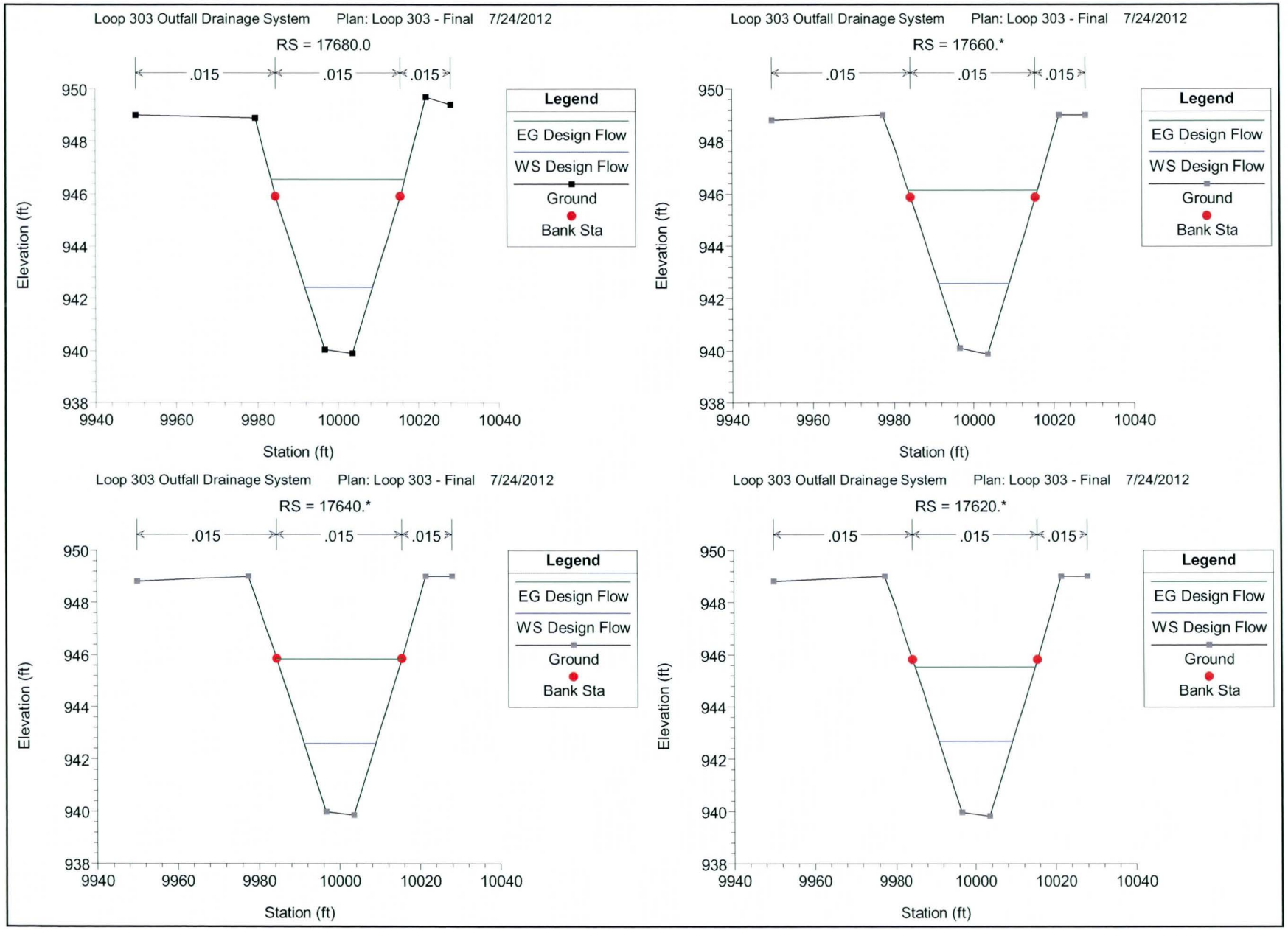

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 18196.5*
.015 .015 .015
Elevation (ft)
Station (ft)
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 18098.2*
.015 .015 .015
Elevation (ft)
Station (ft)
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 18000.0
.015 .015 .015
Elevation (ft)
Station (ft)
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 17950.0
.015 .015 .015
Elevation (ft)
Station (ft)
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta

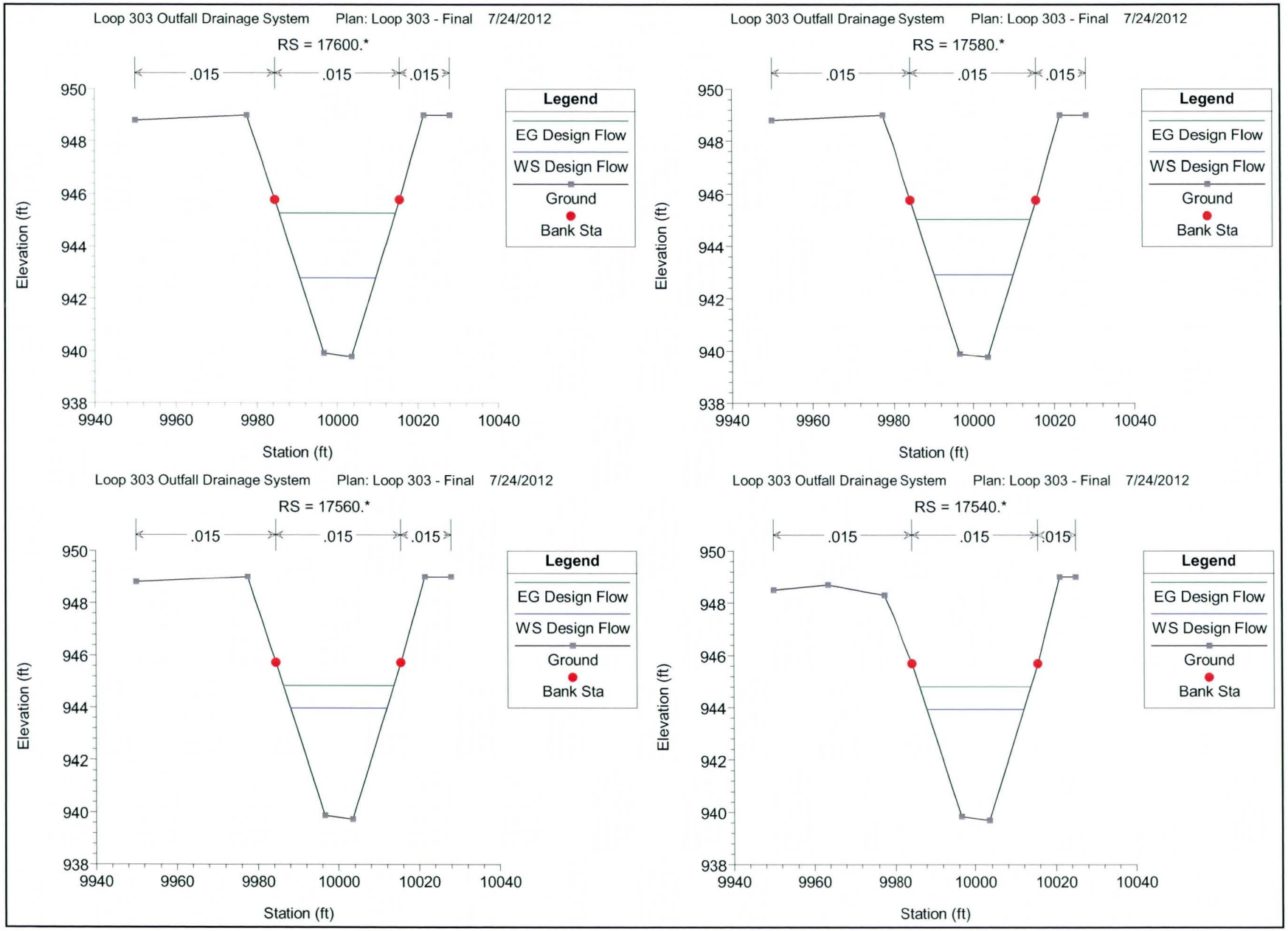

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 17885.*
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
952
950
948
946
944
942
9940
9960
9980
10000
10020
10040
Station (ft)

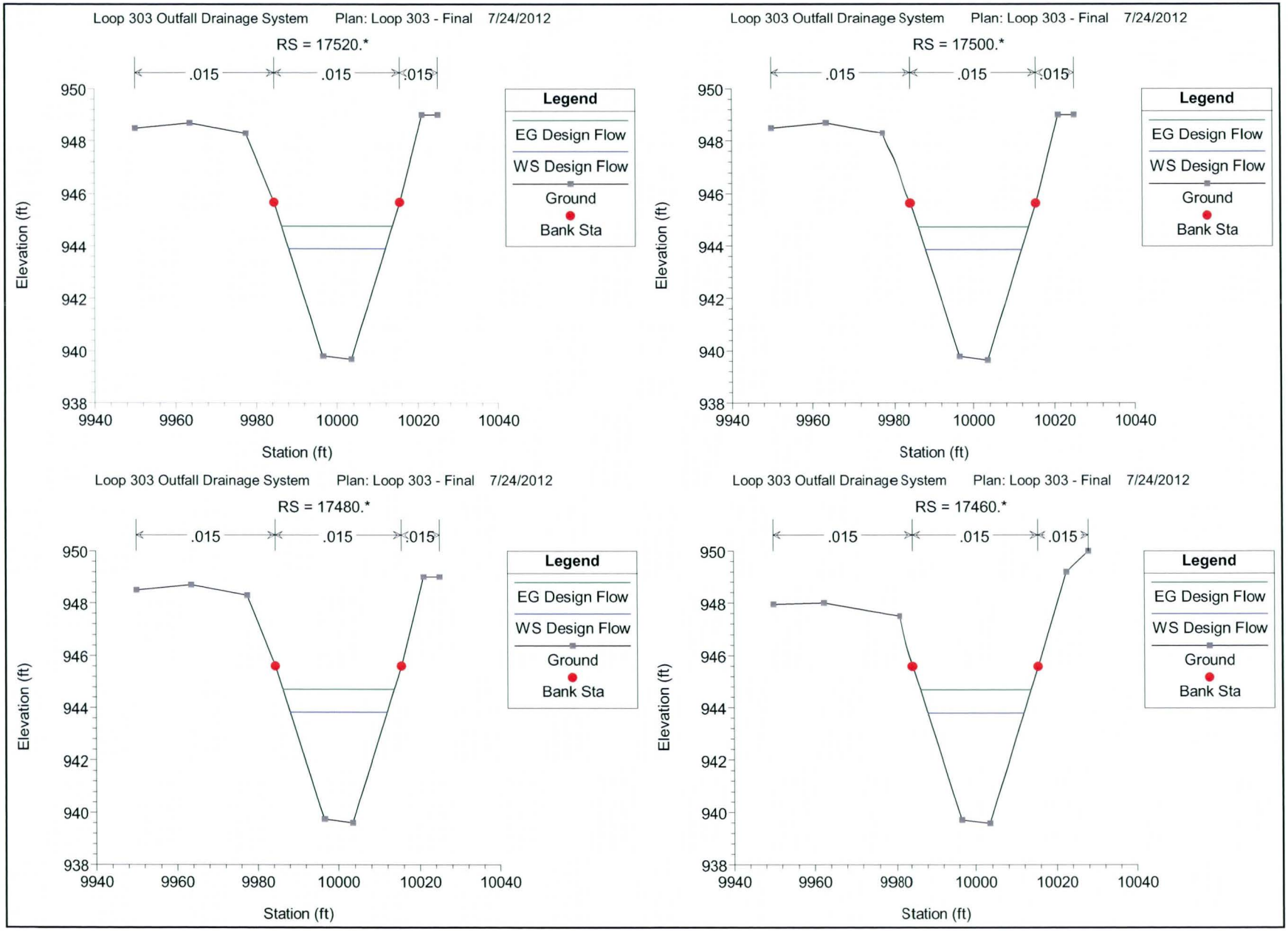

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 17820
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
950
949
948
947
946
945
944
943
9940
9960
9980
10000
10020
10040
Station (ft)

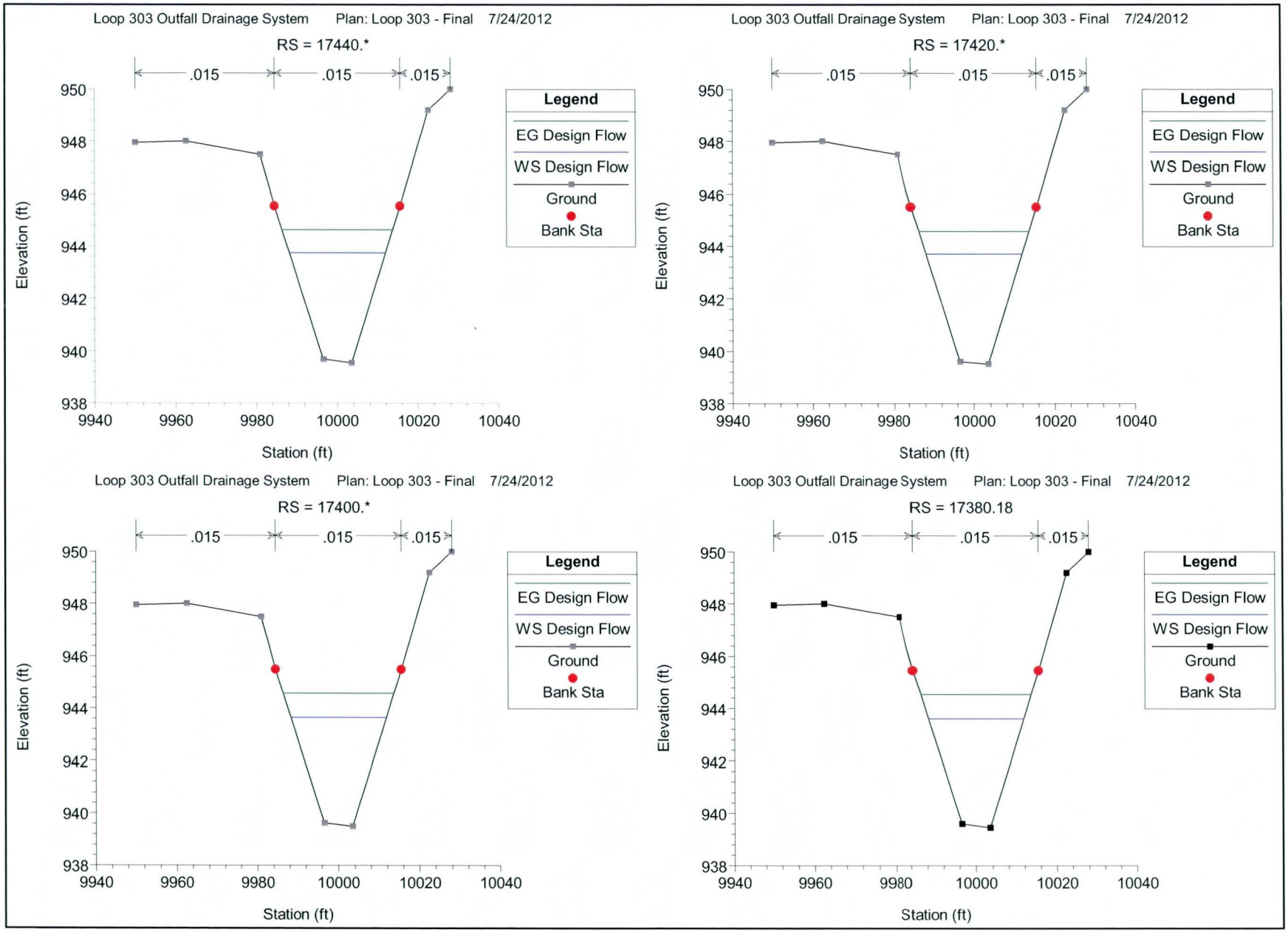

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 17800
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
950
948
946
944
942
9940
9960
9980
10000
10020
10040
Station (ft)

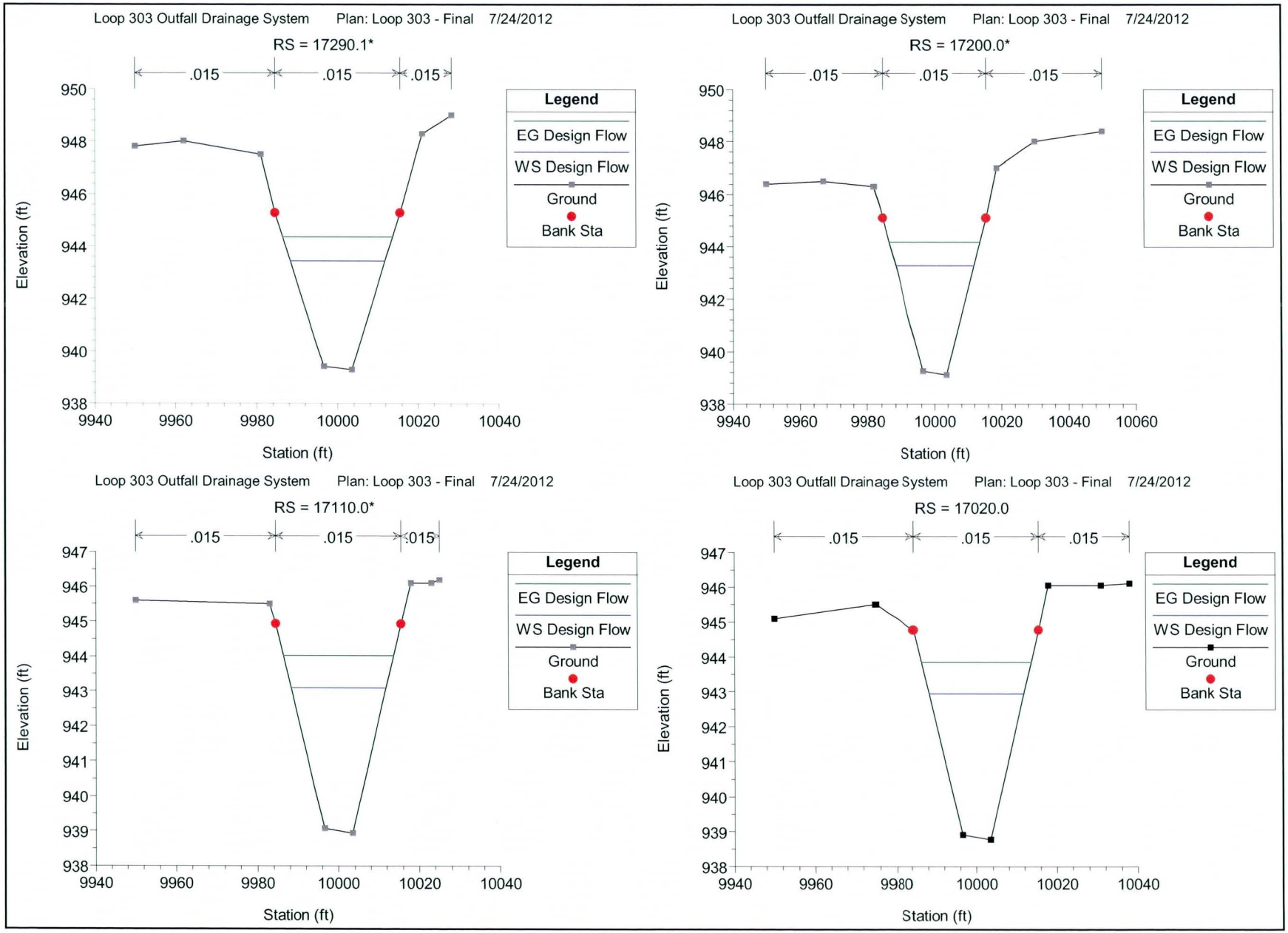

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 17700.0
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
950
948
946
944
942
940
9940
9960
9980
10000
10020
10040
Station (ft)

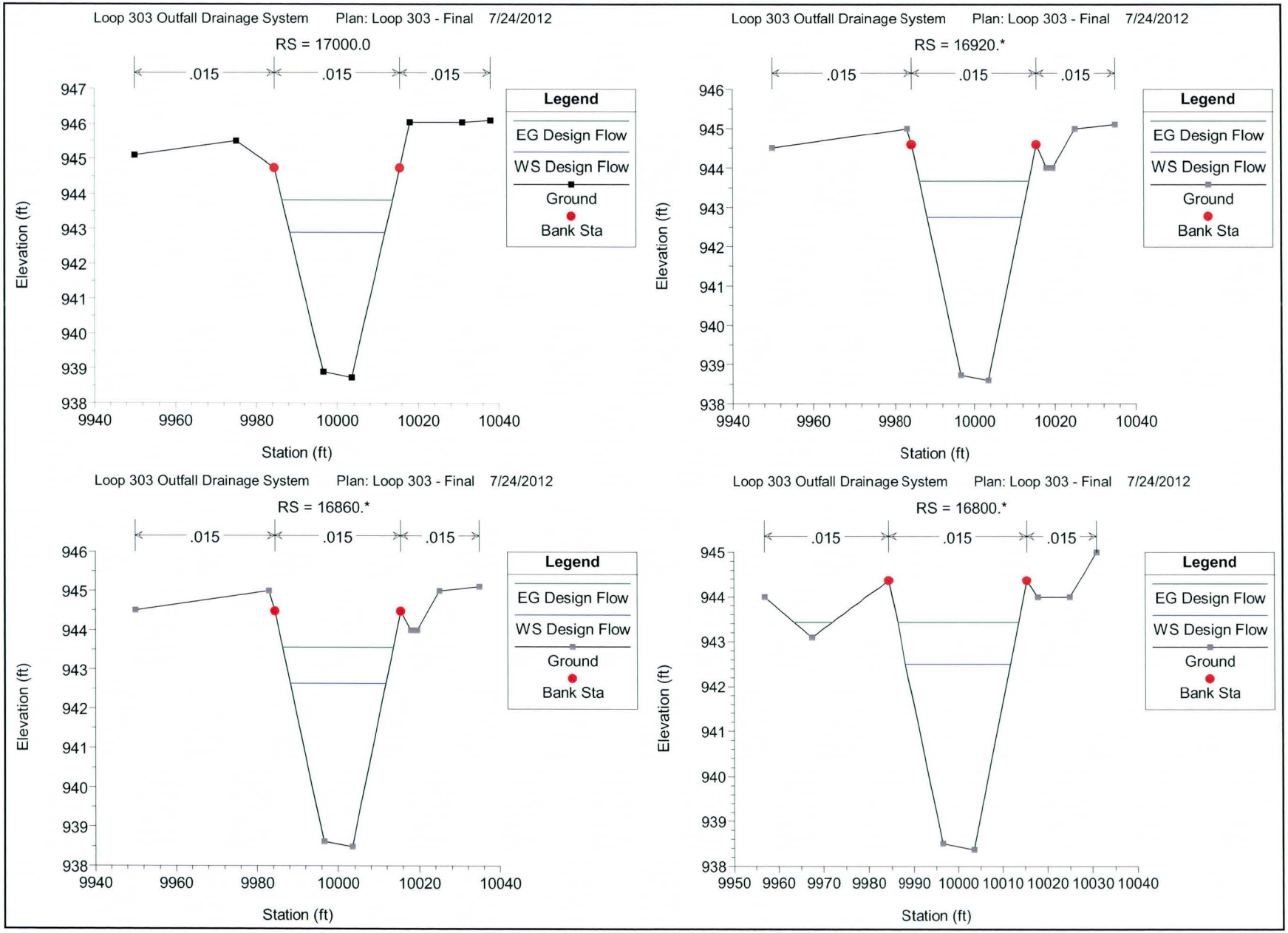

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 17680.0
.015 .015 .015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 17660.*
.015 .015 .015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 17640.*
.015 .015 .015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 17620.*
.015 .015 .015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

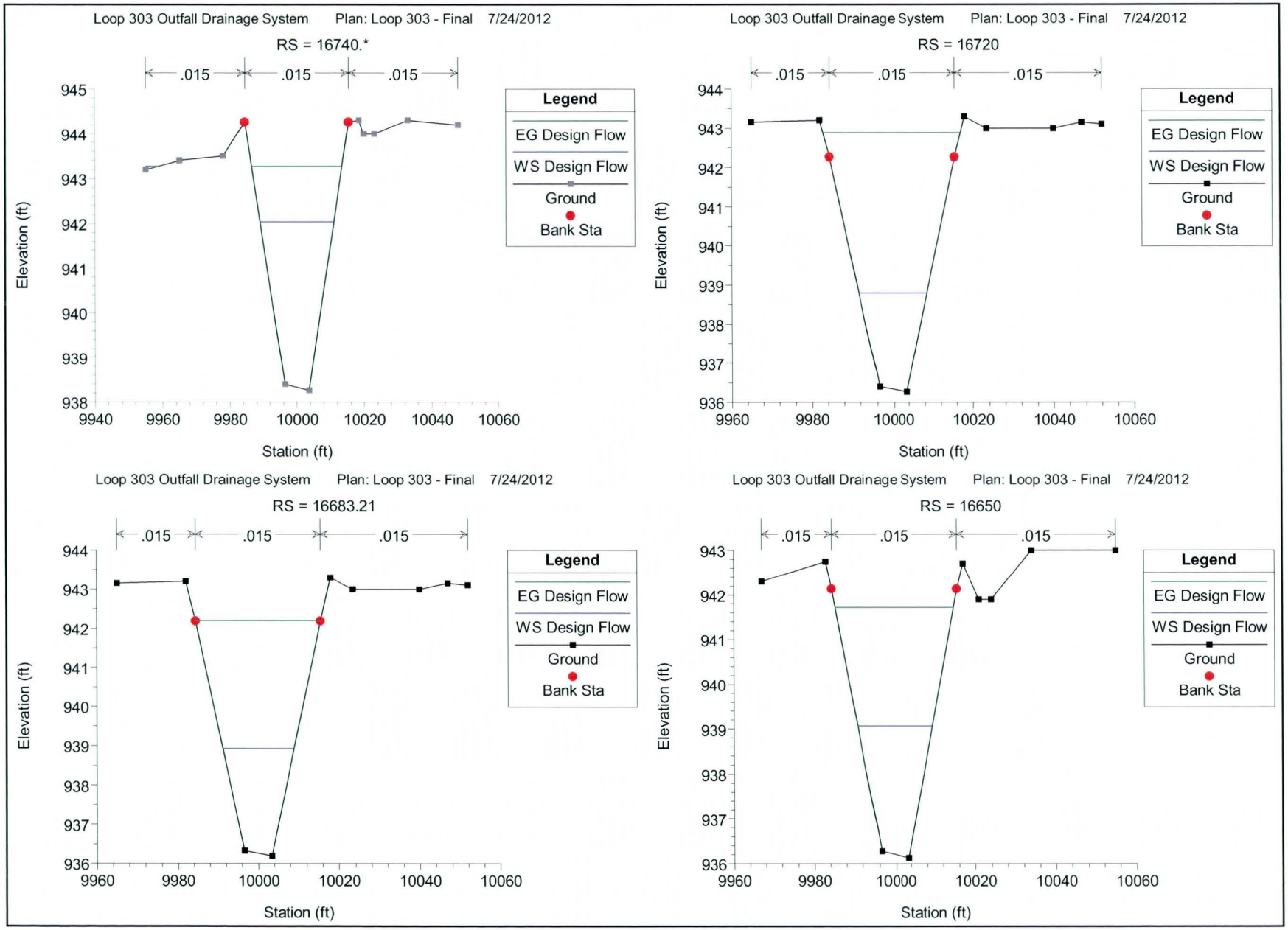

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 17600.*
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 17580.*
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 17560.*
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 17540.*
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

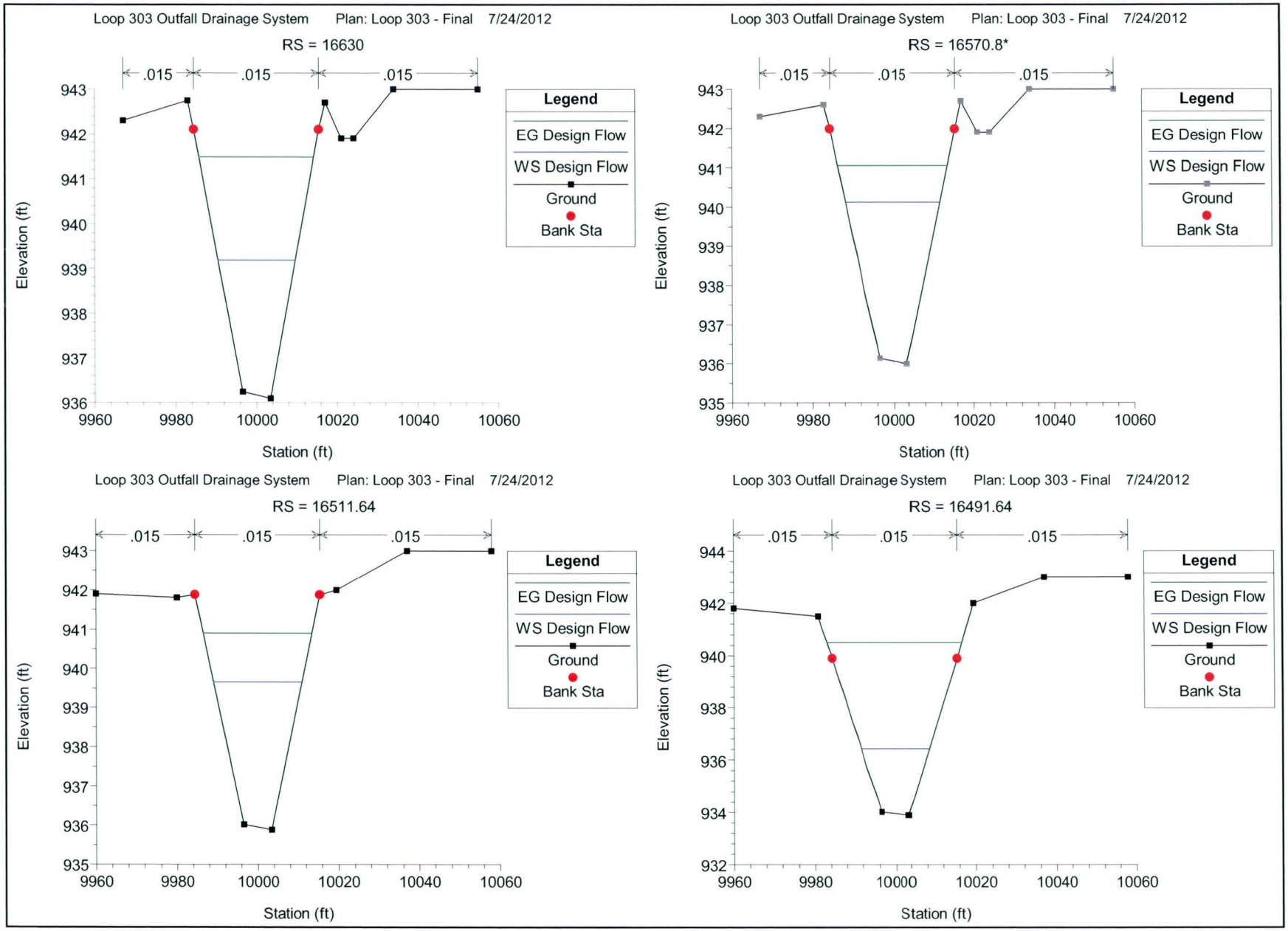

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 17520.*
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 17500.*
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 17480.*
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 17460.*
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

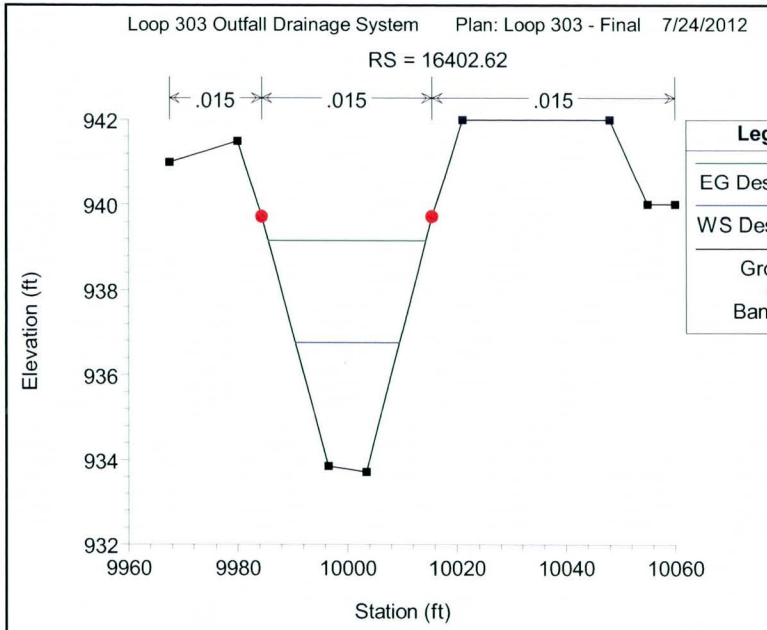

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 17440.*
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 17420.*
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 17400.*
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 17380.18
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

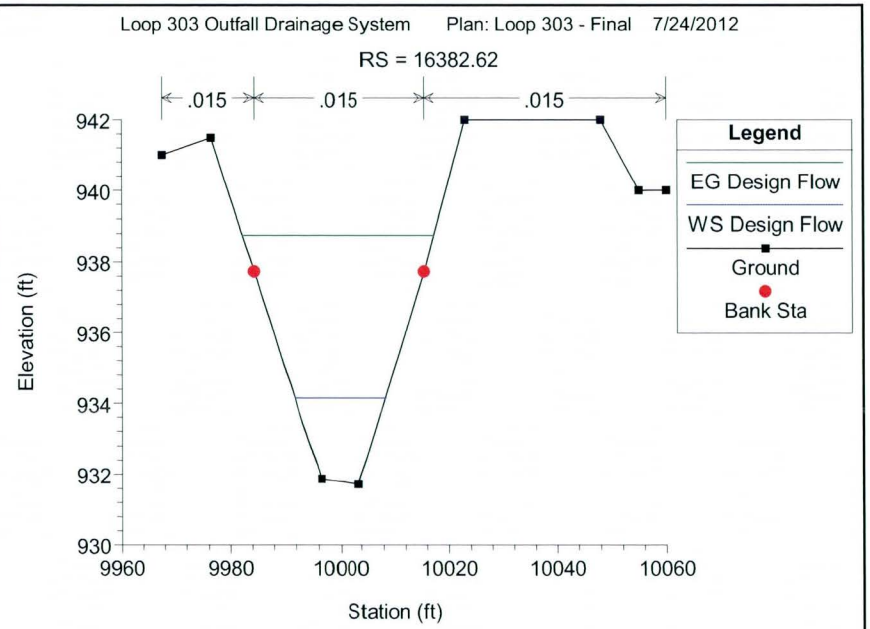

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 17290.1*
.015 .015 .015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 17200.0*
.015 .015 .015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 17110.0*
.015 .015 .015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 17020.0
.015 .015 .015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

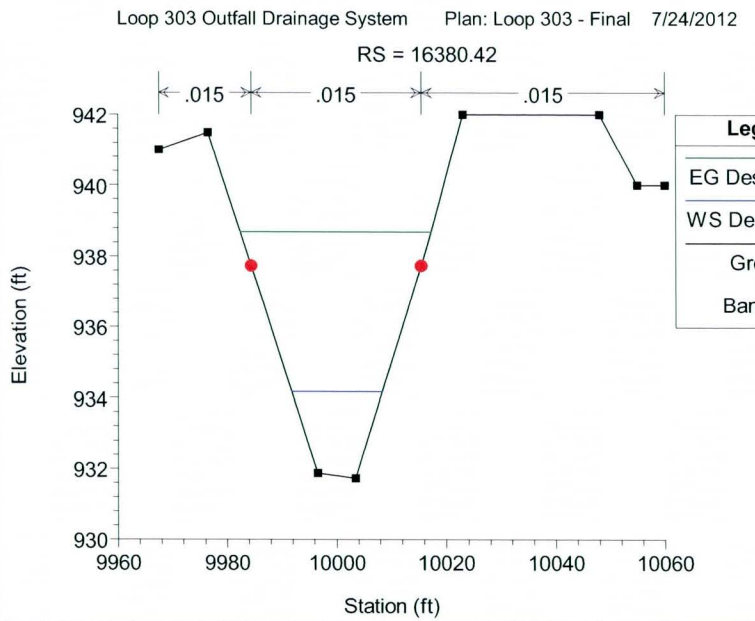

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 17000.0
.015 .015 .015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 16920.*
.015 .015 .015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 16860.*
.015 .015 .015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 16800.*
.015 .015 .015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

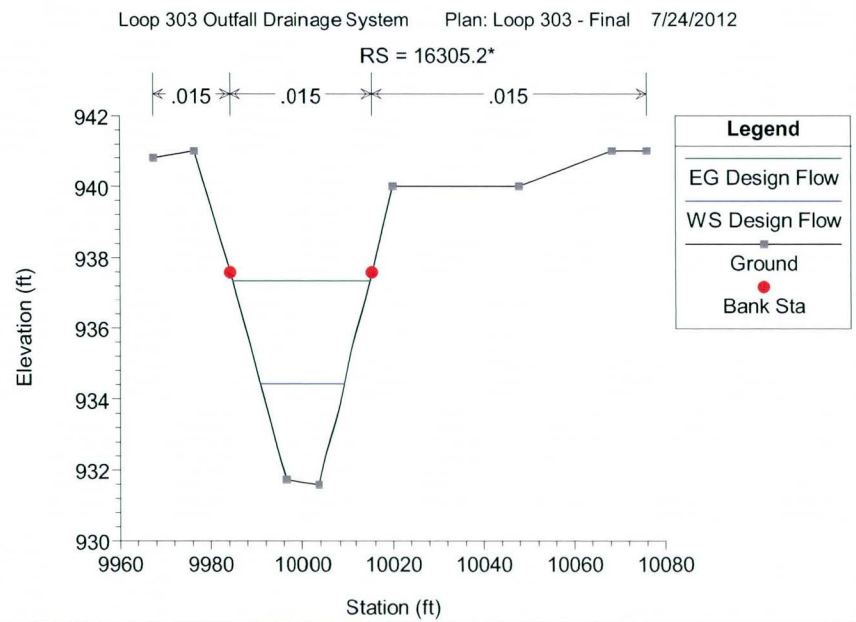

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 16740.*
.015 .015 .015
Elevation (ft)
Station (ft)
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 16720
.015 .015 .015
Elevation (ft)
Station (ft)
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 16683.21
.015 .015 .015
Elevation (ft)
Station (ft)
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 16650
.015 .015 .015
Elevation (ft)
Station (ft)
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta

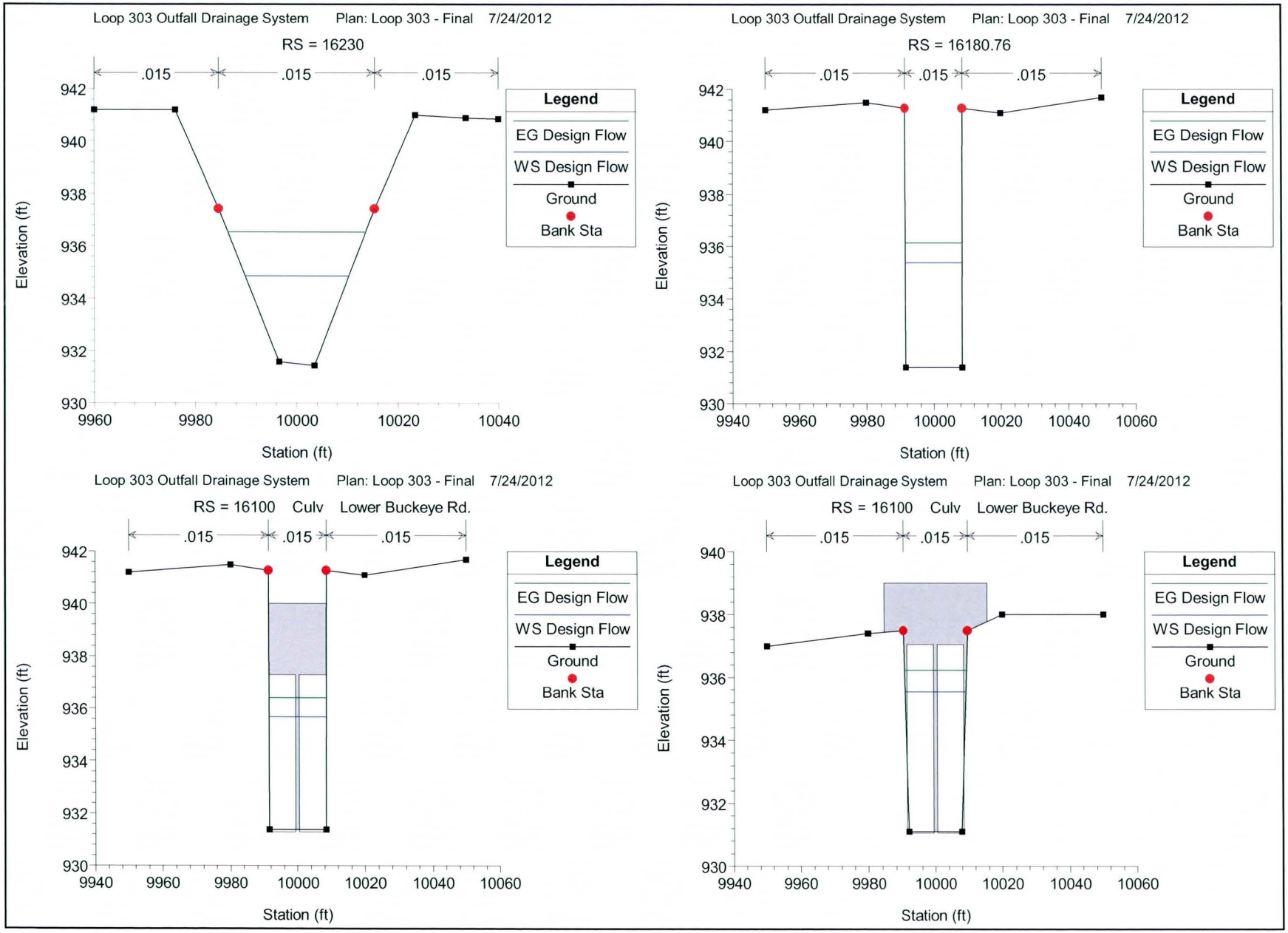

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 16630
.015 .015 .015
Elevation (ft)
Station (ft)
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 16570.8*
.015 .015 .015
Elevation (ft)
Station (ft)
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 16511.64
.015 .015 .015
Elevation (ft)
Station (ft)
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 16491.64
.015 .015 .015
Elevation (ft)
Station (ft)
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta

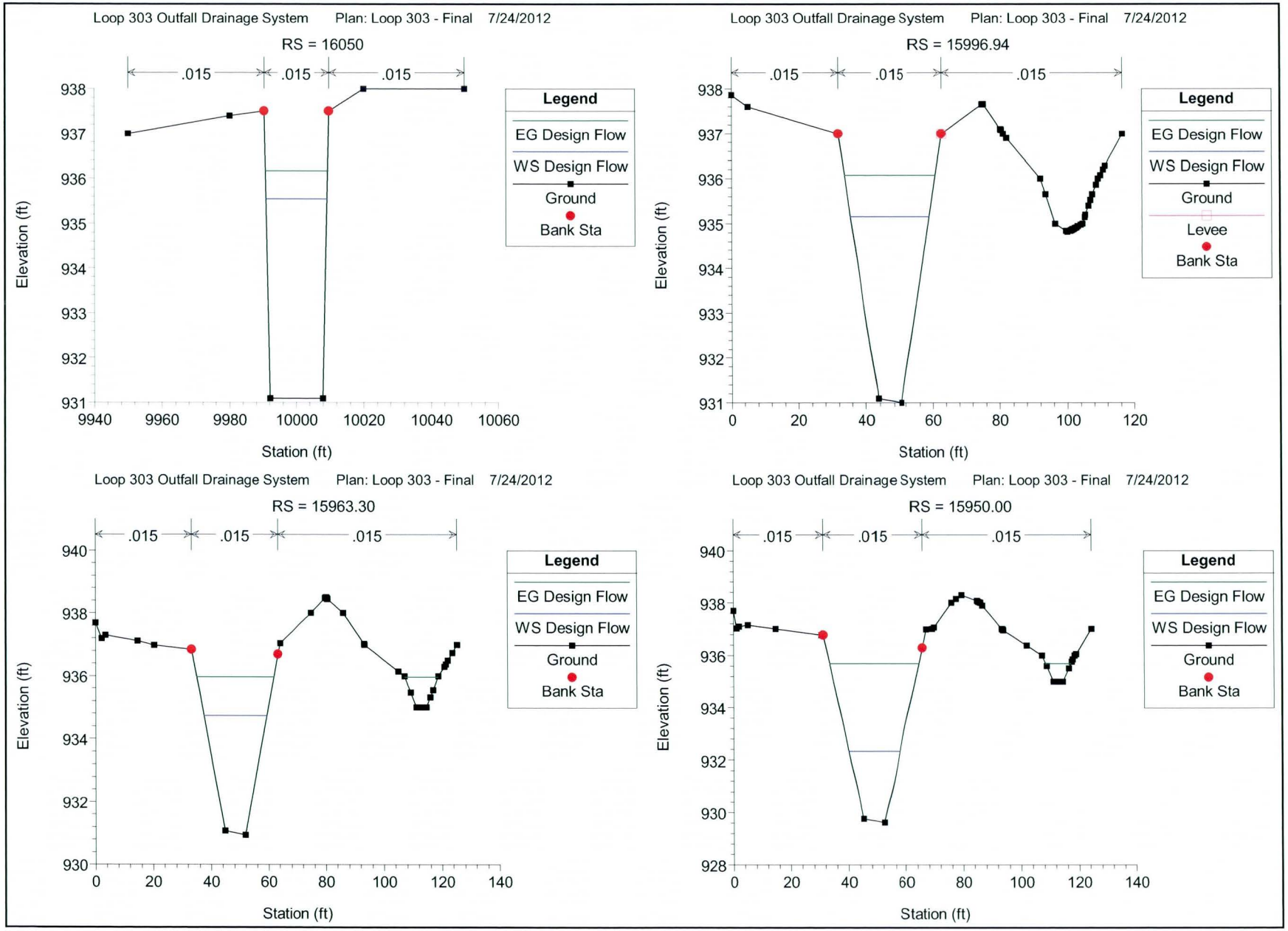

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 16402.62
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

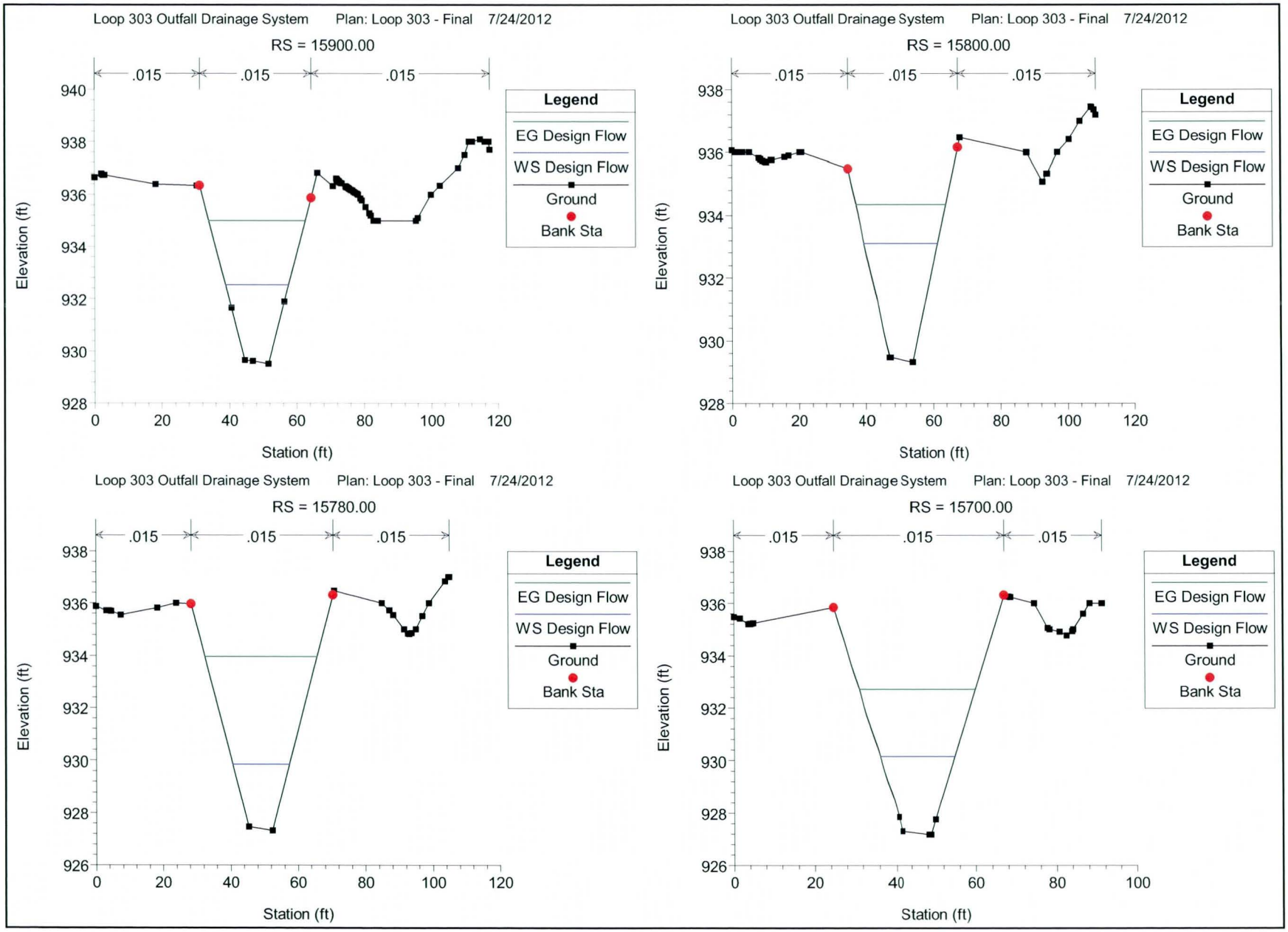

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 16382.62
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

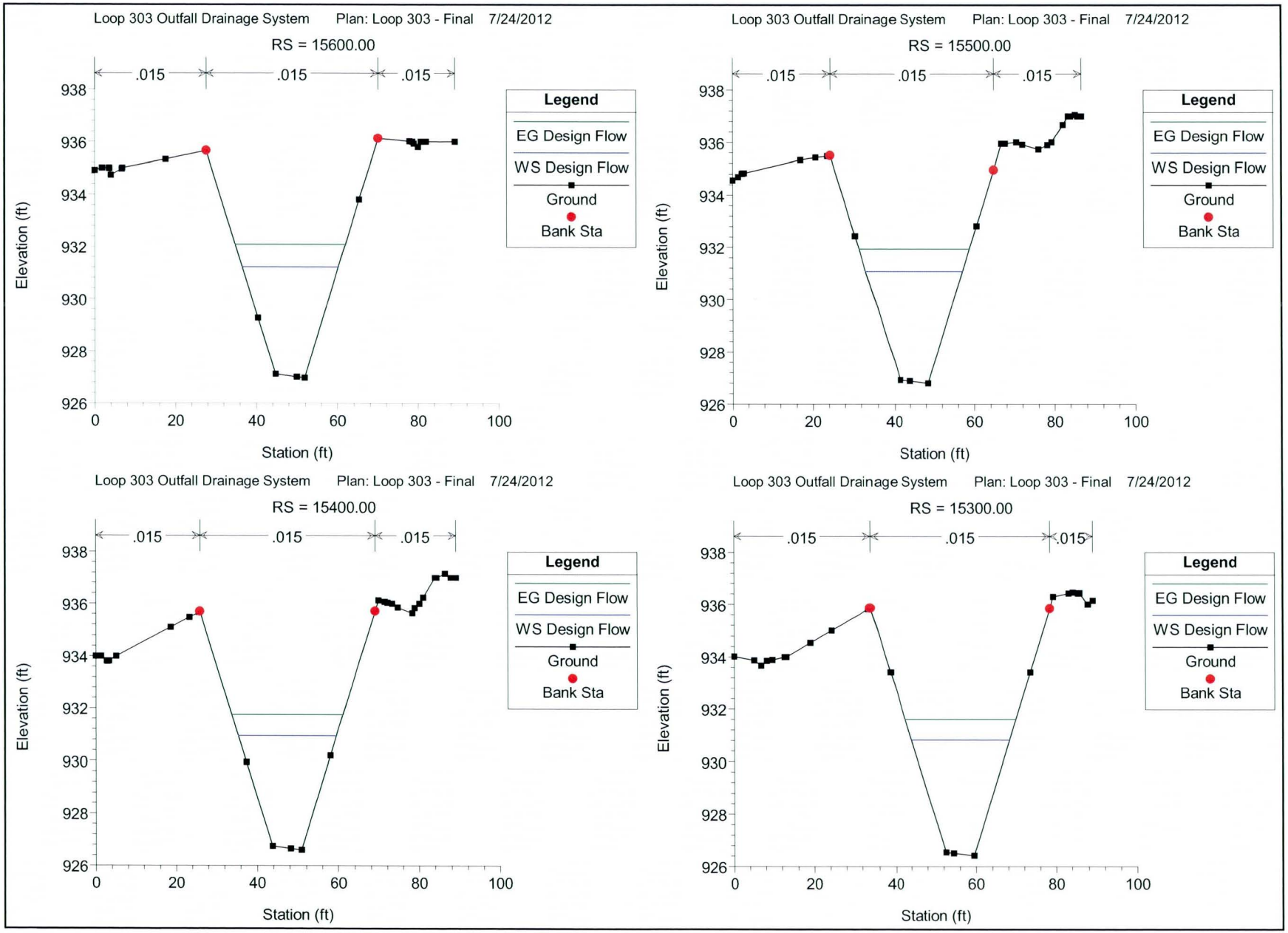

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 16380.42
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

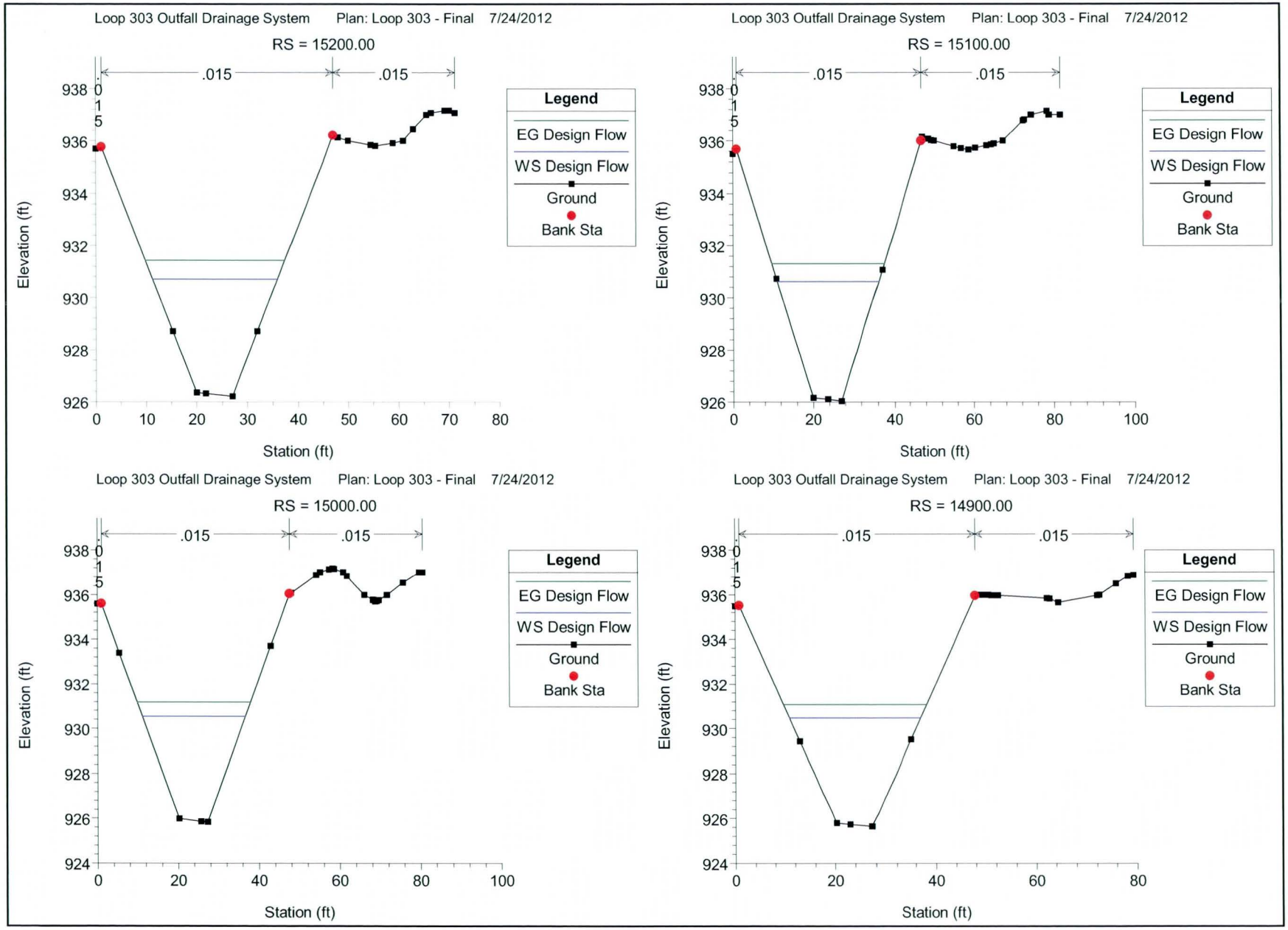

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 16305.2*
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

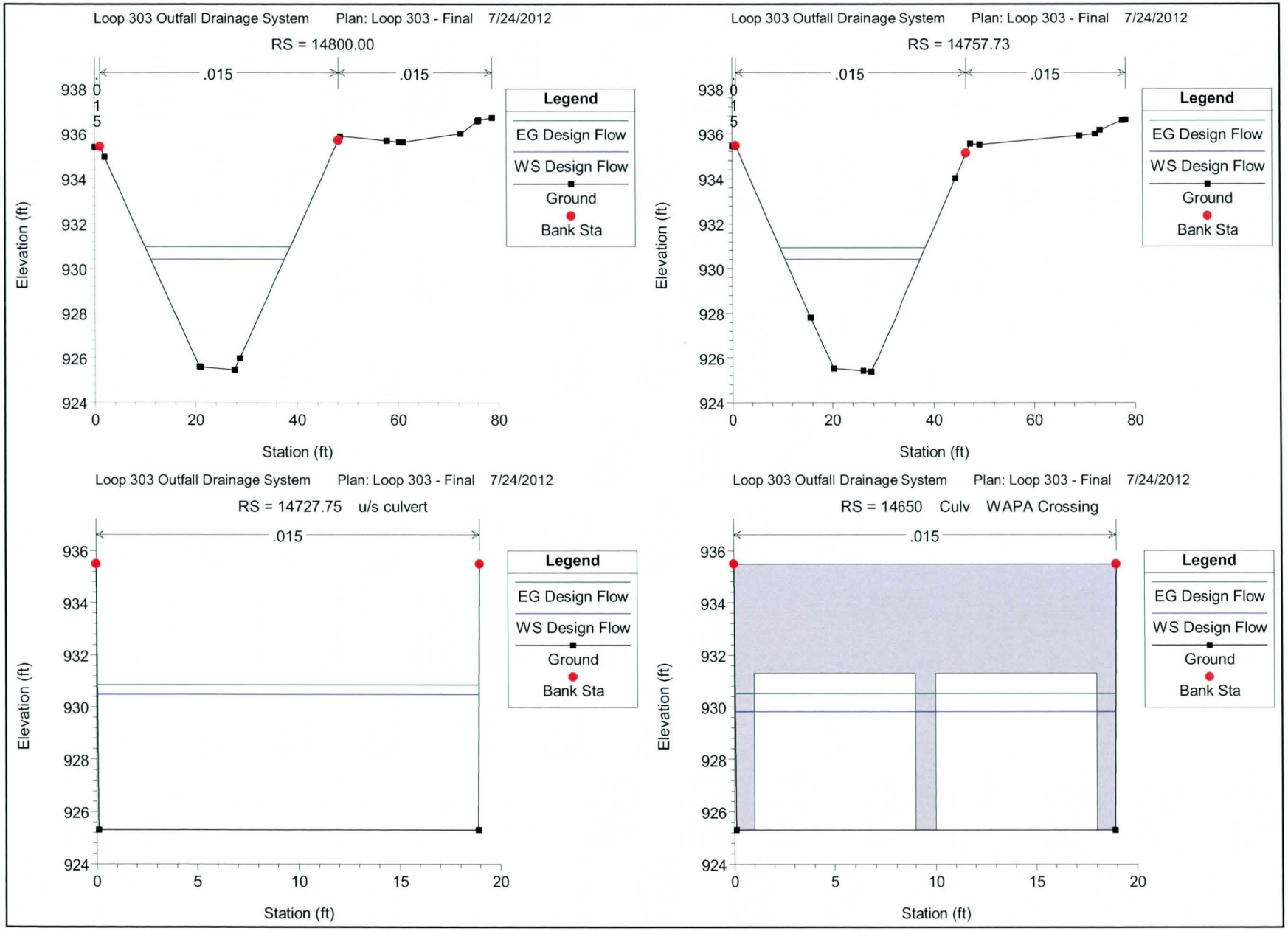

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 16230
.015 .015 .015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 16180.76
.015 .015 .015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 16100 Culv Lower Buckeye Rd.
.015 .015 .015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 16100 Culv Lower Buckeye Rd.
.015 .015 .015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

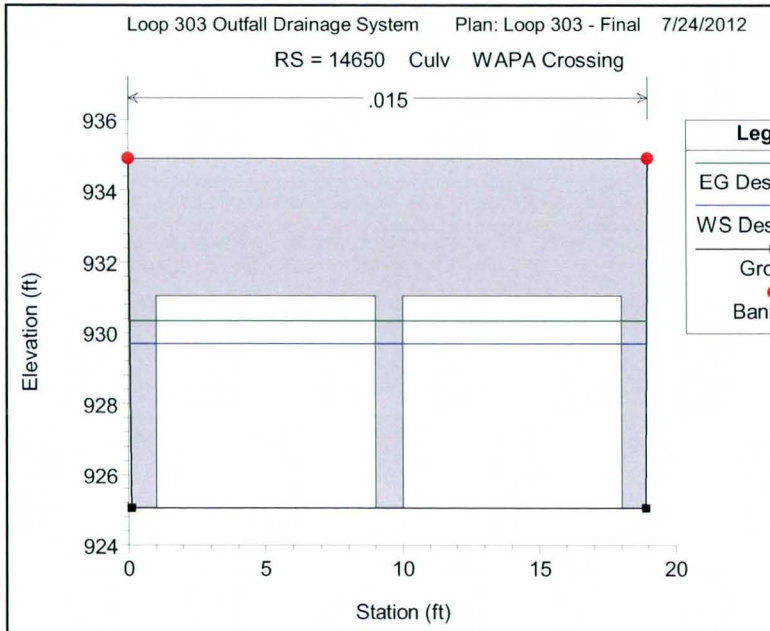

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 16050
.015 .015 .015
Elevation (ft)
Station (ft)
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 15996.94
.015 .015 .015
Elevation (ft)
Station (ft)
Legend
EG Design Flow
WS Design Flow
Ground
Levee
Bank Sta
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 15963.30
.015 .015 .015
Elevation (ft)
Station (ft)
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 15950.00
.015 .015 .015
Elevation (ft)
Station (ft)
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta

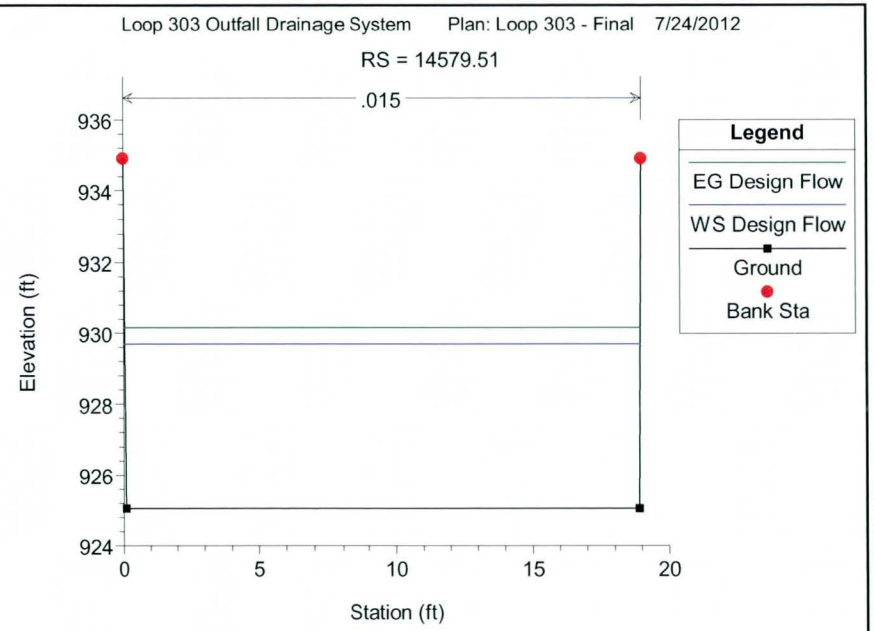

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 15900.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 15800.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 15780.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 15700.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

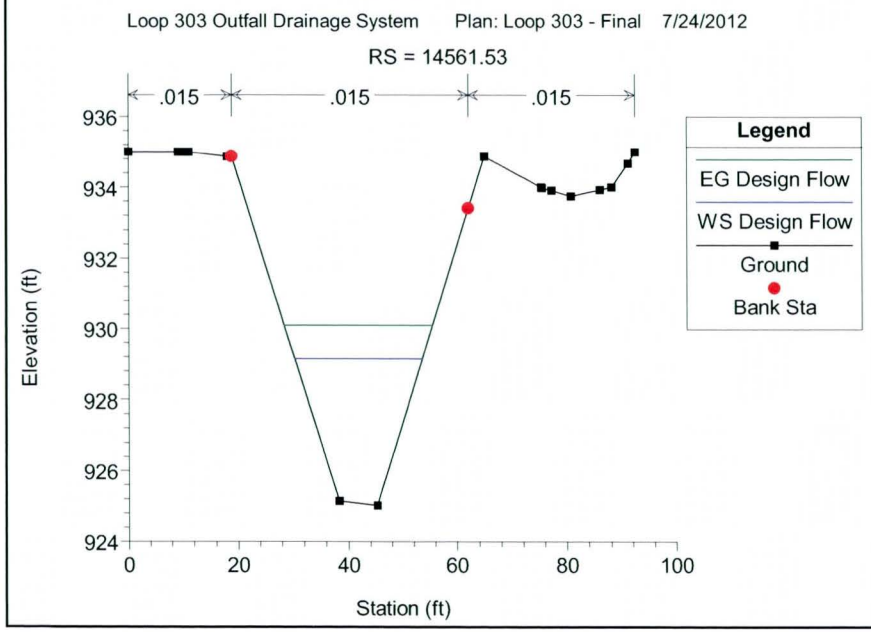

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 15600.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 15500.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 15400.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 15300.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

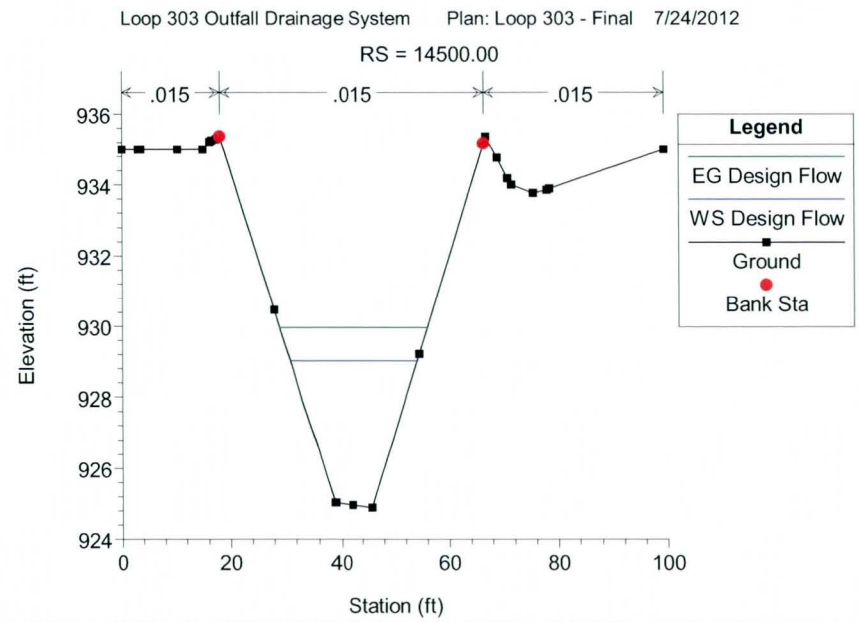

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 15200.00
.015
.015
Elevation (ft)
Station (ft)
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 15100.00
.015
.015
Elevation (ft)
Station (ft)
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 15000.00
.015
.015
Elevation (ft)
Station (ft)
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 14900.00
.015
.015
Elevation (ft)
Station (ft)
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta

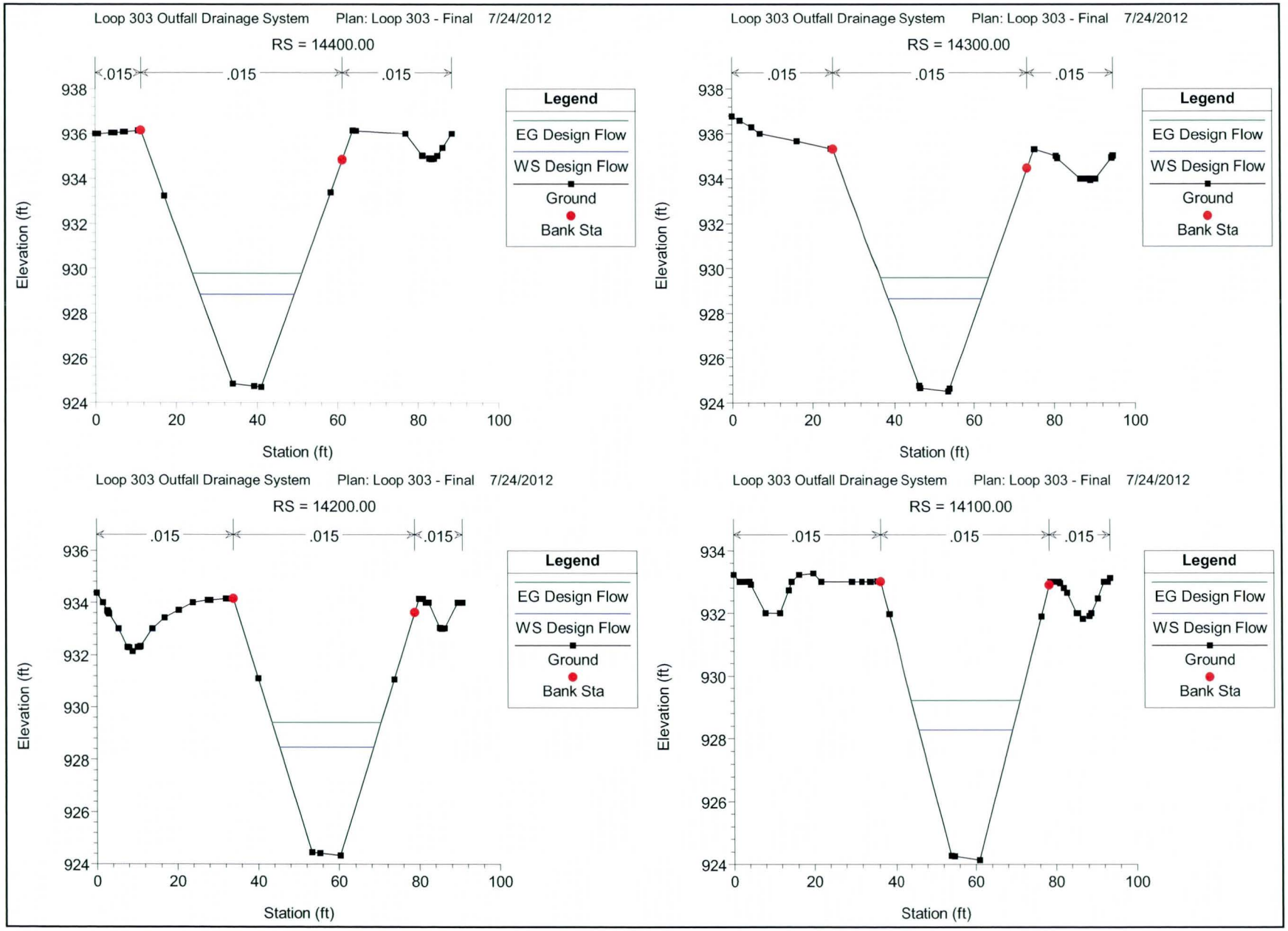

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 14800.00
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 14757.73
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 14727.75 u/s culvert
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 14650 Culv WAPA Crossing
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

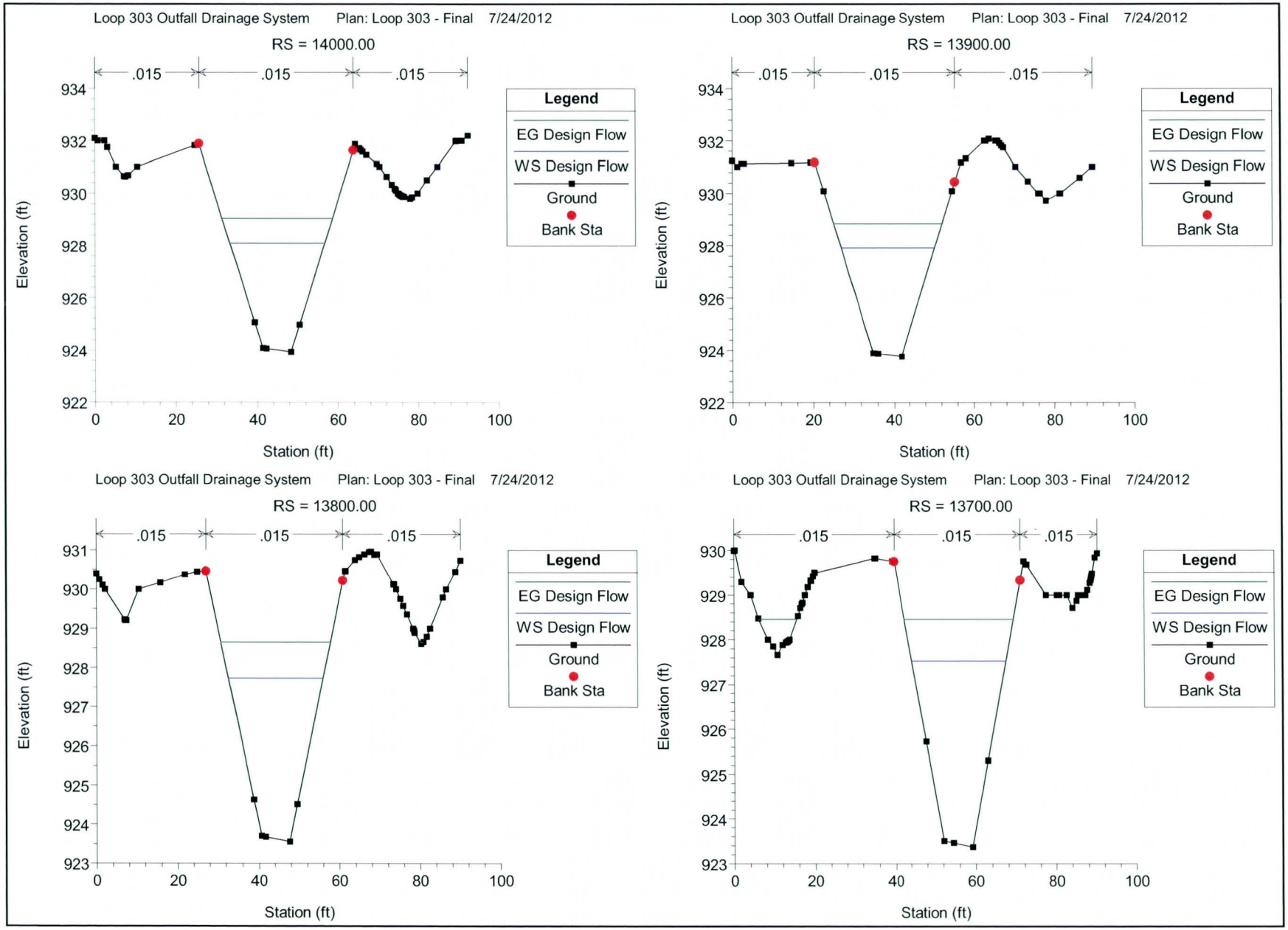

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 14650 Culv WAPA Crossing
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

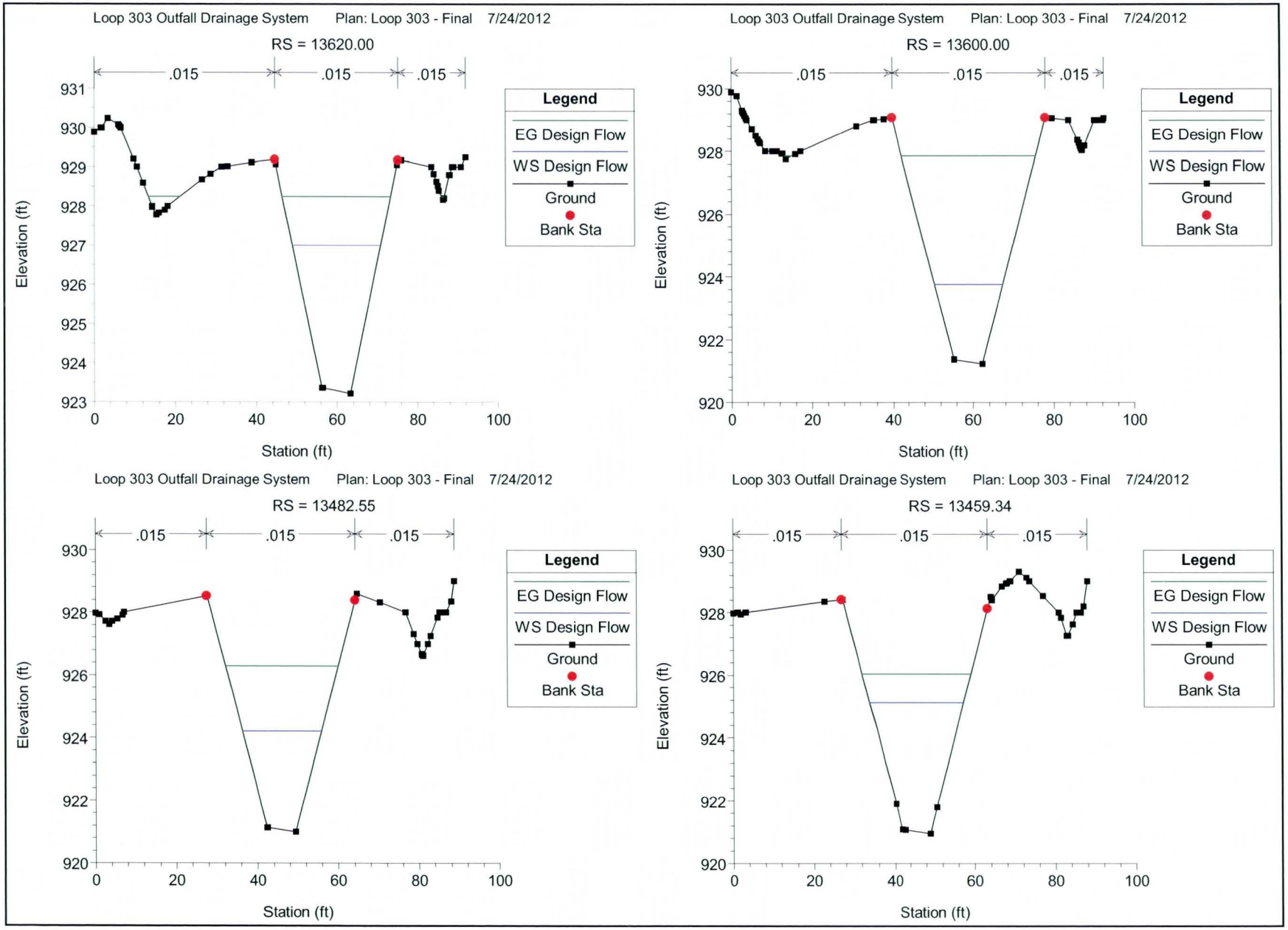

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 14579.51
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

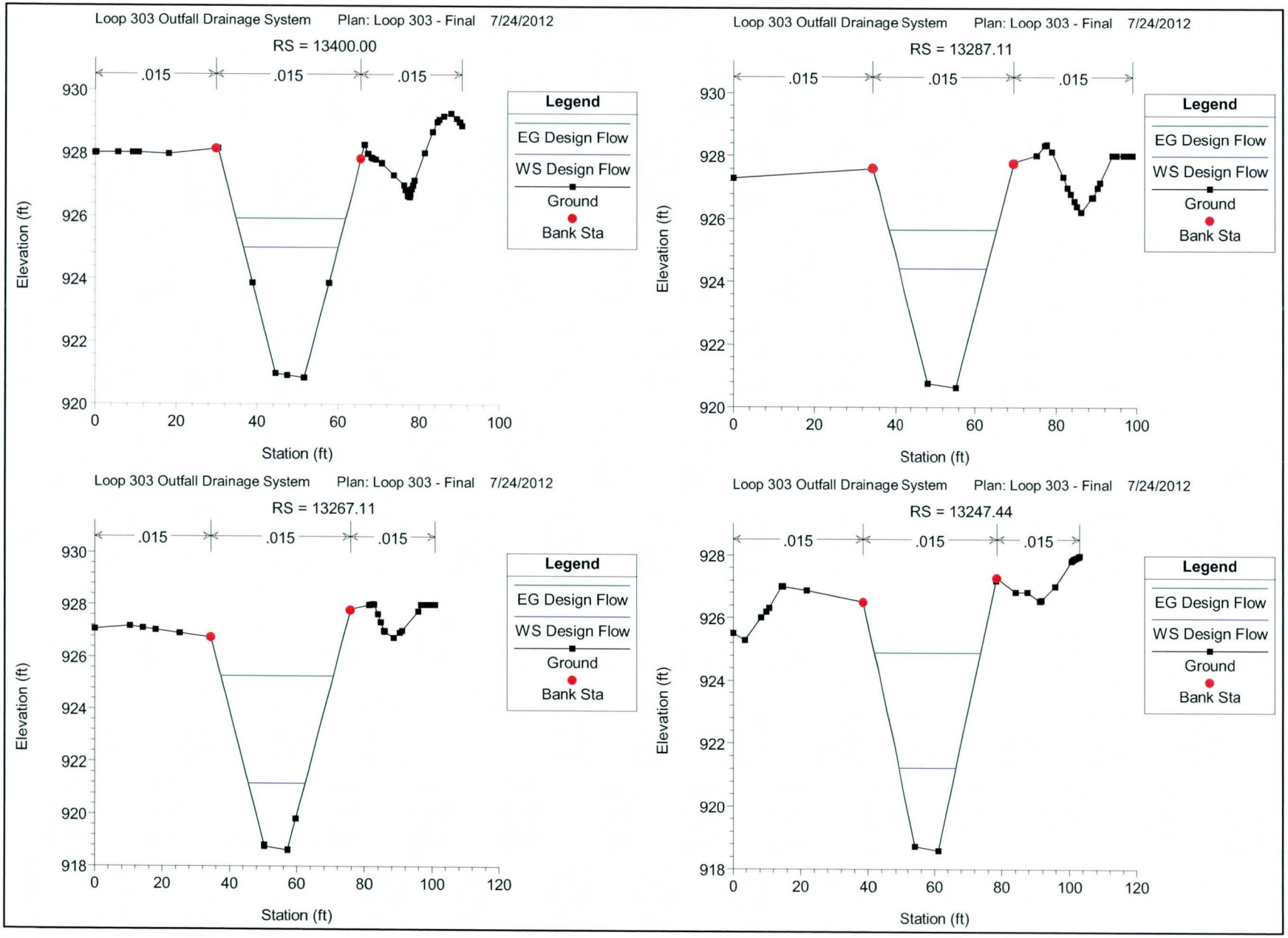

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 14561.53
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

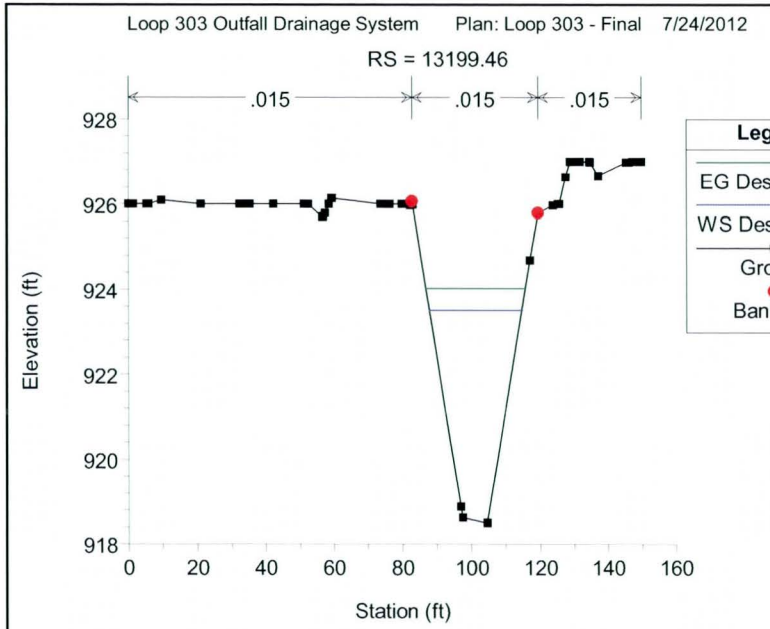

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 14500.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

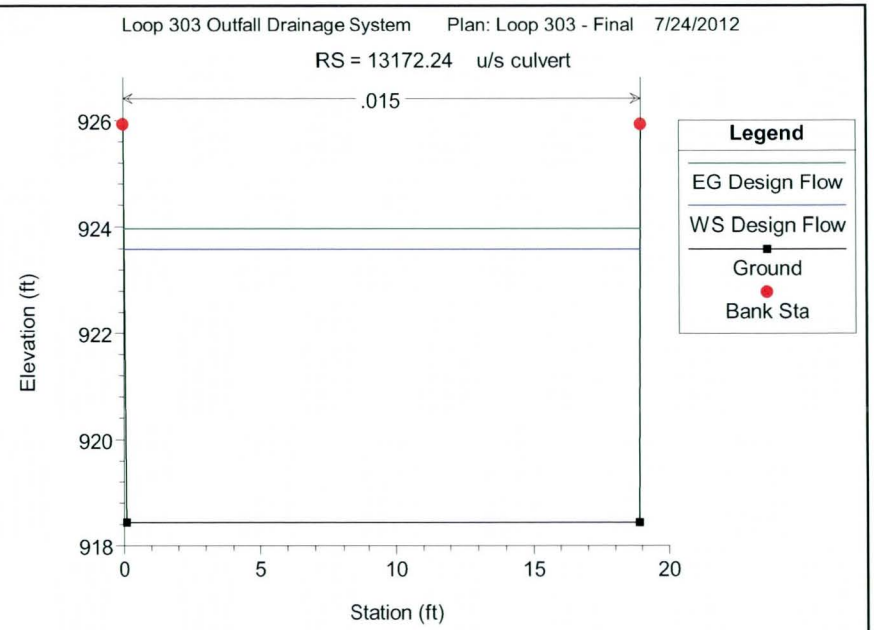

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 14400.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 14300.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 14200.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 14100.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

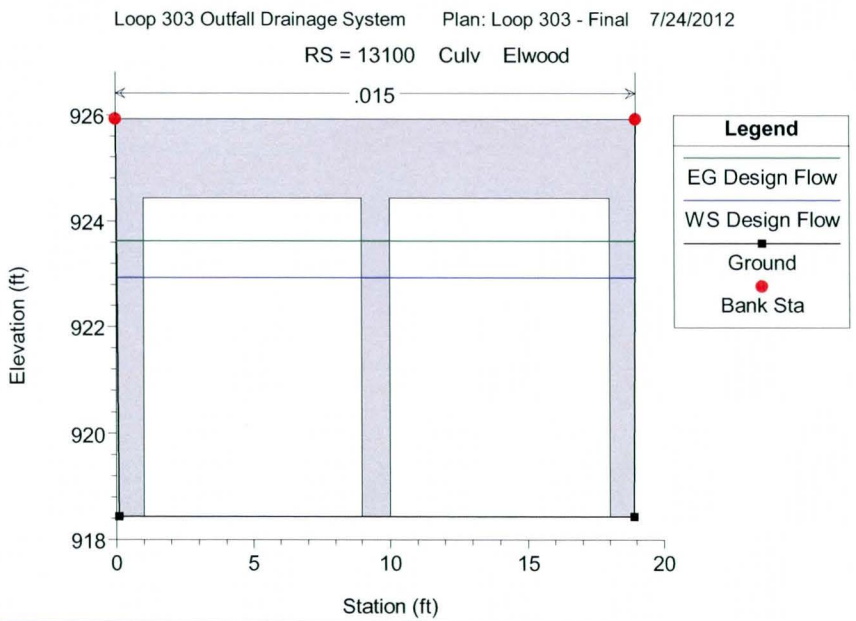

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 14000.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 13900.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 13800.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 13700.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

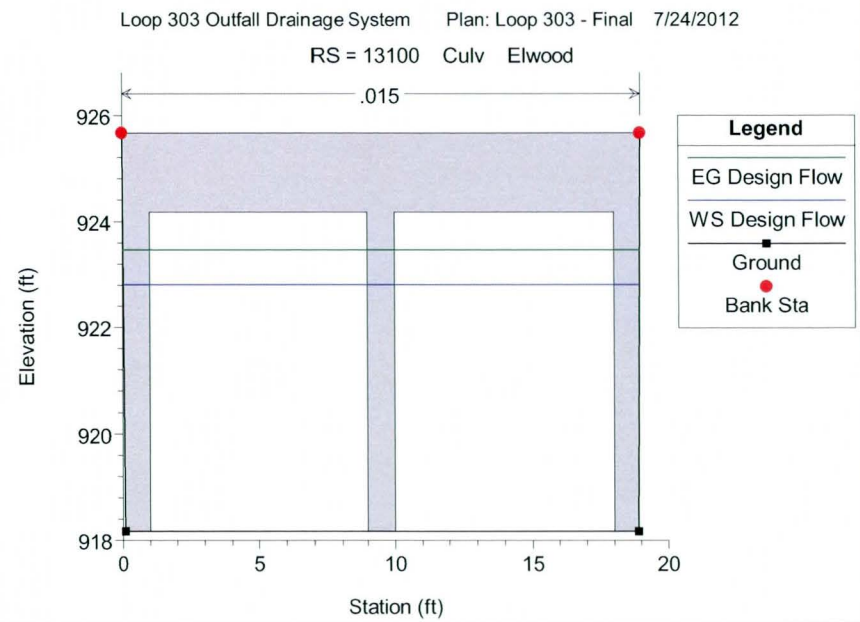

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 13620.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 13600.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 13482.55
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 13459.34
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

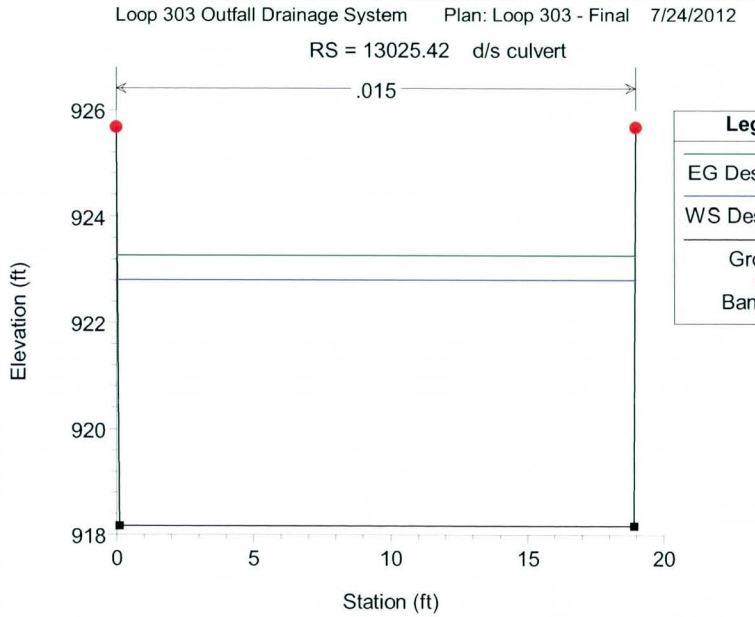

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 13400.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 13287.11
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 13267.11
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 13247.44
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

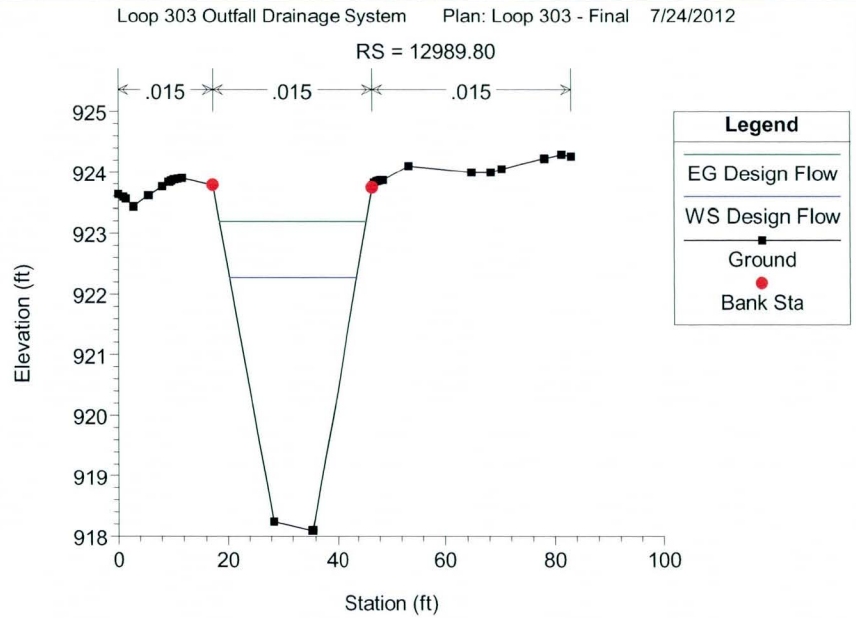

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 13199.46
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

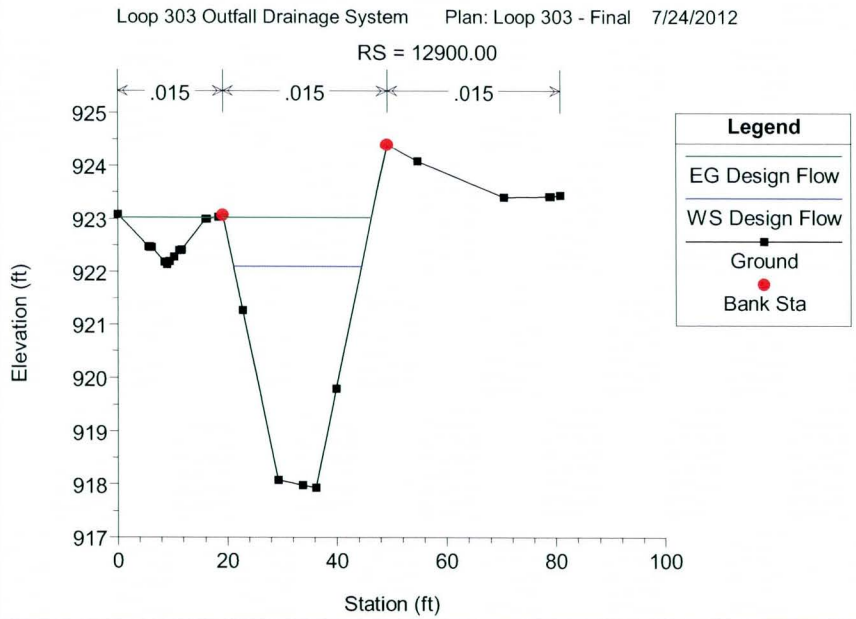

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 13172.24 u/s culvert
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

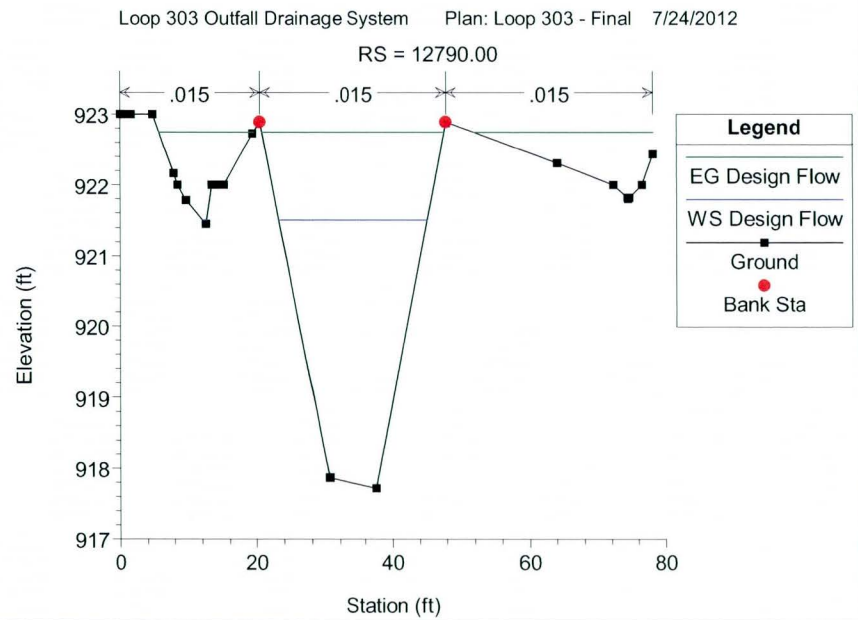

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 13100 Culv Elwood
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

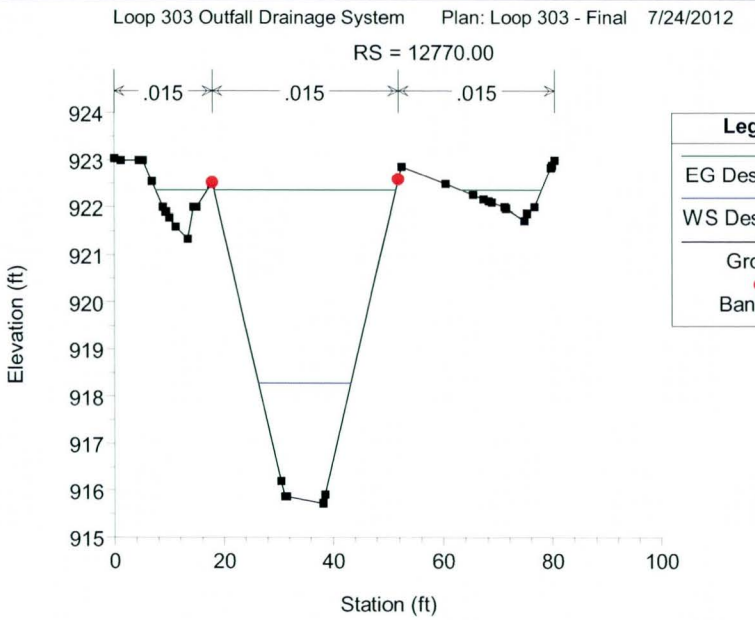

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 13100 Culv Elwood
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

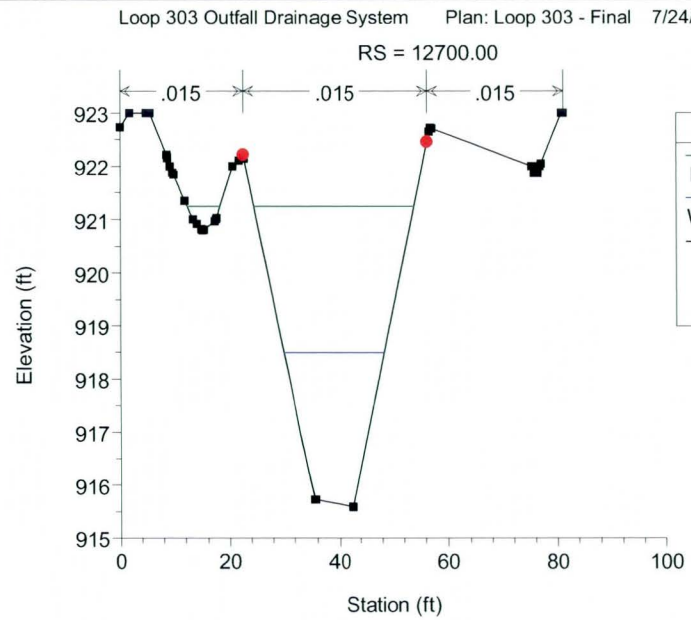

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 13025.42 d/s culvert
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

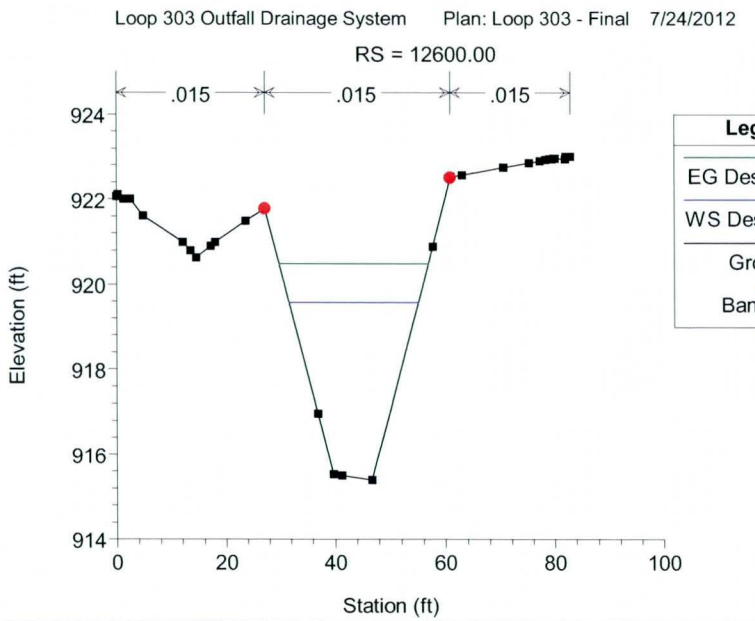

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 12989.80
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

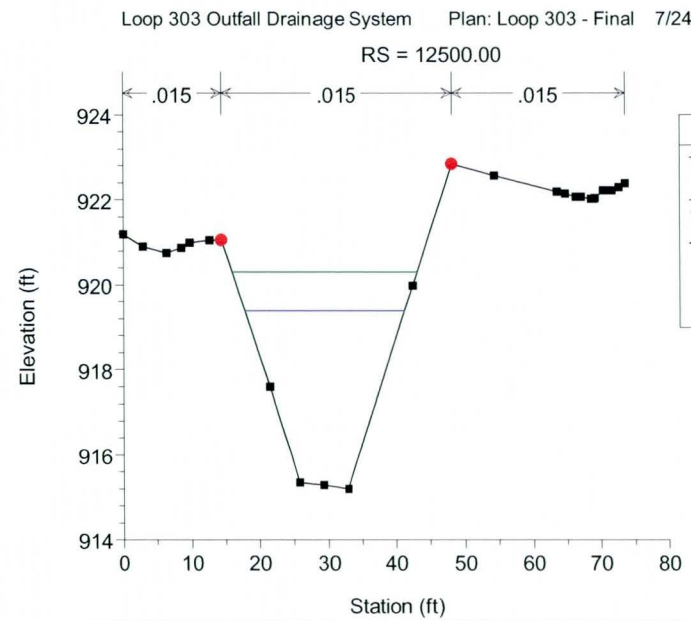

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 12900.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

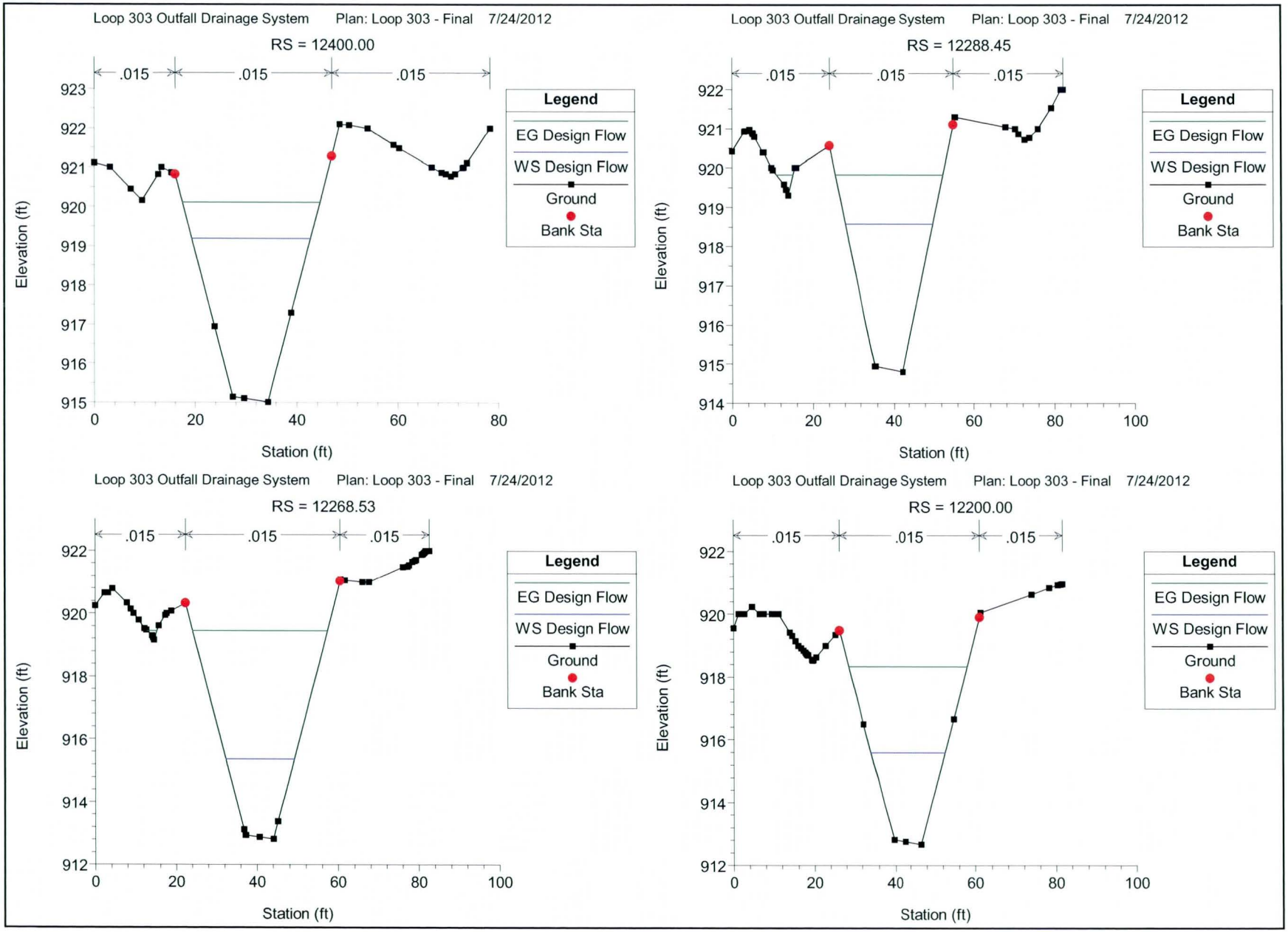

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 12790.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

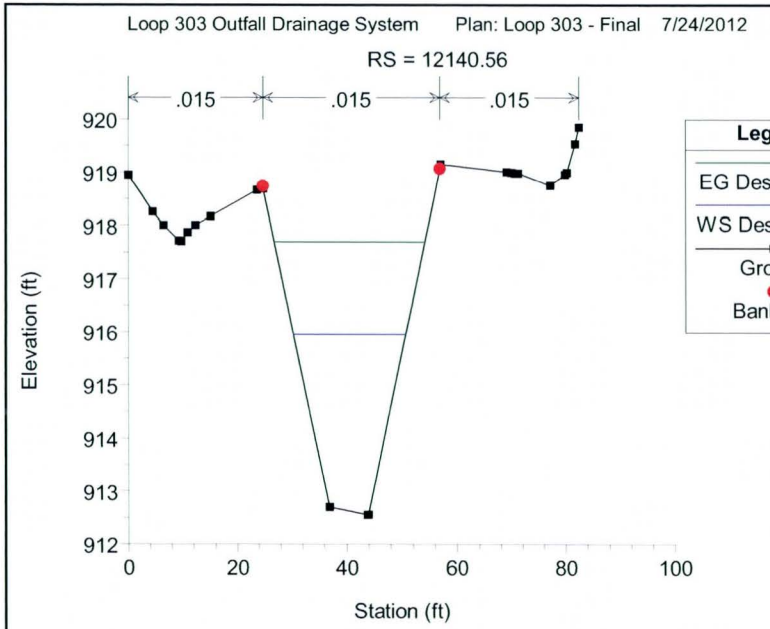

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 12770.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

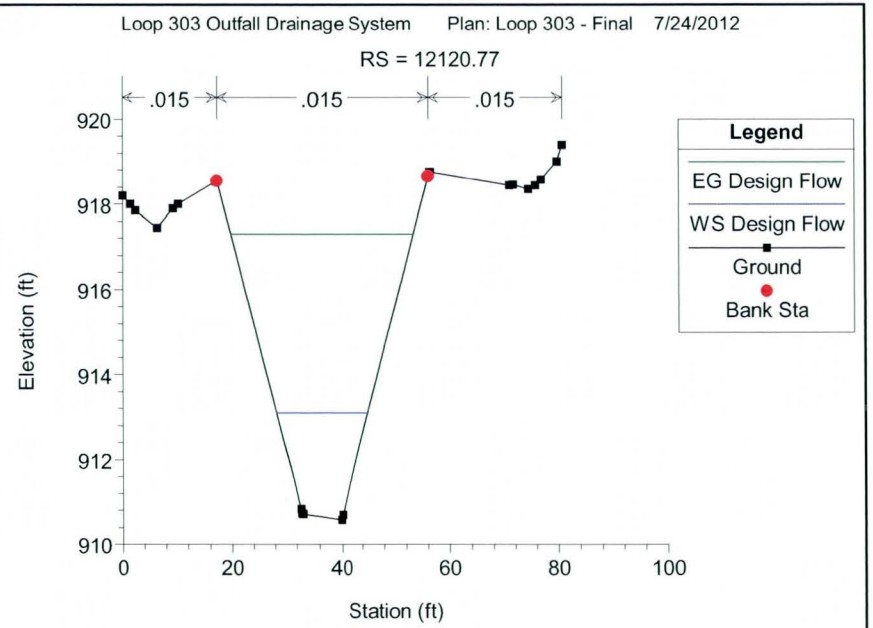

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 12700.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

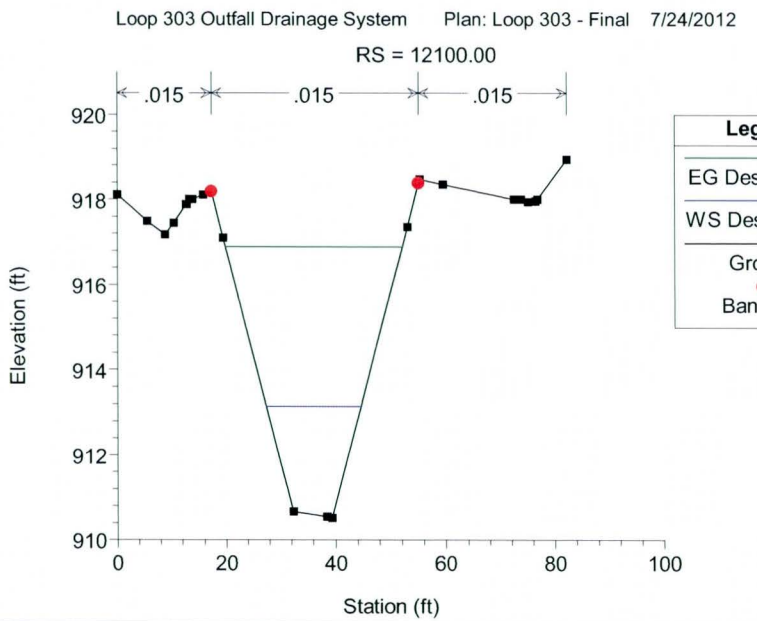

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 12600.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

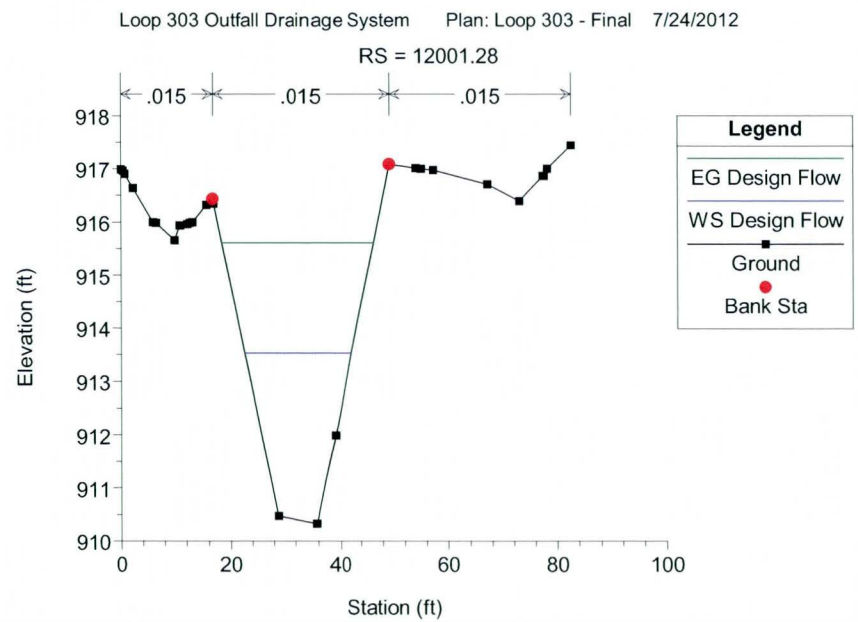

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 12500.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

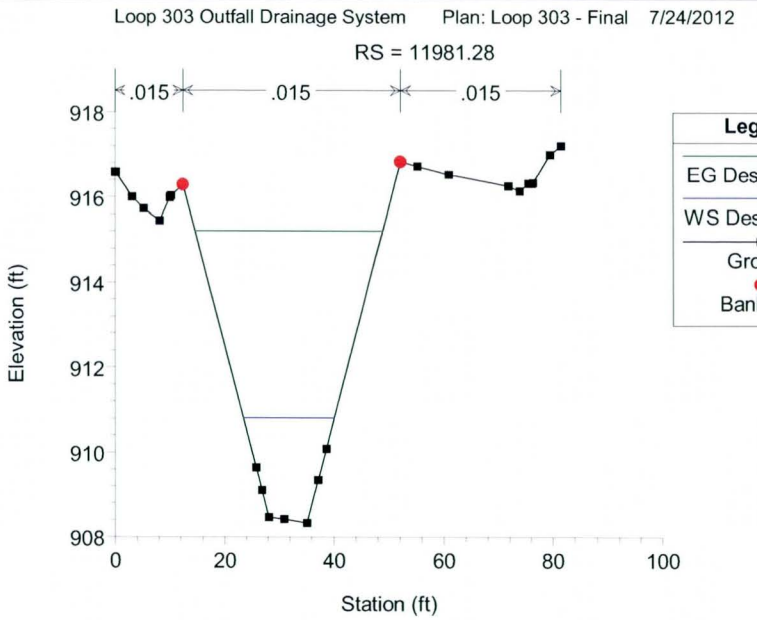

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 12400.00
.015 .015 .015
Elevation (ft)
Station (ft)
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 12288.45
.015 .015 .015
Elevation (ft)
Station (ft)
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 12268.53
.015 .015 .015
Elevation (ft)
Station (ft)
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 12200.00
.015 .015 .015
Elevation (ft)
Station (ft)
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta

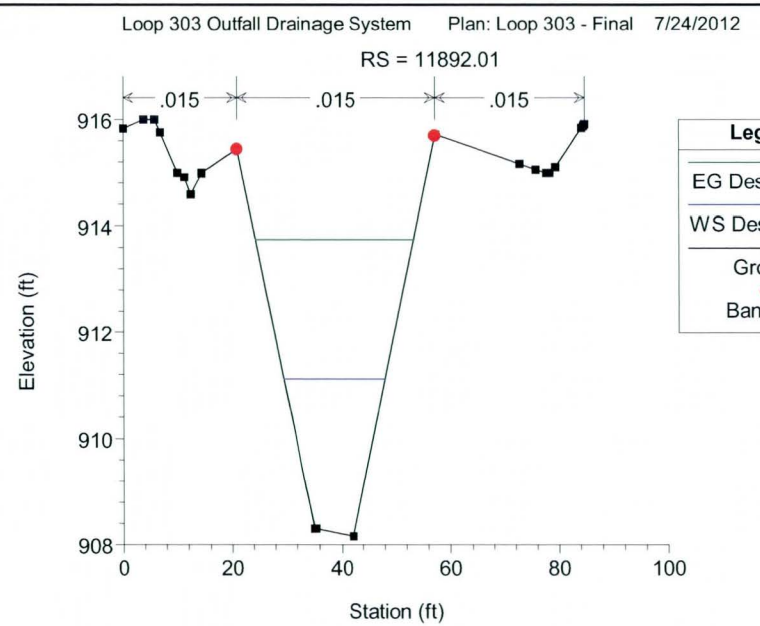

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 12140.56
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

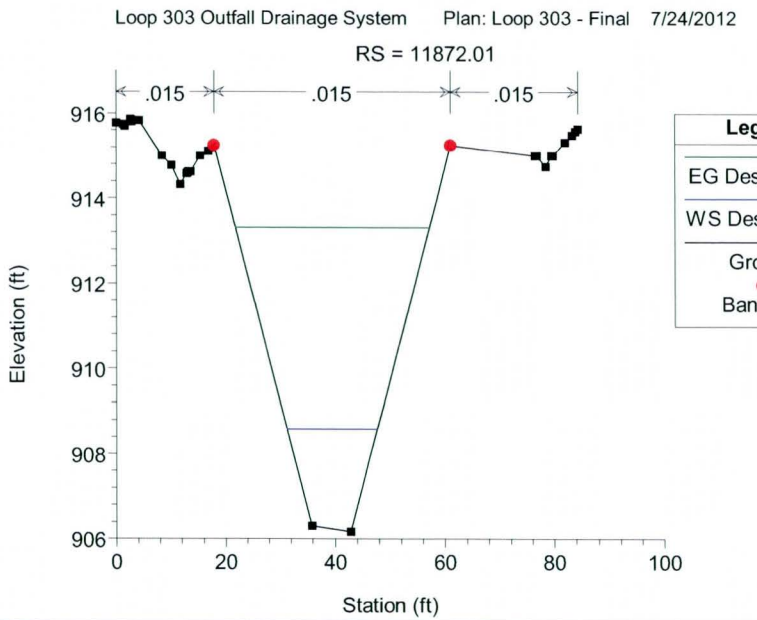

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 12120.77
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

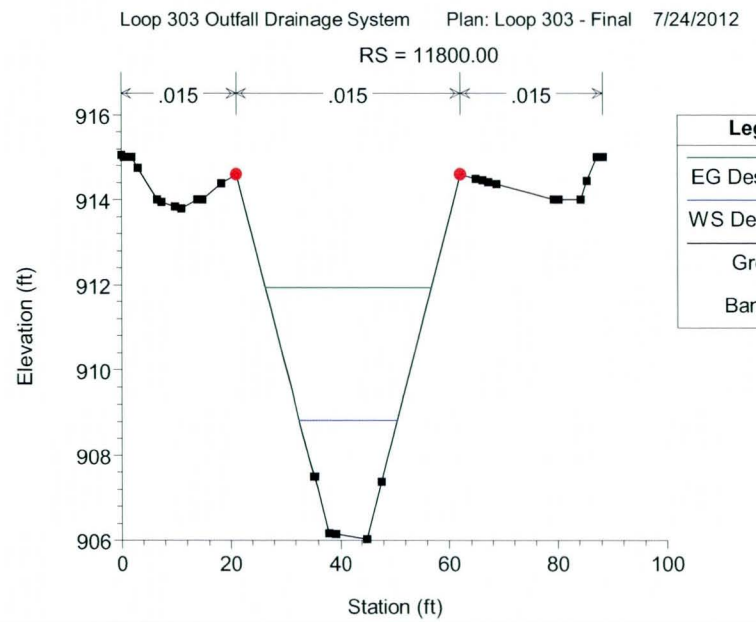

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 12100.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

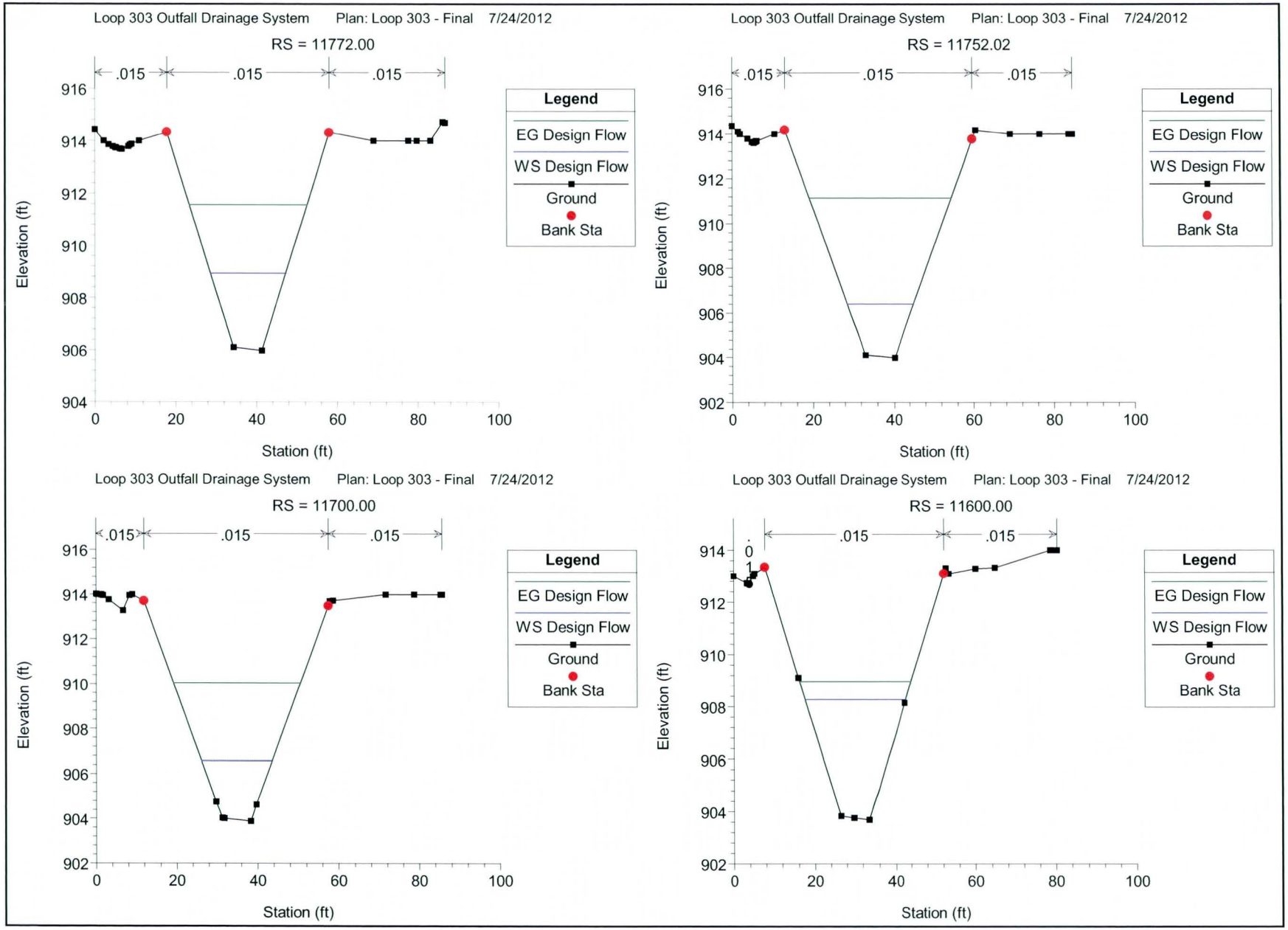

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 12001.28
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

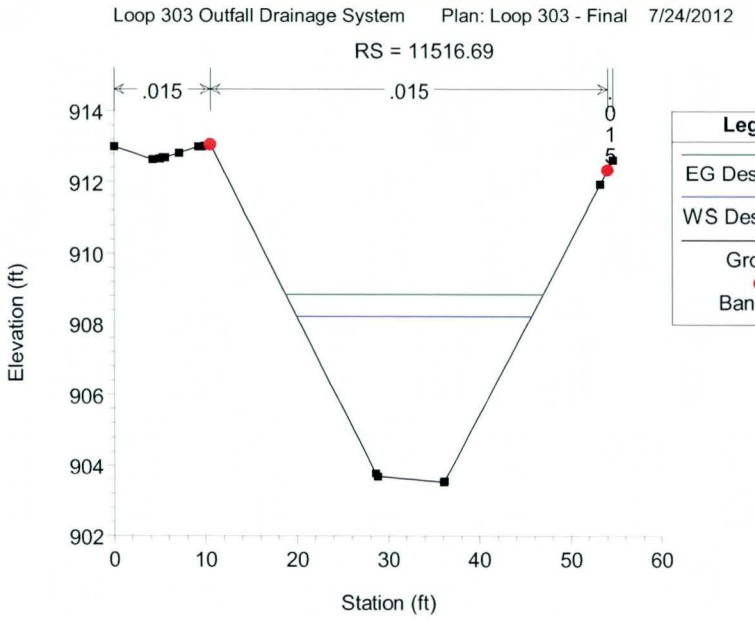

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 11981.28
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

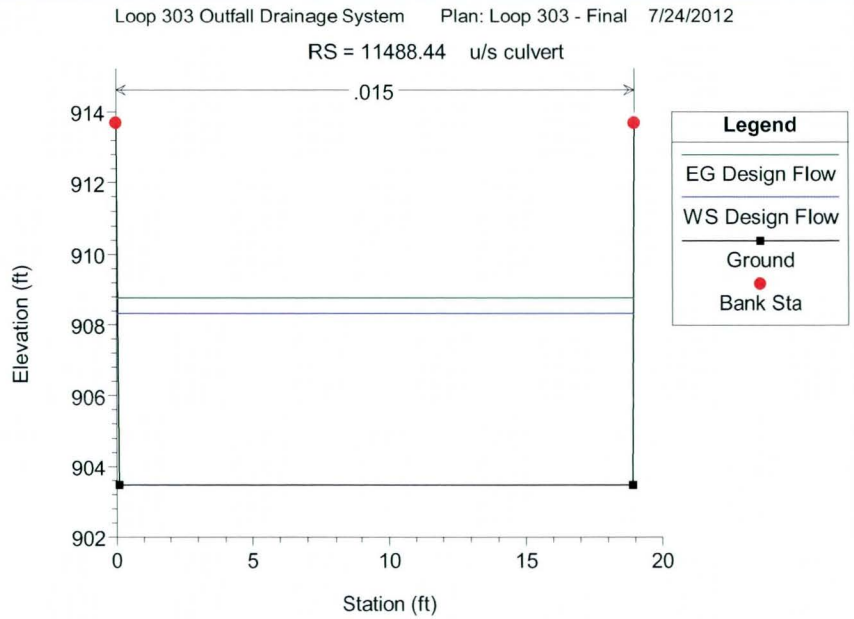

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 11892.01
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

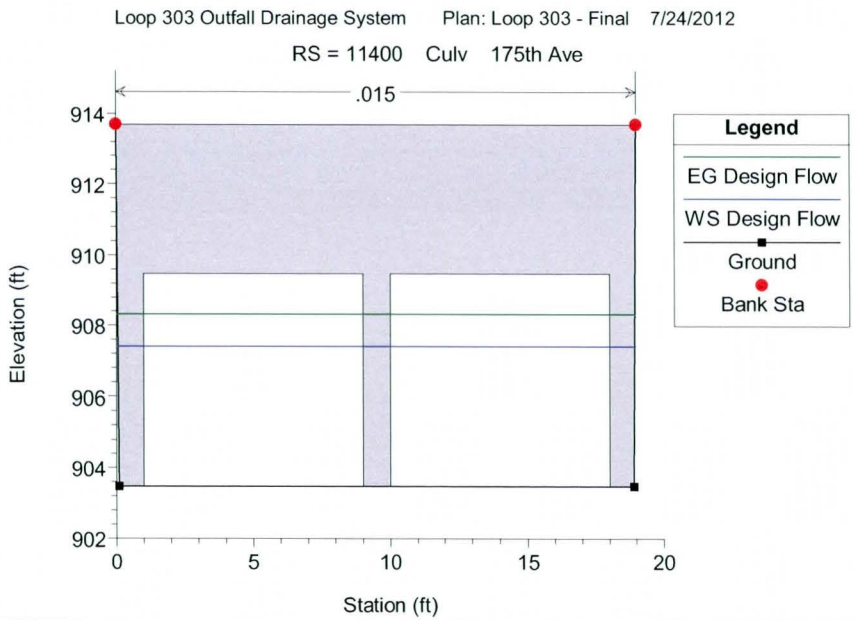

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 11872.01
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

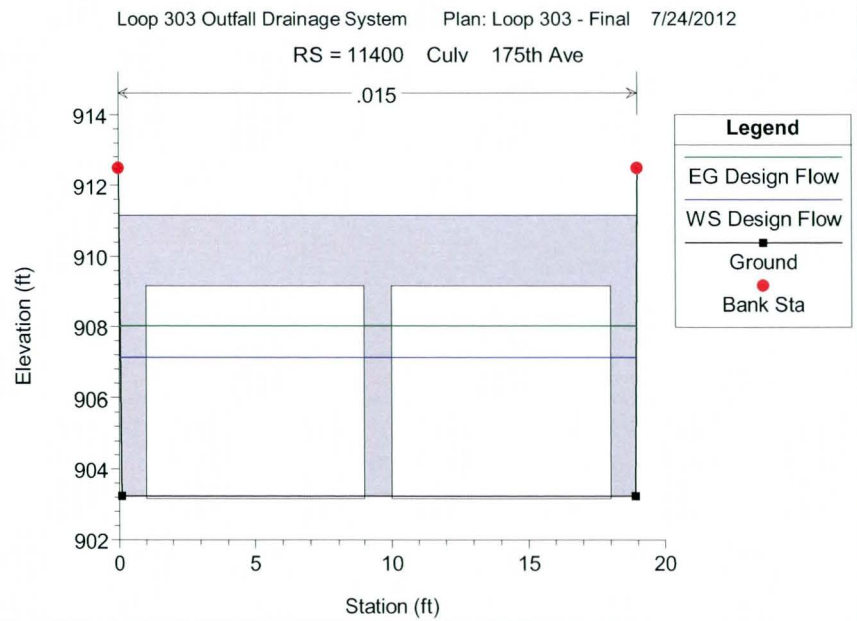

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 11800.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

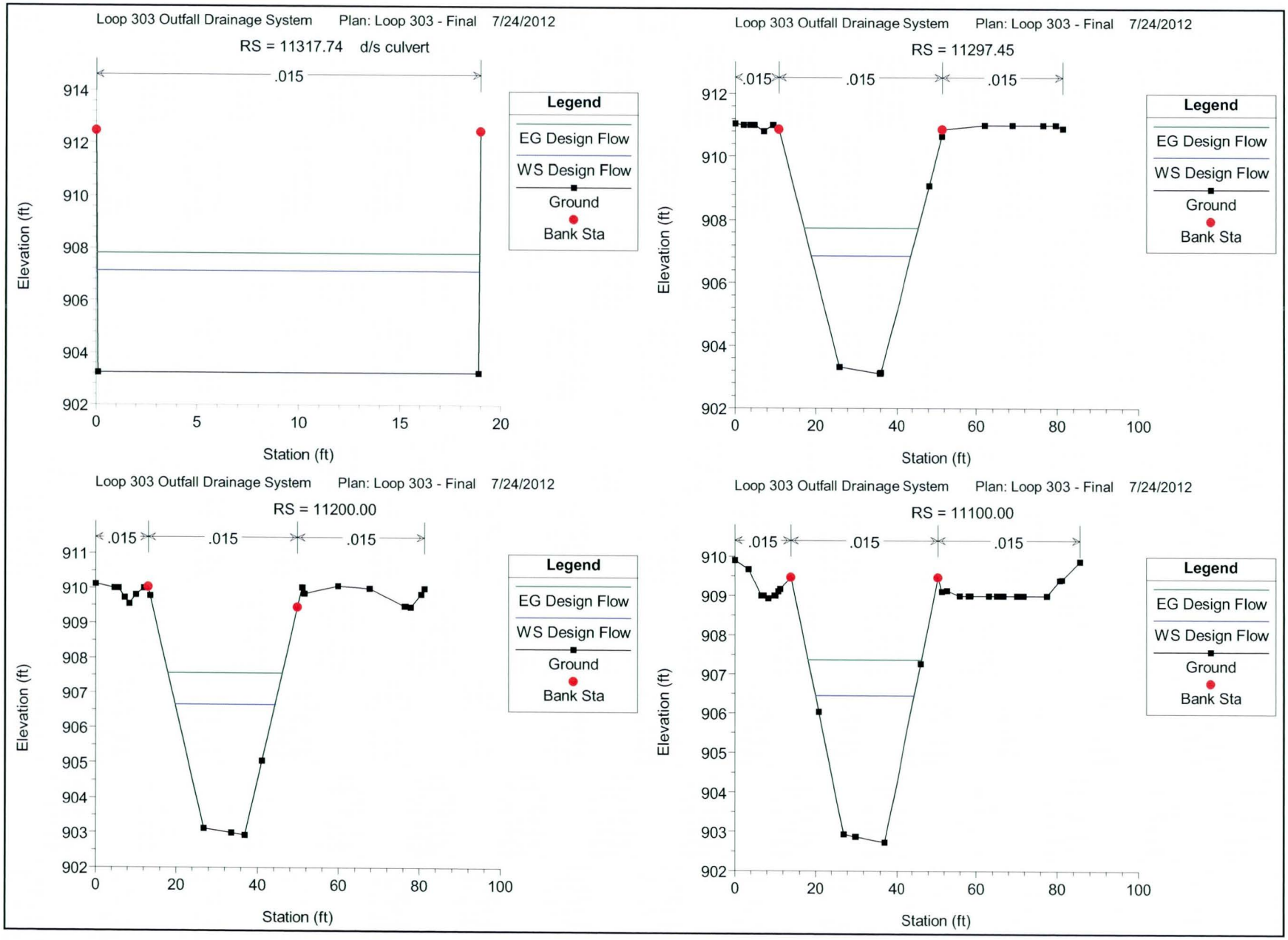

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 11772.00
.015
.015
.015
Elevation (ft)
Station (ft)
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 11752.02
.015
.015
.015
Elevation (ft)
Station (ft)
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 11700.00
.015
.015
.015
Elevation (ft)
Station (ft)
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 11600.00
.015
.015
Elevation (ft)
Station (ft)
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta

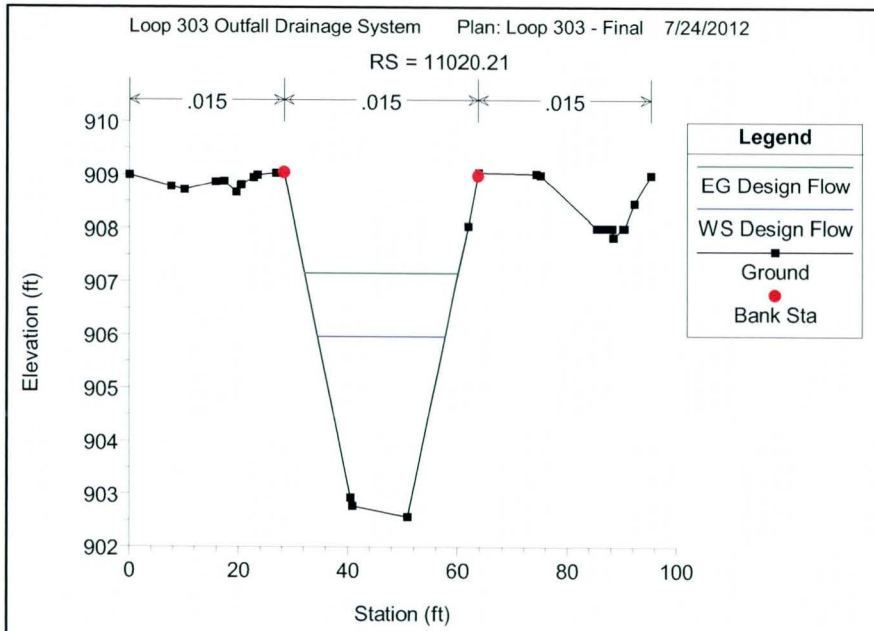

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 11516.69
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

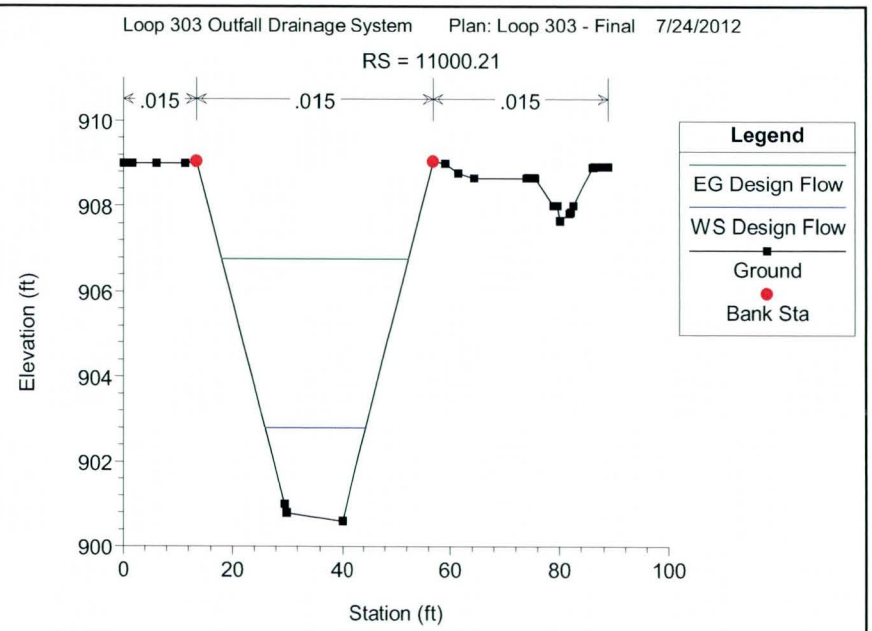

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 11488.44 u/s culvert
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

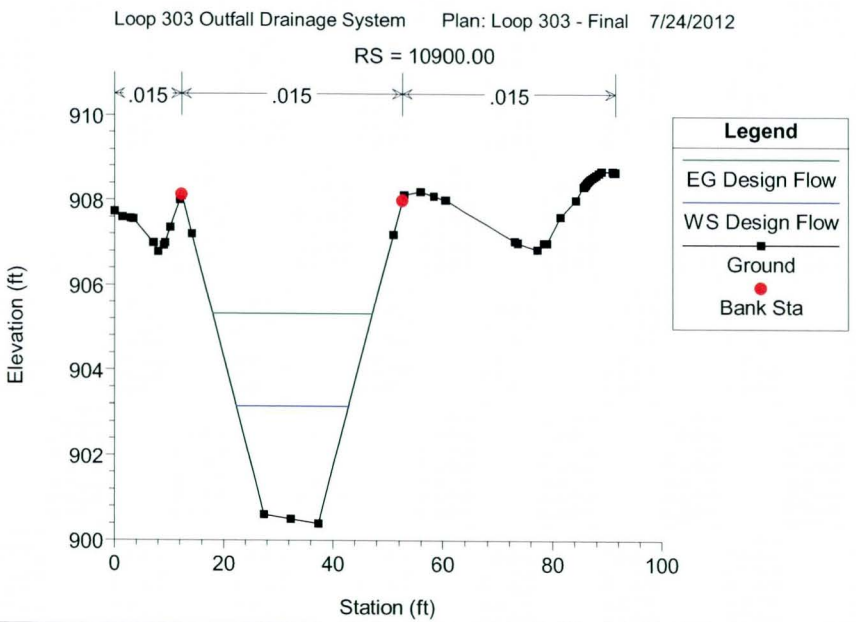

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 11400 Culv 175th Ave
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

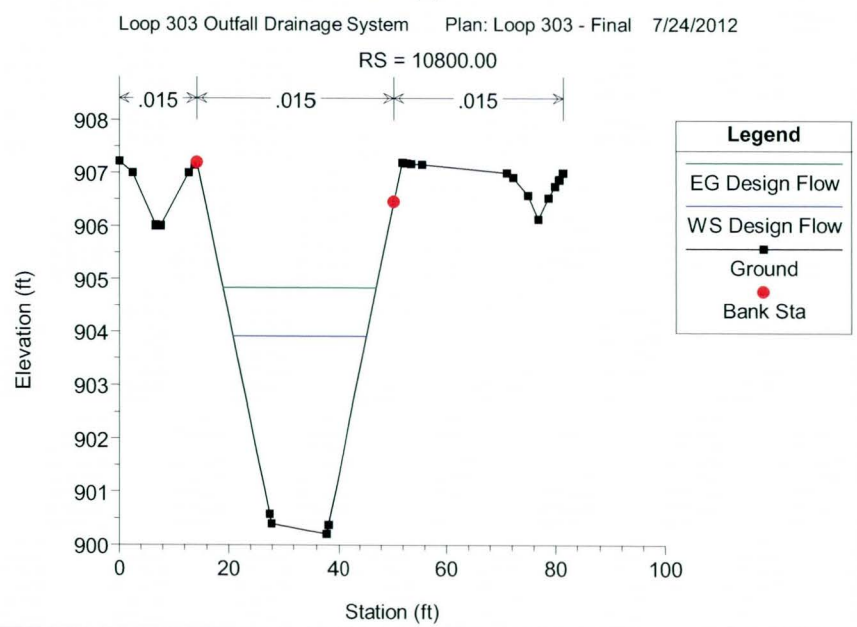

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 11400 Culv 175th Ave
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

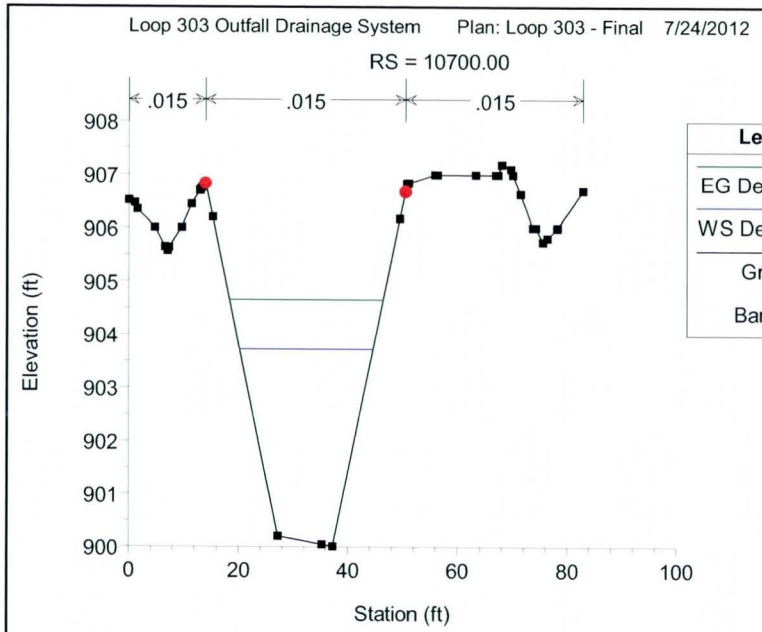

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 11317.74 d/s culvert
.015
Elevation (ft)
Station (ft)
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 11297.45
.015
.015
.015
Elevation (ft)
Station (ft)
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 11200.00
.015
.015
.015
Elevation (ft)
Station (ft)
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 11100.00
.015
.015
.015
Elevation (ft)
Station (ft)
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta

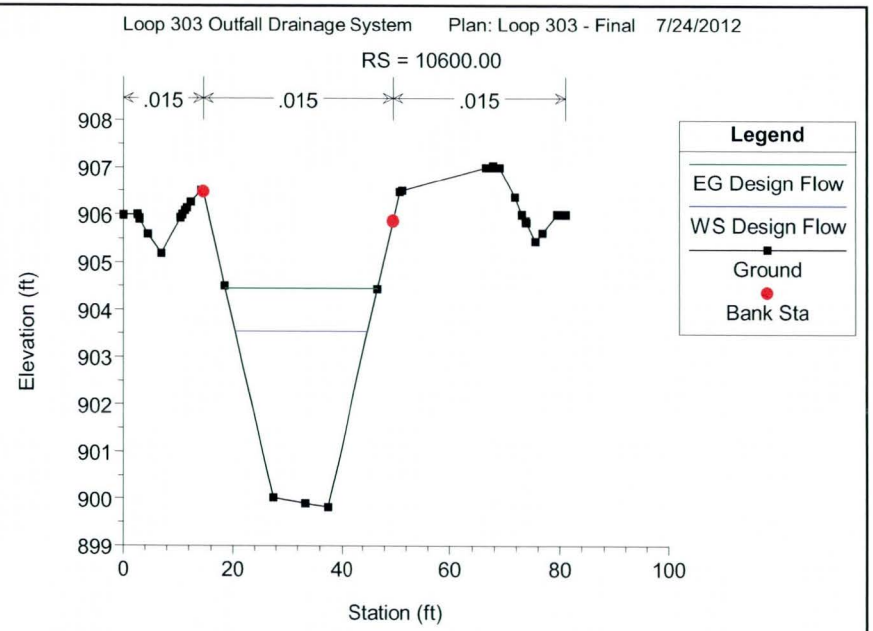

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 11020.21
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

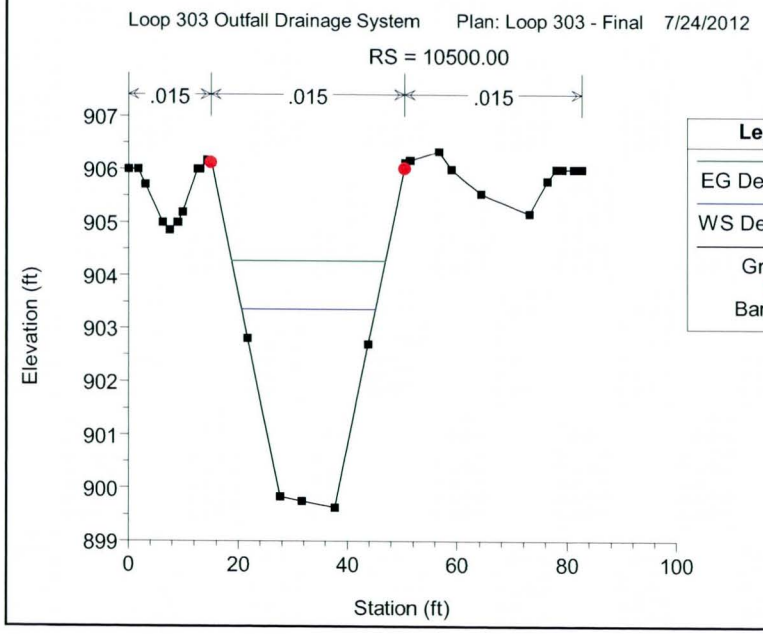

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 11000.21
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

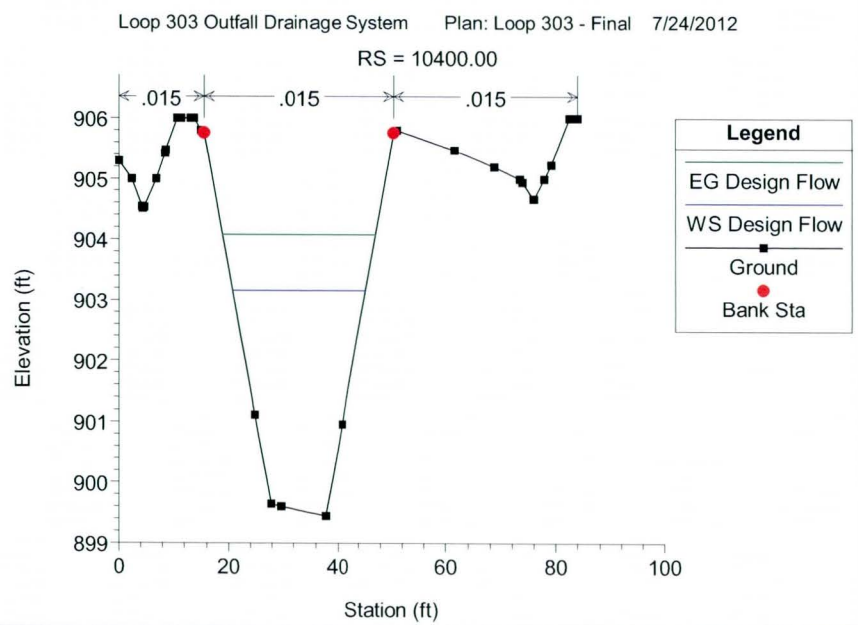

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 10900.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

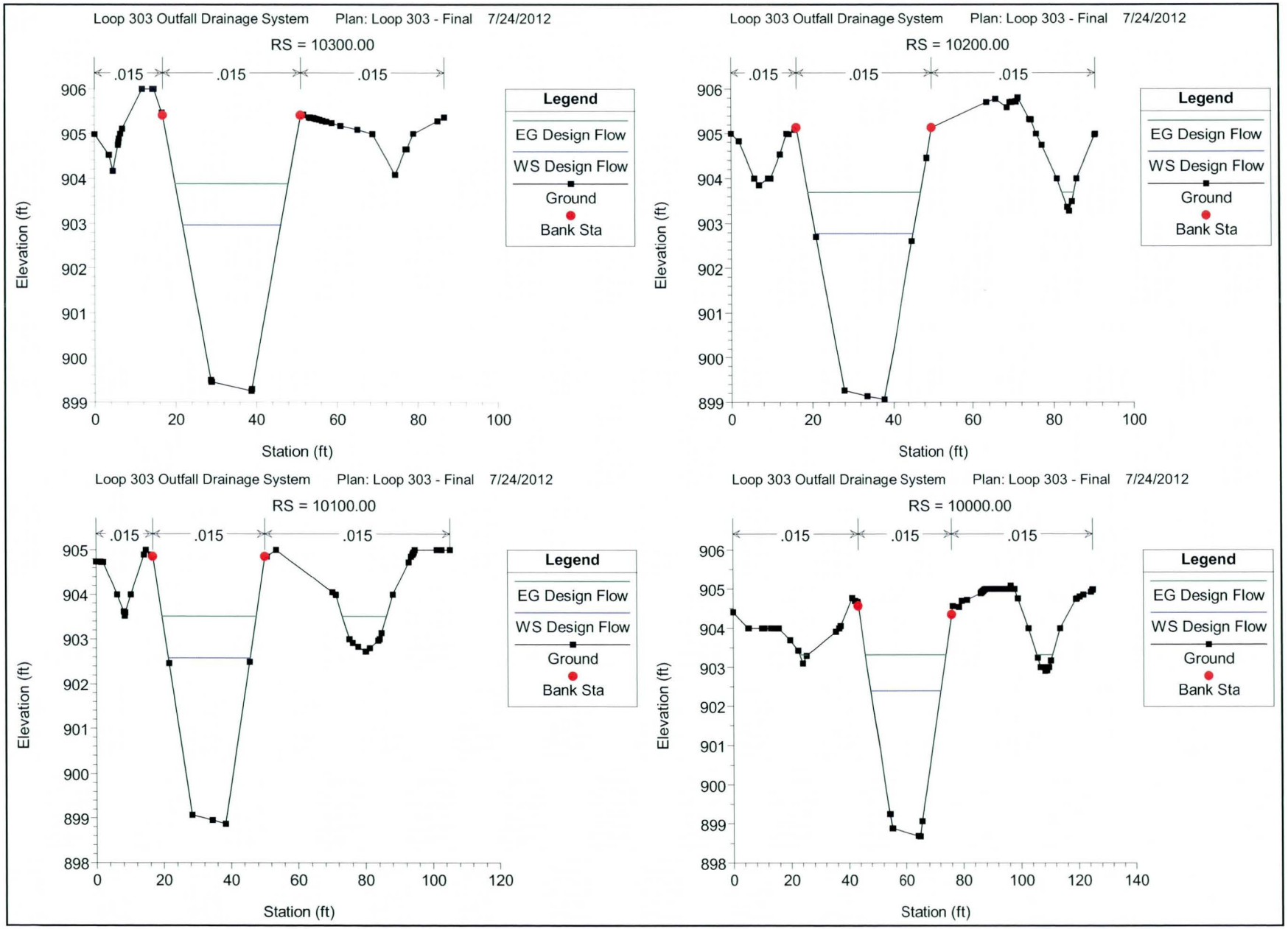

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 10800.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

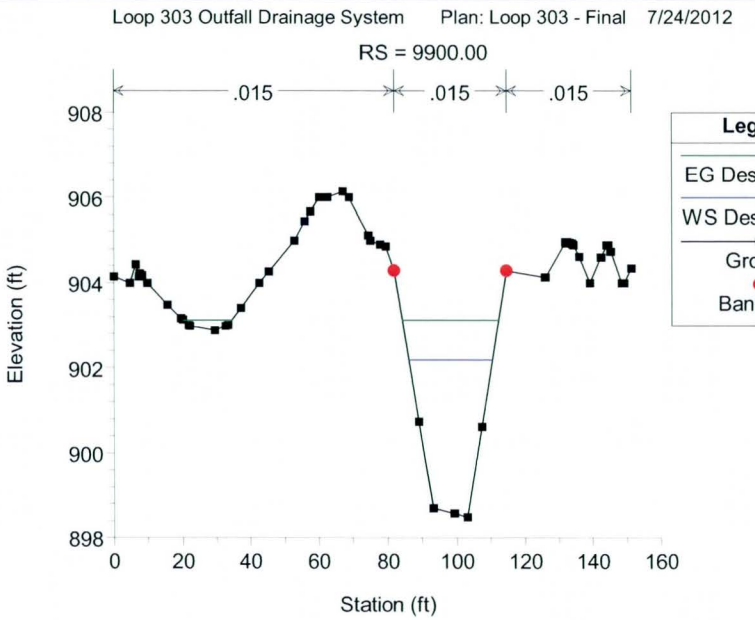

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 10700.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

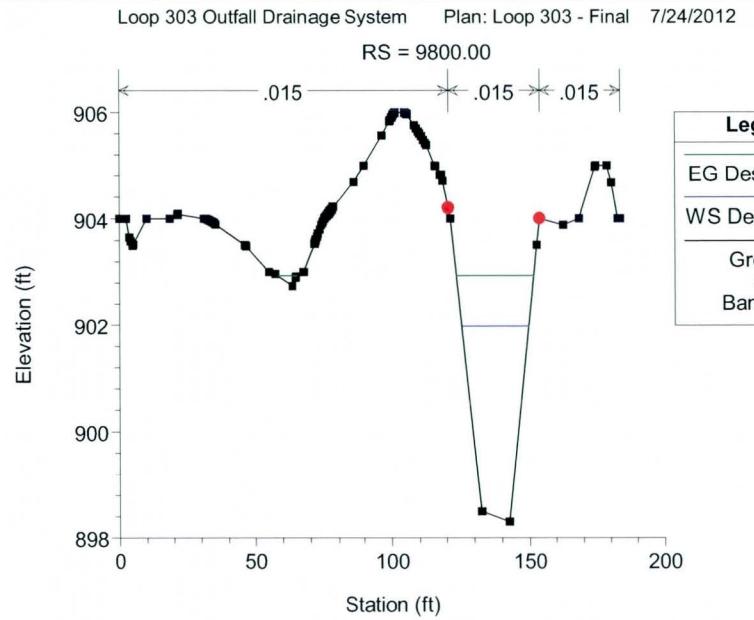

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 10600.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

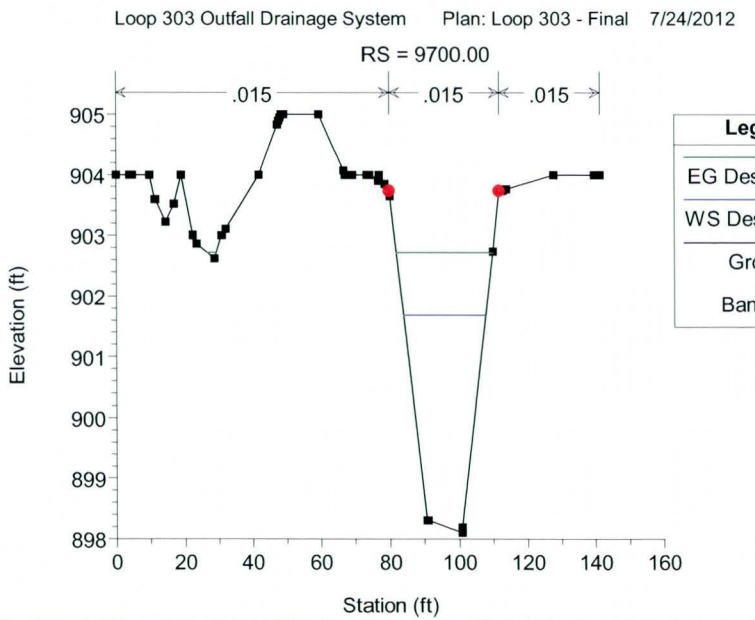

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 10500.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

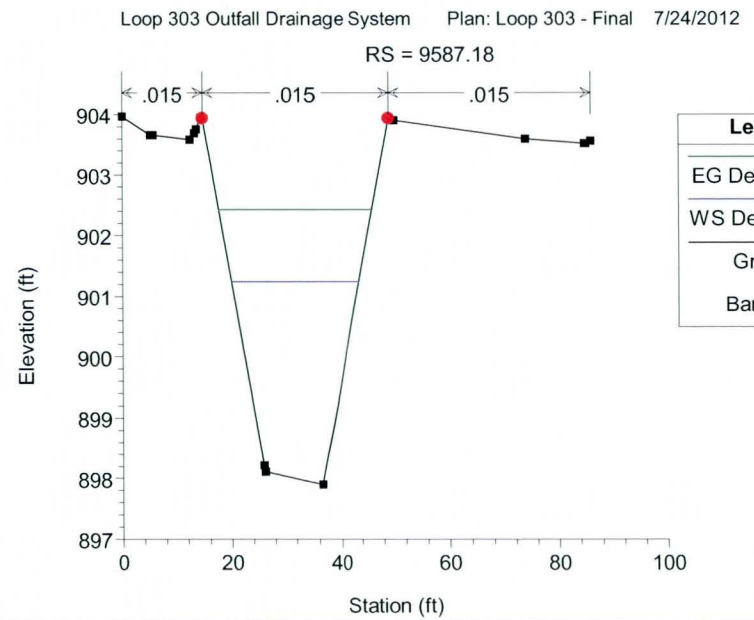

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 10400.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

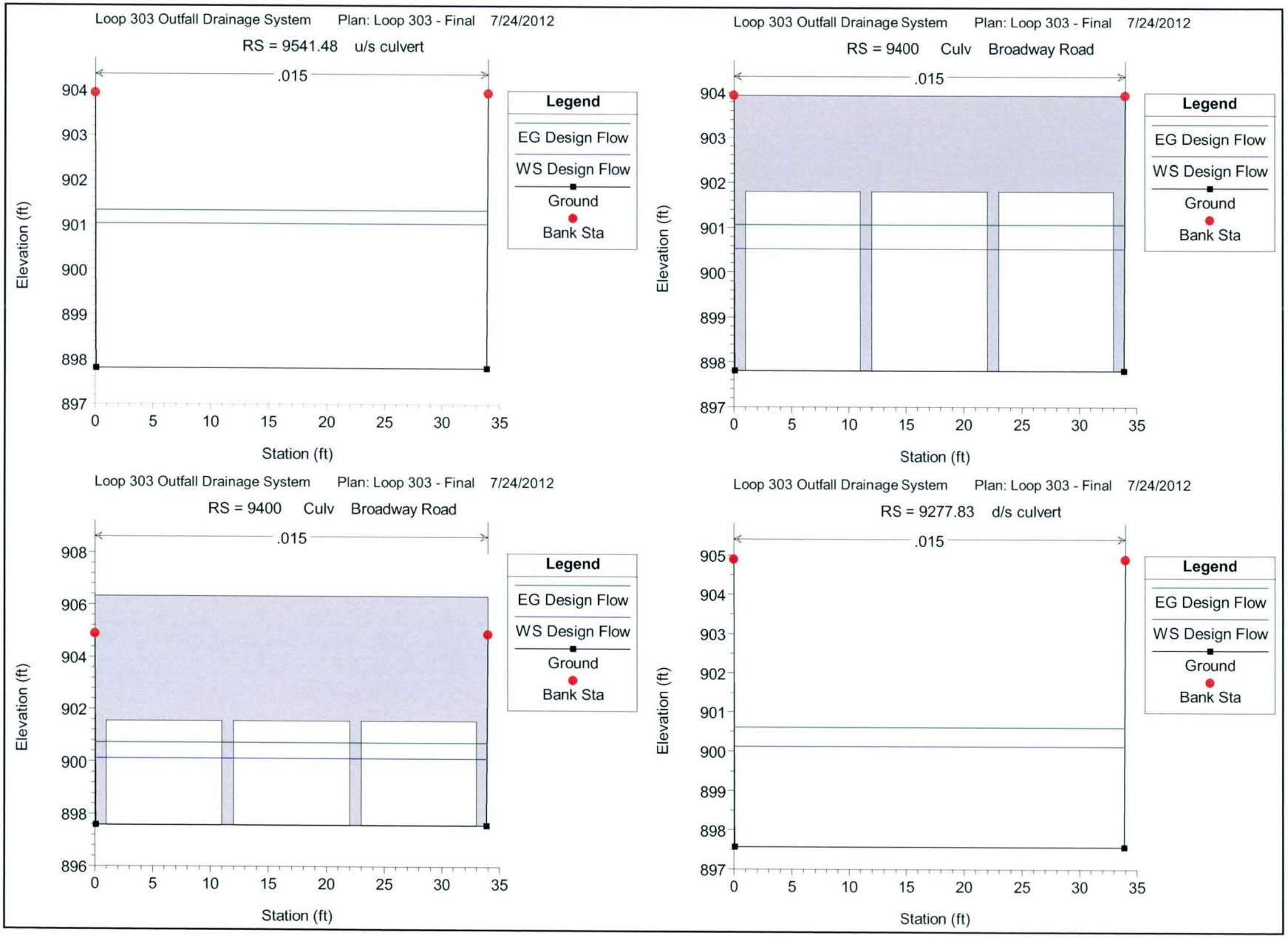

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 10300.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 10200.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 10100.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 10000.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

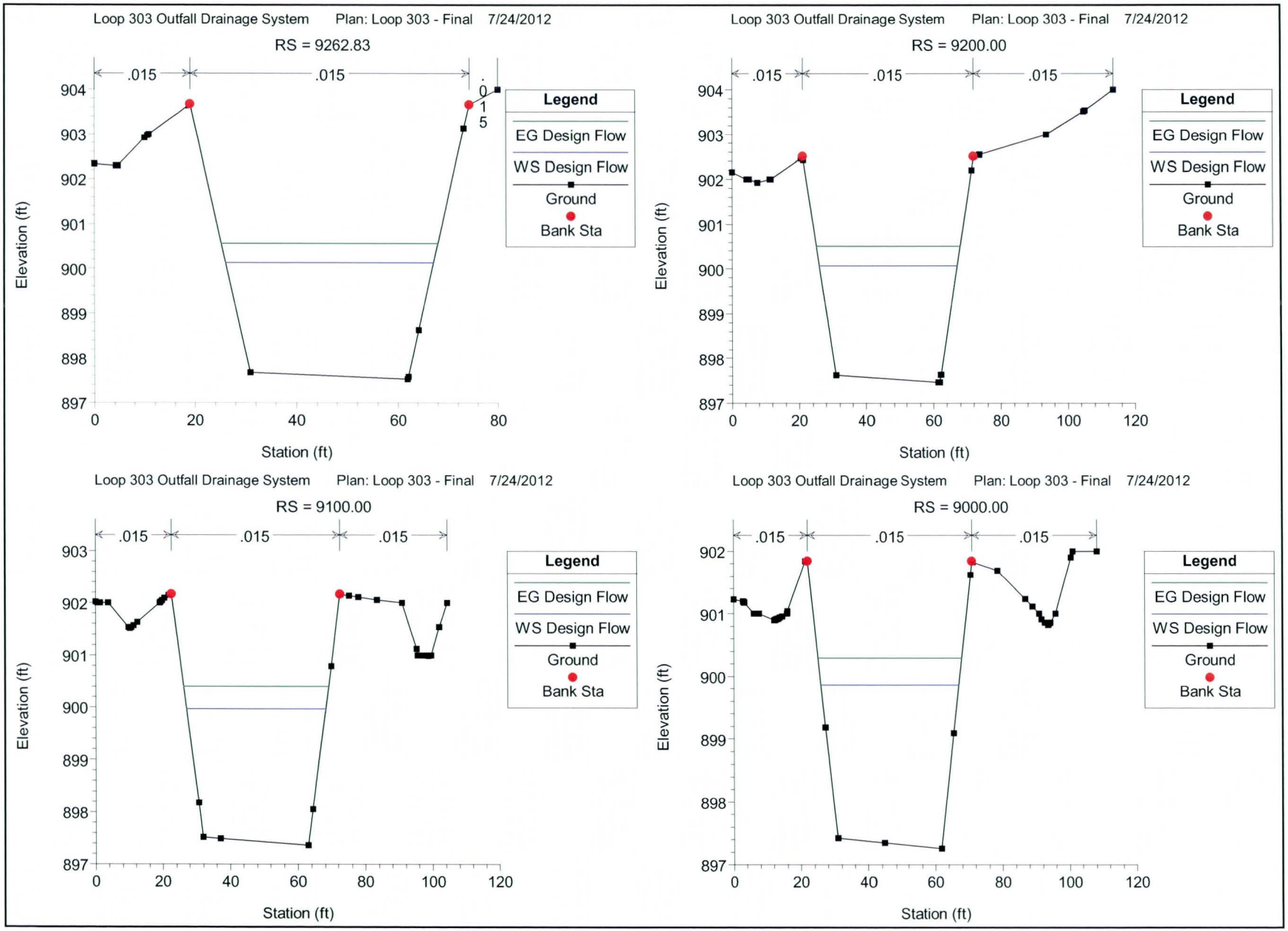

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 9900.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

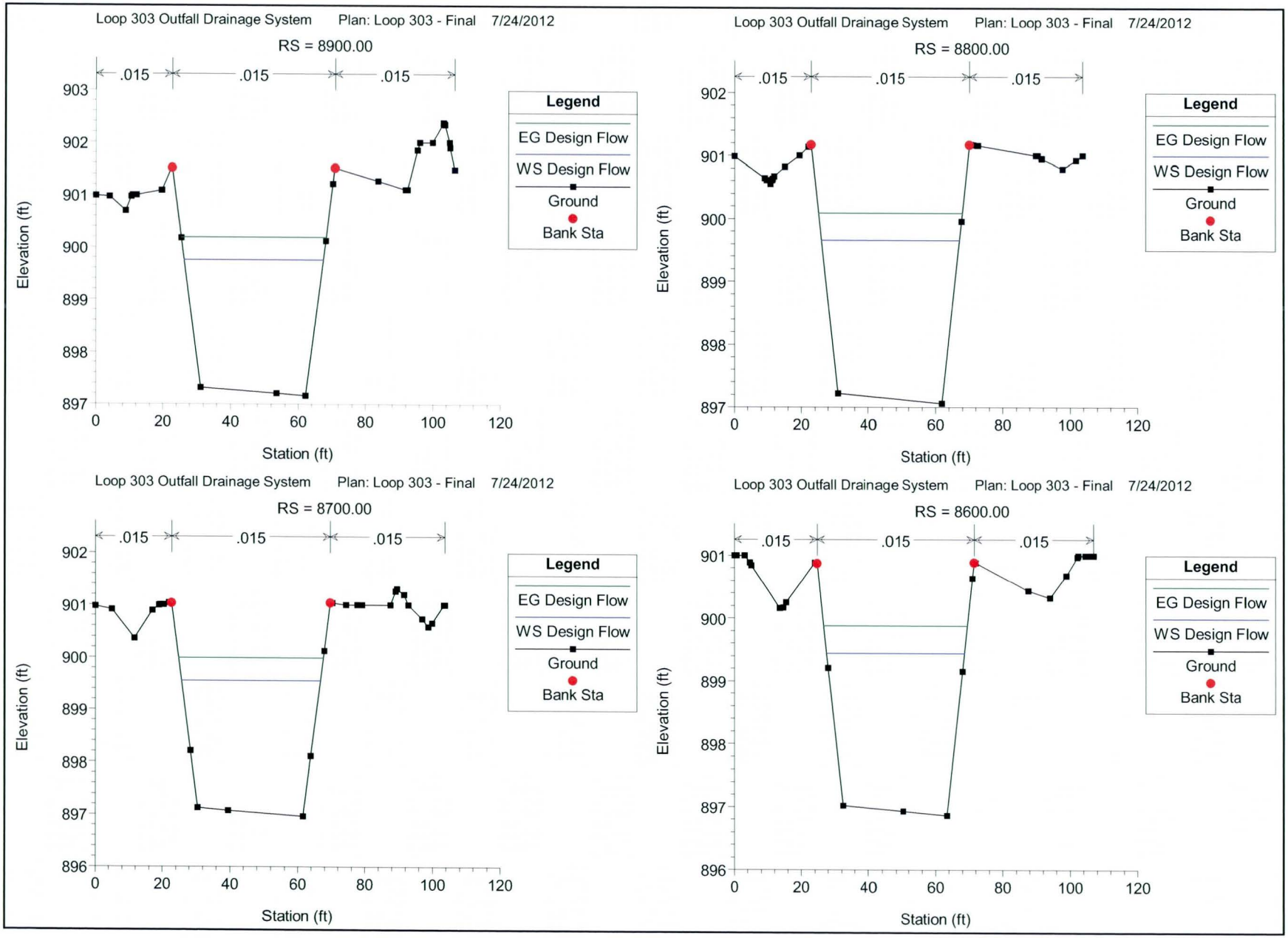

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 9800.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

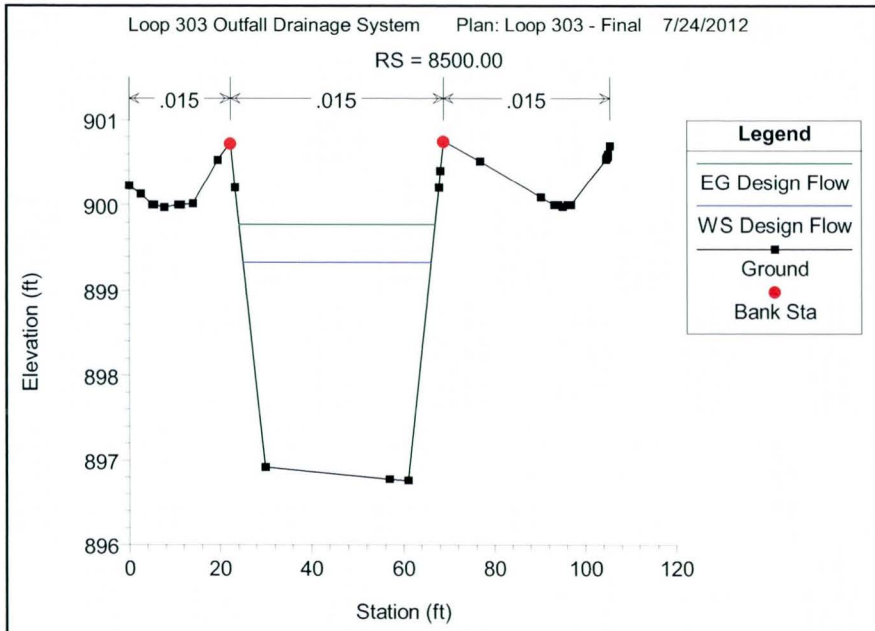

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 9700.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

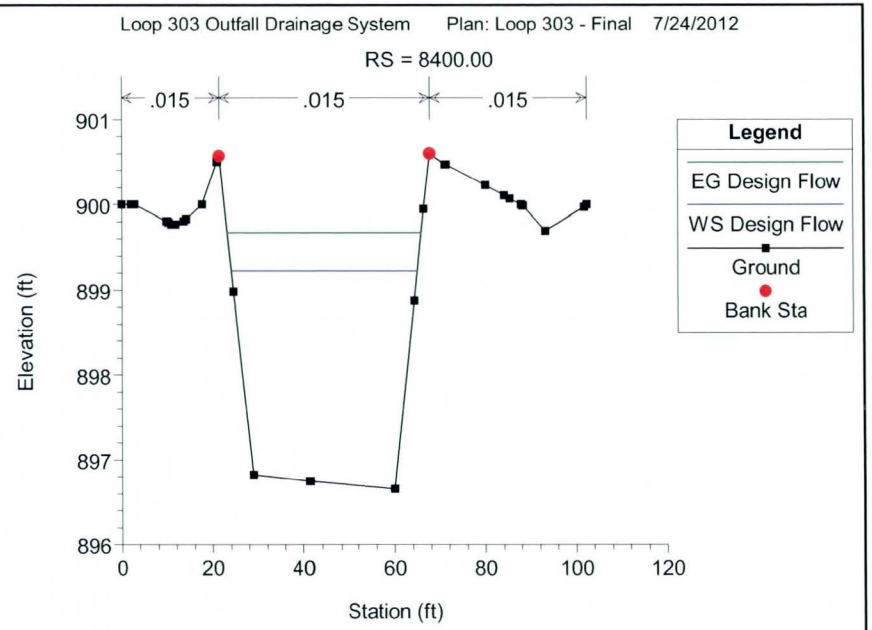

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 9587.18
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

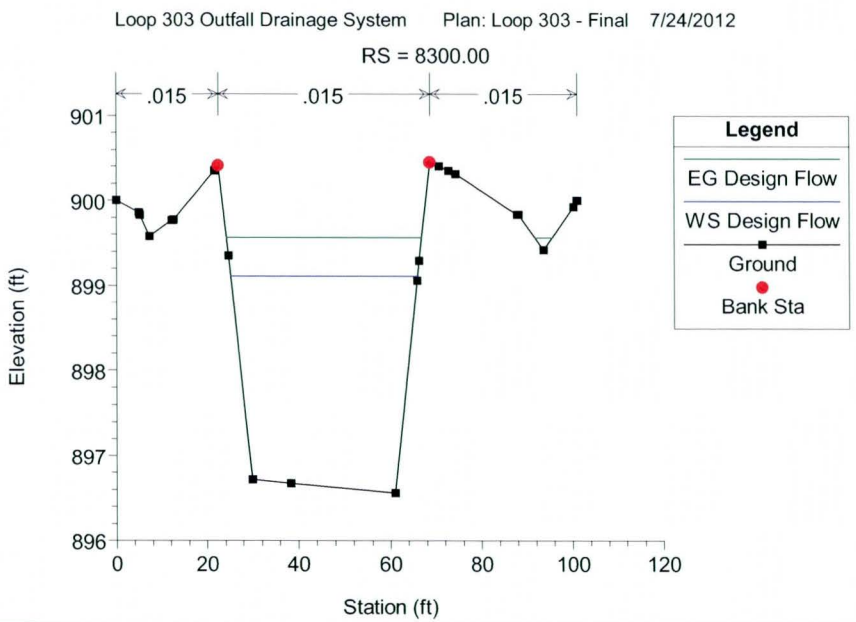

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 9541.48 u/s culvert
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 9400 Culv Broadway Road
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 9400 Culv Broadway Road
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 9277.83 d/s culvert
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

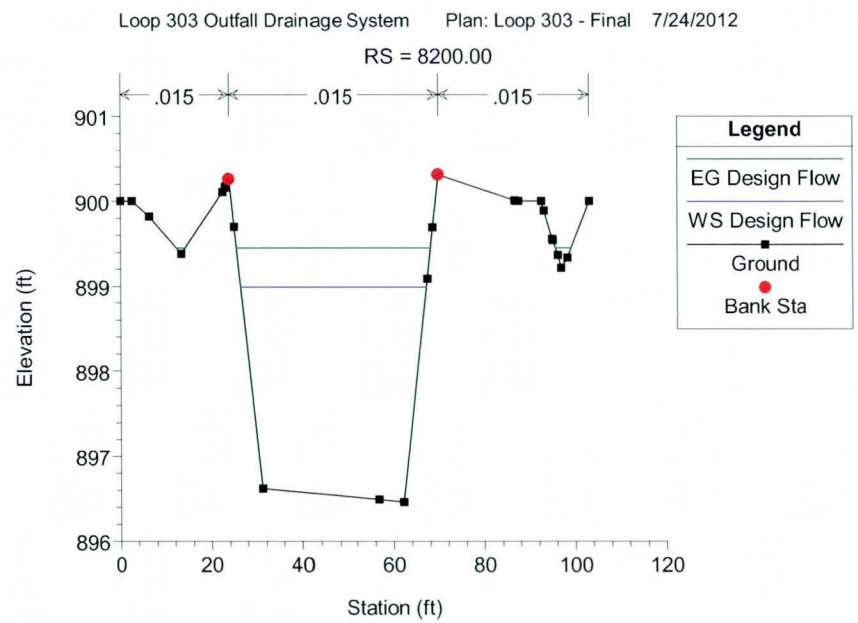

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 9262.83
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 9200.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 9100.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 9000.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

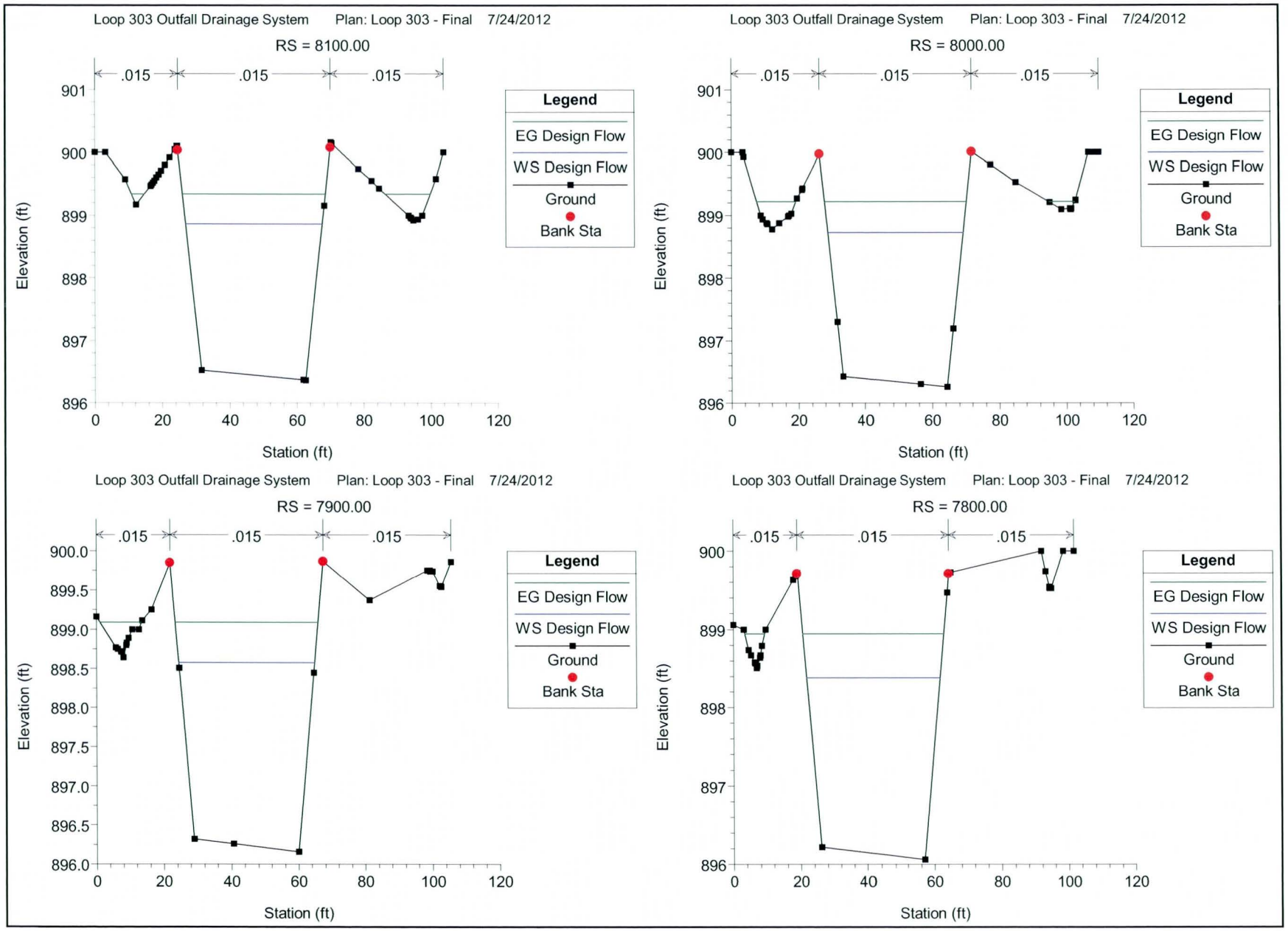

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 8900.00
.015 .015 .015
Elevation (ft)
Station (ft)
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 8800.00
.015 .015 .015
Elevation (ft)
Station (ft)
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 8700.00
.015 .015 .015
Elevation (ft)
Station (ft)
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 8600.00
.015 .015 .015
Elevation (ft)
Station (ft)
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta

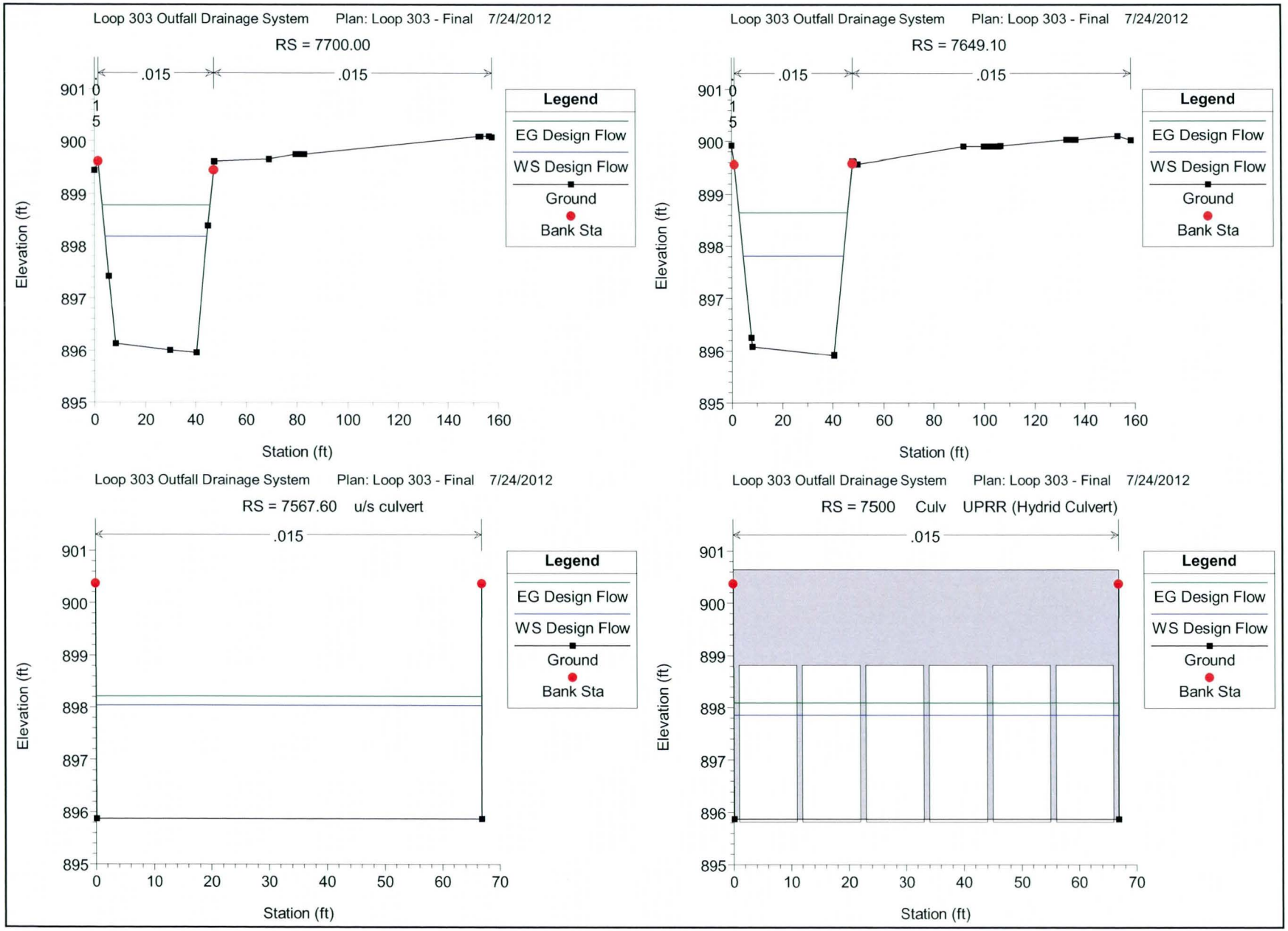

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 8500.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

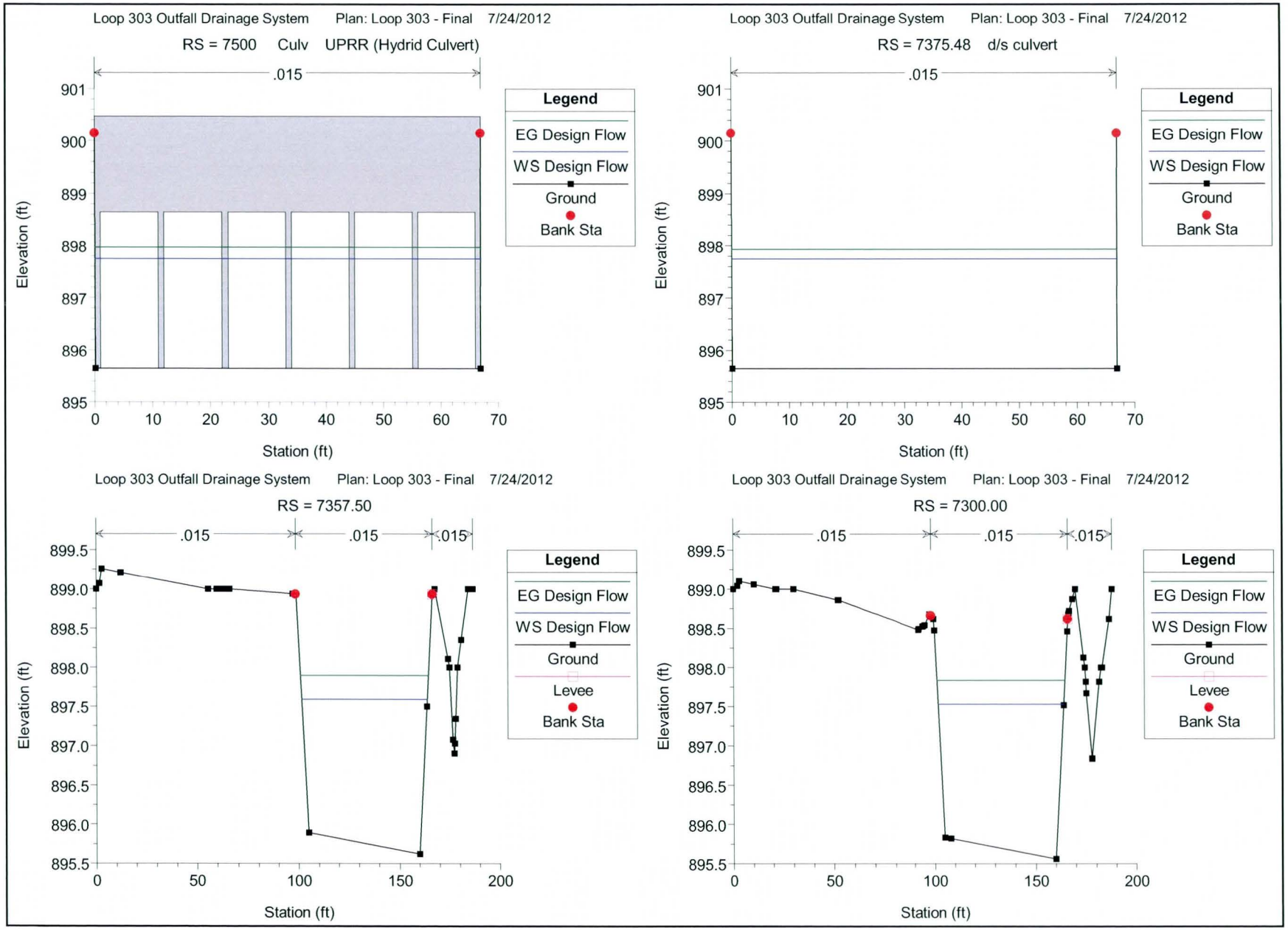

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 8400.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

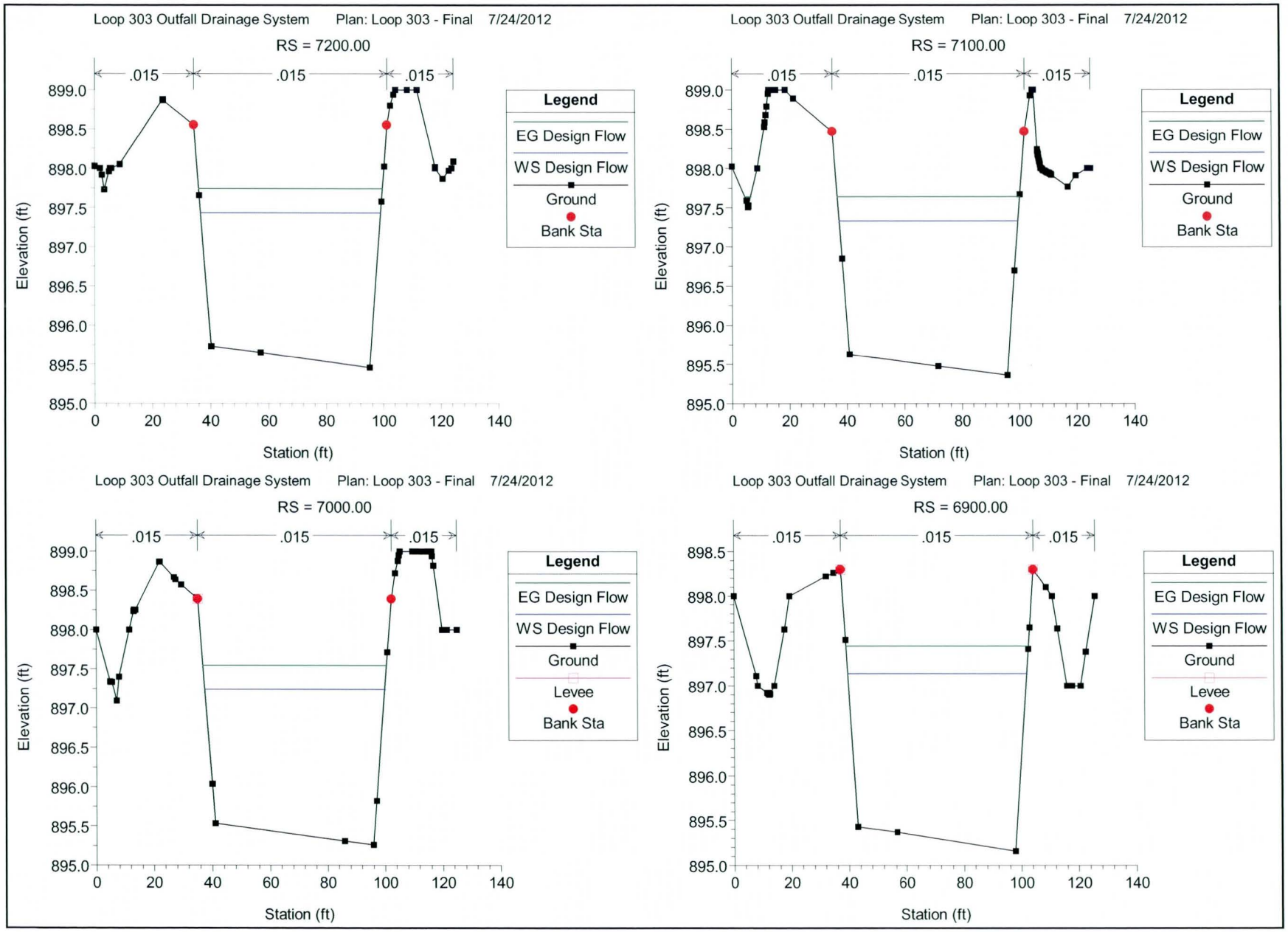

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 8300.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

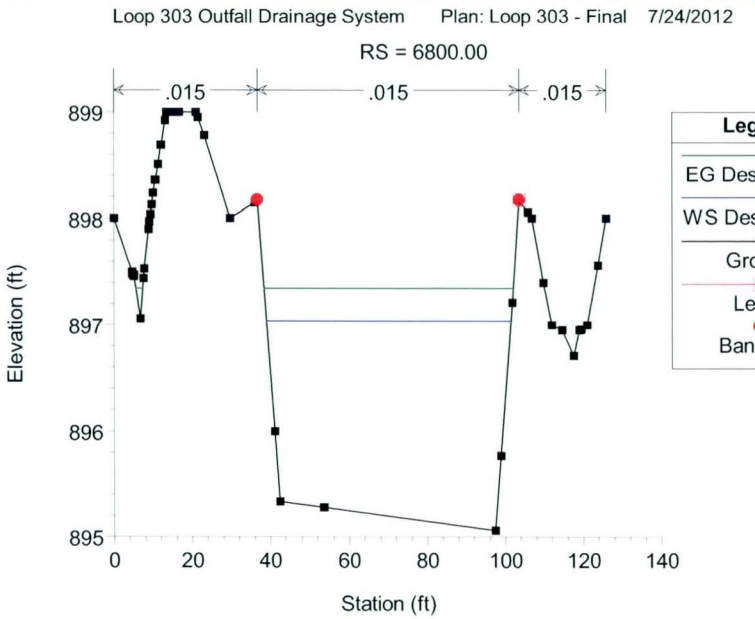

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 8200.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

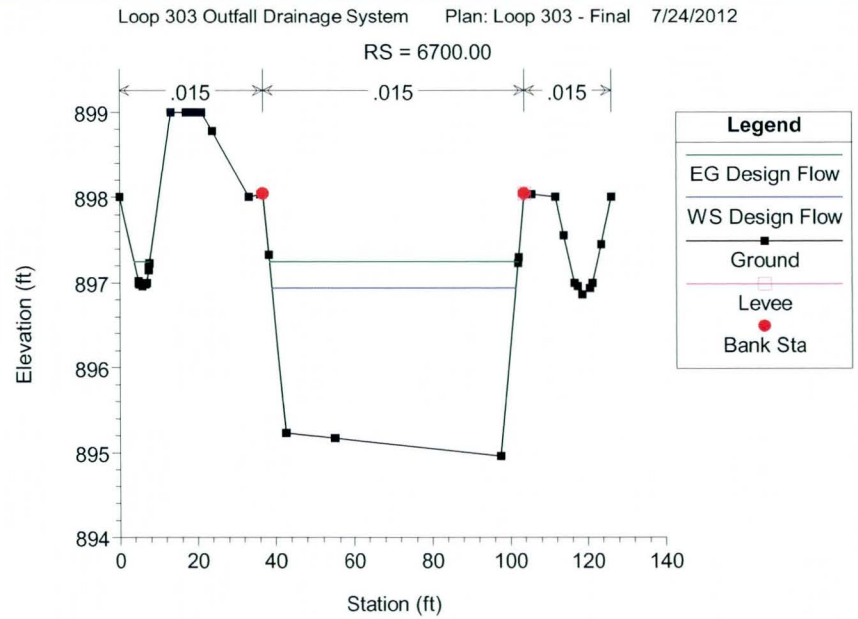

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 8100.00
.015 .015 .015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 8000.00
.015 .015 .015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 7900.00
.015 .015 .015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 7800.00
.015 .015 .015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

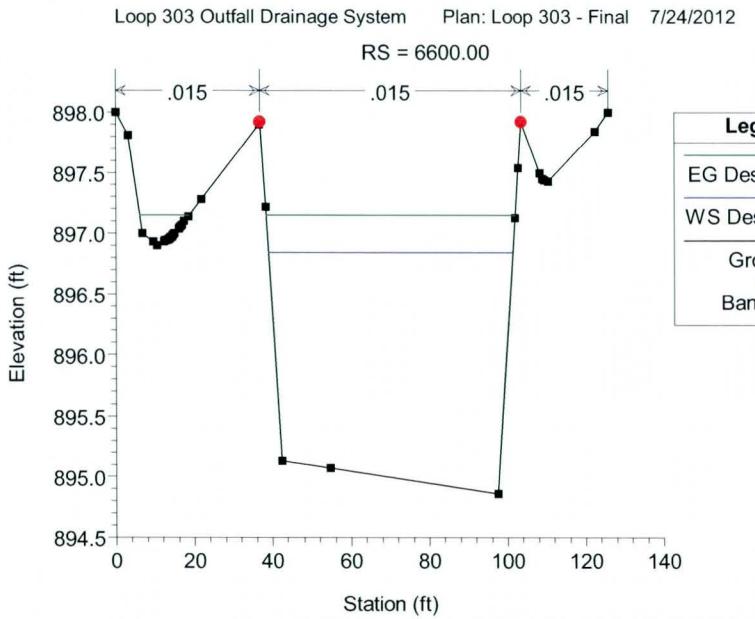

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 7700.00
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 7649.10
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 7567.60 u/s culvert
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 7500 Culv UPRR (Hydrid Culvert)
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

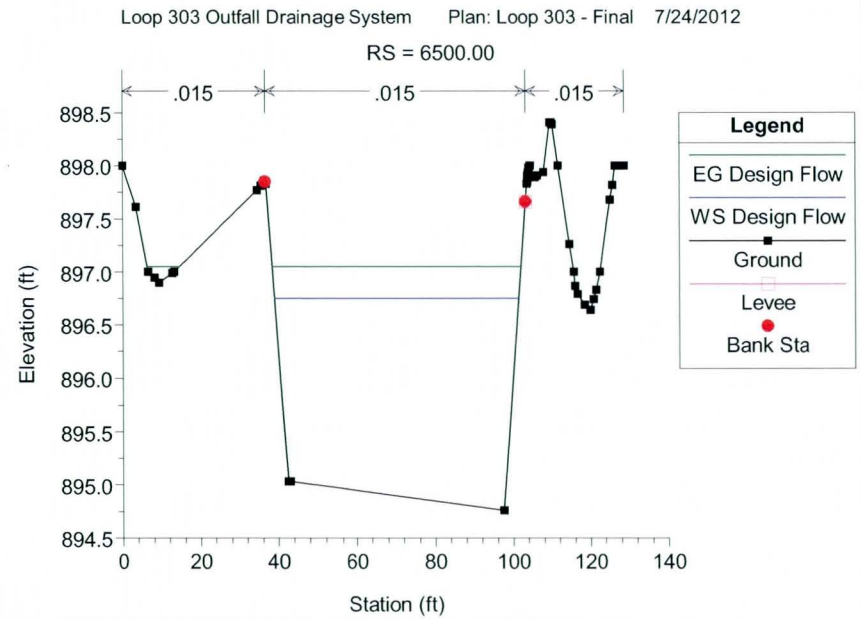

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 7500 Culv UPRR (Hydrid Culvert)
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 7375.48 d/s culvert
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 7357.50
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Levee
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 7300.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Levee
Bank Sta
Elevation (ft)
Station (ft)

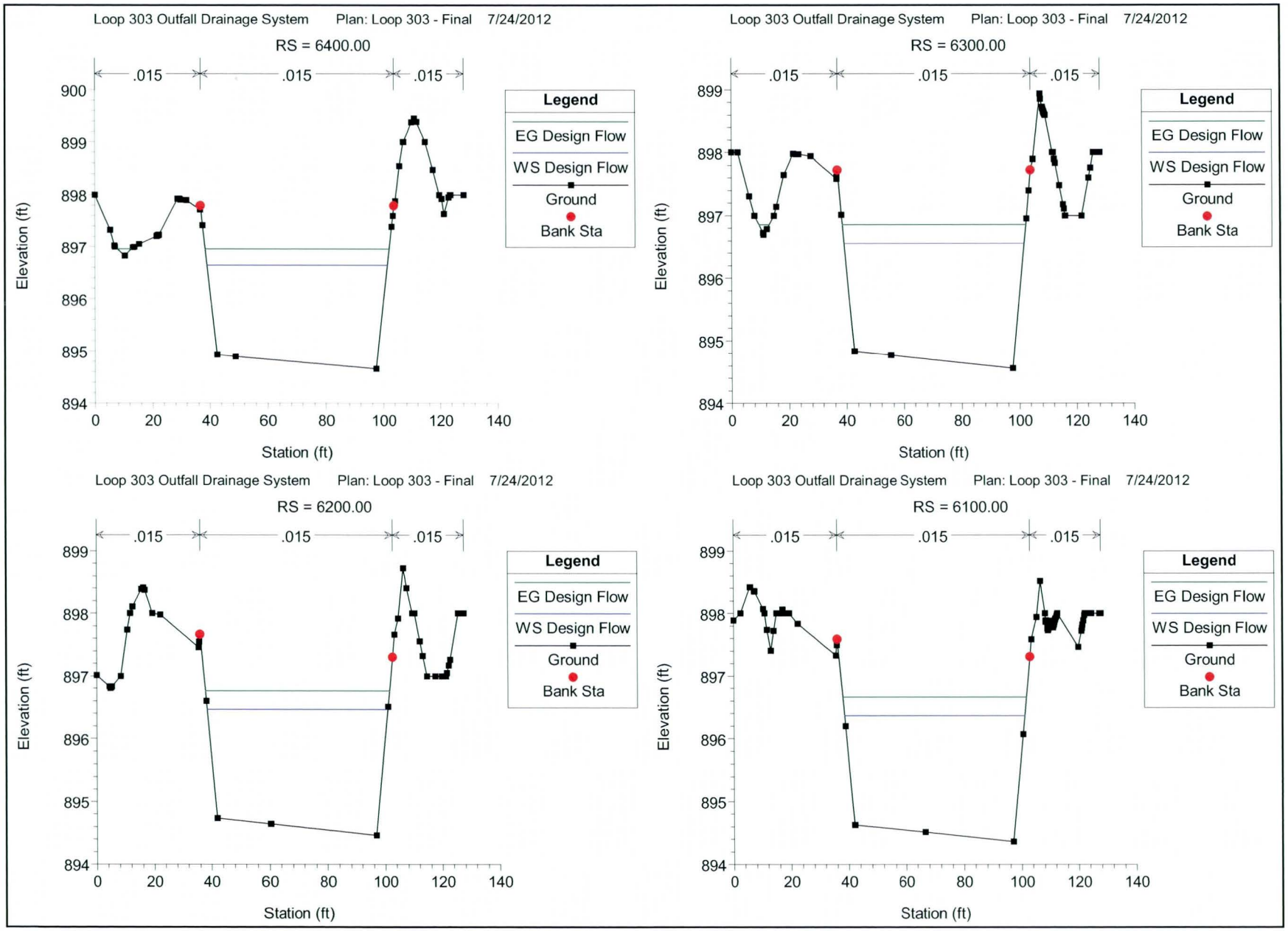

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 7200.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 7100.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 7000.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Levee
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 6900.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Levee
Bank Sta
Elevation (ft)
Station (ft)

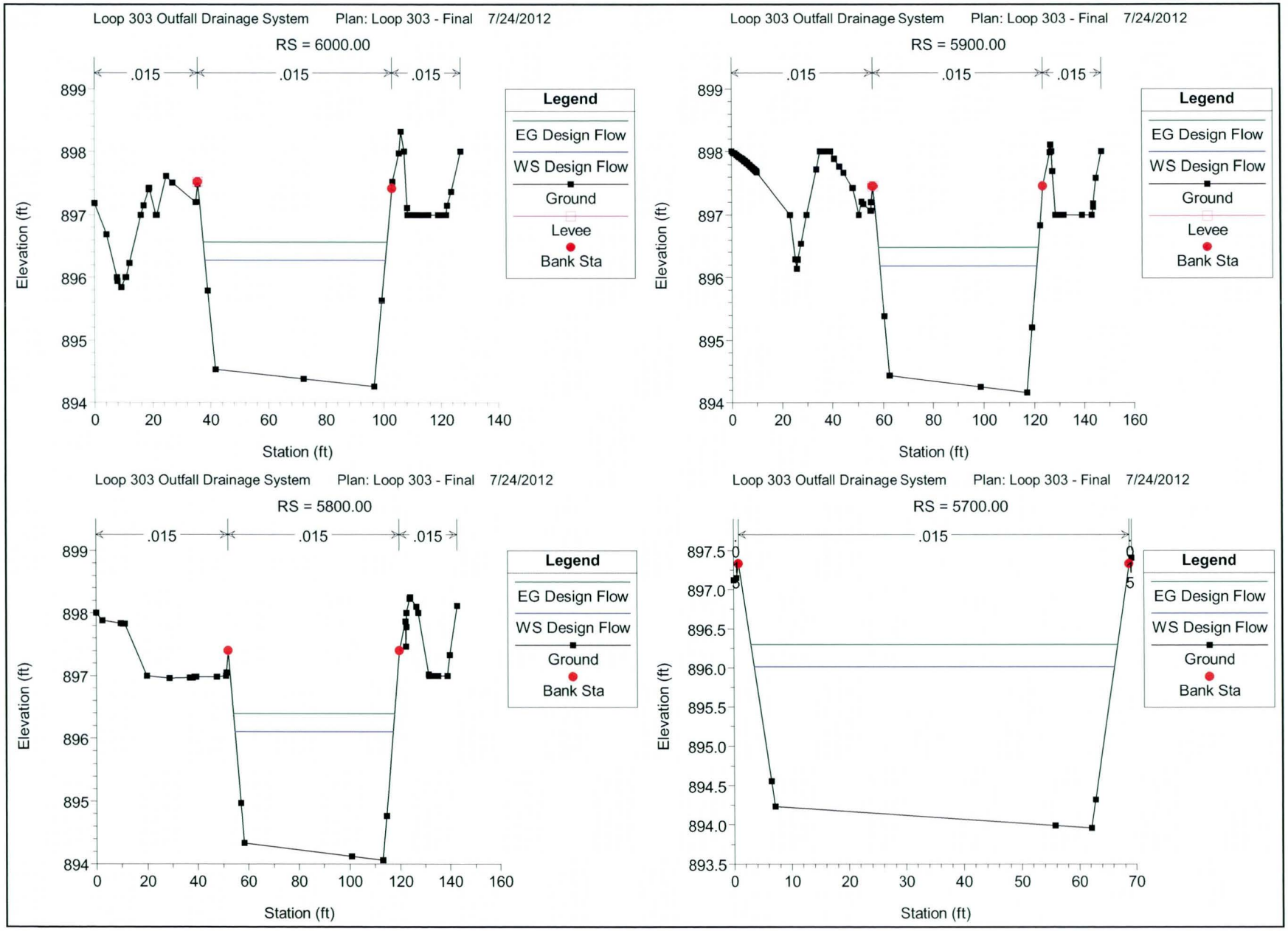

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 6800.00
.015
.015
.015
Elevation (ft)
Station (ft)
Legend
EG Design Flow
WS Design Flow
Ground
Levee
Bank Sta

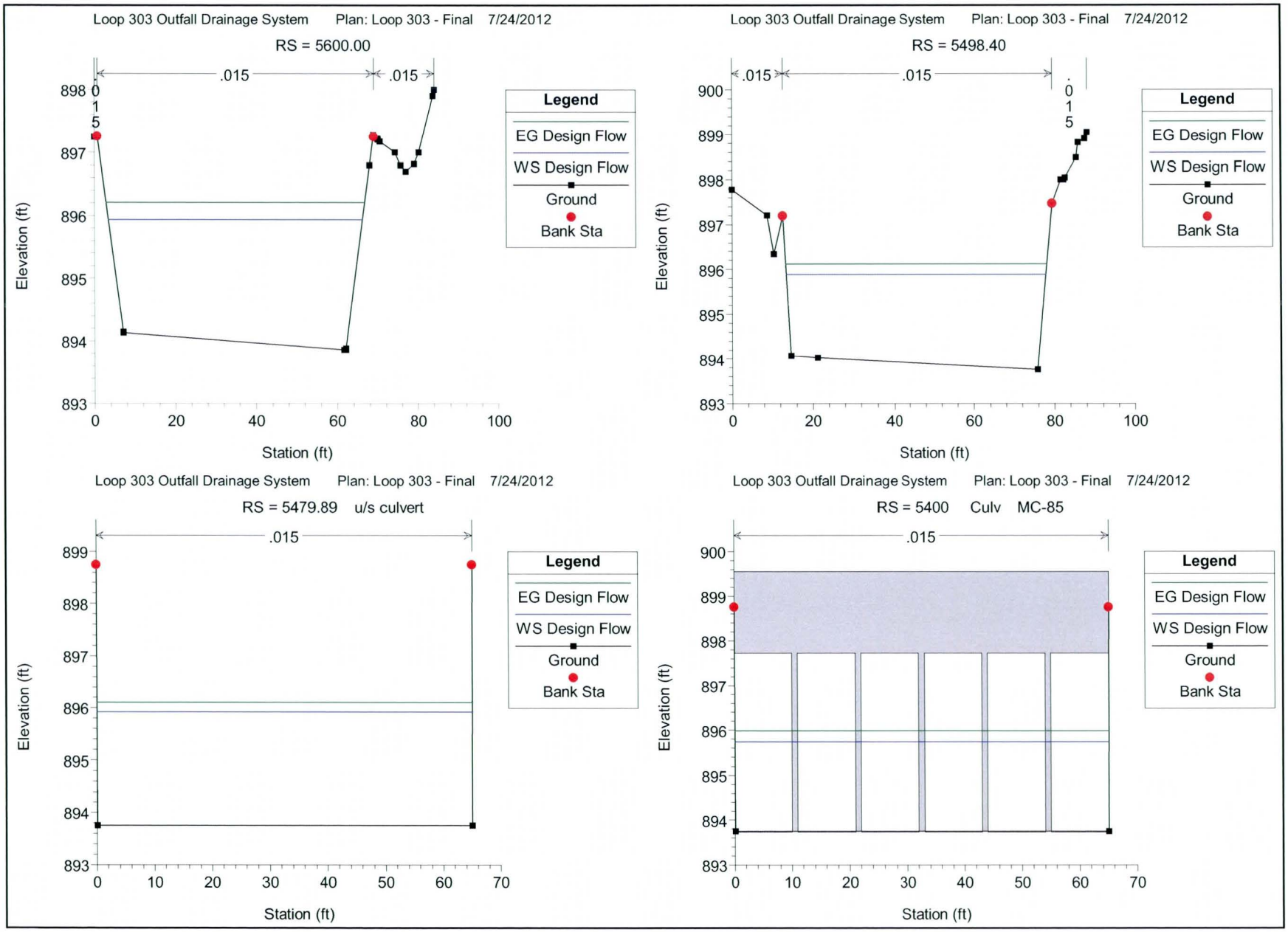

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 6700.00
.015
.015
.015
Elevation (ft)
Station (ft)
Legend
EG Design Flow
WS Design Flow
Ground
Levee
Bank Sta

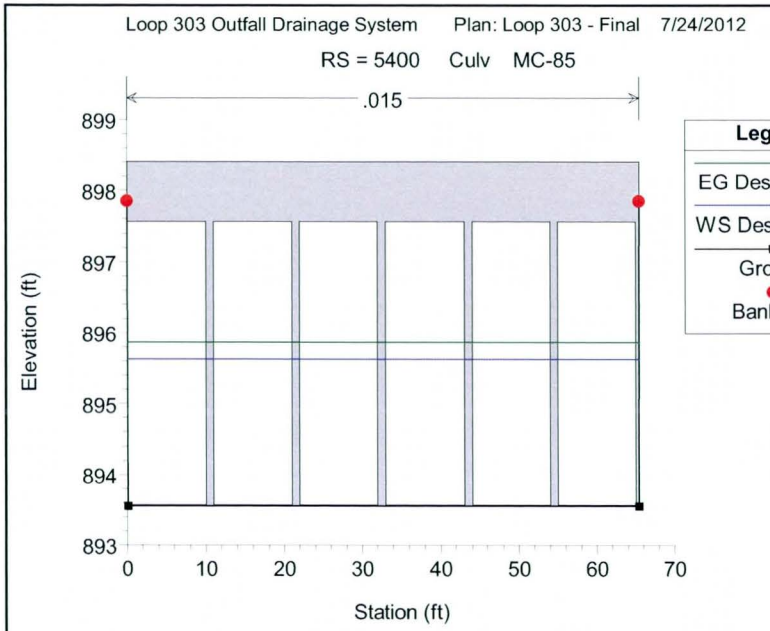

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 6600.00
.015
.015
.015
Elevation (ft)
Station (ft)
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta

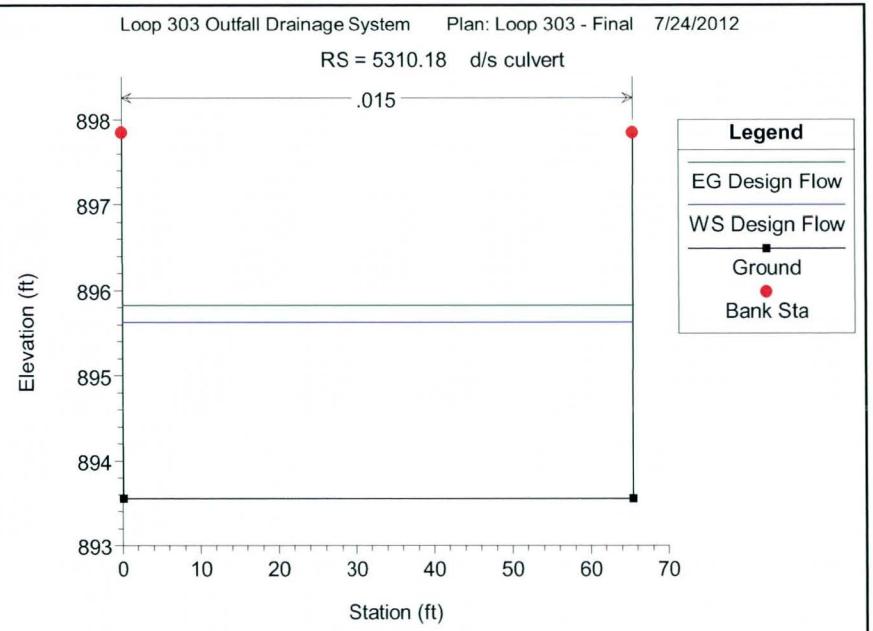

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 6500.00
.015
.015
.015
Elevation (ft)
Station (ft)
Legend
EG Design Flow
WS Design Flow
Ground
Levee
Bank Sta

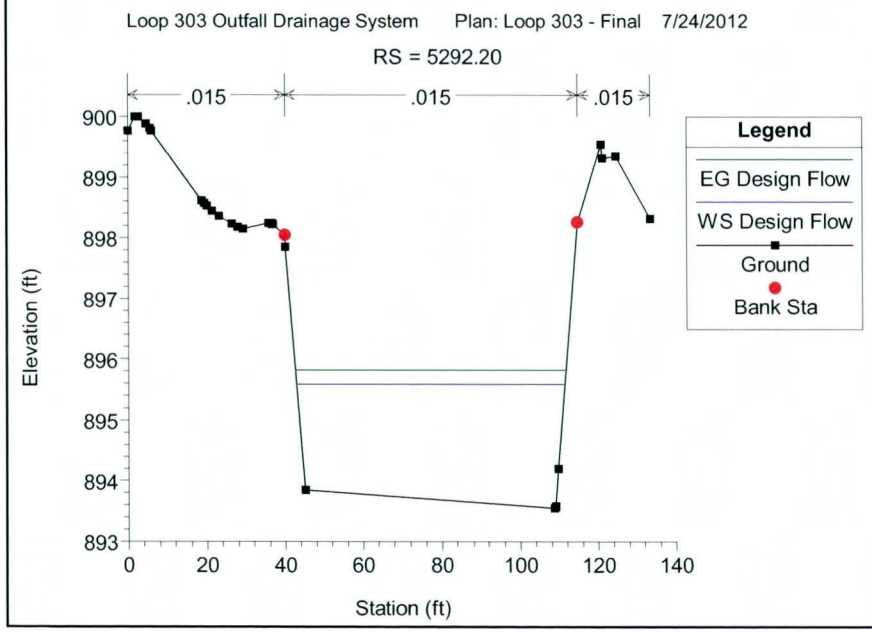

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 6400.00
.015 .015 .015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 6300.00
.015 .015 .015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 6200.00
.015 .015 .015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 6100.00
.015 .015 .015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

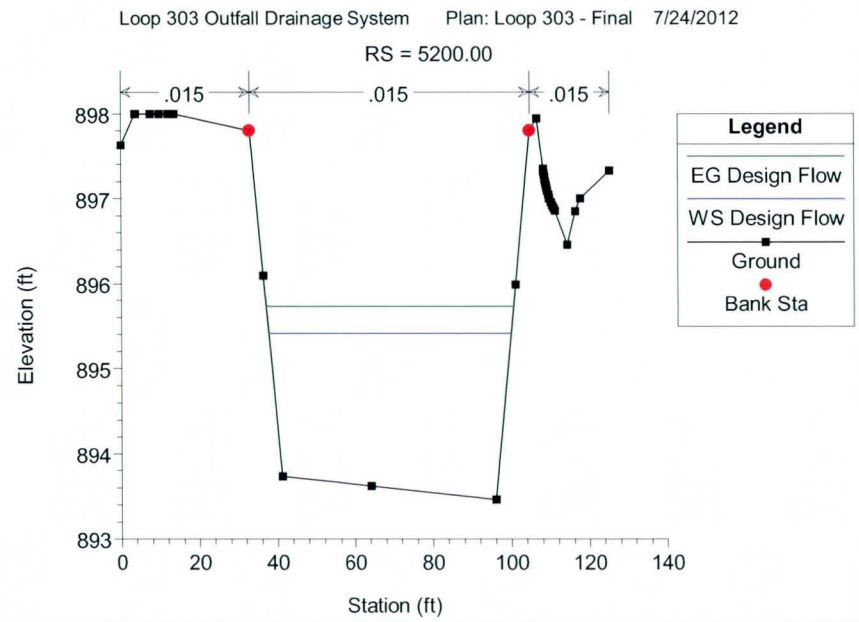

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 6000.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Levee
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 5900.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Levee
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 5800.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 5700.00
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

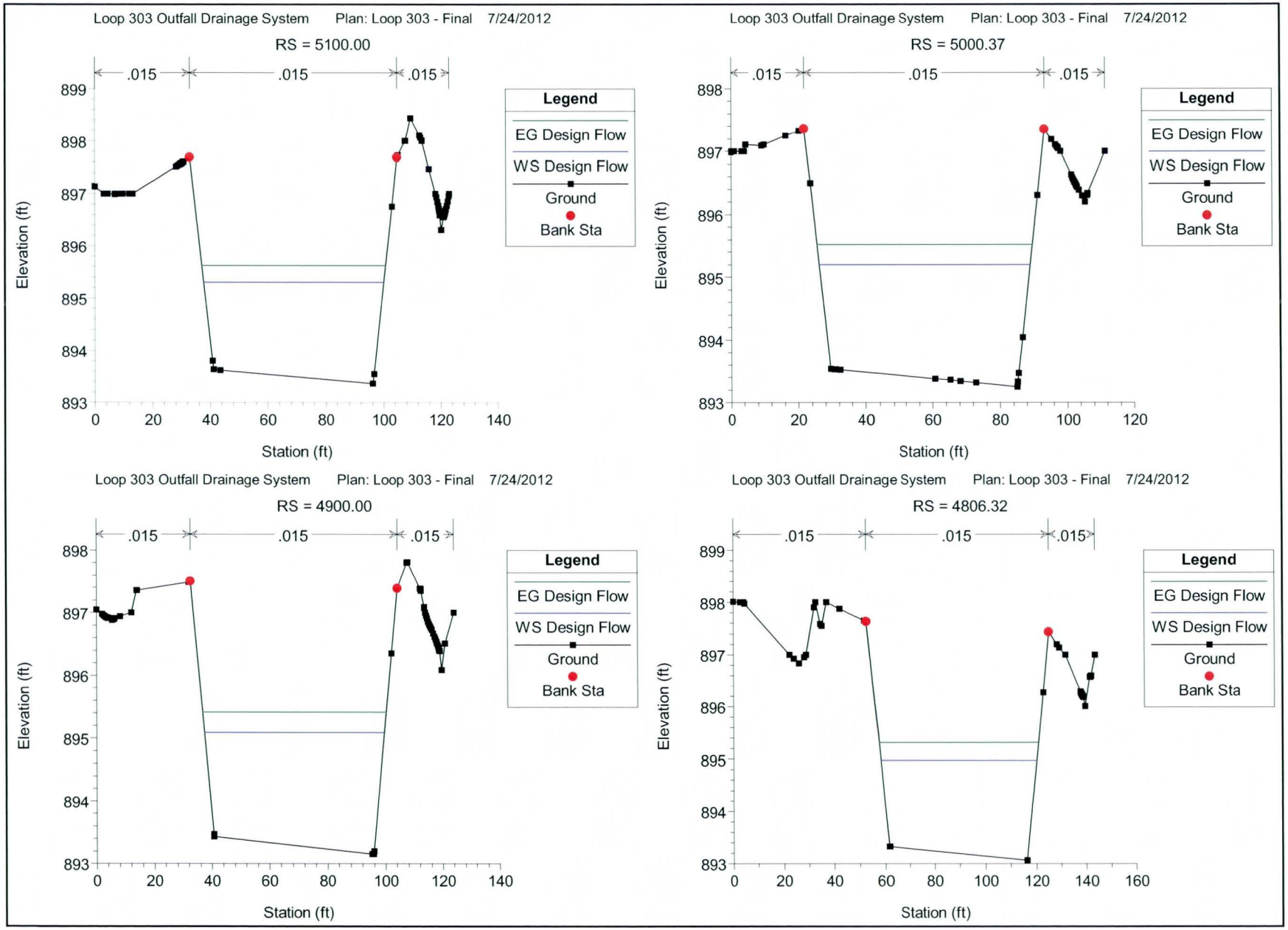

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 5600.00
.015
.015
Elevation (ft)
Station (ft)
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 5498.40
.015
.015
Elevation (ft)
Station (ft)
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 5479.89 u/s culvert
.015
Elevation (ft)
Station (ft)
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 5400 Culv MC-85
.015
Elevation (ft)
Station (ft)
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta

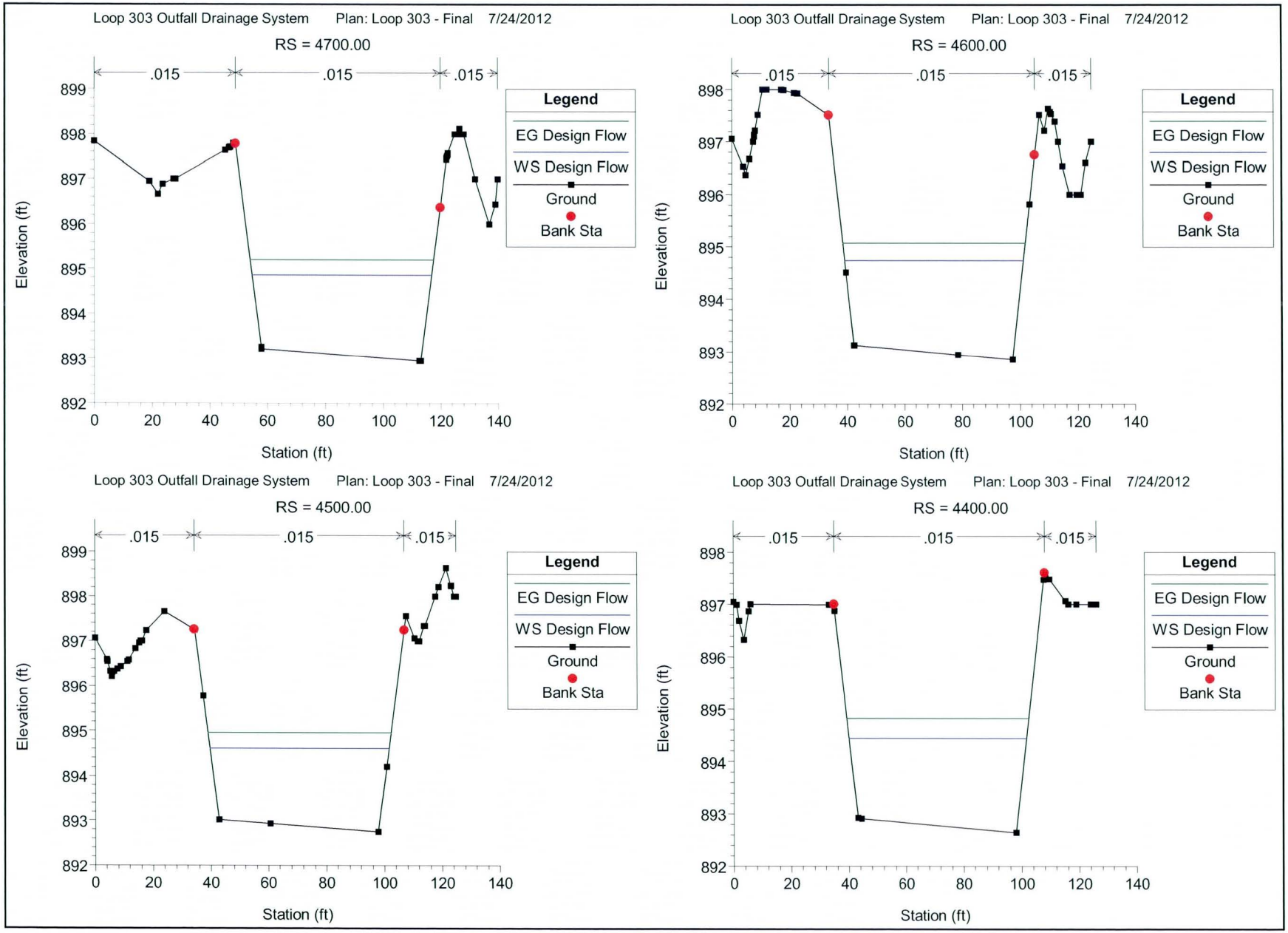

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 5400 Culv MC-85
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

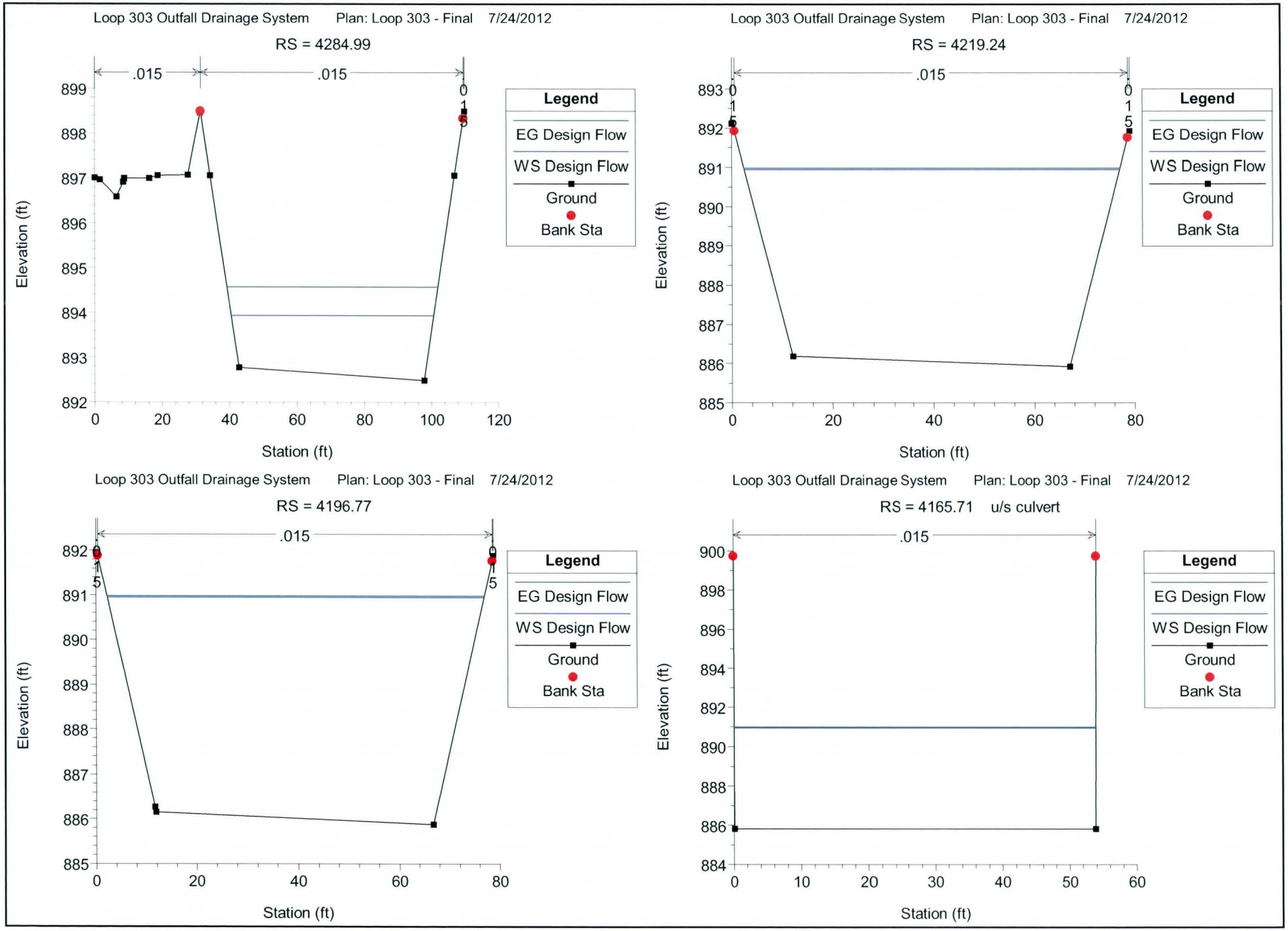

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 5310.18 d/s culvert
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

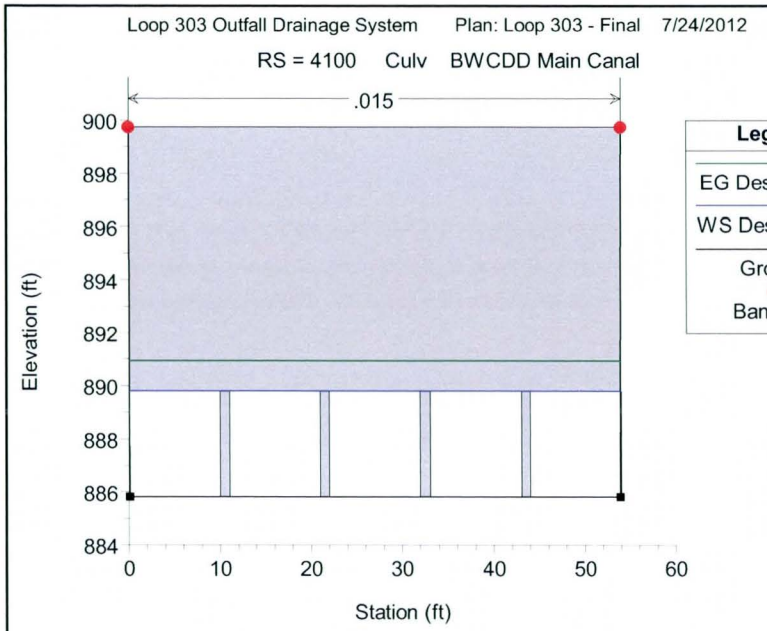

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 5292.20
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

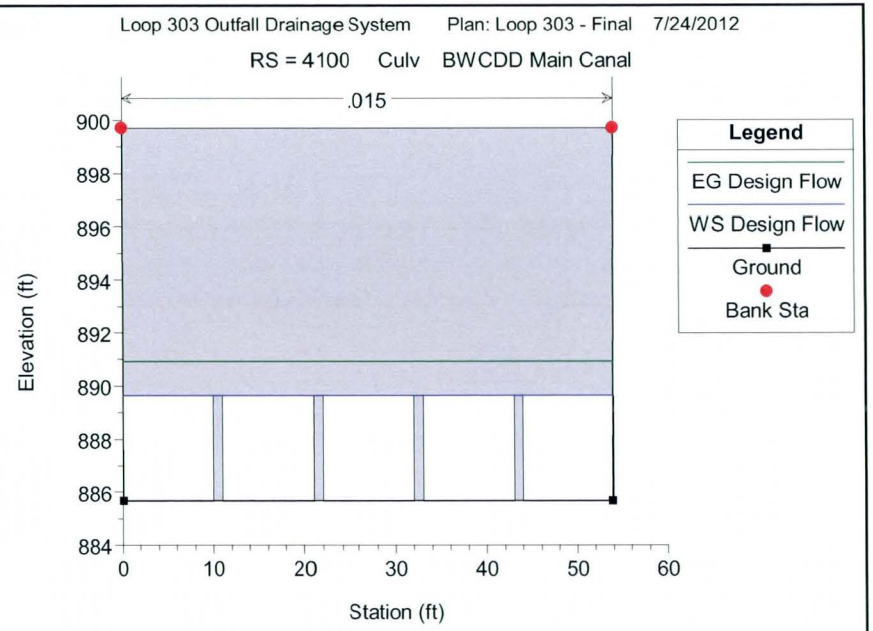

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 5200.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

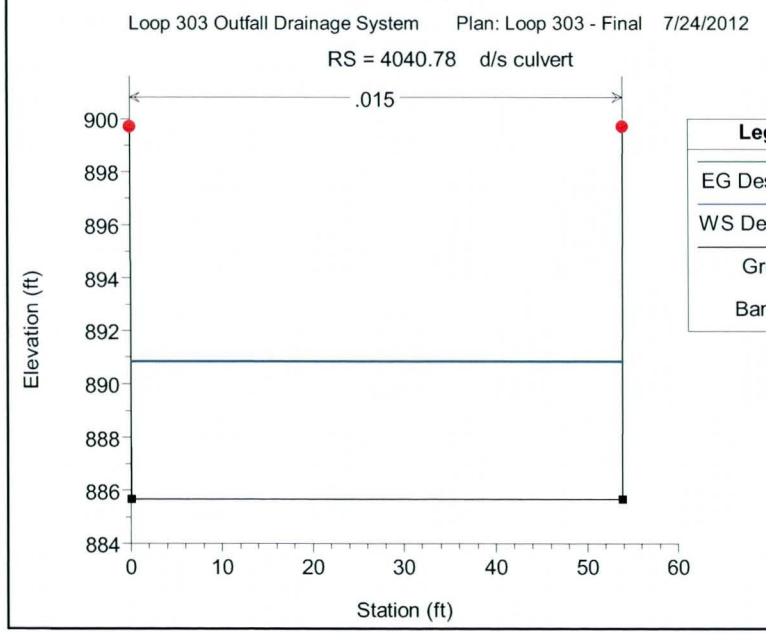

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 5100.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 5000.37
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 4900.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 4806.32
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

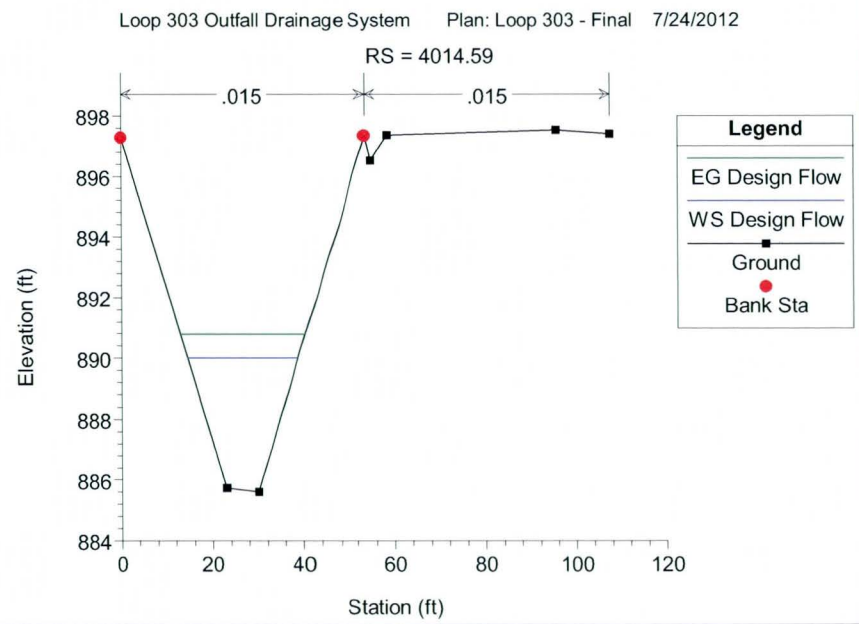

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 4700.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 4600.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 4500.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 4400.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

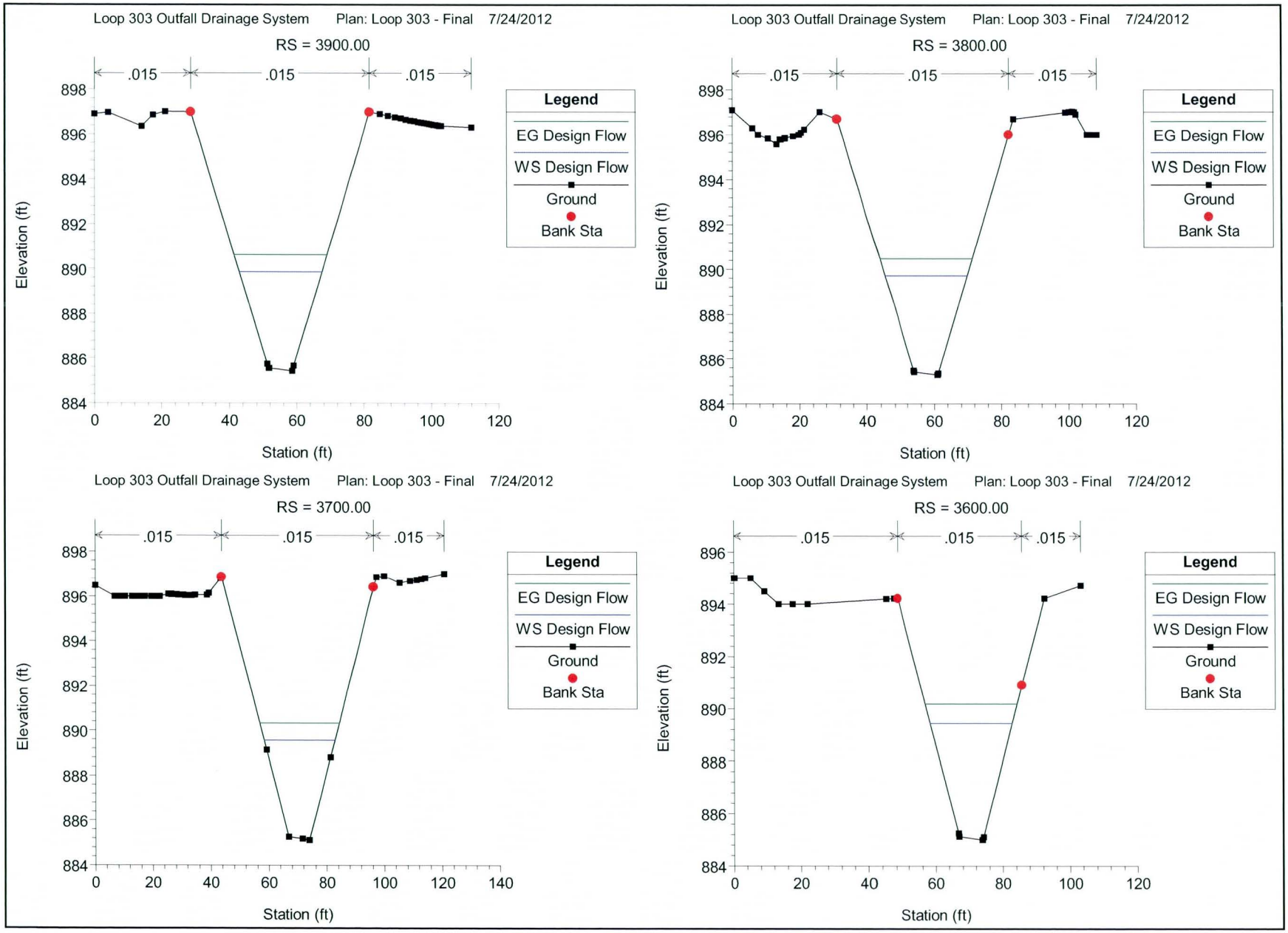

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 4284.99
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 4219.24
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 4196.77
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 4165.71 u/s culvert
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

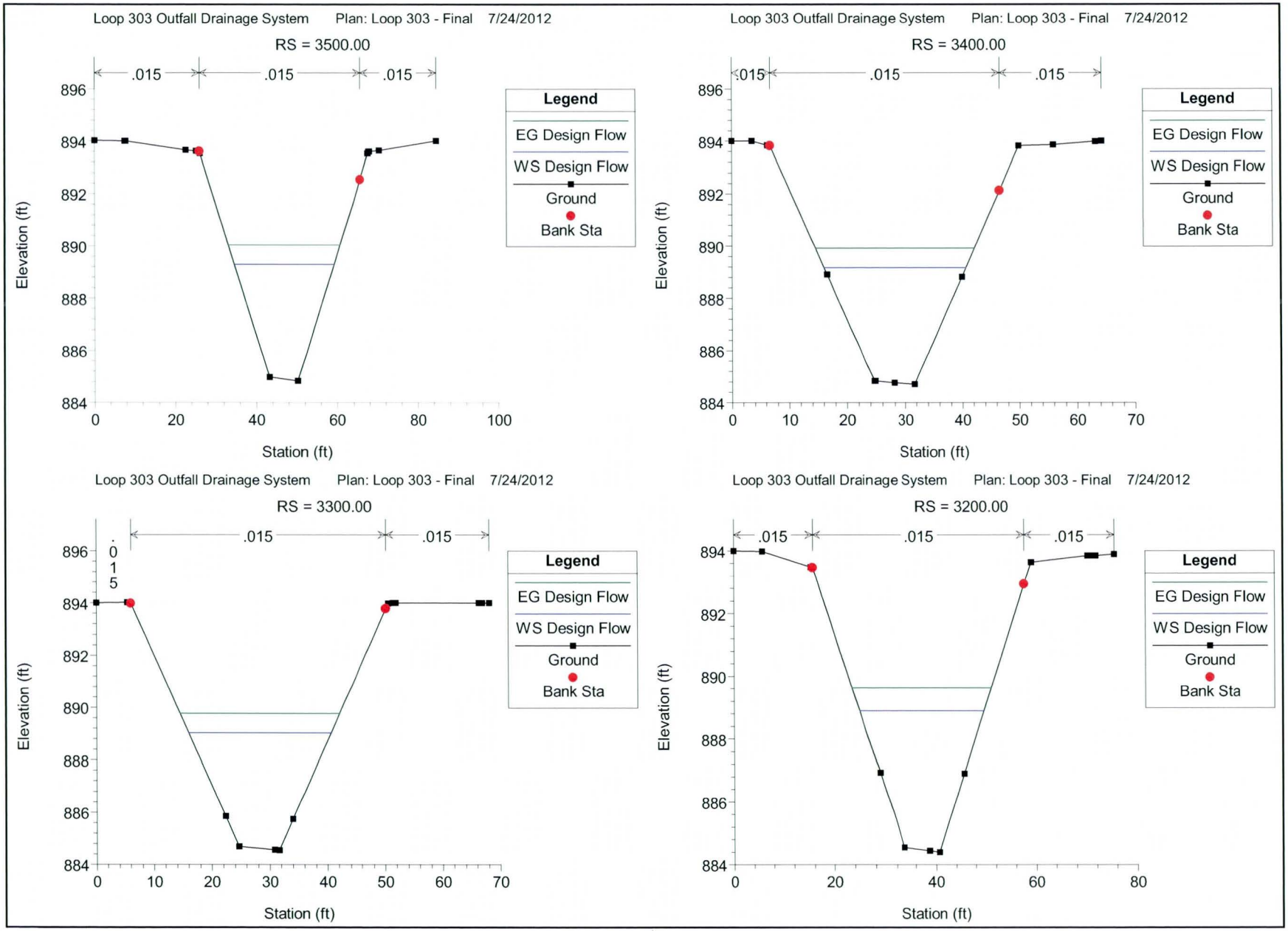

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 4100 Culv BWCDD Main Canal
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

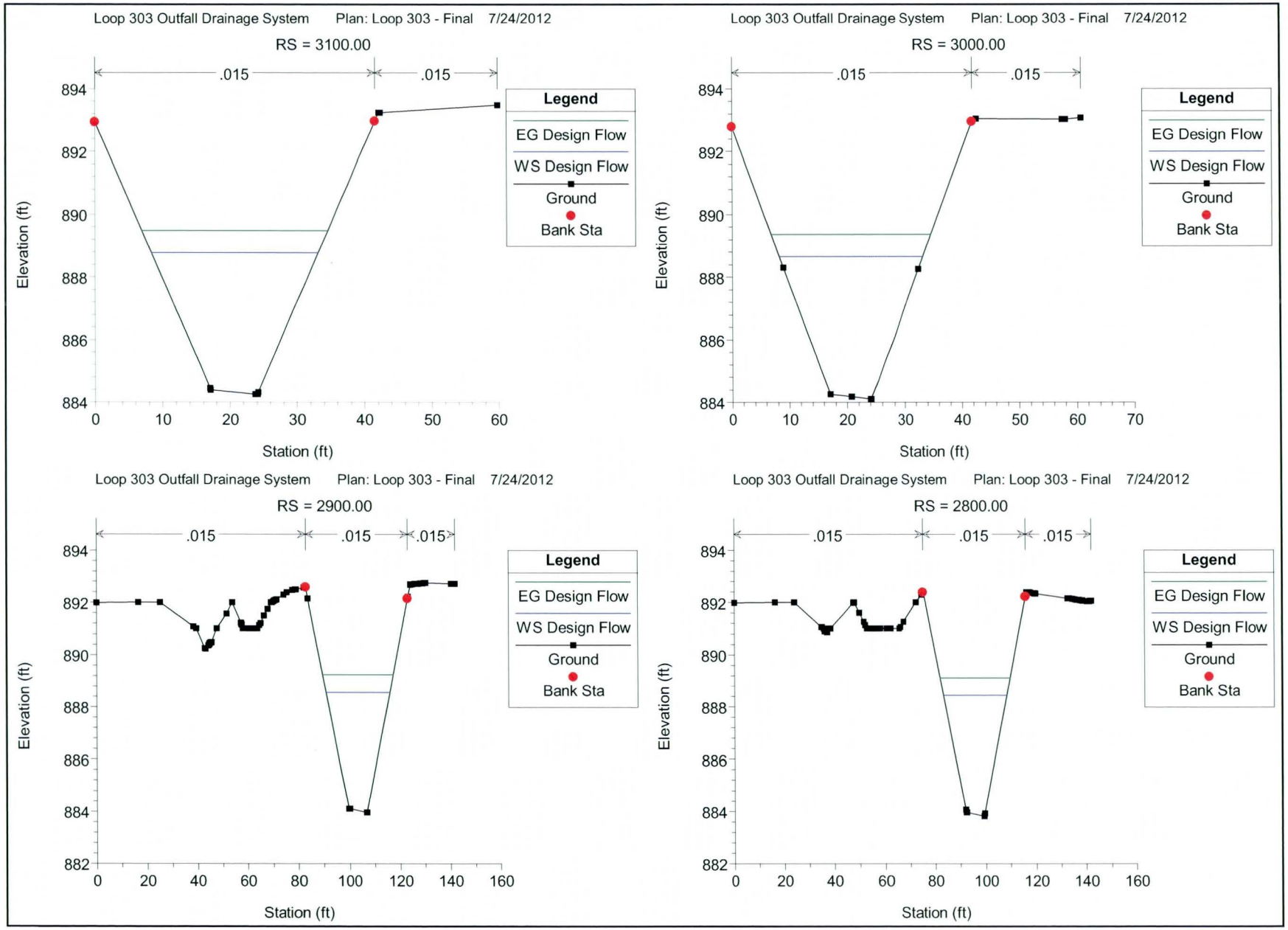

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 4100 Culv BWCDD Main Canal
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

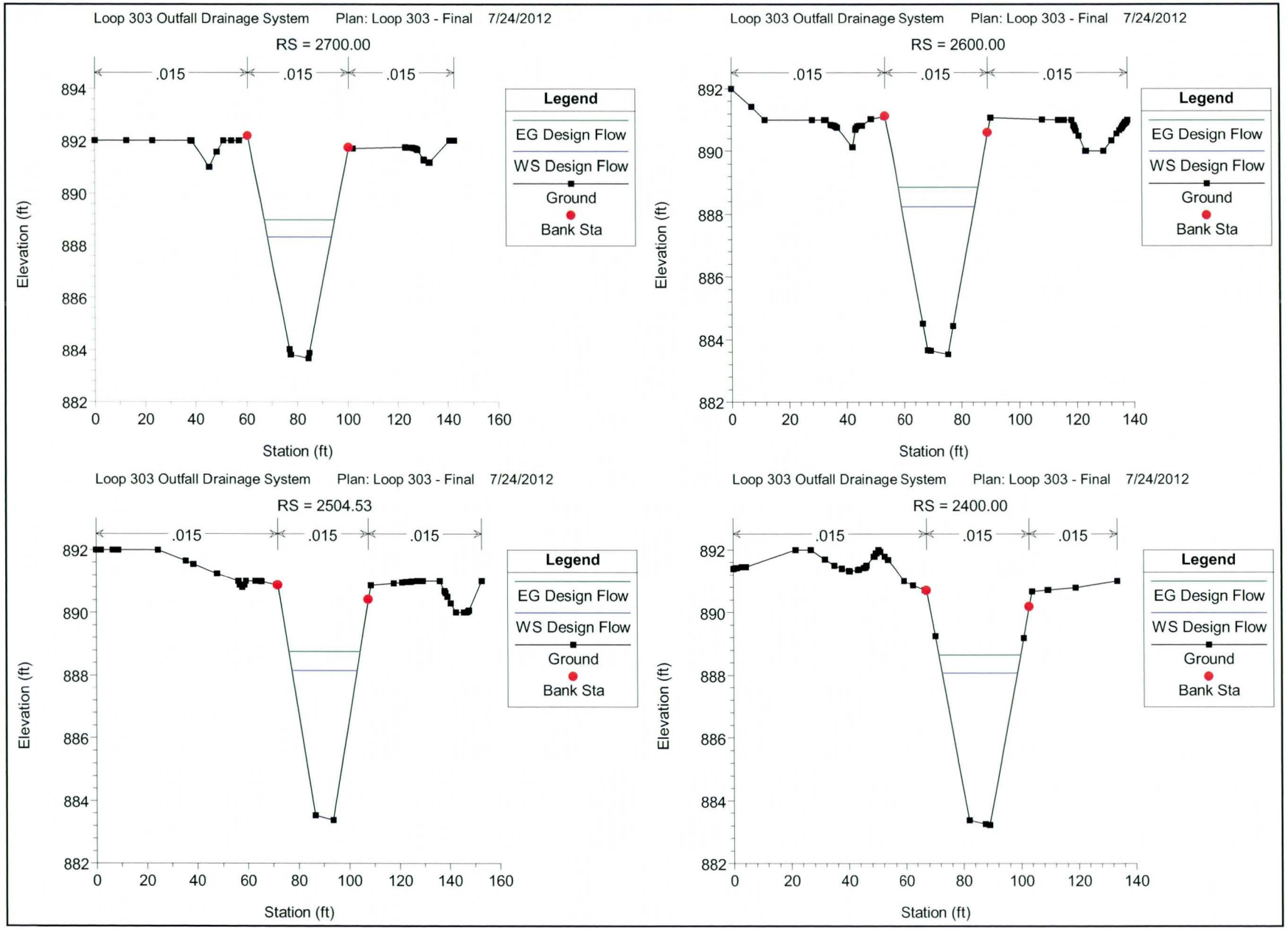

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 4040.78 d/s culvert
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

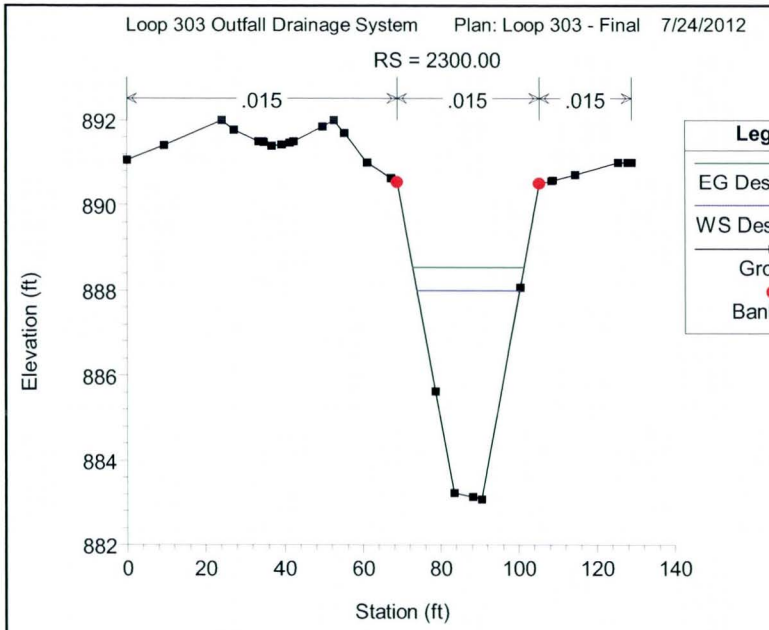

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 4014.59
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

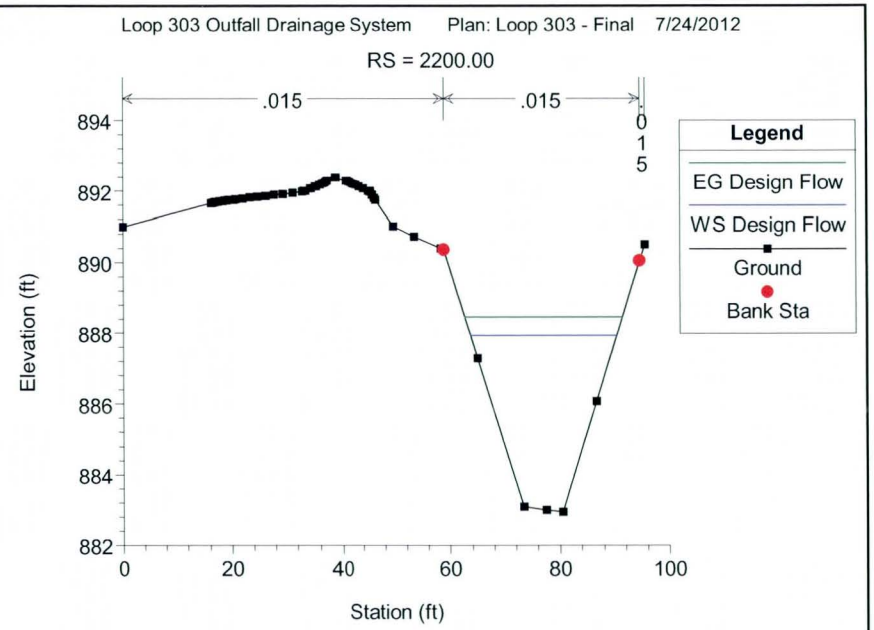

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 3900.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 3800.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 3700.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 3600.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

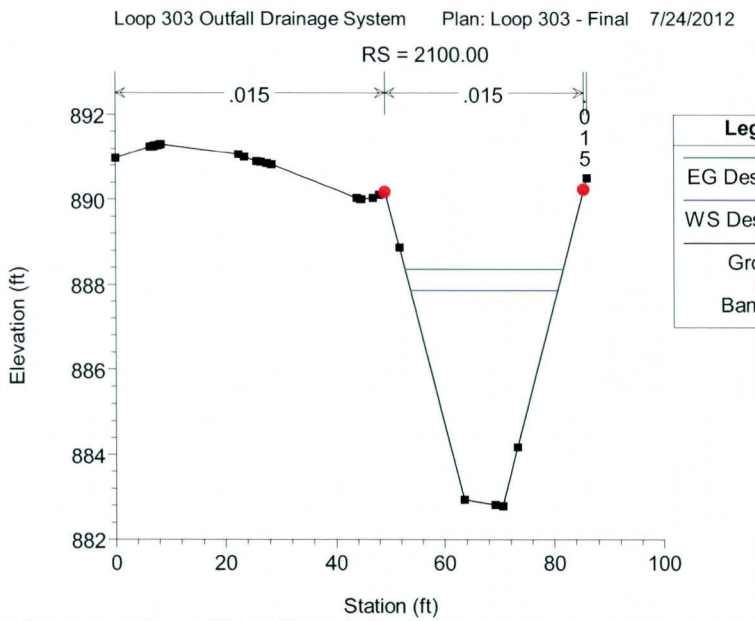

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 3500.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 3400.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 3300.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 3200.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

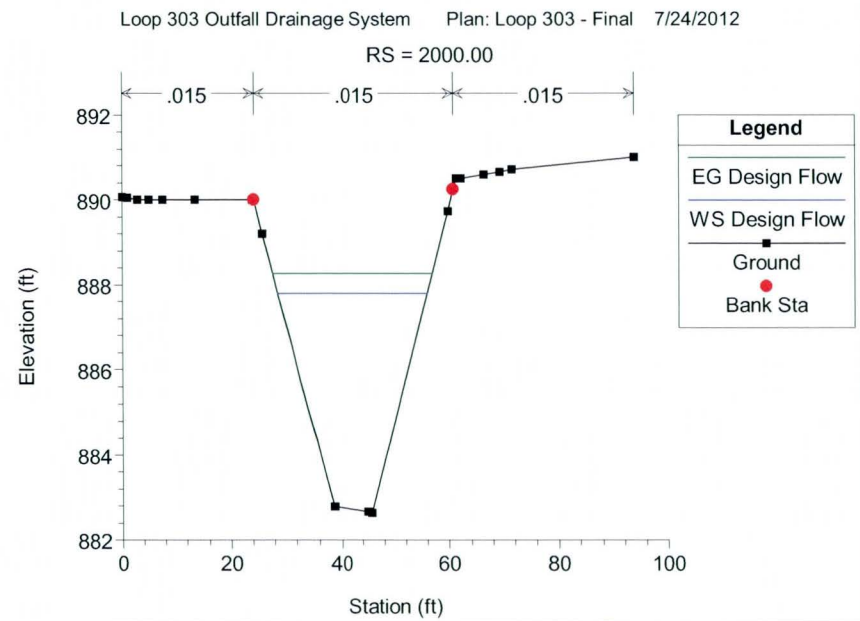

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 3100.00
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 3000.00
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 2900.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 2800.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

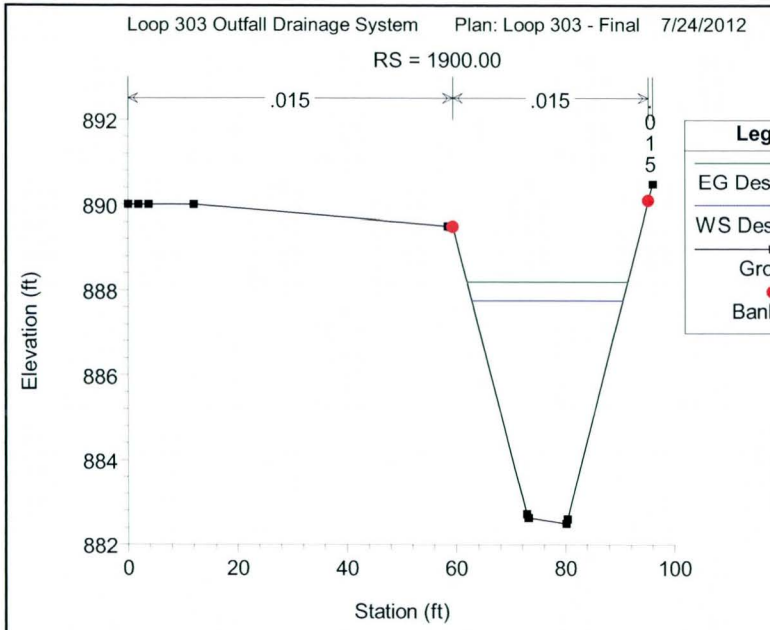

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 2700.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 2600.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 2504.53
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 2400.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

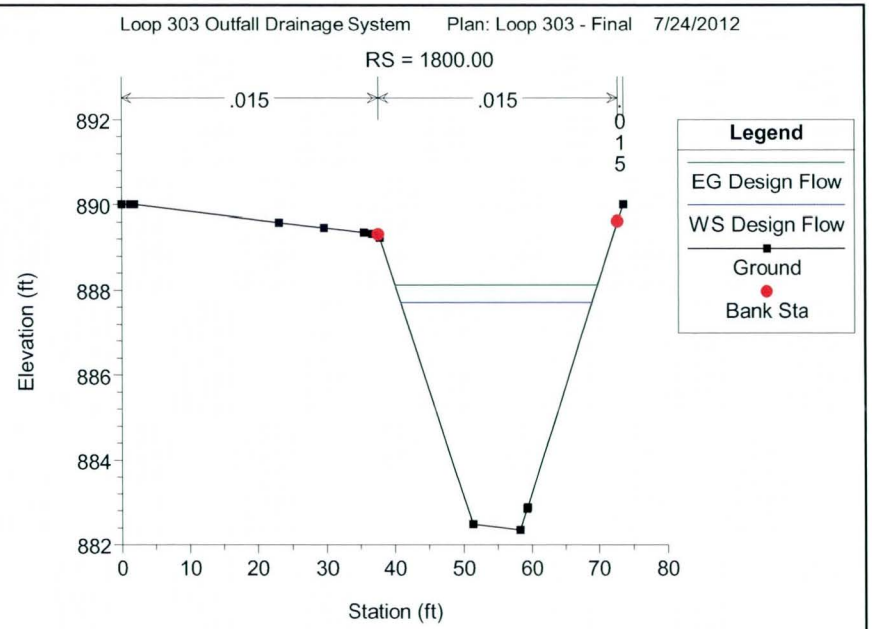

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 2300.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

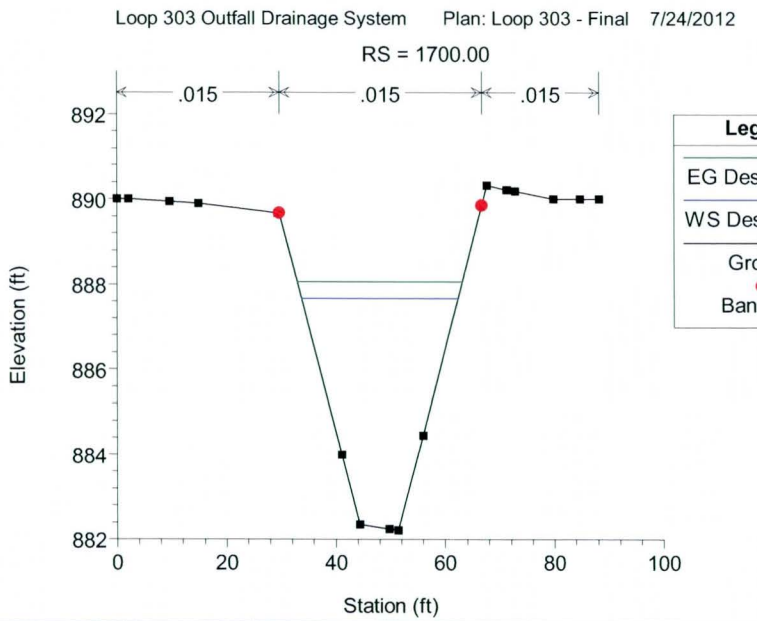

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 2200.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

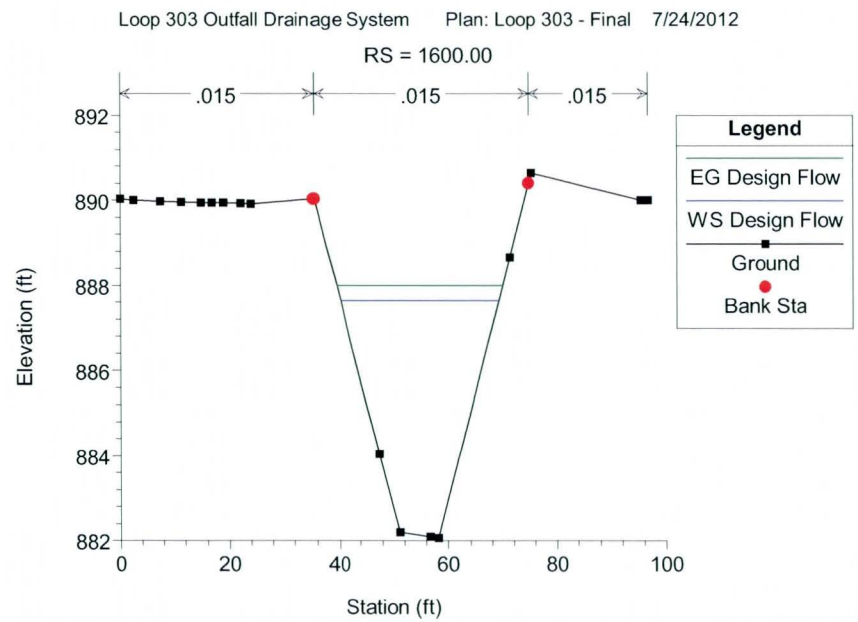

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 2100.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

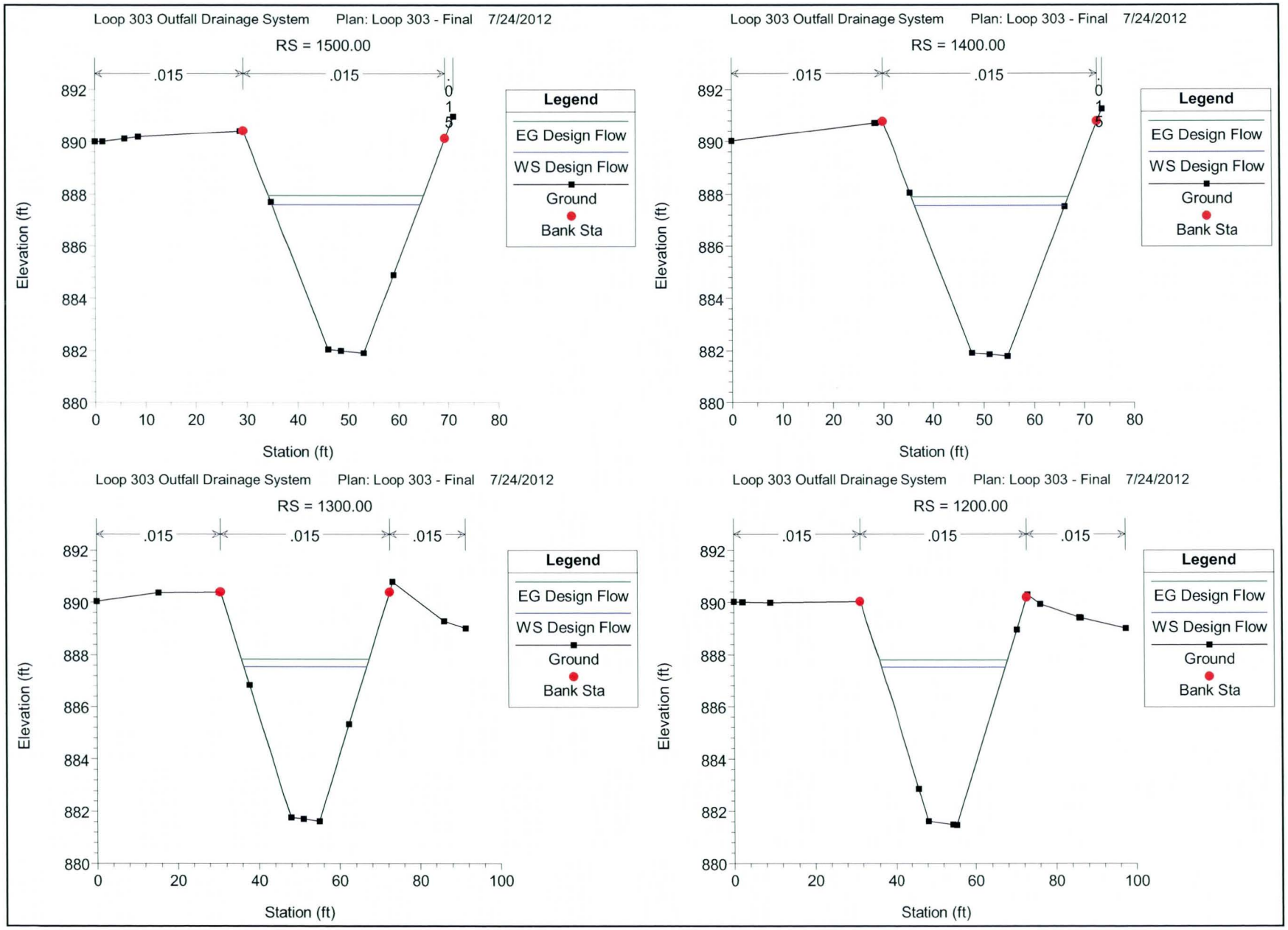

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 2000.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

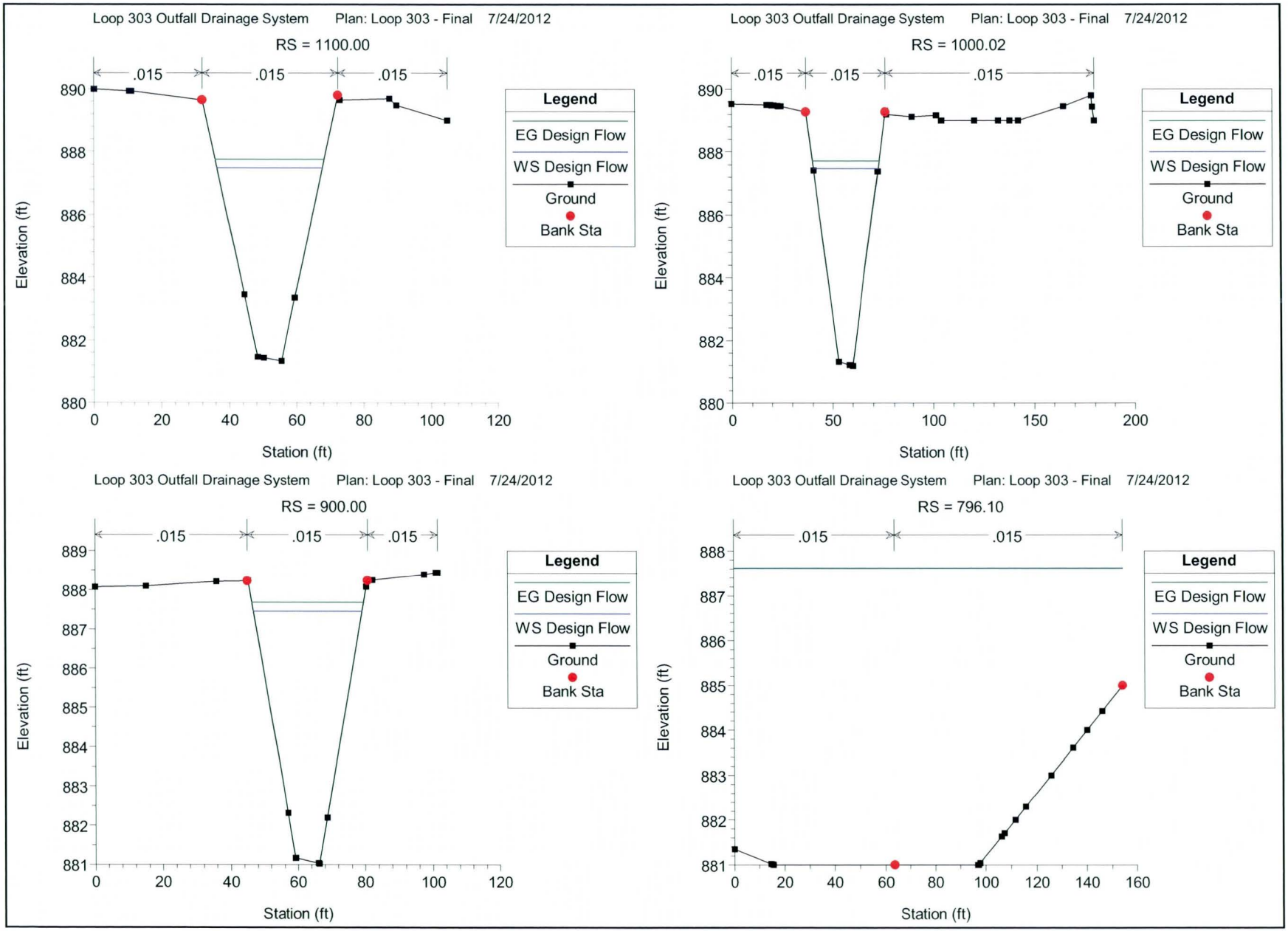

Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 1900.00
.015
.015
0.15
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)


Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 1800.00
.015
.015
0.15
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)


Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 1700.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)


Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 1600.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)


Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 1500.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 1400.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 1300.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 1200.00
.015
.015
.015
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)


Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 1100.00
.015
.015
.015
Elevation (ft)
Station (ft)
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 1000.02
.015
.015
.015
Elevation (ft)
Station (ft)
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 900.00
.015
.015
.015
Elevation (ft)
Station (ft)
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta
Loop 303 Outfall Drainage System Plan: Loop 303 - Final 7/24/2012
RS = 796.10
.015
.015
Elevation (ft)
Station (ft)
Legend
EG Design Flow
WS Design Flow
Ground
Bank Sta

APPENDIX B3

Lateral Spillway Calculations

Cross Section for Broad Crested Weir - 1

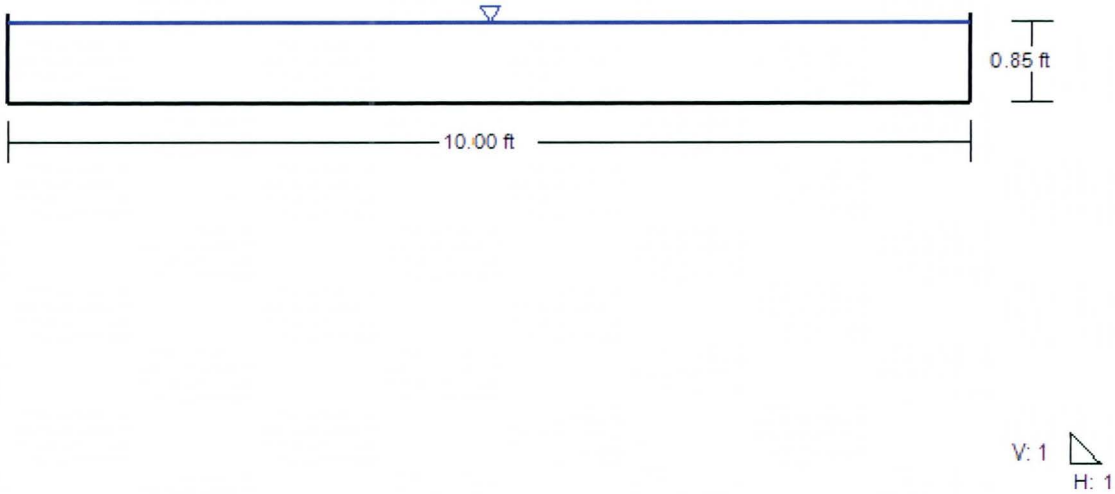
Project Description

Solve For	Headwater Elevation

Input Data

Discharge		24.00	ft^3/s
Headwater Elevation		1.85	ft
Crest Elevation		1.00	ft
Tailwater Elevation		0.00	ft
Crest Surface Type	Paved		
Crest Breadth		5.00	ft
Crest Length		10.00	ft

Cross Section Image



Cross Section for Broad Crested Weir - 2

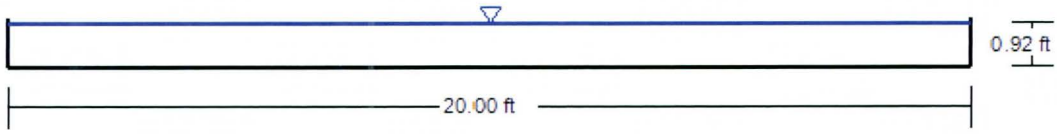
Project Description

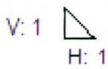
Solve For	Headwater Elevation

Input Data

Discharge		54.00	ft^3/s
Headwater Elevation		1.92	ft
Crest Elevation		1.00	ft
Tailwater Elevation		0.00	ft
Crest Surface Type	Paved		
Crest Breadth		5.00	ft
Crest Length		20.00	ft

Cross Section Image





Cross Section for Broad Crested Weir - 5

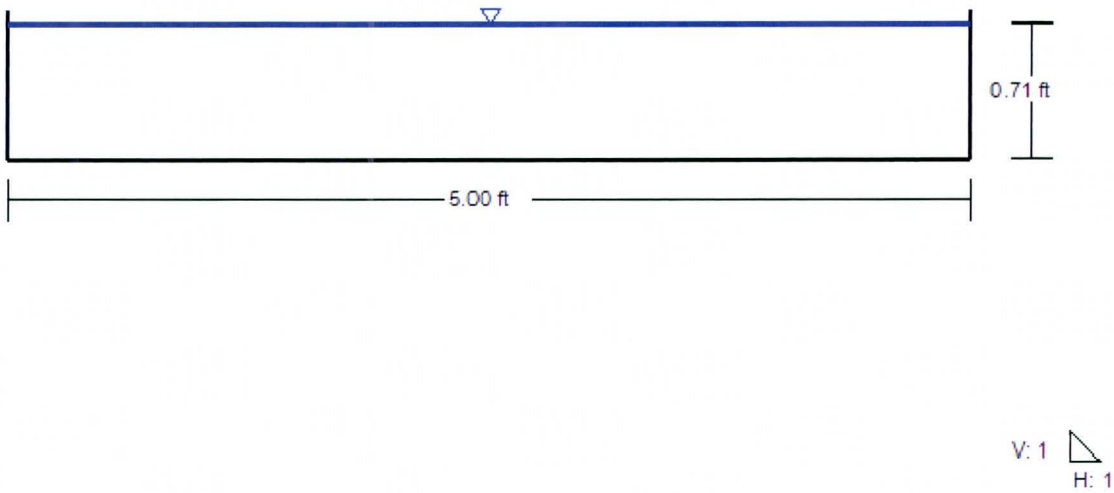
Project Description

Solve For	Headwater Elevation

Input Data

Discharge		9.00	ft^3/s
Headwater Elevation		1.71	ft
Crest Elevation		1.00	ft
Tailwater Elevation		0.00	ft
Crest Surface Type	Paved		
Crest Breadth		5.00	ft
Crest Length		5.00	ft

Cross Section Image



Cross Section for Broad Crested Weir - 6

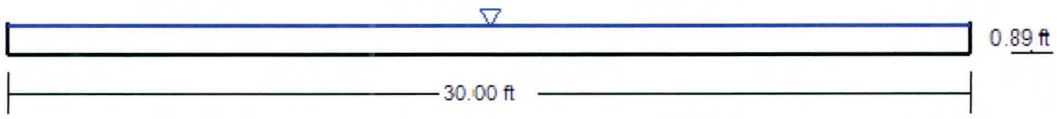
Project Description

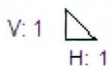
Solve For	Headwater Elevation

Input Data

Discharge		77.00	ft^3/s
Headwater Elevation		1.89	ft
Crest Elevation		1.00	ft
Tailwater Elevation		0.00	ft
Crest Surface Type	Paved		
Crest Breadth		14.00	ft
Crest Length		30.00	ft

Cross Section Image





Cross Section for Broad Crested Weir - 7

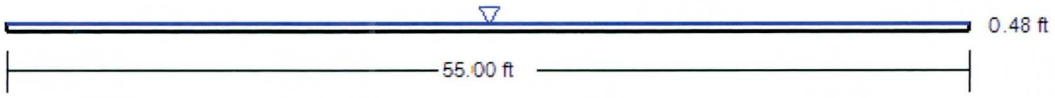
Project Description

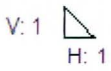
Solve For	Headwater Elevation

Input Data

Discharge		55.00	ft³/s
Headwater Elevation		1.48	ft
Crest Elevation		1.00	ft
Tailwater Elevation		0.00	ft
Crest Surface Type	Paved		
Crest Breadth		14.00	ft
Crest Length		55.00	ft

Cross Section Image





Cross Section for Broad Crested Weir - 8

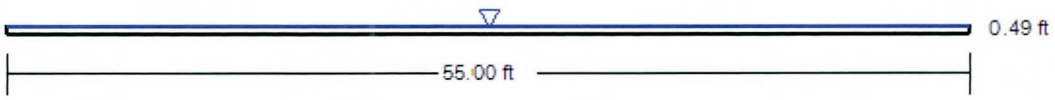
Project Description

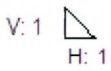
Solve For	Headwater Elevation

Input Data

Discharge		56.00	ft³/s
Headwater Elevation		1.49	ft
Crest Elevation		1.00	ft
Tailwater Elevation		0.00	ft
Crest Surface Type	Paved		
Crest Breadth		5.00	ft
Crest Length		55.00	ft

Cross Section Image





Cross Section for Broad Crested Weir - 9

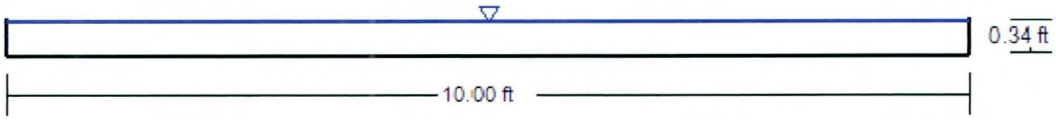
Project Description

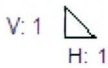
Solve For	Headwater Elevation

Input Data

Discharge		6.00	ft^3/s
Headwater Elevation		1.34	ft
Crest Elevation		1.00	ft
Tailwater Elevation		0.00	ft
Crest Surface Type	Paved		
Crest Breadth		5.00	ft
Crest Length		10.00	ft

Cross Section Image





Cross Section for Broad Crested Weir - 10

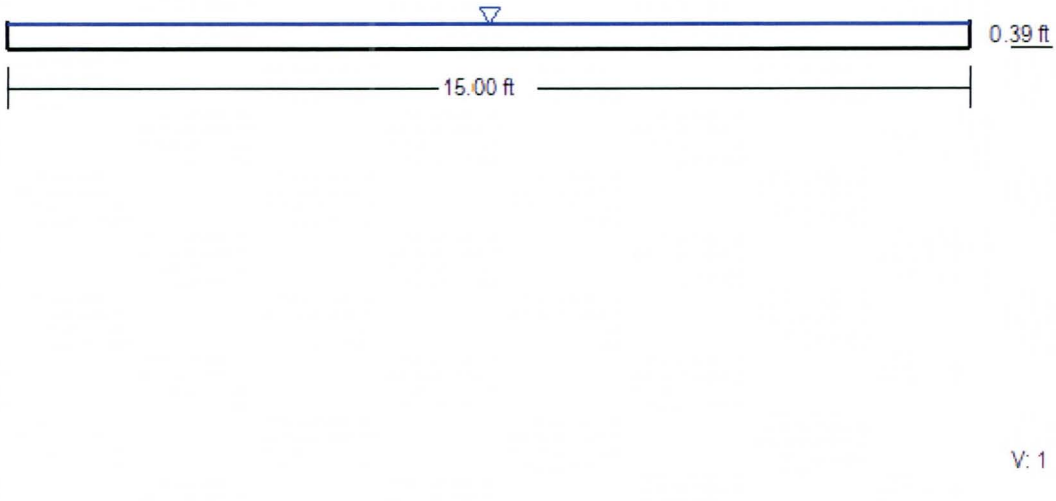
Project Description

Solve For	Headwater Elevation

Input Data

Discharge		11.00	ft^3/s
Headwater Elevation		1.39	ft
Crest Elevation		1.00	ft
Tailwater Elevation		0.00	ft
Crest Surface Type	Paved		
Crest Breadth		14.00	ft
Crest Length		15.00	ft

Cross Section Image



Cross Section for Broad Crested Weir - 11

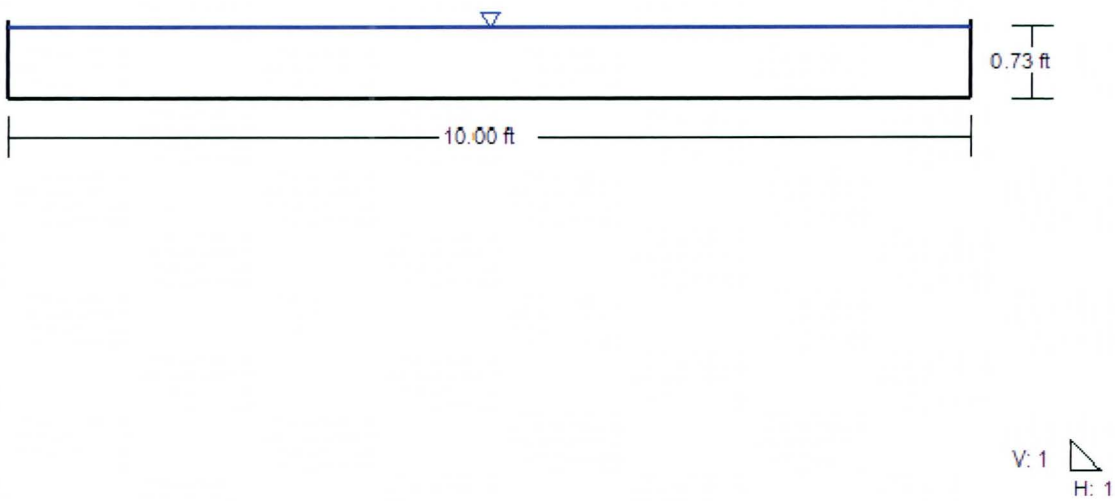
Project Description

Solve For	Headwater Elevation

Input Data

Discharge		19.00	ft^3/s
Headwater Elevation		1.73	ft
Crest Elevation		1.00	ft
Tailwater Elevation		0.00	ft
Crest Surface Type	Paved		
Crest Breadth		5.00	ft
Crest Length		10.00	ft

Cross Section Image



Cross Section for Broad Crested Weir - 12

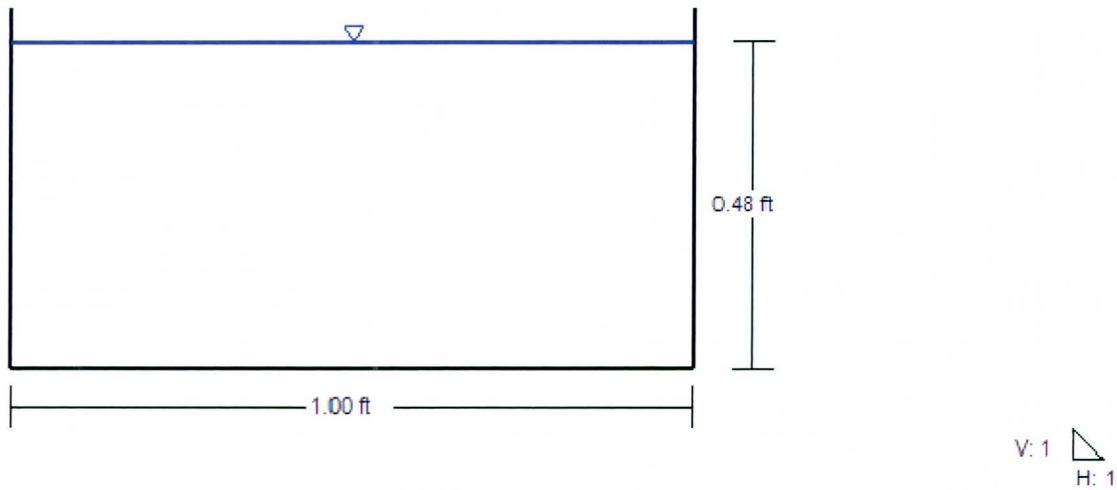
Project Description

Solve For	Headwater Elevation

Input Data

Discharge		1.00	ft³/s
Headwater Elevation		1.48	ft
Crest Elevation		1.00	ft
Tailwater Elevation		0.00	ft
Crest Surface Type	Paved		
Crest Breadth		5.00	ft
Crest Length		1.00	ft

Cross Section Image



Cross Section for Broad Crested Weir - 13

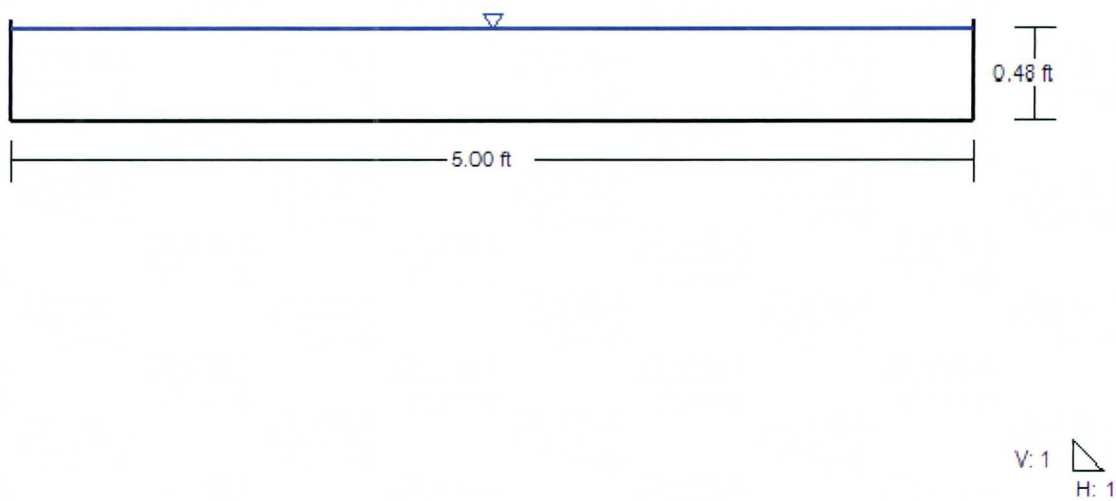
Project Description

Solve For	Headwater Elevation

Input Data

Discharge		5.00	ft³/s
Headwater Elevation		1.48	ft
Crest Elevation		1.00	ft
Tailwater Elevation		0.00	ft
Crest Surface Type	Paved		
Crest Breadth		14.00	ft
Crest Length		5.00	ft

Cross Section Image



Cross Section for Broad Crested Weir - 14

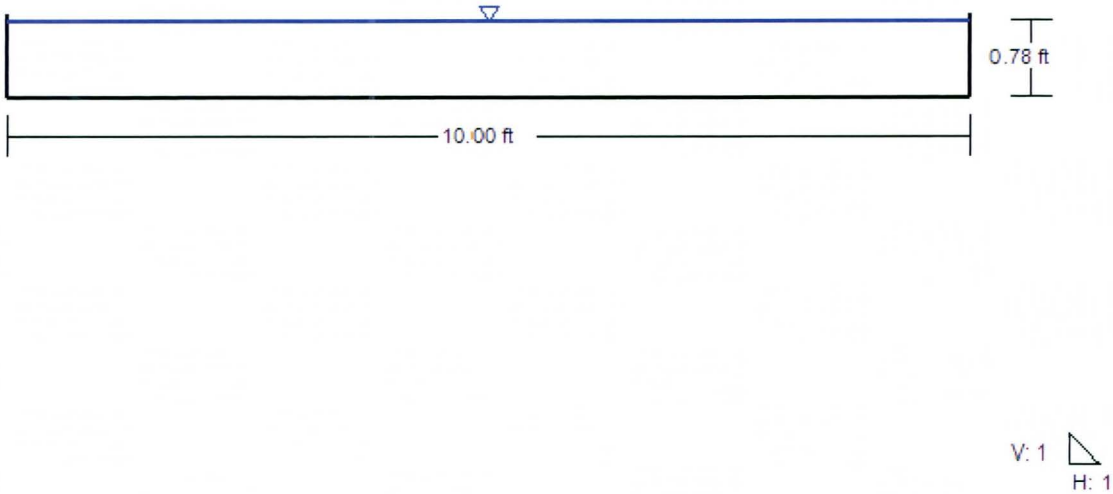
Project Description

Solve For	Headwater Elevation

Input Data

Discharge		21.00	ft^3/s
Headwater Elevation		1.78	ft
Crest Elevation		1.00	ft
Tailwater Elevation		0.00	ft
Crest Surface Type	Paved		
Crest Breadth		14.00	ft
Crest Length		10.00	ft

Cross Section Image



Cross Section for Broad Crested Weir - 15

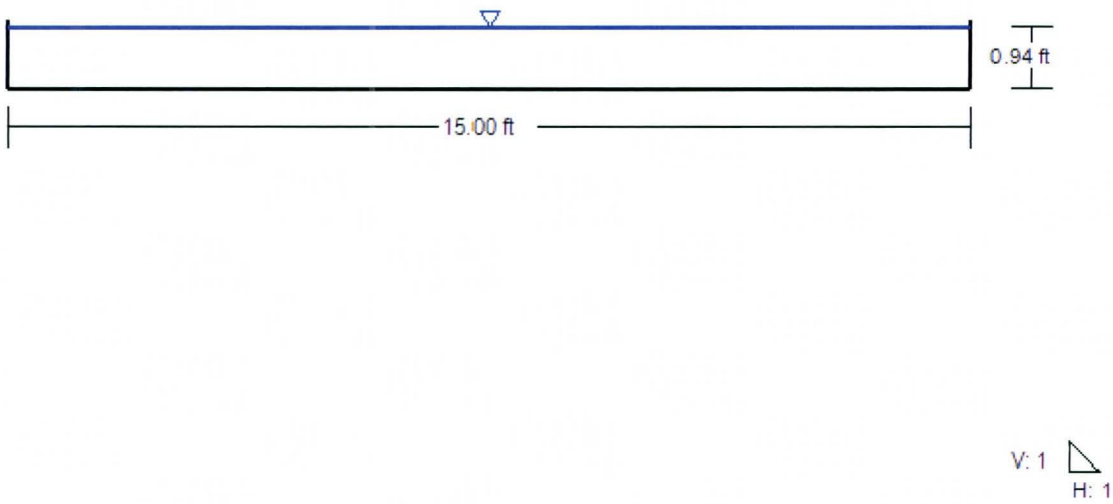
Project Description

Solve For	Headwater Elevation

Input Data

Discharge		42.00	ft³/s
Headwater Elevation		1.94	ft
Crest Elevation		1.00	ft
Tailwater Elevation		0.00	ft
Crest Surface Type	Paved		
Crest Breadth		5.00	ft
Crest Length		15.00	ft

Cross Section Image



Cross Section for Broad Crested Weir - 16

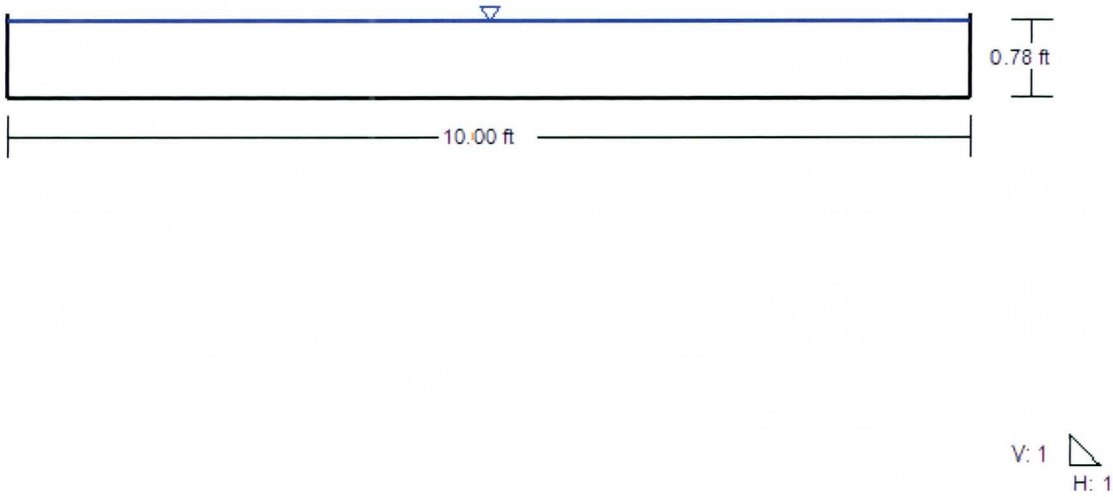
Project Description

Solve For	Headwater Elevation

Input Data

Discharge		21.00	ft^3/s
Headwater Elevation		1.78	ft
Crest Elevation		1.00	ft
Tailwater Elevation		0.00	ft
Crest Surface Type	Paved		
Crest Breadth		5.00	ft
Crest Length		10.00	ft

Cross Section Image



Cross Section for Broad Crested Weir - 18

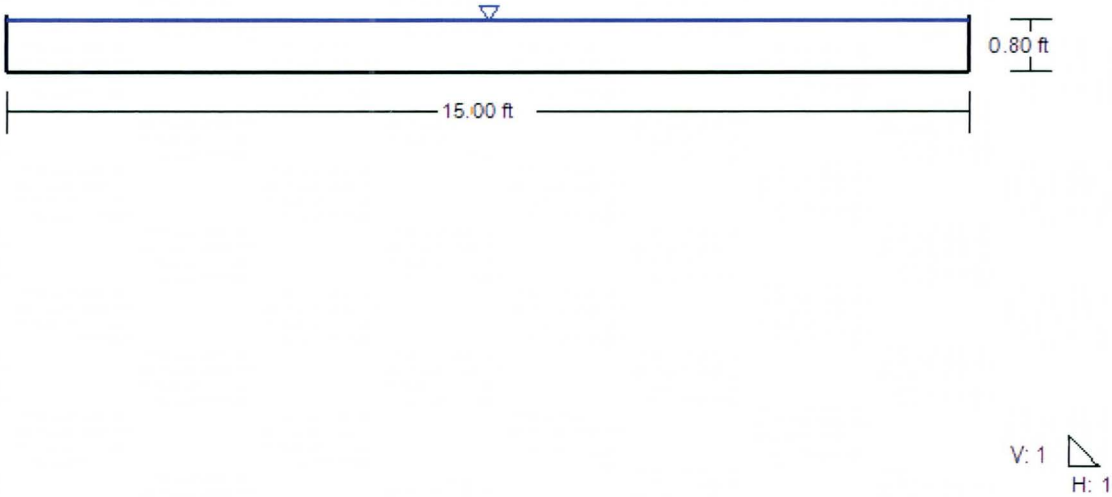
Project Description

Solve For	Headwater Elevation

Input Data

Discharge		33.00	ft³/s
Headwater Elevation		1.80	ft
Crest Elevation		1.00	ft
Tailwater Elevation		0.00	ft
Crest Surface Type	Paved		
Crest Breadth		5.00	ft
Crest Length		15.00	ft

Cross Section Image



Cross Section for Broad Crested Weir - 19

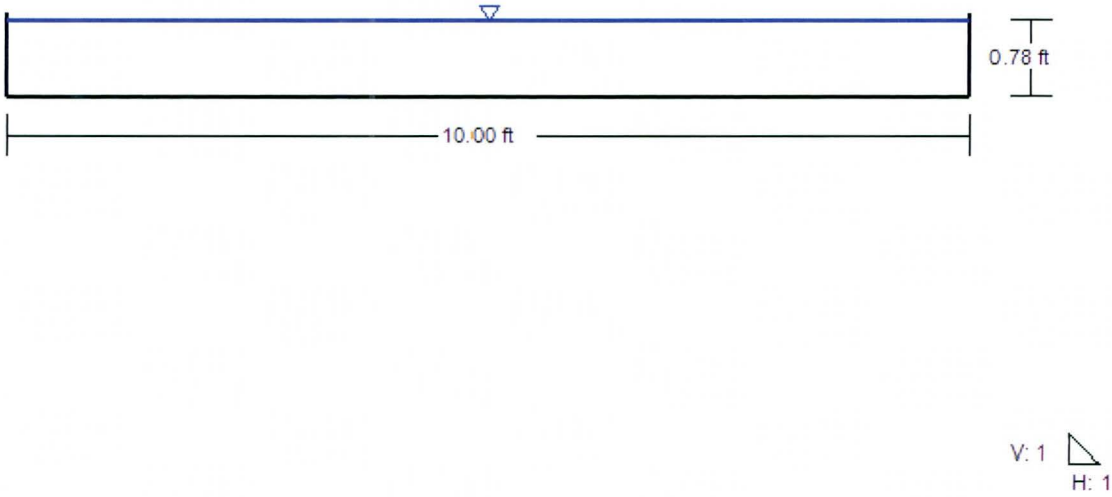
Project Description

Solve For	Headwater Elevation

Input Data

Discharge	21.00	ft^3/s
Headwater Elevation	1.78	ft
Crest Elevation	1.00	ft
Tailwater Elevation	0.00	ft
Crest Surface Type	Paved	
Crest Breadth	5.00	ft
Crest Length	10.00	ft

Cross Section Image



Cross Section for Broad Crested Weir - 20

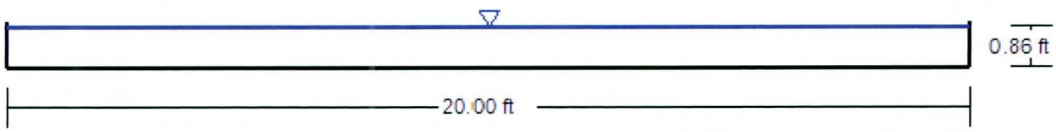
Project Description

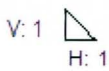
Solve For	Headwater Elevation

Input Data

Discharge		49.00	ft³/s
Headwater Elevation		1.86	ft
Crest Elevation		1.00	ft
Tailwater Elevation		0.00	ft
Crest Surface Type	Paved		
Crest Breadth		5.00	ft
Crest Length		20.00	ft

Cross Section Image





Cross Section for Broad Crested Weir - 21

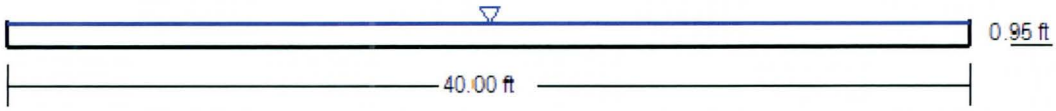
Project Description

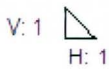
Solve For	Headwater Elevation

Input Data

Discharge		113.00	ft^3/s
Headwater Elevation		1.95	ft
Crest Elevation		1.00	ft
Tailwater Elevation		0.00	ft
Crest Surface Type	Paved		
Crest Breadth		5.00	ft
Crest Length		40.00	ft

Cross Section Image





Cross Section for Broad Crested Weir - 22

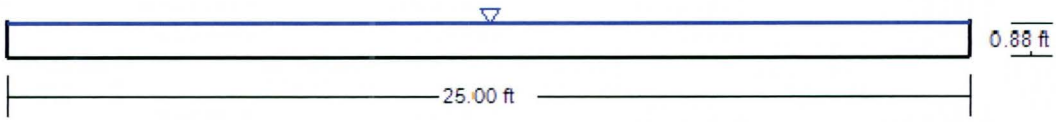
Project Description

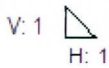
Solve For	Headwater Elevation

Input Data

Discharge		63.00	ft^3/s
Headwater Elevation		1.88	ft
Crest Elevation		1.00	ft
Tailwater Elevation		0.00	ft
Crest Surface Type	Paved		
Crest Breadth		5.00	ft
Crest Length		25.00	ft

Cross Section Image





Loop 303 Outfall Drainage System **W/P Job: 103484**

LATERAL INFLOW RIPRAP SIZING

Flood Control District of Maricopa County

FCD # 2010C002

References: DDMSW - River Mechanics, Jan. 2009. FCDMC, Equation
Channel bed on straight reach (Eq. 48)

Specific weight of stone γ_s = 167.0 lb/ft^3

Specific weight of water γ_w = 62.4 lb/ft^3

Location: Maricopa County/City of Goodyear

Segment	Station	Sub-basin Label	Area (acre)	Q100 (cfs)	Representative Velocity (fps) (1)	D50 Required (ft)	D50 Required (in)	D50 Provided (in)
WPA	19+85.15	1	31.2	24	2.82	0.09	2	6
WPA	25+88.98	2	58.4	54	2.94	0.10	2	6
WPA	37+11.80	5	8.6	9	2.54	0.07	1	6
WPA	42+51.77	6	80.6	77	2.87	0.09	2	6
WPA	58+20.71	7	60.6	55	2.08	0.05	1	6
WPA	77+29.22	8	50.6	56	2.1	0.05	1	6
WPA	66+00.67	9	4.1	6	1.75	0.03	1	6
WPA	79+00.00	10	9.0	11	1.87	0.04	1	6
WPA	96+01.45	11	15.2	19	2.59	0.08	1	6
WPA	110+11.65	12	0.6	1	2.08	0.05	1	6
WPA	110+81.46	13	3.6	5	2.08	0.05	1	6
WPA	115+61.94	14	14.2	21	2.68	0.08	1	6
WPA	132+41.46	15	27.0	42	2.97	0.10	2	6
WPA	145+01.88	16	16.2	21	2.7	0.08	1	6
Aztec	217+40.00	18	24.9	33	2.74	0.09	2	6
Aztec	229+10.00	19	14.3	21	2.7	0.08	1	6
Aztec	242+20.00	20	42.4	49	2.84	0.09	2	6
PEC	162+84.63	21	32.0	113	2.98	0.10	2	6
PEC	174+98.66	22	18.6	63	2.87	0.09	2	6
WPA	30+30.00	Wasteway	N/A	50	5.83	0.39	5	6

(1) Velocity calculated using broadcrested weir calculation. Calculations are conservative and do not include sideslope areas.

APPENDIX B4

Trash Rack Calculations

Loop 303 Outfall Channel at Culvert at UPRR

6 - 10' x 3' Box Culvert Inlet Structure and Access Barrier

Based on FCDMC Drainage Design Manual Criteria

Access Barrier Computations	
Rack Data (End Cell)	
Number of End Cells (ea) =	2
Panel Width (in) =	115.5
Bar Dia or Width (in) =	0.5
Bar Depth (in) =	2
Bar Spacing C_L to C_L (in) =	5.5
Open Area Space Between Bars (in) =	5
# of Spaces Between Bars=	21
Clear Spacing Between Panels - Middle (in) =	5
Clear Spacing Between Panels - End (in) =	2
Total Width Including 1/2 Space Bet. Panels (in) =	125.5
Open Width Per Panel/Cell W_P (ft) =	9.50
Rack Data (Interior Cell)	
Number of Interior Cells (ea) =	4
Panel Width (in) =	121
Bar Dia or Width (in) =	0.5
Bar Depth (in) =	2
Bar Spacing C_L to C_L (in) =	5.5
Open Area Space Between Bars (in) =	5
# of Spaces Between Bars=	22
Clear Spacing Between Panels (in) =	5
Clear Spacing Between Panels - End (in) =	2
Total Width Including 1/2 Space Bet. Panels (in) =	131
Open Width Per Panel/Cell W_P (ft) =	9.92
Culvert Data	
# Cells =	6
Box Width (ft) =	10
Box Height (ft) =	3
Wall Thickness T (in) =	11
Area Box (ft^2) =	180.0
Min interior structure Width =	64.58
Design Structure Interior Width =	64.58
Design Flow Q (cfs) =	480
Panel Sizing Calculations	
Rack Open Area/Culvert Open Area Ratio =	1.61
Required Rack Open Area A_R (ft^2) =	289.8
Reduction Factor (% of Grate Clogged) =	50%
Grate Open Area (% of Grate Not Clogged) =	50%
Rack Open Area w/Clogging Factor Applied A_{RC} (ft^2) =	144.9
# Panels (includes space between panels) =	6.0
Total Open Width for All Panels $W_{PT} = W_P$ * # Panels (ft) =	58.7
Efffective Panel Slope Length L = A_R/W_{PT} (ft) =	4.94
Height (sill to WSEL) =	2.23
Horizontal Length from Sill (ft) =	4.41
Grate Installation Height =	3.52
~ Total Panel Slope Length (ft) =	7.80
~ Horizontal Length from Culvert (ft) =	6.96
~ Angle of Panel to Channel Bottom θ (degrees) =	27
Head Loss Calculations	
Gravitational Constant g (ft/s^2) =	32.2
Velocity Through Racks Vg = Q/A_{RC} (ft/s) =	3.3
Approach velocity Va (ft/s) =	3.3
Loss Factors for Approach Angle Skewed to Trashrack, f =	1.0
Hg = $(1.5[Vg^2 - Va^2]/2g)$*f (ft) =	**0.00**

NOTE:

Channel WSEL = 898.05
Sill Elev = 895.82
Top of Grate Elevation = 899.34

HEC-RAS Plan: Loop 303 Final River: Loop 303 Outfall Reach: Combined Profile: Design Flow

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Combined	7649.10	Design Flow	480.00	895.91	897.81	897.81	898.64	0.002898	7.33	65.45	39.71	1.01
Combined	7567.60	Design Flow	480.00	895.87	898.03	897.04	898.20	0.000436	3.32	144.62	66.90	0.40
Combined	7500		Culvert									
Combined	7375.48	Design Flow	480.00	895.64	897.74		897.92	0.000479	3.42	140.49	66.89	0.42

Loop 303 Outfall Channel at Culvert at Yuma Road

2 - 8' x 6' Box Culvert Inlet Structure and Access Barrier

Based on FCDMC Drainage Design Manual Criteria

Access Barrier Computations	
Rack Data (End Cell)	
Number of End Cells (ea) =	2
Panel Width (in) =	93.5
Bar Dia or Width (in) =	0.5
Bar Depth (in) =	2
Bar Spacing C_L to C_L (in) =	5.5
Open Area Space Between Bars (in) =	5
# of Spaces Between Bars=	17
Clear Spacing Between Panels - Middle (in) =	2.5
Clear Spacing Between Panels - End (in) =	1.75
Total Width Including 1/2 Space Bet. Panels (in) =	100.5
Open Width Per Panel/Cell W_P (ft) =	7.58
Rack Data (Interior Cell)	
Number of Interior Cells (ea) =	0
Panel Width (in) =	0
Bar Dia or Width (in) =	0
Bar Depth (in) =	0
Bar Spacing C_L to C_L (in) =	0
Open Area Space Between Bars (in) =	0
# of Spaces Between Bars=	0
Clear Spacing Between Panels (in) =	0
Clear Spacing Between Panels - End (in) =	0
Total Width Including 1/2 Space Bet. Panels (in) =	0
Open Width Per Panel/Cell W_P (ft) =	0.00
Culvert Data	
# Cells =	2
Box Width (ft) =	8
Box Height (ft) =	6
Wall Thickness T (in) =	9
Area Box (ft^2) =	96.0
Min interior structure Width =	16.75
Design Structure Interior Width =	16.75
Design Flow Q (cfs) =	480
Panel Sizing Calculations	
Rack Open Area/Culvert Open Area Ratio =	1.80
Required Rack Open Area A_R (ft^2) =	172.8
Reduction Factor (% of Grate Clogged) =	50%
Grate Open Area (% of Grate Not Clogged) =	50%
Rack Open Area w/Clogging Factor Applied A_{RC} (ft^2) =	86.4
# Panels (includes space between panels) =	2.0
Total Open Width for All Panels $W_{PT} = W_P$ * # Panels (ft) =	15.2
Efffective Panel Slope Length L = A_R/W_{PT} (ft) =	11.39
Height (sill to WSEL) =	4.81
Horizontal Length from Sill (ft) =	10.33
Grate Installation Height =	6.52
~ Total Panel Slope Length (ft) =	15.44
~ Horizontal Length from Culvert (ft) =	14.00
~ Angle of Panel to Channel Bottom θ (degrees) =	25
Head Loss Calculations	
Gravitational Constant g (ft/s^2) =	32.2
Velocity Through Racks Vg = Q/A_{RC} (ft/s) =	5.6
Approach velocity Va (ft/s) =	5.6
Loss Factors for Approach Angle Skewed to Trashrack, f =	1.0
Hg = $(1.5[Vg^2 - Va^2]/2g)$*f (ft) =	**Negligible**

NOTE:

Channel WSEL = 961.72
Sill Elev = 956.91
Top of Grate Elevation = 963.43

HEC-RAS Plan: Loop 303 Final River: Loop 303 Outfall Reach: Combined Profile: Design Flow

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Hydr Radius	Froude # Chl	LOB Elev	ROB Elev
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	(ft)		(ft)	(ft)
Combined	21524.85	Design Flow	480.00	956.94	961.68		962.23	0.000821	5.94	80.75	17.05	3.03	0.48	966.77	966.77
Combined	21511.83	Design Flow	480.00	956.91	961.72	959.72	962.20	0.000696	5.59	85.81	17.91	3.13	0.45	966.00	966.00
Combined	21000		Culvert												
Combined	20119.61	Design Flow	480.00	954.28	959.20		959.67	0.000665	5.51	87.07	17.83	3.17	0.44	963.00	963.00

APPENDIX C

Scour Analysis Memo and Supporting Data

Flood Control District
of Maricopa County

Date: September 19, 2011

To: Project File – Loop 303 Outfall

From: Mike Duncan, Project Manager

Subject: Riprap Sizing of Apron at Gila River

The location of this loose riprap apron is at the south end of the project channel at the toe of the north bank of the Gila River. The hydraulic model of the river indicates that the 100-year velocity of the river is approximately 7 feet per second. However, the highest velocities occur when the river has little or no flow and the project channel is at the design flow. The slope of the channel upstream of the apron is 0.0015 ft/ft. Here are Manning's normal depth results.

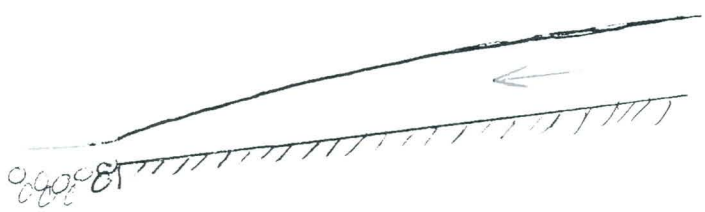
** HYDRAULICS OF TRAPEZOID CHANNEL PROGRAM **

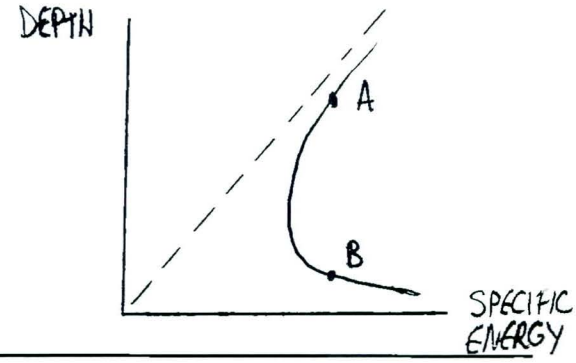
Channel Bottom Width (ft)	Side Slope Lt. (Horz. to 1)	Side Slope RT. (Horz. to 1)	Normal Water Depth (ft)	Area of Normal Depth (ft^2)
7.00	2.00	2.00	(C) 4.30 AT A	66.96

Discharge (cfs)	Channel Slope (ft/ft)	Manning Coefficient	Normal Depth Velocity (f/s)	Froude Number
480.00	0.0015	0.015	7.17	0.7591

Critical Depth (ft)	Critical Depth Velocity (f/s)	Critical Slope (ft/ft)	Sequent Depth (ft)
3.73	8.90	0.00270	3.21 AT B

As the flow in the channel approaches the end of the concrete lining and the apron, the flow depth decreases and the velocity increases. The highest possible velocity would correspond to the Sequent Depth (which is the corresponding supercritical depth with the same specific energy).





2801 West Durango Street Phoenix, Arizona 85009 Phone: 602-506-1501 Fax: 602-506-4601

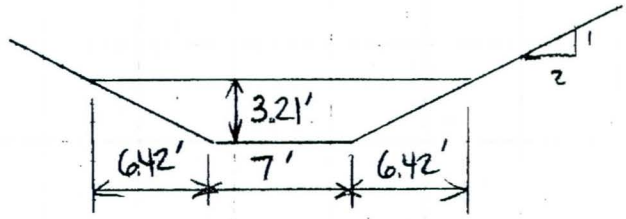
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT LOOP 303 OUTFALL PAGE 2 OF 3

DETAIL RIPRAP SIZING AT APRON COMPUTED MIKE DUNCAN DATE 9-19-11

CHECKED BY DATE

FOR A DEPTH OF 3.21 FT.,



$$AREA = \frac{1}{2}(3.21\,ft)(6.42+7+6.42+7)(ft)$$

$$A = 43.08\,ft^2$$

$$\text{THEN VELOCITY} = \frac{Q}{A} = \frac{480\,\frac{ft^3}{s}}{43.08\,ft^2} = 11.14\,fps$$

USING THE LOOSE RIPRAP SIZING OPTIONS, AS SHOWN IN THE DISTRICT'S LATEST DDMSW, THE APPROPRIATE EQUATION IS DDMS48 WHICH IS FOR CHANNEL BED ON STRAIGHT REACH

$$D_{50} = 0.019\,V_a^2\left(\frac{\gamma_w}{\gamma_s-\gamma_w}\right)$$

V_a = AVERAGE VELOCITY = 11.14 fps

SPECIFIC GRAVITY OF WATER = 1

SPECIFIC GRAVITY OF RIPRAP STONE = 2.7

$$D_{50} = 0.019\,(11.14)^2\left(\frac{1}{2.7-1}\right) = \underline{1.39\,ft}$$

USE A D_{50} OF 1.5 ft OR 18 INCHES.

NEXT PAGE HAS CHECK FOR RIVER VELOCITY.

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT LOOP 303 OUTFALL PAGE 3 OF 3

DETAIL RIPRAP SIZING AT APRON COMPUTED MIKE DUNCAN DATE 9-19-11

CHECKED BY _____ DATE _____

RIVER BANK IS AT THE OUTSIDE OF A CURVE; 100-YR VELOCITY IS 7 FPS; THEN USING THE CURVED EQUATION, CHANNEL BED ON CURVED REACH

DDMS 49

$$D_{50} = 0.0372\, V_a^2 \left(\frac{\gamma_w}{\gamma_s - \gamma_w}\right)$$

$$= 0.0372 (7)^2 \left(\frac{1}{2.7-1}\right)$$

$$= 1.07 \text{ ft}$$

SO 1.5 ft IS OK FOR THE RIVER.

MEMO

TO: Jeff Minch, P.E.

FROM: Shimin Zou, P.E., PhD., CFM

DATE: June 14, 2011

RE: Loop 303 Outfall Drainage System (Woodlands Avenue to Gila River)
WP#103484, FCD Contract No. 2010C002

SUBJECT: Scour Analysis Summary Report

I. INTRODUCTION

The Loop 303 Outfall Channel is a concrete lined channel. However, approximately 2,100 ft of the most downstream reach is within the Gila River floodplain and the outlet of the channel needs protection for erosion caused by both the flowing water from the Gila River and the outfall channel. Soil cement, in additional to the loose riprap at the outlet, is proposed to protect the channel outlet into the Gila River.

The toe-down depth of the outlet soil cement is designed for the worst case of the local scour caused by the flowing water from the Loop 303 outfall channel and Gila River scour which is the sum of Cotton Lane bridge scour, Dos Rio mining pit headcut, and local scour caused by the channel acting like a grade control structure.

II. LOCAL SCOUR CAUSED BY THE FLOWING WATER FROM LOOP 303 OUTFALL CHANNEL

The local scour caused by the flowing water from the Loop 303 outfall channel is protected by loose riprap which is designed by the method from US DOT, FHWA, HEC-14, Hydraulic Design of Energy Dissipators for Culverts and Channel, third edition, July 2006, p10-16 to p10-18. The designed parameters for the loose riprap is shown in the spreadsheet (included). The estimated riprap size D50 is also verified by the velocity from the Gila River.

III. TOTAL SCOUR CAUSED BY THE FLOWING WATER FROM THE GILA RIVER

The total scour caused by the flowing water from the Gila River is the sum of the three components: 1) the estimated total scour from the Cotton Lane bridge project; 2) local scour caused by the Dos Rio mining pit headcut; and 3) local scour caused by the channel embankments acting like a grade control structure since the most downstream portion of the channel is within the Gila River 100-year floodplain (about 2,100 ft).

The estimated total scour from the Cotton Lane bridge project is 9.1 ft based on the Hydraulic Report – Cotton Lane Bridge Channel Design by West Consultants and R2D, Appendix G, page 342 of 407 (pertinent pages are attached).

The local scour caused by the Dos Rio mining pit headcut is around 1 ft obtained from the HEC-6T output file from the FCDMC.

The local scour caused by the channel embankments acting like a grade control structure is estimated by using the FCDMC's DDMSW software and the estimated scour depth is 0.04 ft. The Schoklitsch equation was applied to calculate scour depth below a structure with a free over-fall of water on an unprotected river bed. It can also be used for evaluating local scour below a sharp-crested spillway, drop structure or grade control structure. The soil data is from the report of Cotton Lane bridge project (DDMSW output is included).

The toe-down depth for the soil cement from the total scour is equal to 10.5 ft (9.1 + 1.3(1.0+0.04) = 10.5 ft) below the river thalweg which is about 877.0 ft (NAVD88). Therefore the soil cement toe-down invert elevation is about 866.5 ft which is about 14.5 ft below the outfall channel outlet invert elevation of 881 ft.

IV. LATERAL MIGRATION POTENTIAL FROM GILA RIVER

The length of the soil cement protection along the channel is impacted by the potential main channel lateral migration of the Gila River. The lateral migration estimation procedures documented in Arizona State Standard 5-96 (ADWR, 1996) were followed for this project according to FCDMC's drainage design manual for hydraulics.

Quantifying bank movement or lateral migration is more difficult than quantifying vertical bed movement. The Level I procedures documented in State Standard SSA 5-96 were applied to estimate the size of buffer (setback distance) that shall be provided along watercourses to allow for the lateral migration that may occur during future floods. This level of analysis requires drainage area and peak discharge associated with the 100-year flood (Q_{100}) and should be applied to watercourses which have drainage areas of less than 30 square miles. Therefore, Level I analysis is not applicable for Gila River watershed at this project. Nonetheless, the Level I analysis was performed and the setback distance of 480 ft is required. The calculation spreadsheet is included.

The Level II analysis procedures - a*llowable velocity analysis and tractive stress analysis,* do not estimate setback distance directly, but are used to demonstrate the stability of the channel material under 100-year flood conditions, and to justify a lesser setback requirement than that computed using the Level I equations. Setback allowances for conditions which pass one or more of the channel stability approaches, and which are not located in areas of specific concern should be based on normal building safety criteria rather than the Level I equations presented above, since the bank limits would not be expected to change during the course of a 100-year design event. The Level II analysis results show that the Gila River is stable at the project site. The calculation spreadsheet is included where hydraulic parameters from RM 191.86 were used.

The lateral migration potential for the channel outlet area is directly impacted by the vertical scour depth (toe-down depth of 10.5 ft is applied). The outlet is approximately at the floodway limit of the Gila River which is located at Sta. 22,645 ft for RM 191.86 (U/S of the channel alignment). The station of the main channel toe at right bank of the Gila River is about 22,499 ft. The natural stable slope of the main channel is about 7 (H:V) from the geometric cross section data and the total depth from the toe-down elevation (866.5 ft) to the Loop 303 outfall channel outlet invert (881 ft) is about 14.5 ft. Assuming the same stable side slope of 7 the impact zone from the vertical scour depth of 14.5 ft is 14.5 x 7 = 102 ft which is equal to the station of 22,601 ft (22,499 + 102 = 22,601). The soil cement protection limit is about 50 ft outside of the floodway limit which is equal to station 22,695 ft (22,645 + 50 = 22,695). Therefore, the soil cement protection limit (length) is 94 ft (22,695 – 22,601 = 94) outside of the lateral migration zone caused by the vertical scour and is adequate for the channel erosion protection.

Wood, Patel & Associates, Inc. ♦ 2051 West Northern, Suite 100 ♦ Phoenix, Arizona 85021
Phone: (602) 335-8500 ♦ Fax: (602) 335-8580
E-Mail: woodpatel@woodpatel.com

Riprap Apron Design Spreadsheet

References: US DOT, FHWA, HEC-14, Hydraulic Design of Energy Dissipators for Culverts and Channel. Third Edition, July 2006, p10-16 to p10-18.

FCDMC, Drainage Design Manual for Maricpa County Arizona, Vol. II - Hydraulics. March 2009.

Project Name: Loop 303 Outfall Channel **Project No.** 103484
Location: Channel Outlet into Gila River

Equation:

$$D_{50} = 0.2\,D\left(\frac{Q}{\sqrt{g}D^{2.5}}\right)^{4/3}\left(\frac{D}{TW}\right) \qquad (10.4)$$

where,

D_{50} = riprap size, m (ft)
Q = design discharge, m^3/s (ft^3/s)
D = culvert diameter (circular), m (ft)
TW = tailwater depth, m (ft)
g = acceleration due to gravity, 9.81 m/s^2 (32.2 ft/s^2)

Input Data:

Q =	480	(cfs)	(if multi-barrel, one barrel flow)
Dp =	0	(ft)	(pipe diameter)
TW =	6.6	(ft)	(tailwater depth)
Yn =	6.6	(ft)	(culvert normal flow depth)
Wo =	14.4	(ft)	(total culvert width)
b =	36	(ft)	(wash bottom width)
P =	32.1	(ft)	(box wetted perimeter)
A =	95.0	(ft^2)	(box flow area)
R =	3.0	(ft)	(box hydraulic radius)
De =	11.8	(ft)	(box equivalent D)
Does TW meet the limits ?	Yes		(0.4D<= TW <= 1.0D)
Is culvert flow supercritical ?	No		(Yes or No)
D' =	0.0	(ft)	(culvert D adjustment)
D =	11.8	(ft)	(input D)

Riprap Size D_{50}:

Computed Riprap Size D_{50} =	5	(in)
Design Riprap Size D_{50} =	6	(in)
Class No. =	1	

Riprap Sizes D_{15} and D_{85}:

Design Riprap Size D_{15} =	3	(in)
Design Riprap Size D_{85} =	9	(in)

Riprap Apron Length:

Riprap Apron Length =	47	(ft)

Rirap Apron Width:

U/S Riprap Apron Width =	38	(ft)
D/S Riprap Apron Width =	60	(ft)

Riprap Thickness:

Riprap Thickness =	21	(in)

Total Riprap Volume:

Riprap Rock Volume =	150	(CY)

HEC-14 Figure 10.4 and Table 10.1

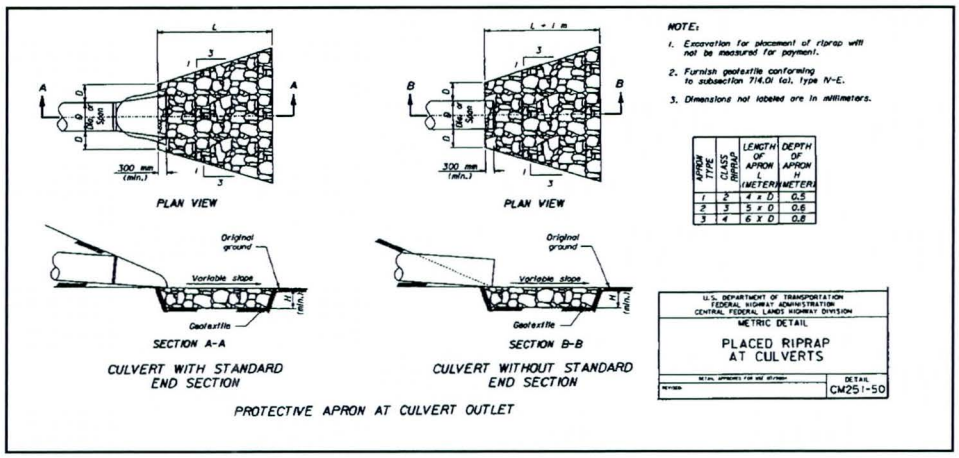


Figure 10.4. Placed Riprap at Culverts (Central Federal Lands Highway Division)

Riprap Classes and Apron Dimensions

Class	D_{50} (in)	Apron Length (ft)	Apron Depth (ft)
1	6	4D	$3.5D_{50}$
2	8	4D	$3.3D_{50}$
3	12	5D	$2.4D_{50}$
4	18	6D	$2.2D_{50}$
5	24	7D	$2.0D_{50}$
6	30	8D	$2.0D_{50}$
7	36	9D	$2.0D_{50}$

20050042

HYDRAULIC REPORT

Cotton Lane Bridge Channel Design

Goodyear, Arizona

Prepared for:

S.D. Construction, L.L.C.
3040 N 44th St, Suite 3
Phoenix, AZ 85018

Prepared by

WEST Consultants, Inc.
960 West Elliot Rd, Suite 201
Tempe, AZ 85284

River Research & Design, Inc.
1345 E Spur Ave
Gilbert, AZ 85296

With Assistance from

Coe & Van Loo Consultants, Inc.
4550 N 12th St.
Phoenix AZ, 85014

Registered Professional Engineer (Civil) CERTIFICATE NO. 21560 DENNIS L. RICHARDS Date Signed 3/9/06 ARIZONA, U.S.A.

Registered Professional Engineer (Civil) CERTIFICATE NO. 36225 GARY E. FREEMAN Date Signed 3/9/06 ARIZONA, U.S.A.

March 7, 2006

APPENDIX G

SECTION I

Scour Calculations for Bank Protection

Calculation of General Scour Depths - English Units (ft)

November 2, 2005

Gila River / Cotton Lane Bridge - w/Protected South Bank - 500 Year Flood Flow = 285,000 cfs

Gila River - King Ranch/Cotton Lane Bridge
Cotton Lane Bridge Section
Method not Applicable

© River Research & Design, Inc. 2005

Stream Values

Incised / Bankfull Q cfs	Qi	285000
Incised / Bankfull Width	Wi	3150
Incised / Bankfull q cfs/ft	qi	90.48
Depth of Incision	di	10
Competent Veloc.(p. 38 USBR)	Vc	2.5
Design Q (Channel)		285000
Design Channel Width		3150
Design Flow / Width	qf	90.48
Average Depth / Hydraulic Depth	dm	11
Maximum Depth	Ymax	19.26
Average Velocity	Vm	8.8
Radius of Curvature	Rc	4210
Neill's m - 0.67 Sand to 0.85 Coarse Gravel	m	0.85
D50 - mm		6
D85 - mm		35
D90 - mm		50
Slope		0.0012
Froude Number for Channel		0.44
USBR - Lacey Z - Straight Reach	Zl	0.25
Neill Z (p. 36 USBR) Straight Reach	Zn	0.5
Blench Z (p. 36 USBR) Straight Rch	Zb	0.6
Blench "zero bed factor" (p35)	Fbo	2.5

Using All Equations

Average Scour Depth	6.4
Safety Factor	1.3
Toe Down below Thalweg	8.3

Total Scour Depth Calculations		Meth. Used
Average of Similar Values	3.3	3,4,7
Bend Scour Average (See Sum Below)	3.8	
Bend + Average w/o Blench	7.1	
Ave w/Blench ((3 Avg +Blench) /4	7.5	
Long Term Scour (HEC-6T 105 Yrs)	0.5	
Bed Form Scour (See Tab) (BF)	1.2	
Low Flow Incisement (LFI)	2	
Safety Factor x (LT+BF+BS+LFI)	1.3	
Recommended Toe Down / with Bend	14.6	

Recommended Toe Down -No Bend	9.1 Feet

This Spreadsheet is provided without impled or express warranty as to the applicability, accuracy or correctness of any formulas or calculations. The use of this spreadsheet indicates the willingness of the user to accept all risks and liabilities arising from its use. The user is encouraged to veryify the accuracy and applicability of all equations prior to their use in determining toe down depths.

Methodology Adapted from "Computing Degradation and Local Scour", US Bureau of Reclamation, Ernest L. Pemberton and Joseph M. Lara, January 1984
Zeller Equation from the Flood Control District of Maricopa County Drainage Design Manual - Hydraulics, September 2003 (Draft)

	Scour Depth	Bend Scour: Moderate Bend	Severe Bend	Right Angle Bend	Vertical Wall
1 Neill - Incised					
df = di*(qf/qi)^m; di = 10; qf = 90.48; m = 0.85; df = 10.0; Z = 0.5 (ds = Z*df)	Don't Use				
Includes Bend Scour; qi = 90.48; dfo Calculated Below	5.0				
2 Neill - Competent Velocity - Sand or Coarser Material					
ds = dm((Vm/Vc)-1); dm = 11; Vm = 8.8; Vc = 2.5; ds = 27.7; Zn = 0.5 (d = Z*ds)	13.9				
Moderate Bend 0.6		2.8			
Severe Bend 0.7			5.5		
3 USBR - D90 Method; 50% of Average Flow Depth (dm); ds = Z*dm; Z = 0.25; dm = 11; ds = 2.8	2.8				
4 Lacey - Zero Bed Sediment Transport Assumed					
dm=0.47*(Q/f)^1/3; Q = 285000; f = 4.3; dm = 19.0; Z = 0.25 (ds = Z*dm)	4.8				
Mod Bend 0.5		4.8			
Sharp Bend 0.6			6.7		
Right Angle Bend 1				14.3	
Vertical Rock Bank or Wall 1.25					19.0
Includes Bend Scour; Dm = D50; f = 1.76 * 6^0.5 = 4.3					
5 Blench - Zero Bed Factor					
dfo = qf ^(2/3) / Fbo^(1/3); qf = 90.48; Fbo = 2.5; dfo = 14.8; Z = 0.6 (ds = Z*dfo)	8.9	8.9	8.9		
Includes Bend Scour; Right Angle Bend 1.25				9.7	
6 Abbot - SW Streams; 0.5 < d50 < 0.7 Design Assumption					
ds = K * (qi)^0.24; K = 2.45; qi = 90.48; ds = 7.2	Don't Use 7.2				
7 Zeller Equation - General Scour - Minor Watercourses; IGNORE IF NEGATIVE!					
Z = Ymax * [0.0685 * v^0.8 / (yh^0.4 * Se^0.3) - 1]; Ymax = 19.26; V = 8.8; Yh = 11; Se = 0.0012	OK 2.4				
Average Bend Scour Values		5.5	7.0	12.0	19.0

Add Bend Scour Value to Calculations at Left

Applicability of Neill Incised Eqn

No	dm < df	19.0 dm
No	dm < df < dfo	10.0 df
OK	df < dfo	14.8 dfo

Middle Section			Recommede Toe Down
USBR Calcs			
Straight Bank	9.1	ft	10
With Bend	14.6	ft	15
Corps Calcs			
Outer Bend	18.1	ft	18.1

Table LR

Method	Neill	Lacey	Blench
Straight	0.5	0.25	0.6
Moderate Bend	0.6	0.5	0.6
Severe Bend	0.7	0.75	0.6
Right Angle Bend		1	1.25
Vertical Rock Bank		1.25	

Final Design Calculations - Section 3 (Downstream Section)

Method	Design FlowRate (cfs)	Downstream Hydraulic Depth (ft)	Average Width (ft)	Head (ft)	D84 (mm)	D90 (mm)	Scour Depth (ft)
Maior Basin ID: 01							
ID: 010005		**Cross Section ID: Manual**					
Schoklitsch	9,714	2.46	2,063.00	2.00	-	50.000	0.04

Local Scour at Grade Controls or Drop Structures

DDMSW411 - Equations 32-34

Methodology from "Computing Degradation and Local Scour" by E. Pemberton and J. Lara, 1984, Technical Guideline for Bureau of Reclamation, pages 40-45, equation type "D"

100-year Discharge =	9,714	cfs				
Total Flow Area =	5083	ft^2	2	ft Long-Term Degradation		
Total Top Width =	2063	ft	0.0	ft Depth to Top of Soil-Cement		
Mean Flow Depth =	2.46	ft	Existing Bed Elevation		890.0	ft
Discharge per foot =	4.71	cfs/ft	Top of Floor Elevation		890.0	ft

Schoklitsch (1932)

$$d_s = \frac{K(H)^{0.2} q^{0.57}}{D_{90}^{0.32}} - d_m$$

ds = 0.04 ft

d_s = depth of scour (ft)
K = 3.15 3.15 inch-pound units
H = 2.00 difference between U/S and D/S WSEL
q = 4.71 discharge per unit width (cfs per ft)
D_{90} = 50.00 particle size for which 90% is finer (mm)
d_m = 2.46 D/S mean water depth

Veronese (1937)

$$d_s = KH_T^{0.225} q^{0.54} - d_m$$

ds = 1.1 ft

d_s = depth of scour (ft)
K = 1.32 1.32 inch-pound units
H_T = 2.00 head from U/S to D/S
q = 4.71 discharge per unit width (cfs per ft)
d_m = 2.46 D/S mean water depth

Zimmerman & Maniak (1967)

$$d_s = K\left(\frac{q^{0.82}}{D_{85}^{0.23}}\right)\left(\frac{d_m}{q^{2/3}}\right)^{0.93} - d_m$$

ds = 1.2 ft

d_s = depth of scour (ft)
K = 1.95 1.95 inch-pound units
q = 4.71 discharge per unit width (cfs per ft)
D_{85} = 10.00 particle size for which 85% is finer (mm)
d_m = 2.46 D/S mean water depth

Average Scour Depth at Toe = 0.8 ft

Recommended Downstream Toe-Down = 3 ft below existing channel bed

Level 1 Analysis of Watercourse Setback

Reference: ADWR, Flood Warning and Dam Safety Section, 1996.
State Standard 5-96: "Watercourrse System Sediment Balance - Guideline 1: Lateral Migration Setback Allowance for Riverine Floodplains in Arizona"

Assumptions: Drainage area less than 30 square miles with normal condition, minimal channel geometry and hydraulic information.

Equations:

For straight channel reaches or reaches with minor curvature:

Setback = 1.0(Q100)^0.5

For channel reaches with obvious curvature or channel bend:

Setback = 2.5(Q100)^0.5

where setback is feet and Q100 is in cubic feet per second.

Project Name: Loop 303 Outfall Channel **Location:** Gila River CS 191.86

Input Data:

Q100 =	227000	cfs	
Setback =	476	ft	for straight channel
Setback =	1191	ft	otherwise
Recommended Setback =	**480**	ft	

Level 2 Analysis of Watercourse Setback

Reference: ADWR, Flood Warning and Dam Safety Section, 1996.
State Standard 5-96: "Watercourrse System Sediment Balance - Guideline 1: Lateral Migration Setback Allowance for Riverine Floodplains in Arizona"

Assumptions: For the reach is not located in areas of specific concern, such as mining sites, highly aggradational areas, or areas with artificial flow redirection, setback allowances should be based on normal building safety criteria if one or more of the following conditions is met.

1. Average flow velocity less than maximum allowable flow velocity;
2. Tractive stress exerted on the boundary by the flow of water less than maximum allowable tractive stress.

Equations:

1. Allowable flow velocity:

   Va = Vb*Ca*Cb*Cd

   where: Va = maximum allowable flow velocity (ft/s);
   Vb = basic maximum allowable flow velocity from Fig. 1;
   Ca, Cb, Cd = correction factors for channel alignment, bank slope, and flow depth, respectively, from Figs 2 to 4.

2. Tractive stress analysis:

   Case 1: 0.25 inches < D75 < 5.0 inches
   Tau (actual- nonadjusted) = Gama*Y[D75^(1/6)/(39n)]^2*Se
   Tau (allowable) = 0.4*[(Z^2 - Cot^2(phiR))/(1 + Z^2)]^(0.5)*D75
   where: Tau = tractive stress lbs/ft^2; Gama = unit weight (62.4 lbs/ft^3);
   D75 = 75 % finer diameter, inches; n = Manning's n;
   Se = energy slope; Y = flow depth, ft; Z = channel side slope;
   phiR = angle of repose of soil, degrees (see Fig. 8).

   Case 2: D75 <= 0.25 inches
   Using Figs 9 through 12.

Project Name: Loop 303 Outfall Channel **Location:** Gila River CS 191.86

Input Data:

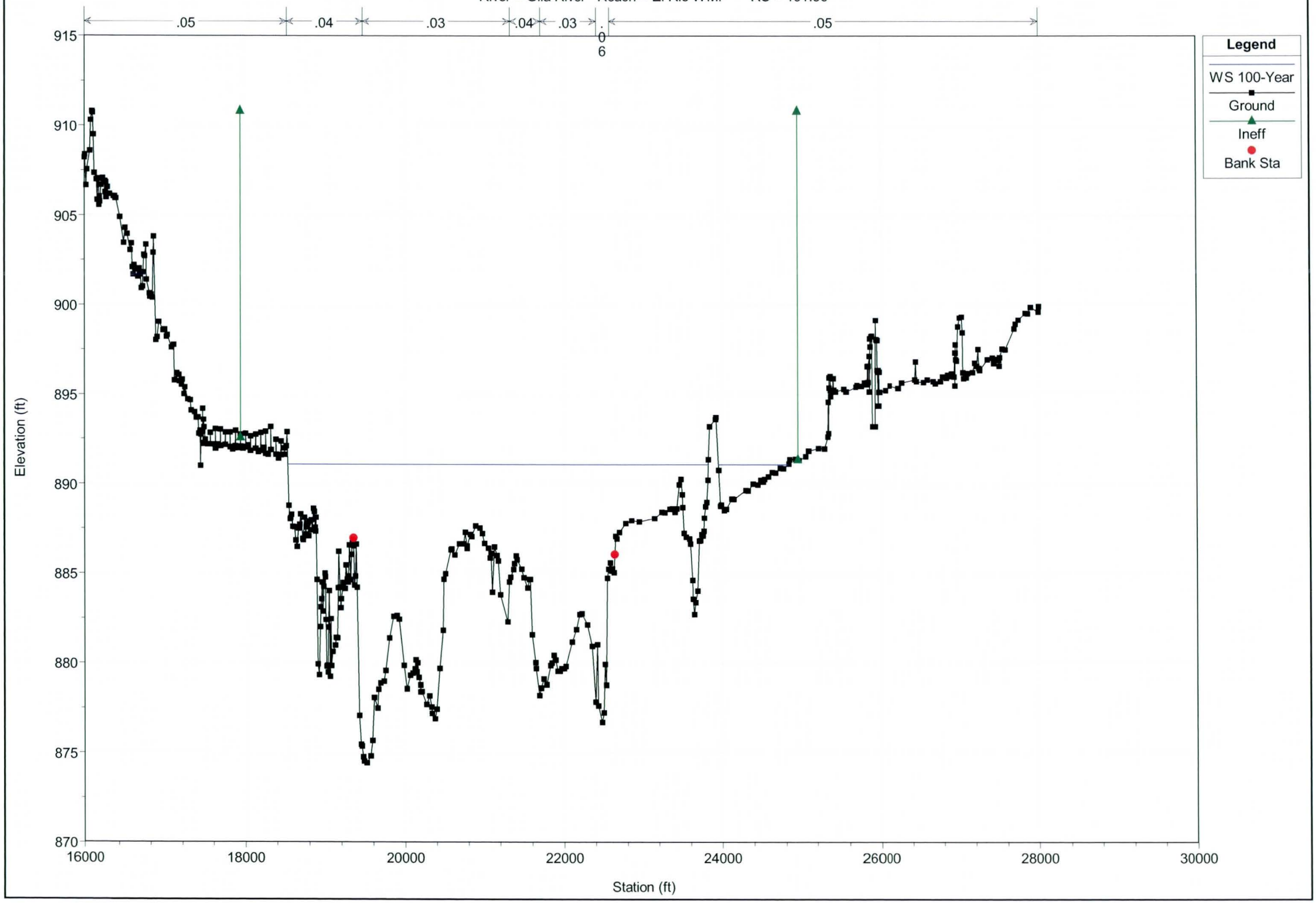
	Vb =	7		Ca =	1	Cb =	0.84
	Va =	**6.94**	ft/s	Vavg =	6.5 ft/s	Cd =	1.18
	D75 =	1	in	n =	0.035	Se =	0.001
	Y =	6.6	ft	Z =	7	phiR =	33
	Tau(actual-nonadjusted) =			0.22	**Tau(actual-adjusted) =**		**0.18**
Case 1:	**Tau(allowable) =**			**2.80**			
Case 2:	**Tau(allowable) =**			0.08	**Tau (Actual) =**	0.23	

Is One of the Criteria Satisfied ? = YES **Channel Stable**

Revised El Rio Base File 2007R3 Plan: ElRio3w/Levee 9/24/2010

Geom: Redelineation With Levee

River = Gila River Reach = El Rio WMP RS = 191.86



APPENDIX D
Project Geometry and Earthwork Report

```
            Project Name: Loop 303 Outfall Channel
             Description: Loop 303 Outfall Channel
Horizontal Alignment Name: Channel CCL HZ Alignment
             Description: Channel Construction Center Line Horizontal Alignment
                   Style: Default
                                          STATION      NORTHING       EASTING

Element: Linear
            POB (        )              5+00.00     869189.70     541701.69
             PI (        )              7+96.10     869485.79     541703.26
        Tangent Direction:       N  0^18'08" E
           Tangent Length:               296.10

Element: Linear
             PI (        )              7+96.10     869485.79     541703.26
             PI (        )              9+03.06     869592.75     541703.82
        Tangent Direction:       N  0^18'08" E
           Tangent Length:               106.96

Element: Linear
             PI (        )              9+03.06     869592.75     541703.82
             PI (        )              9+12.65     869602.34     541703.96
        Tangent Direction:       N  0^51'00" E
           Tangent Length:                 9.59

Element: Linear
             PI (        )              9+12.65     869602.34     541703.96
             PI (        )             11+48.37     869837.99     541709.71
        Tangent Direction:       N  1^23'51" E
           Tangent Length:               235.72

Element: Linear
             PI (        )             11+48.37     869837.99     541709.71
             PI (        )             11+67.36     869856.98     541709.81
        Tangent Direction:       N  0^18'22" E
           Tangent Length:                18.98

Element: Linear
             PI (        )             11+67.36     869856.98     541709.81
             PI (        )             13+98.38     870087.98     541706.65
        Tangent Direction:       N  0^47'08" W
           Tangent Length:               231.03

Element: Linear
             PI (        )             13+98.38     870087.98     541706.65
             PI (        )             14+17.43     870107.04     541706.75
        Tangent Direction:       N  0^18'08" E
           Tangent Length:                19.05

Element: Linear
             PI (        )             14+17.43     870107.04     541706.75
             PI (        )             16+48.43     870337.96     541712.35
        Tangent Direction:       N  1^23'24" E
           Tangent Length:               230.99

Element: Linear
             PI (        )             16+48.43     870337.96     541712.35
             PI (        )             16+67.48     870357.01     541712.45
        Tangent Direction:       N  0^17'41" E
           Tangent Length:                19.05

Element: Linear
             PI (        )             16+67.48     870357.01     541712.45
             PI (        )             19+03.14     870592.65     541709.15
        Tangent Direction:       N  0^48'02" W
           Tangent Length:               235.66

Element: Linear
```

```
                PI (        )          19+03.14     870592.65     541709.15
                PI (        )          19+12.80     870602.31     541709.11
           Tangent Direction:      N  0^14'57" W
              Tangent Length:               9.66

Element: Linear
                PI (        )          19+12.80     870602.31     541709.11
                PC (        )          19+71.26     870660.77     541709.42
           Tangent Direction:      N  0^18'08" E
              Tangent Length:              58.46

Element: Circular
                PC (        )          19+71.26     870660.77     541709.42
                PI (        )          20+02.21     870691.72     541709.58
                CC (        )                       870661.80     541512.92
                PT (        )          20+32.66     870721.23     541700.22
                      Radius:            196.50
                       Delta:          17^54'19" Left
  Degree of Curvature(Arc):            29^09'29"
                      Length:              61.41
                     Tangent:              30.96
                       Chord:              61.16
             Middle Ordinate:               2.39
                    External:               2.42
           Tangent Direction:      N  0^18'08" E
            Radial Direction:      S 89^41'52" E
             Chord Direction:      N  8^39'01" W
            Radial Direction:      N 72^23'49" E
           Tangent Direction:      N 17^36'11" W

Element: Linear
                PT (        )          20+32.66     870721.23     541700.22
                PC (        )          20+53.20     870740.80     541694.01
           Tangent Direction:      N 17^36'11" W
              Tangent Length:              20.54

Element: Circular
                PC (        )          20+53.20     870740.80     541694.01
                PI (        )          20+85.26     870771.36     541684.32
                CC (        )                       870802.35     541887.98
               PRC (        )          21+16.80     870803.42     541684.49
                      Radius:            203.50
                       Delta:          17^54'19" Right
  Degree of Curvature(Arc):            28^09'19"
                      Length:              63.59
                     Tangent:              32.06
                       Chord:              63.34
             Middle Ordinate:               2.48
                    External:               2.51
           Tangent Direction:      N 17^36'11" W
            Radial Direction:      N 72^23'49" E
             Chord Direction:      N  8^39'01" W
            Radial Direction:      S 89^41'52" E
           Tangent Direction:      N  0^18'08" E

Element: Circular
               PRC (        )          21+16.80     870803.42     541684.49
                PI (        )          21+39.78     870826.40     541684.61
                CC (        )                       870806.04     541187.99
                PT (        )          21+62.72     870849.29     541682.61
                      Radius:            496.50
                       Delta:          5^18'00" Left
  Degree of Curvature(Arc):            11^32'24"
                      Length:              45.93
                     Tangent:              22.98
                       Chord:              45.91
             Middle Ordinate:               0.53
                    External:               0.53
```

```
          Tangent Direction:      N  0^18'08" E
           Radial Direction:      S 89^41'52" E
            Chord Direction:      N  2^20'52" W
           Radial Direction:      N 85^00'08" E
          Tangent Direction:      N  4^59'52" W

Element: Linear
               PT (        )            21+62.72     870849.29     541682.61
               PC (        )            22+51.59     870937.82     541674.86
          Tangent Direction:      N  4^59'52" W
             Tangent Length:               88.86

Element: Circular
               PC (        )            22+51.59     870937.82     541674.86
               PI (        )            23+13.22     870999.22     541669.49
               CC (        )                         870981.68     542176.45
               PT (        )            23+74.25     871060.11     541679.10
                     Radius:              503.50
                      Delta:           13^57'32" Right
  Degree of Curvature(Arc):           11^22'46"
                     Length:              122.67
                    Tangent:               61.64
                      Chord:              122.36
            Middle Ordinate:                3.73
                   External:                3.76
          Tangent Direction:      N  4^59'52" W
           Radial Direction:      N 85^00'08" E
            Chord Direction:      N  1^58'54" E
           Radial Direction:      S 81^02'20" E
          Tangent Direction:      N  8^57'40" E

Element: Linear
               PT (        )            23+74.25     871060.11     541679.10
               PC (        )            25+04.53     871188.79     541699.39
          Tangent Direction:      N  8^57'40" E
             Tangent Length:              130.27

Element: Circular
               PC (        )            25+04.53     871188.79     541699.39
               PI (        )            25+78.21     871261.58     541710.87
               CC (        )                         871266.13     541208.95
               PT (        )            26+50.83     871334.56     541700.71
                     Radius:              496.50
                      Delta:           16^52'59" Left
  Degree of Curvature(Arc):           11^32'24"
                     Length:              146.30
                    Tangent:               73.68
                      Chord:              145.77
            Middle Ordinate:                5.38
                   External:                5.44
          Tangent Direction:      N  8^57'40" E
           Radial Direction:      S 81^02'20" E
            Chord Direction:      N  0^31'11" E
           Radial Direction:      N 82^04'41" E
          Tangent Direction:      N  7^55'19" W

Element: Linear
               PT (        )            26+50.83     871334.56     541700.71
               PC (        )            28+16.81     871498.96     541677.83
          Tangent Direction:      N  7^55'19" W
             Tangent Length:              165.98

Element: Circular
               PC (        )            28+16.81     871498.96     541677.83
               PI (        )            28+53.01     871534.81     541672.84
               CC (        )                         871568.35     542176.53
               PT (        )            28+89.08     871571.01     541673.04
                     Radius:              503.50
```

```
                    Delta:          8^13'27" Right
  Degree of Curvature(Arc):        11^22'46"
                  Length:              72.27
                 Tangent:              36.20
                   Chord:              72.21
        Middle Ordinate:                1.30
                External:               1.30
       Tangent Direction:      N  7^55'19" W
        Radial Direction:      N 82^04'41" E
         Chord Direction:      N  3^48'35" W
        Radial Direction:      S 89^41'52" E
       Tangent Direction:      N  0^18'08" E

Element: Linear
            PT (        )          28+89.08     871571.01     541673.04
            PC (        )          36+69.34     872351.25     541677.15
       Tangent Direction:      N  0^18'08" E
          Tangent Length:            780.25

Element: Circular
            PC (        )          36+69.34     872351.25     541677.15
            PI (        )          37+13.39     872395.30     541677.38
            CC (        )                       872348.59     542180.64
            PT (        )          37+57.21     872438.64     541685.26
                  Radius:            503.50
                   Delta:         10^00'00" Right
  Degree of Curvature(Arc):        11^22'46"
                  Length:              87.88
                 Tangent:              44.05
                   Chord:              87.77
        Middle Ordinate:                1.92
                External:               1.92
       Tangent Direction:      N  0^18'08" E
        Radial Direction:      S 89^41'52" E
         Chord Direction:      N  5^18'08" E
        Radial Direction:      S 79^41'52" E
       Tangent Direction:      N 10^18'08" E

Element: Linear
            PT (        )          37+57.21     872438.64     541685.26
            PC (        )          37+58.99     872440.38     541685.58
       Tangent Direction:      N 10^18'08" E
          Tangent Length:              1.77

Element: Circular
            PC (        )          37+58.99     872440.38     541685.58
            PI (        )          38+02.42     872483.12     541693.35
            CC (        )                       872529.18     541197.08
            PT (        )          38+45.64     872526.56     541693.58
                  Radius:            496.50
                   Delta:         10^00'00" Left
  Degree of Curvature(Arc):        11^32'24"
                  Length:              86.66
                 Tangent:              43.44
                   Chord:              86.55
        Middle Ordinate:                1.89
                External:               1.90
       Tangent Direction:      N 10^18'08" E
        Radial Direction:      S 79^41'52" E
         Chord Direction:      N  5^18'08" E
        Radial Direction:      S 89^41'52" E
       Tangent Direction:      N  0^18'08" E

Element: Linear
            PT (        )          38+45.64     872526.56     541693.58
            PC (        )          38+71.26     872552.18     541693.71
       Tangent Direction:      N  0^18'08" E
          Tangent Length:             25.62
```

```
Element: Circular
              PC (        )          38+71.26     872552.18     541693.71
              PI (        )          39+12.15     872593.06     541693.93
              CC (        )                       872553.22     541497.21
              PT (        )          39+51.88     872630.64     541677.82
                    Radius:            196.50
                     Delta:         23^30'24" Left
  Degree of Curvature(Arc):         29^09'29"
                    Length:             80.62
                   Tangent:             40.88
                     Chord:             80.05
          Middle Ordinate:               4.12
                  External:              4.21
        Tangent Direction:      N  0^18'08" E
         Radial Direction:      S 89^41'52" E
          Chord Direction:      N 11^27'04" W
         Radial Direction:      N 66^47'44" E
        Tangent Direction:      N 23^12'16" W

Element: Linear
              PT (        )          39+51.88     872630.64     541677.82
              PI (        )          40+14.59     872688.28     541653.11
        Tangent Direction:      N 23^12'16" W
           Tangent Length:             62.71

Element: Linear
              PI (        )          40+14.59     872688.28     541653.11
              PI (        )          40+47.83     872700.62     541622.25
        Tangent Direction:      N 68^12'16" W
           Tangent Length:             33.23

Element: Linear
              PI (        )          40+47.83     872700.62     541622.25
              PI (        )          41+60.67     872804.33     541577.79
        Tangent Direction:      N 23^12'16" W
           Tangent Length:            112.85

Element: Linear
              PI (        )          41+60.67     872804.33     541577.79
              PI (        )          41+96.78     872837.32     541563.11
        Tangent Direction:      N 23^59'53" W
           Tangent Length:             36.10

Element: Linear
              PI (        )          41+96.78     872837.32     541563.11
              PI (        )          42+19.24     872857.96     541554.25
        Tangent Direction:      N 23^12'16" W
           Tangent Length:             22.46

Element: Linear
              PI (        )          42+19.24     872857.96     541554.25
              PI (        )          42+84.99     872918.39     541528.35
        Tangent Direction:      N 23^12'16" W
           Tangent Length:             65.75

Element: Linear
              PI (        )          42+84.99     872918.39     541528.35
              PC (        )          48+06.32     873397.55     541322.94
        Tangent Direction:      N 23^12'16" W
           Tangent Length:            521.33

Element: Circular
              PC (        )          48+06.32     873397.55     541322.94
              PI (        )          49+31.15     873512.29     541273.75
              CC (        )                       873290.18     541072.48
              PT (        )          50+40.44     873549.97     541154.74
                    Radius:            272.50
```

```
                    Delta:          49^13'34" Left
  Degree of Curvature(Arc):         21^01'34"
                   Length:             234.12
                  Tangent:             124.84
                    Chord:             226.99
          Middle Ordinate:              24.76
                 External:              27.23
        Tangent Direction:      N 23^12'16" W
         Radial Direction:      N 66^47'44" E
          Chord Direction:      N 47^49'03" W
         Radial Direction:      N 17^34'10" E
        Tangent Direction:      N 72^25'50" W

Element: Linear
             PT (        )          50+40.44     873549.97     541154.74
             PI (        )          52+92.20     873625.97     540914.72
        Tangent Direction:      N 72^25'50" W
           Tangent Length:             251.76

Element: Linear
             PI (        )          52+92.20     873625.97     540914.72
             PI (        )          53+15.30     873628.01     540891.71
        Tangent Direction:      N 84^55'50" W
           Tangent Length:              23.10

Element: Linear
             PI (        )          53+15.30     873628.01     540891.71
             PI (        )          54+75.30     873676.31     540739.17
        Tangent Direction:      N 72^25'50" W
           Tangent Length:             160.00

Element: Linear
             PI (        )          54+75.30     873676.31     540739.17
             PI (        )          54+98.40     873687.88     540719.18
        Tangent Direction:      N 59^55'50" W
           Tangent Length:              23.10

Element: Linear
             PI (        )          54+98.40     873687.88     540719.18
             PC (        )          55+50.00     873703.46     540669.99
        Tangent Direction:      N 72^25'50" W
           Tangent Length:              51.59

Element: Circular
             PC (        )          55+50.00     873703.46     540669.99
             PI (        )          55+71.90     873710.07     540649.11
             CC (        )                       873443.67     540587.73
             PT (        )          55+93.71     873713.26     540627.44
                   Radius:             272.50
                    Delta:           9^11'28" Left
  Degree of Curvature(Arc):         21^01'34"
                   Length:              43.71
                  Tangent:              21.90
                    Chord:              43.67
          Middle Ordinate:               0.88
                 External:               0.88
        Tangent Direction:      N 72^25'50" W
         Radial Direction:      N 17^34'10" E
          Chord Direction:      N 77^01'34" W
         Radial Direction:      N  8^22'42" E
        Tangent Direction:      N 81^37'18" W

Element: Linear
             PT (        )          55+93.71     873713.26     540627.44
             PC (        )          65+06.42     873846.25     539724.47
        Tangent Direction:      N 81^37'18" W
           Tangent Length:             912.71
```

```
Element: Circular
              PC (        )          65+06.42     873846.25     539724.47
              PI (        )          67+52.17     873882.05     539481.35
              CC (        )                       874170.25     539772.19
              PT (        )          69+28.07     874125.49     539447.76
                     Radius:            327.50
                      Delta:         73^46'00" Right
  Degree of Curvature(Arc):          17^29'42"
                     Length:            421.65
                    Tangent:            245.74
                      Chord:            393.12
           Middle Ordinate:              65.55
                   External:              81.95
          Tangent Direction:      N 81^37'18" W
           Radial Direction:      N  8^22'42" E
            Chord Direction:      N 44^44'19" W
           Radial Direction:      N 82^08'41" E
          Tangent Direction:      N  7^51'19" W

Element: Linear
              PT (        )          69+28.07     874125.49     539447.76
              PI (        )          73+57.50     874550.90     539389.07
          Tangent Direction:      N  7^51'19" W
             Tangent Length:            429.44

Element: Linear
              PI (        )          73+57.50     874550.90     539389.07
              PI (        )          73+80.55     874572.50     539381.04
          Tangent Direction:      N 20^23'04" W
             Tangent Length:             23.05

Element: Linear
              PI (        )          73+80.55     874572.50     539381.04
              PI (        )          75+70.55     874760.72     539355.08
          Tangent Direction:      N  7^51'19" W
             Tangent Length:            190.00

Element: Linear
              PI (        )          75+70.55     874760.72     539355.08
              PI (        )          76+49.10     874839.01     539361.44
          Tangent Direction:      N  4^38'41" E
             Tangent Length:             78.54

Element: Linear
              PI (        )          76+49.10     874839.01     539361.44
              PC (        )          80+67.94     875253.92     539304.19
          Tangent Direction:      N  7^51'19" W
             Tangent Length:            418.84

Element: Circular
              PC (        )          80+67.94     875253.92     539304.19
              PI (        )          82+90.31     875474.20     539273.80
              CC (        )                       875297.04     539616.73
              PT (        )          84+55.34     875576.89     539471.04
                     Radius:            315.50
                      Delta:         70^21'11" Right
  Degree of Curvature(Arc):          18^09'37"
                     Length:            387.40
                    Tangent:            222.37
                      Chord:            363.52
           Middle Ordinate:              57.62
                   External:              70.49
          Tangent Direction:      N  7^51'19" W
           Radial Direction:      N 82^08'41" E
            Chord Direction:      N 27^19'17" E
           Radial Direction:      S 27^30'08" E
          Tangent Direction:      N 62^29'52" E
```

```
Element: Linear
              PT (        )          84+55.34     875576.89     539471.04
              PI (        )          92+62.83     875949.77     540187.28
         Tangent Direction:      N 62^29'52" E
            Tangent Length:             807.49

Element: Linear
              PI (        )          92+62.83     875949.77     540187.28
              PI (        )          92+82.83     875959.45     540204.78
         Tangent Direction:      N 61^03'57" E
            Tangent Length:              20.01

Element: Linear
              PI (        )          92+82.83     875959.45     540204.78
              PI (        )          95+36.36     876076.52     540429.66
         Tangent Direction:      N 62^29'52" E
            Tangent Length:             253.53

Element: Linear
              PI (        )          95+36.36     876076.52     540429.66
              PI (        )          95+87.18     876089.68     540478.75
         Tangent Direction:      N 74^59'52" E
            Tangent Length:              50.82

Element: Linear
              PI (        )          95+87.18     876089.68     540478.75
              PC (        )         100+21.53     876290.25     540864.01
         Tangent Direction:      N 62^29'52" E
            Tangent Length:             434.35

Element: Circular
              PC (        )         100+21.53     876290.25     540864.01
              PI (        )         100+76.44     876315.61     540912.72
              CC (        )                       876551.92     540727.79
              PT (        )         101+30.11     876356.80     540949.04
                     Radius:             295.00
                      Delta:         21^05'22" Left
  Degree of Curvature(Arc):          19^25'20"
                     Length:             108.58
                    Tangent:              54.91
                      Chord:             107.97
           Middle Ordinate:                4.98
                   External:               5.07
         Tangent Direction:      N 62^29'52" E
          Radial Direction:      S 27^30'08" E
           Chord Direction:      N 51^57'11" E
          Radial Direction:      S 48^35'30" E
         Tangent Direction:      N 41^24'30" E

Element: Linear
              PT (        )         101+30.11     876356.80     540949.04
              PI (        )         112+97.46     877232.32     541721.15
         Tangent Direction:      N 41^24'30" E
            Tangent Length:            1167.35

Element: Linear
              PI (        )         112+97.46     877232.32     541721.15
              PI (        )         113+22.87     877254.57     541733.43
         Tangent Direction:      N 28^54'30" E
            Tangent Length:              25.41

Element: Linear
              PI (        )         113+22.87     877254.57     541733.43
              PI (        )         114+84.35     877375.68     541840.24
         Tangent Direction:      N 41^24'30" E
            Tangent Length:             161.48

Element: Linear
```

```
                PI (        )          114+84.35     877375.68     541840.24
                PI (        )          115+16.69     877394.73     541866.38
           Tangent Direction:      N 53^54'30" E
              Tangent Length:              32.34

Element: Linear
                PI (        )          115+16.69     877394.73     541866.38
                PC (        )          116+69.88     877509.62     541967.69
           Tangent Direction:      N 41^24'30" E
              Tangent Length:             153.18

Element: Circular
                PC (        )          116+69.88     877509.62     541967.69
                PI (        )          116+81.29     877518.18     541975.24
                CC (        )                        877705.73     541745.31
                PT (        )          116+92.69     877527.30     541982.11
                      Radius:             296.50
                       Delta:           4^24'32" Left
  Degree of Curvature(Arc):           19^19'27"
                      Length:              22.82
                     Tangent:              11.41
                       Chord:              22.81
            Middle Ordinate:                0.22
                    External:               0.22
           Tangent Direction:      N 41^24'30" E
            Radial Direction:      S 48^35'30" E
             Chord Direction:      N 39^12'14" E
            Radial Direction:      S 53^00'02" E
           Tangent Direction:      N 36^59'58" E

Element: Linear
                PT (        )          116+92.69     877527.30     541982.11
                PC (        )          118+05.41     877617.32     542049.95
           Tangent Direction:      N 36^59'58" E
              Tangent Length:             112.72

Element: Circular
                PC (        )          118+05.41     877617.32     542049.95
                PI (        )          118+53.15     877655.45     542078.68
                CC (        )                        877013.41     542851.39
                PT (        )          119+00.82     877690.68     542110.90
                      Radius:            1003.50
                       Delta:           5^26'50" Right
  Degree of Curvature(Arc):            5^42'35"
                      Length:              95.41
                     Tangent:              47.74
                       Chord:              95.37
            Middle Ordinate:                1.13
                    External:               1.13
           Tangent Direction:      N 36^59'58" E
            Radial Direction:      S 53^00'02" E
             Chord Direction:      N 39^43'23" E
            Radial Direction:      S 47^33'12" E
           Tangent Direction:      N 42^26'48" E

Element: Linear
                PT (        )          119+00.82     877690.68     542110.90
                PC (        )          119+06.07     877694.55     542114.44
           Tangent Direction:      N 42^26'48" E
              Tangent Length:               5.25

Element: Circular
                PC (        )          119+06.07     877694.55     542114.44
                PI (        )          120+09.39     877770.79     542184.17
                CC (        )                        878367.09     541379.12
                PT (        )          121+11.97     877859.71     542236.78
                      Radius:             996.50
                       Delta:          11^50'19" Left
```

```
  Degree of Curvature(Arc):          5^44'59"
                    Length:            205.90
                   Tangent:            103.32
                     Chord:            205.53
           Middle Ordinate:              5.31
                  External:              5.34
         Tangent Direction:      N 42^26'48" E
          Radial Direction:      S 47^33'12" E
           Chord Direction:      N 36^31'39" E
          Radial Direction:      S 59^23'30" E
         Tangent Direction:      N 30^36'30" E

Element: Linear
              PT (        )          121+11.97     877859.71     542236.78
              PC (        )          121+30.50     877875.66     542246.21
         Tangent Direction:      N 30^36'30" E
            Tangent Length:             18.53

Element: Circular
              PC (        )          121+30.50     877875.66     542246.21
              PI (        )          122+08.93     877943.16     542286.14
              CC (        )                        877492.00     542894.72
              PT (        )          122+86.79     878000.99     542339.12
                    Radius:            753.50
                     Delta:          11^53'05" Right
  Degree of Curvature(Arc):          7^36'14"
                    Length:            156.30
                   Tangent:             78.43
                     Chord:            156.02
           Middle Ordinate:              4.05
                  External:              4.07
         Tangent Direction:      N 30^36'30" E
          Radial Direction:      S 59^23'30" E
           Chord Direction:      N 36^33'02" E
          Radial Direction:      S 47^30'25" E
         Tangent Direction:      N 42^29'35" E

Element: Linear
              PT (        )          122+86.79     878000.99     542339.12
              PC (        )          123+04.71     878014.20     542351.23
         Tangent Direction:      N 42^29'35" E
            Tangent Length:             17.92

Element: Circular
              PC (        )          123+04.71     878014.20     542351.23
              PI (        )          124+08.95     878091.06     542421.64
              CC (        )                        878687.34     541616.45
              PT (        )          125+12.43     878180.83     542474.62
                    Radius:            996.50
                     Delta:          11^56'36" Left
  Degree of Curvature(Arc):          5^44'59"
                    Length:            207.72
                   Tangent:            104.24
                     Chord:            207.34
           Middle Ordinate:              5.41
                  External:              5.44
         Tangent Direction:      N 42^29'35" E
          Radial Direction:      S 47^30'25" E
           Chord Direction:      N 36^31'17" E
          Radial Direction:      S 59^27'01" E
         Tangent Direction:      N 30^32'59" E

Element: Linear
              PT (        )          125+12.43     878180.83     542474.62
              PC (        )          125+15.23     878183.24     542476.04
         Tangent Direction:      N 30^32'59" E
            Tangent Length:              2.80
```

```
Element: Circular
              PC (        )          125+15.23     878183.24     542476.04
              PI (        )          126+07.77     878262.93     542523.08
              CC (        )                        877673.17     543340.25
              PT (        )          126+99.79     878332.68     542583.90
                     Radius:            1003.50
                      Delta:          10^32'16" Right
  Degree of Curvature(Arc):           5^42'35"
                     Length:             184.56
                    Tangent:              92.54
                      Chord:             184.30
           Middle Ordinate:                4.24
                   External:               4.26
         Tangent Direction:       N 30^32'59" E
          Radial Direction:       S 59^27'01" E
           Chord Direction:       N 35^49'07" E
          Radial Direction:       S 48^54'45" E
         Tangent Direction:       N 41^05'15" E

Element: Linear
              PT (        )          126+99.79     878332.68     542583.90
              PC (        )          127+21.38     878348.96     542598.09
         Tangent Direction:       N 41^05'15" E
            Tangent Length:               21.59

Element: Circular
              PC (        )          127+21.38     878348.96     542598.09
              PI (        )          127+56.94     878375.76     542621.46
              CC (        )                        879003.87     541847.02
              PT (        )          127+92.48     878404.16     542642.87
                     Radius:             996.50
                      Delta:           4^05'17" Left
  Degree of Curvature(Arc):           5^44'59"
                     Length:              71.10
                    Tangent:              35.56
                      Chord:              71.08
           Middle Ordinate:                0.63
                   External:               0.63
         Tangent Direction:       N 41^05'15" E
          Radial Direction:       S 48^54'45" E
           Chord Direction:       N 39^02'37" E
          Radial Direction:       S 53^00'02" E
         Tangent Direction:       N 36^59'58" E

Element: Linear
              PT (        )          127+92.48     878404.16     542642.87
              PI (        )          129+89.81     878561.76     542761.62
         Tangent Direction:       N 36^59'58" E
            Tangent Length:             197.33

Element: Linear
              PI (        )          129+89.81     878561.76     542761.62
              PI (        )          130+30.48     878598.77     542778.49
         Tangent Direction:       N 24^29'58" E
            Tangent Length:              40.67

Element: Linear
              PI (        )          130+30.48     878598.77     542778.49
              PI (        )          131+67.12     878712.88     542853.65
         Tangent Direction:       N 33^22'23" E
            Tangent Length:             136.64

Element: Linear
              PI (        )          131+67.12     878712.88     542853.65
              PI (        )          131+99.46     878735.40     542876.87
         Tangent Direction:       N 45^52'23" E
            Tangent Length:              32.34
```

```
Element: Linear
              PI (        )          131+99.46     878735.40     542876.87
              PC (        )          132+47.44     878775.47     542903.26
         Tangent Direction:      N 33^22'23" E
            Tangent Length:               47.98

Element: Circular
              PC (        )          132+47.44     878775.47     542903.26
              PI (        )          132+63.38     878788.78     542912.03
              CC (        )                        878498.50     543323.74
              PT (        )          132+79.31     878801.51     542921.62
                     Radius:             503.50
                      Delta:           3^37'35" Right
  Degree of Curvature(Arc):           11^22'46"
                     Length:              31.87
                    Tangent:              15.94
                      Chord:              31.86
           Middle Ordinate:                0.25
                   External:               0.25
         Tangent Direction:      N 33^22'23" E
          Radial Direction:      S 56^37'37" E
           Chord Direction:      N 35^11'11" E
          Radial Direction:      S 53^00'02" E
         Tangent Direction:      N 36^59'58" E

Element: Linear
              PT (        )          132+79.31     878801.51     542921.62
              PC (        )          134+82.56     878963.83     543043.93
         Tangent Direction:      N 36^59'58" E
            Tangent Length:             203.24

Element: Circular
              PC (        )          134+82.56     878963.83     543043.93
              PI (        )          135+15.86     878990.42     543063.98
              CC (        )                        879262.62     542647.41
              PT (        )          135+49.06     879019.46     543080.29
                     Radius:             496.50
                      Delta:           7^40'30" Left
  Degree of Curvature(Arc):           11^32'24"
                     Length:              66.51
                    Tangent:              33.30
                      Chord:              66.46
           Middle Ordinate:                1.11
                   External:               1.12
         Tangent Direction:      N 36^59'58" E
          Radial Direction:      S 53^00'02" E
           Chord Direction:      N 33^09'43" E
          Radial Direction:      S 60^40'32" E
         Tangent Direction:      N 29^19'28" E

Element: Linear
              PT (        )          135+49.06     879019.46     543080.29
              PC (        )          135+70.88     879038.48     543090.97
         Tangent Direction:      N 29^19'28" E
            Tangent Length:              21.82

Element: Circular
              PC (        )          135+70.88     879038.48     543090.97
              PI (        )          136+38.82     879097.72     543124.25
              CC (        )                        878791.89     543529.95
              PT (        )          137+05.94     879146.01     543172.03
                     Radius:             503.50
                      Delta:          15^22'09" Right
  Degree of Curvature(Arc):           11^22'46"
                     Length:             135.06
                    Tangent:              67.94
                      Chord:             134.66
           Middle Ordinate:                4.52
```

```
                External:              4.56
       Tangent Direction:      N 29^19'28" E
        Radial Direction:      S 60^40'32" E
         Chord Direction:      N 37^00'32" E
        Radial Direction:      S 45^18'23" E
       Tangent Direction:      N 44^41'37" E

Element: Linear
            PT (        )          137+05.94     879146.01     543172.03
            PC (        )          138+16.38     879224.52     543249.70
       Tangent Direction:      N 44^41'37" E
          Tangent Length:             110.44

Element: Circular
            PC (        )          138+16.38     879224.52     543249.70
            PI (        )          139+21.71     879299.40     543323.78
            CC (        )                        879925.37     542541.31
            PT (        )          140+26.27     879388.11     543380.57
                  Radius:             996.50
                   Delta:          12^04'04" Left
  Degree of Curvature(Arc):         5^44'59"
                  Length:             209.88
                 Tangent:             105.33
                   Chord:             209.50
        Middle Ordinate:                5.52
                External:               5.55
       Tangent Direction:      N 44^41'37" E
        Radial Direction:      S 45^18'23" E
         Chord Direction:      N 38^39'35" E
        Radial Direction:      S 57^22'27" E
       Tangent Direction:      N 32^37'33" E

Element: Linear
            PT (        )          140+26.27     879388.11     543380.57
            PC (        )          140+57.94     879414.79     543397.65
       Tangent Direction:      N 32^37'33" E
          Tangent Length:              31.68

Element: Circular
            PC (        )          140+57.94     879414.79     543397.65
            PI (        )          141+08.84     879457.65     543425.09
            CC (        )                        879143.33     543821.70
            PT (        )          141+59.39     879494.16     543460.56
                  Radius:             503.50
                   Delta:          11^32'39" Right
  Degree of Curvature(Arc):         11^22'46"
                  Length:             101.45
                 Tangent:              50.90
                   Chord:             101.28
        Middle Ordinate:                2.55
                External:               2.57
       Tangent Direction:      N 32^37'33" E
        Radial Direction:      S 57^22'27" E
         Chord Direction:      N 38^23'53" E
        Radial Direction:      S 45^49'48" E
       Tangent Direction:      N 44^10'12" E

Element: Linear
            PT (        )          141+59.39     879494.16     543460.56
            PC (        )          143+63.52     879640.58     543602.79
       Tangent Direction:      N 44^10'12" E
          Tangent Length:             204.13

Element: Circular
            PC (        )          143+63.52     879640.58     543602.79
            PI (        )          144+38.03     879694.02     543654.71
            CC (        )                        879986.54     543246.67
            PT (        )          145+11.44     879760.35     543688.65
```

```
                    Radius:            496.50
                     Delta:          17^04'09" Left
  Degree of Curvature(Arc):          11^32'24"
                    Length:            147.91
                   Tangent:             74.51
                     Chord:            147.37
          Middle Ordinate:               5.50
                  External:              5.56
         Tangent Direction:      N 44^10'12" E
          Radial Direction:      S 45^49'48" E
           Chord Direction:      N 35^38'08" E
          Radial Direction:      S 62^53'56" E
         Tangent Direction:      N 27^06'04" E

Element: Linear
              PT (        )          145+11.44     879760.35     543688.65
              PI (        )          145+61.54     879804.95     543711.48
         Tangent Direction:      N 27^06'04" E
            Tangent Length:              50.10

Element: Linear
              PI (        )          145+61.54     879804.95     543711.48
              PI (        )          145+84.64     879827.31     543717.30
         Tangent Direction:      N 14^36'04" E
            Tangent Length:              23.10

Element: Linear
              PI (        )          145+84.64     879827.31     543717.30
              PI (        )          147+22.64     879950.15     543780.17
         Tangent Direction:      N 27^06'04" E
            Tangent Length:             138.00

Element: Linear
              PI (        )          147+22.64     879950.15     543780.17
              PI (        )          147+45.74     879967.95     543794.89
         Tangent Direction:      N 39^36'04" E
            Tangent Length:              23.10

Element: Linear
              PI (        )          147+45.74     879967.95     543794.89
              PC (        )          150+57.62     880245.59     543936.98
         Tangent Direction:      N 27^06'04" E
            Tangent Length:             311.89

Element: Circular
              PC (        )          150+57.62     880245.59     543936.98
              PI (        )          151+13.69     880295.50     543962.52
              CC (        )                        880471.78     543494.99
              PT (        )          151+69.28     880349.85     543976.28
                    Radius:            496.50
                     Delta:          12^53'05" Left
  Degree of Curvature(Arc):          11^32'24"
                    Length:            111.65
                   Tangent:             56.06
                     Chord:            111.42
          Middle Ordinate:               3.14
                  External:              3.16
         Tangent Direction:      N 27^06'04" E
          Radial Direction:      S 62^53'56" E
           Chord Direction:      N 20^39'31" E
          Radial Direction:      S 75^47'01" E
         Tangent Direction:      N 14^12'59" E

Element: Linear
              PT (        )          151+69.28     880349.85     543976.28
              PC (        )          152+91.14     880467.98     544006.21
         Tangent Direction:      N 14^12'59" E
            Tangent Length:             121.86
```

```
Element: Circular
              PC (        )          152+91.14     880467.98     544006.21
              PI (        )          153+20.58     880496.51     544013.44
              CC (        )                        880405.72     544251.95
              PT (        )          153+49.75     880522.63     544027.02
                     Radius:             253.50
                      Delta:          13^14'53" Right
  Degree of Curvature(Arc):           22^36'07"
                     Length:              58.61
                    Tangent:              29.44
                      Chord:              58.48
           Middle Ordinate:                1.69
                   External:               1.70
         Tangent Direction:       N 14^12'59" E
          Radial Direction:       S 75^47'01" E
           Chord Direction:       N 20^50'25" E
          Radial Direction:       S 62^32'09" E
         Tangent Direction:       N 27^27'51" E

Element: Linear
              PT (        )          153+49.75     880522.63     544027.02
              PC (        )          153+71.42     880541.86     544037.01
         Tangent Direction:       N 27^27'51" E
            Tangent Length:               21.67

Element: Circular
              PC (        )          153+71.42     880541.86     544037.01
              PI (        )          154+39.16     880601.96     544068.25
              CC (        )                        880770.84     543596.47
              PT (        )          155+06.06     880668.24     544082.25
                     Radius:             496.50
                      Delta:          15^32'16" Left
  Degree of Curvature(Arc):           11^32'24"
                     Length:             134.64
                    Tangent:              67.74
                      Chord:             134.23
           Middle Ordinate:                4.56
                   External:               4.60
         Tangent Direction:       N 27^27'51" E
          Radial Direction:       S 62^32'09" E
           Chord Direction:       N 19^41'43" E
          Radial Direction:       S 78^04'24" E
         Tangent Direction:       N 11^55'36" E

Element: Linear
              PT (        )          155+06.06     880668.24     544082.25
              PC (        )          155+22.35     880684.17     544085.61
         Tangent Direction:       N 11^55'36" E
            Tangent Length:               16.28

Element: Circular
              PC (        )          155+22.35     880684.17     544085.61
              PI (        )          155+55.33     880716.44     544092.43
              CC (        )                        880580.12     544578.25
              PT (        )          155+88.22     880747.55     544103.40
                     Radius:             503.50
                      Delta:           7^29'47" Right
  Degree of Curvature(Arc):           11^22'46"
                     Length:              65.88
                    Tangent:              32.99
                      Chord:              65.83
           Middle Ordinate:                1.08
                   External:               1.08
         Tangent Direction:       N 11^55'36" E
          Radial Direction:       S 78^04'24" E
           Chord Direction:       N 15^40'29" E
          Radial Direction:       S 70^34'37" E
```

```
          Tangent Direction:      N 19^25'23" E

Element: Linear
               PT (        )          155+88.22     880747.55     544103.40
               PC (        )          156+34.70     880791.39     544118.86
          Tangent Direction:      N 19^25'23" E
             Tangent Length:              46.48

Element: Circular
               PC (        )          156+34.70     880791.39     544118.86
               PI (        )          156+64.76     880819.74     544128.85
               CC (        )                        880889.98     543839.23
               PT (        )          156+94.62     880849.52     544132.96
                     Radius:             296.50
                      Delta:          11^34'43" Left
  Degree of Curvature(Arc):           19^19'27"
                     Length:              59.92
                    Tangent:              30.06
                      Chord:              59.82
           Middle Ordinate:                1.51
                   External:               1.52
          Tangent Direction:      N 19^25'23" E
           Radial Direction:      S 70^34'37" E
            Chord Direction:      N 13^38'01" E
           Radial Direction:      S 82^09'20" E
          Tangent Direction:      N  7^50'40" E

Element: Linear
               PT (        )          156+94.62     880849.52     544132.96
              POE (        )          159+96.95     881149.02     544174.22
          Tangent Direction:      N  7^50'40" E
             Tangent Length:             302.33
```

```
            Project Name: PEC
             Description: PEC
Horizontal Alignment Name: PEC-NOV-2-2011
             Description:
                   Style: Default
                                          STATION      NORTHING       EASTING

Element: Linear
             POB (        )            159+97.00     881149.02     544174.22
              PI (        )            160+01.62     881153.60     544174.85
         Tangent Direction:       N  7^50'40" E
            Tangent Length:                 4.62

Element: Linear
              PI (        )            160+01.62     881153.60     544174.85
              PI (        )            160+51.66     881203.60     544176.82
         Tangent Direction:       N  2^15'23" E
            Tangent Length:                50.04

Element: Linear
              PI (        )            160+51.66     881203.60     544176.82
              PI (        )            161+78.76     881329.88     544191.18
         Tangent Direction:       N  6^29'23" E
            Tangent Length:               127.10

Element: Linear
              PI (        )            161+78.76     881329.88     544191.18
              PI (        )            162+48.93     881398.88     544203.99
         Tangent Direction:       N 10^30'48" E
            Tangent Length:                70.17

Element: Linear
              PI (        )            162+48.93     881398.88     544203.99
              PC (        )            165+40.34     881688.39     544237.13
         Tangent Direction:       N  6^31'47" E
            Tangent Length:               291.41

Element: Circular
              PC (        )            165+40.34     881688.39     544237.13
              PI (        )            166+70.41     881817.62     544251.92
              CC (        )                          881849.08     542833.29
             PRC (        )            167+99.74     881947.37     544242.87
                     Radius:             1413.00
                      Delta:            10^31'06" Left
  Degree of Curvature(Arc):             4^03'18"
                     Length:              259.40
                    Tangent:              130.06
                      Chord:              259.03
           Middle Ordinate:                 5.95
                   External:                5.97
         Tangent Direction:       N  6^31'47" E
          Radial Direction:       S 83^28'13" E
           Chord Direction:       N  1^16'14" E
          Radial Direction:       N 86^00'41" E
         Tangent Direction:       N  3^59'19" W

Element: Circular
             PRC (        )            167+99.74     881947.37     544242.87
              PI (        )            168+51.55     881999.04     544239.27
              CC (        )                          882046.13     545659.43
              PT (        )            169+03.30     882050.85     544239.44
                     Radius:             1420.00
                      Delta:             4^10'43" Right
  Degree of Curvature(Arc):             4^02'06"
                     Length:              103.56
                    Tangent:               51.80
                      Chord:              103.54
           Middle Ordinate:                 0.94
```

```
                External:                0.94
      Tangent Direction:       N  3^59'19" W
       Radial Direction:       N 86^00'41" E
        Chord Direction:       N  1^53'57" W
       Radial Direction:       S 89^48'35" E
      Tangent Direction:       N  0^11'25" E

Element: Linear
            PT (        )          169+03.30     882050.85     544239.44
            PC (        )          178+93.74     883041.28     544242.73
      Tangent Direction:       N  0^11'25" E
         Tangent Length:              990.44

Element: Circular
            PC (        )          178+93.74     883041.28     544242.73
            PI (        )          179+27.57     883075.11     544242.84
            CC (        )                        883040.55     544462.73
           PRC (        )          179+60.87     883107.34     544253.11
                Radius:               220.00
                 Delta:            17^28'59" Right
  Degree of Curvature(Arc):        26^02'37"
                Length:                67.13
               Tangent:                33.83
                 Chord:                66.87
        Middle Ordinate:                 2.56
                External:                2.59
      Tangent Direction:       N  0^11'25" E
       Radial Direction:       S 89^48'35" E
        Chord Direction:       N  8^55'54" E
       Radial Direction:       S 72^19'36" E
      Tangent Direction:       N 17^40'24" E

Element: Circular
           PRC (        )          179+60.87     883107.34     544253.11
            PI (        )          179+93.62     883138.55     544263.05
            CC (        )                        883172.00     544050.16
            PT (        )          180+25.87     883171.30     544263.16
                Radius:               213.00
                 Delta:            17^28'59" Left
  Degree of Curvature(Arc):        26^53'58"
                Length:                64.99
               Tangent:                32.75
                 Chord:                64.74
        Middle Ordinate:                 2.47
                External:                2.50
      Tangent Direction:       N 17^40'24" E
       Radial Direction:       S 72^19'36" E
        Chord Direction:       N  8^55'54" E
       Radial Direction:       S 89^48'35" E
      Tangent Direction:       N  0^11'25" E

Element: Linear
            PT (        )          180+25.87     883171.30     544263.16
            PC (        )          185+27.16     883672.59     544264.83
      Tangent Direction:       N  0^11'25" E
         Tangent Length:              501.30

Element: Circular
            PC (        )          185+27.16     883672.59     544264.83
            PI (        )          185+59.94     883705.37     544264.93
            CC (        )                        883673.30     544051.83
           PRC (        )          185+92.21     883736.66     544255.18
                Radius:               213.00
                 Delta:            17^29'45" Left
  Degree of Curvature(Arc):        26^53'58"
                Length:                65.04
               Tangent:                32.78
                 Chord:                64.79
```

```
          Middle Ordinate:              2.48
                 External:              2.51
        Tangent Direction:      N  0^11'25" E
         Radial Direction:      S 89^48'35" E
          Chord Direction:      N  8^33'28" W
         Radial Direction:      N 72^41'40" E
        Tangent Direction:      N 17^18'20" W

Element: Circular
             PRC (        )         185+92.21     883736.66     544255.18
              PI (        )         186+26.09     883769.01     544245.11
              CC (        )                       883802.10     544465.23
              PT (        )         186+59.44     883802.89     544245.23
                     Radius:           220.00
                      Delta:         17^30'37" Right
  Degree of Curvature(Arc):          26^02'37"
                     Length:            67.23
                    Tangent:            33.88
                      Chord:            66.97
          Middle Ordinate:               2.56
                 External:              2.59
        Tangent Direction:      N 17^18'20" W
         Radial Direction:      N 72^41'40" E
          Chord Direction:      N  8^33'01" W
         Radial Direction:      S 89^47'43" E
        Tangent Direction:      N  0^12'17" E

Element: Linear
              PT (        )         186+59.44     883802.89     544245.23
              PC (        )         190+15.25     884158.69     544246.50
        Tangent Direction:      N  0^12'17" E
           Tangent Length:           355.81

Element: Circular
              PC (        )         190+15.25     884158.69     544246.50
              PI (        )         190+49.07     884192.52     544246.62
              CC (        )                       884157.91     544466.50
             PRC (        )         190+82.37     884224.74     544256.90
                     Radius:           220.00
                      Delta:         17^28'56" Right
  Degree of Curvature(Arc):          26^02'37"
                     Length:            67.13
                    Tangent:            33.83
                      Chord:            66.87
          Middle Ordinate:               2.56
                 External:              2.59
        Tangent Direction:      N  0^12'17" E
         Radial Direction:      S 89^47'43" E
          Chord Direction:      N  8^56'45" E
         Radial Direction:      S 72^18'47" E
        Tangent Direction:      N 17^41'13" E

Element: Circular
             PRC (        )         190+82.37     884224.74     544256.90
              PI (        )         191+15.12     884255.95     544266.85
              CC (        )                       884289.46     544053.97
              PT (        )         191+47.36     884288.70     544266.96
                     Radius:           213.00
                      Delta:         17^28'56" Left
  Degree of Curvature(Arc):          26^53'58"
                     Length:            64.99
                    Tangent:            32.75
                      Chord:            64.74
          Middle Ordinate:               2.47
                 External:              2.50
        Tangent Direction:      N 17^41'13" E
         Radial Direction:      S 72^18'47" E
          Chord Direction:      N  8^56'45" E
```

```
          Radial Direction:      S 89^47'43" E
         Tangent Direction:      N  0^12'17" E

Element: Linear
              PT (        )          191+47.36     884288.70     544266.96
              PC (        )          196+57.36     884798.69     544268.79
         Tangent Direction:      N  0^12'17" E
            Tangent Length:             510.00

Element: Circular
              PC (        )          196+57.36     884798.69     544268.79
              PI (        )          196+90.11     884831.44     544268.90
              CC (        )                        884799.45     544055.79
             PRC (        )          197+22.35     884862.71     544259.18
                     Radius:             213.00
                      Delta:          17^28'56" Left
  Degree of Curvature(Arc):          26^53'58"
                     Length:              64.99
                    Tangent:              32.75
                      Chord:              64.74
           Middle Ordinate:                2.47
                   External:               2.50
         Tangent Direction:      N  0^12'17" E
          Radial Direction:      S 89^47'43" E
           Chord Direction:      N  8^32'11" W
          Radial Direction:      N 72^43'22" E
         Tangent Direction:      N 17^16'38" W

Element: Circular
             PRC (        )          197+22.35     884862.71     544259.18
              PI (        )          197+56.18     884895.01     544249.13
              CC (        )                        884928.05     544469.25
              PT (        )          197+89.48     884928.84     544249.25
                     Radius:             220.00
                      Delta:          17^28'56" Right
  Degree of Curvature(Arc):          26^02'37"
                     Length:              67.13
                    Tangent:              33.83
                      Chord:              66.87
           Middle Ordinate:                2.56
                   External:               2.59
         Tangent Direction:      N 17^16'38" W
          Radial Direction:      N 72^43'22" E
           Chord Direction:      N  8^32'11" W
          Radial Direction:      S 89^47'43" E
         Tangent Direction:      N  0^12'17" E

Element: Linear
              PT (        )          197+89.48     884928.84     544249.25
              PI (        )          200+96.04     885235.40     544250.35
         Tangent Direction:      N  0^12'17" E
            Tangent Length:             306.56

Element: Linear
              PI (        )          200+96.04     885235.40     544250.35
              PI (        )          201+21.38     885260.41     544246.31
         Tangent Direction:      N  9^09'53" W
            Tangent Length:              25.34

Element: Linear
              PI (        )          201+21.38     885260.41     544246.31
              PI (        )          201+39.38     885278.41     544246.38
         Tangent Direction:      N  0^12'17" E
            Tangent Length:              18.00

Element: Linear
              PI (        )          201+39.38     885278.41     544246.38
              PI (        )          202+72.18     885406.12     544209.96
```

```
          Tangent Direction:      N 15^55'01" W
             Tangent Length:             132.80

Element: Linear
               PI (        )          202+72.18     885406.12     544209.96
               PI (        )          204+94.89     885628.50     544222.11
          Tangent Direction:      N  3^07'40" E
             Tangent Length:             222.71

Element: Linear
               PI (        )          204+94.89     885628.50     544222.11
              POE (        )          214+36.88     886570.49     544223.09
          Tangent Direction:      N  0^03'36" E
             Tangent Length:             941.99
```

```
            Project Name: AZTEC_Loop 303 Outfall Channel_mhm Working
             Description: Loop 303 Outfall Channel_AZTEC Segment
Horizontal Alignment Name: Segment A Meandering
             Description:
                   Style: blue 0.05 dashed
                                        STATION       NORTHING        EASTING

Element: Linear
             POB (        )            213+00.00      886439.67      544222.96
              PI (        )            214+30.82      886570.49      544223.09
         Tangent Direction:       N  0^03'36" E
            Tangent Length:                130.82

Element: Linear
              PI (        )            214+30.82      886570.49      544223.09
              PI (        )            215+09.84      886640.04      544185.58
         Tangent Direction:       N 28^20'16" W
            Tangent Length:                 79.02

Element: Linear
              PI (        )            215+09.84      886640.04      544185.58
              PI (        )            215+24.84      886655.04      544185.69
         Tangent Direction:       N  0^24'36" E
            Tangent Length:                 15.00

Element: Linear
              PI (        )            215+24.84      886655.04      544185.69
              PI (        )            215+85.24      886715.26      544190.42
         Tangent Direction:       N  4^29'18" E
            Tangent Length:                 60.40

Element: Linear
              PI (        )            215+85.24      886715.26      544190.42
              PC (        )            216+91.79      886821.80      544191.18
         Tangent Direction:       N  0^24'36" E
            Tangent Length:                106.55

Element: Circular
              PC (        )            216+91.79      886821.80      544191.18
              PI (        )            217+03.87      886833.88      544191.27
              CC (        )                           886820.37      544391.18
              PT (        )            217+15.93      886845.87      544192.81
                     Radius:                200.00
                      Delta:             6^54'55" Right
  Degree of Curvature(Arc):            28^38'52"
                     Length:                 24.14
                    Tangent:                 12.08
                      Chord:                 24.12
           Middle Ordinate:                   0.36
                   External:                  0.36
         Tangent Direction:       N  0^24'36" E
          Radial Direction:       S 89^35'24" E
           Chord Direction:       N  3^52'04" E
          Radial Direction:       S 82^40'28" E
         Tangent Direction:       N  7^19'32" E

Element: Linear
              PT (        )            217+15.93      886845.87      544192.81
              PC (        )            217+78.04      886907.47      544200.73
         Tangent Direction:       N  7^19'32" E
            Tangent Length:                 62.11

Element: Circular
              PC (        )            217+78.04      886907.47      544200.73
              PI (        )            218+34.12      886963.10      544207.88
              CC (        )                           886971.22      543704.81
              PT (        )            218+89.74      887018.93      544202.53
                     Radius:                500.00
```

```
                    Delta:          12^48'02" Left
Degree of Curvature(Arc):           11^27'33"
                  Length:               111.71
                 Tangent:                56.09
                   Chord:               111.47
       Middle Ordinate:                    3.12
               External:                   3.14
      Tangent Direction:       N  7^19'32" E
       Radial Direction:       S 82^40'28" E
        Chord Direction:       N  0^55'31" E
       Radial Direction:       N 84^31'30" E
      Tangent Direction:       N  5^28'30" W

Element: Linear
            PT (        )          218+89.74     887018.93     544202.53
            PC (        )          220+97.97     887226.20     544182.66
      Tangent Direction:       N  5^28'30" W
         Tangent Length:               208.22

Element: Circular
            PC (        )          220+97.97     887226.20     544182.66
            PI (        )          221+16.38     887244.54     544180.90
            CC (        )                        887321.62     545178.10
            PT (        )          221+34.80     887262.92     544179.82
                  Radius:             1000.00
                   Delta:           2^06'37" Right
Degree of Curvature(Arc):           5^43'46"
                  Length:                36.83
                 Tangent:                18.42
                   Chord:                36.83
       Middle Ordinate:                    0.17
               External:                   0.17
      Tangent Direction:       N  5^28'30" W
       Radial Direction:       N 84^31'30" E
        Chord Direction:       N  4^25'12" W
       Radial Direction:       N 86^38'07" E
      Tangent Direction:       N  3^21'53" W

Element: Linear
            PT (        )          221+34.80     887262.92     544179.82
            PC (        )          224+13.83     887541.47     544163.44
      Tangent Direction:       N  3^21'53" W
         Tangent Length:               279.03

Element: Circular
            PC (        )          224+13.83     887541.47     544163.44
            PI (        )          224+28.68     887556.30     544162.57
            CC (        )                        887529.73     543963.79
            PT (        )          224+43.48     887570.84     544159.52
                  Radius:                200.00
                   Delta:           8^29'46" Left
Degree of Curvature(Arc):          28^38'52"
                  Length:                29.66
                 Tangent:                14.86
                   Chord:                29.63
       Middle Ordinate:                    0.55
               External:                   0.55
      Tangent Direction:       N  3^21'53" W
       Radial Direction:       N 86^38'07" E
        Chord Direction:       N  7^36'46" W
       Radial Direction:       N 78^08'21" E
      Tangent Direction:       N 11^51'39" W

Element: Linear
            PT (        )          224+43.48     887570.84     544159.52
            PC (        )          225+45.20     887670.38     544138.61
      Tangent Direction:       N 11^51'39" W
         Tangent Length:               101.71
```

```
Element: Circular
              PC (        )          225+45.20     887670.38     544138.61
              PI (        )          225+87.23     887711.52     544129.97
              CC (        )                        887773.15     544627.94
              PT (        )          226+29.07     887753.53     544128.32
                     Radius:             500.00
                      Delta:           9^36'43" Right
  Degree of Curvature(Arc):           11^27'33"
                     Length:             83.88
                    Tangent:             42.04
                      Chord:             83.78
           Middle Ordinate:               1.76
                   External:              1.76
         Tangent Direction:       N 11^51'39" W
          Radial Direction:       N 78^08'21" E
           Chord Direction:       N  7^03'18" W
          Radial Direction:       N 87^45'04" E
         Tangent Direction:       N  2^14'56" W

Element: Linear
              PT (        )          226+29.07     887753.53     544128.32
              PI (        )          226+93.72     887818.12     544125.79
         Tangent Direction:       N  2^14'56" W
            Tangent Length:             64.64

Element: Linear
              PI (        )          226+93.72     887818.12     544125.79
              PI (        )          227+54.01     887877.82     544117.35
         Tangent Direction:       N  8^02'55" W
            Tangent Length:             60.29

Element: Linear
              PI (        )          227+54.01     887877.82     544117.35
              PI (        )          228+04.03     887927.80     544115.38
         Tangent Direction:       N  2^15'10" W
            Tangent Length:             50.03

Element: Linear
              PI (        )          228+04.03     887927.80     544115.38
              PI (        )          228+64.34     887988.00     544119.11
         Tangent Direction:       N  3^32'55" E
            Tangent Length:             60.31

Element: Linear
              PI (        )          228+64.34     887988.00     544119.11
              PC (        )          229+75.16     888098.73     544114.76
         Tangent Direction:       N  2^15'00" W
            Tangent Length:            110.82

Element: Circular
              PC (        )          229+75.16     888098.73     544114.76
              PI (        )          230+18.08     888141.62     544113.08
              CC (        )                        888118.36     544614.38
              PT (        )          230+60.79     888184.16     544118.73
                     Radius:             500.00
                      Delta:           9^48'44" Right
  Degree of Curvature(Arc):           11^27'33"
                     Length:             85.63
                    Tangent:             42.92
                      Chord:             85.52
           Middle Ordinate:               1.83
                   External:              1.84
         Tangent Direction:       N  2^15'00" W
          Radial Direction:       N 87^45'00" E
           Chord Direction:       N  2^39'22" E
          Radial Direction:       S 82^26'16" E
         Tangent Direction:       N  7^33'44" E
```

```
Element: Linear
              PT (        )          230+60.79     888184.16     544118.73
              PC (        )          231+24.71     888247.53     544127.14
         Tangent Direction:      N  7^33'44" E
            Tangent Length:              63.92

Element: Circular
              PC (        )          231+24.71     888247.53     544127.14
              PI (        )          231+54.25     888276.81     544131.03
              CC (        )                        888313.33     543631.49
              PT (        )          231+83.73     888306.36     544131.44
                     Radius:             500.00
                      Delta:           6^45'48" Left
  Degree of Curvature(Arc):           11^27'33"
                     Length:              59.02
                    Tangent:              29.55
                      Chord:              58.99
           Middle Ordinate:                0.87
                   External:               0.87
         Tangent Direction:      N  7^33'44" E
          Radial Direction:      S 82^26'16" E
           Chord Direction:      N  4^10'50" E
          Radial Direction:      S 89^12'04" E
         Tangent Direction:      N  0^47'56" E

Element: Linear
              PT (        )          231+83.73     888306.36     544131.44
              PC (        )          233+93.85     888516.46     544134.37
         Tangent Direction:      N  0^47'56" E
            Tangent Length:             210.12

Element: Circular
              PC (        )          233+93.85     888516.46     544134.37
              PI (        )          234+25.49     888548.09     544134.81
              CC (        )                        888509.49     544634.32
              PT (        )          234+57.05     888579.42     544139.23
                     Radius:             500.00
                      Delta:           7^14'29" Right
  Degree of Curvature(Arc):           11^27'33"
                     Length:              63.19
                    Tangent:              31.64
                      Chord:              63.15
           Middle Ordinate:                1.00
                   External:               1.00
         Tangent Direction:      N  0^47'56" E
          Radial Direction:      S 89^12'04" E
           Chord Direction:      N  4^25'10" E
          Radial Direction:      S 81^57'35" E
         Tangent Direction:      N  8^02'25" E

Element: Linear
              PT (        )          234+57.05     888579.42     544139.23
              PC (        )          234+94.97     888616.97     544144.54
         Tangent Direction:      N  8^02'25" E
            Tangent Length:              37.92

Element: Circular
              PC (        )          234+94.97     888616.97     544144.54
              PI (        )          235+62.70     888684.04     544154.01
              CC (        )                        888756.84     543154.37
              PT (        )          236+30.23     888751.77     544154.35
                     Radius:            1000.00
                      Delta:           7^44'59" Left
  Degree of Curvature(Arc):           5^43'46"
                     Length:             135.26
                    Tangent:              67.73
                      Chord:             135.16
```

```
          Middle Ordinate:              2.29
                 External:              2.29
        Tangent Direction:      N  8^02'25" E
         Radial Direction:      S 81^57'35" E
          Chord Direction:      N  4^09'55" E
         Radial Direction:      S 89^42'34" E
        Tangent Direction:      N  0^17'26" E

Element: Linear
             PT (        )          236+30.23     888751.77     544154.35
             PI (        )          239+65.73     889087.27     544156.06
        Tangent Direction:      N  0^17'26" E
           Tangent Length:             335.50

Element: Linear
             PI (        )          239+65.73     889087.27     544156.06
             PI (        )          240+25.94     889147.30     544151.36
        Tangent Direction:      N  4^28'23" W
           Tangent Length:              60.21

Element: Linear
             PI (        )          240+25.94     889147.30     544151.36
             PI (        )          241+21.95     889243.30     544151.85
        Tangent Direction:      N  0^17'26" E
           Tangent Length:              96.00

Element: Linear
             PI (        )          241+21.95     889243.30     544151.85
             PI (        )          241+82.16     889303.28     544157.15
        Tangent Direction:      N  5^03'15" E
           Tangent Length:              60.21

Element: Linear
             PI (        )          241+82.16     889303.28     544157.15
             PC (        )          243+05.30     889426.42     544157.78
        Tangent Direction:      N  0^17'26" E
           Tangent Length:             123.15

Element: Circular
             PC (        )          243+05.30     889426.42     544157.78
             PI (        )          243+35.91     889457.03     544157.93
             CC (        )                        889423.89     544657.77
             PT (        )          243+66.44     889487.39     544161.82
                   Radius:             500.00
                    Delta:            7^00'21" Right
  Degree of Curvature(Arc):          11^27'33"
                   Length:              61.14
                  Tangent:              30.61
                    Chord:              61.10
          Middle Ordinate:               0.93
                 External:               0.94
        Tangent Direction:      N  0^17'26" E
         Radial Direction:      S 89^42'34" E
          Chord Direction:      N  3^47'37" E
         Radial Direction:      S 82^42'13" E
        Tangent Direction:      N  7^17'47" E

Element: Linear
             PT (        )          243+66.44     889487.39     544161.82
             PC (        )          243+83.35     889504.16     544163.96
        Tangent Direction:      N  7^17'47" E
           Tangent Length:              16.90

Element: Circular
             PC (        )          243+83.35     889504.16     544163.96
             PI (        )          244+37.53     889557.90     544170.85
             CC (        )                        889567.66     543668.01
             PT (        )          244+91.30     889611.88     544166.05
```

```
                    Radius:            500.00
                     Delta:         12^22'13" Left
  Degree of Curvature(Arc):         11^27'33"
                    Length:            107.95
                   Tangent:             54.19
                     Chord:            107.74
          Middle Ordinate:               2.91
                  External:              2.93
         Tangent Direction:      N  7^17'47" E
          Radial Direction:      S 82^42'13" E
           Chord Direction:      N  1^06'41" E
          Radial Direction:      N 84^55'34" E
         Tangent Direction:      N  5^04'26" W

Element: Linear
              PT (        )          244+91.30     889611.88     544166.05
              PC (        )          245+91.82     889712.00     544157.16
         Tangent Direction:      N  5^04'26" W
            Tangent Length:            100.52

Element: Circular
              PC (        )          245+91.82     889712.00     544157.16
              PI (        )          246+20.89     889740.96     544154.59
              CC (        )                        889756.22     544655.21
              PT (        )          246+49.90     889770.03     544155.40
                    Radius:            500.00
                     Delta:          6^39'20" Right
  Degree of Curvature(Arc):         11^27'33"
                    Length:             58.08
                   Tangent:             29.07
                     Chord:             58.05
          Middle Ordinate:               0.84
                  External:              0.84
         Tangent Direction:      N  5^04'26" W
          Radial Direction:      N 84^55'34" E
           Chord Direction:      N  1^44'45" W
          Radial Direction:      S 88^25'05" E
         Tangent Direction:      N  1^34'55" E

Element: Linear
              PT (        )          246+49.90     889770.03     544155.40
              PC (        )          247+26.59     889846.69     544157.51
         Tangent Direction:      N  1^34'55" E
            Tangent Length:             76.69

Element: Circular
              PC (        )          247+26.59     889846.69     544157.51
              PI (        )          247+71.76     889891.84     544158.76
              CC (        )                        889860.49     543657.70
              PT (        )          248+16.68     889936.48     544151.90
                    Radius:            500.00
                     Delta:         10^19'22" Left
  Degree of Curvature(Arc):         11^27'33"
                    Length:             90.08
                   Tangent:             45.16
                     Chord:             89.96
          Middle Ordinate:               2.03
                  External:              2.04
         Tangent Direction:      N  1^34'55" E
          Radial Direction:      S 88^25'05" E
           Chord Direction:      N  3^34'46" W
          Radial Direction:      N 81^15'33" E
         Tangent Direction:      N  8^44'27" W

Element: Linear
              PT (        )          248+16.68     889936.48     544151.90
              PC (        )          249+37.14     890055.54     544133.59
         Tangent Direction:      N  8^44'27" W
```

```
            Tangent Length:            120.46

Element: Circular
              PC (        )          249+37.14     890055.54     544133.59
              PI (        )          249+60.47     890078.60     544130.04
              CC (        )                        890131.52     544627.78
              PT (        )          249+83.77     890101.89     544128.66
                     Radius:            500.00
                      Delta:          5^20'38" Right
  Degree of Curvature(Arc):          11^27'33"
                     Length:             46.63
                    Tangent:             23.33
                      Chord:             46.62
           Middle Ordinate:               0.54
                   External:              0.54
          Tangent Direction:      N  8^44'27" W
           Radial Direction:      N 81^15'33" E
            Chord Direction:      N  6^04'08" W
           Radial Direction:      N 86^36'11" E
          Tangent Direction:      N  3^23'49" W

Element: Linear
              PT (        )          249+83.77     890101.89     544128.66
              PC (        )          251+32.18     890250.05     544119.87
          Tangent Direction:      N  3^23'49" W
            Tangent Length:            148.41

Element: Circular
              PC (        )          251+32.18     890250.05     544119.87
              PI (        )          251+55.25     890273.07     544118.50
              CC (        )                        890190.79     543121.63
              PT (        )          251+78.31     890296.01     544116.07
                     Radius:           1000.00
                      Delta:          2^38'34" Left
  Degree of Curvature(Arc):           5^43'46"
                     Length:             46.13
                    Tangent:             23.07
                      Chord:             46.12
           Middle Ordinate:               0.27
                   External:              0.27
          Tangent Direction:      N  3^23'49" W
           Radial Direction:      N 86^36'11" E
            Chord Direction:      N  4^43'06" W
           Radial Direction:      N 83^57'37" E
          Tangent Direction:      N  6^02'23" W

Element: Linear
              PT (        )          251+78.31     890296.01     544116.07
              PC (        )          253+49.85     890466.60     544098.02
          Tangent Direction:      N  6^02'23" W
            Tangent Length:            171.54

Element: Circular
              PC (        )          253+49.85     890466.60     544098.02
              PI (        )          253+99.17     890515.64     544092.84
              CC (        )                        890592.86     545291.36
              PT (        )          254+48.42     890564.94     544091.69
                     Radius:           1200.00
                      Delta:          4^42'23" Right
  Degree of Curvature(Arc):           4^46'29"
                     Length:             98.57
                    Tangent:             49.31
                      Chord:             98.54
           Middle Ordinate:               1.01
                   External:              1.01
          Tangent Direction:      N  6^02'23" W
           Radial Direction:      N 83^57'37" E
            Chord Direction:      N  3^41'11" W
```

```
          Radial Direction:      N 88^40'00" E
         Tangent Direction:      N  1^20'00" W

Element: Linear
              PT (        )          254+48.42     890564.94     544091.69
              PC (        )          255+20.91     890637.41     544090.00
         Tangent Direction:      N  1^20'00" W
            Tangent Length:              72.48

Element: Circular
              PC (        )          255+20.91     890637.41     544090.00
              PI (        )          255+33.71     890650.21     544089.70
              CC (        )                        890649.04     544589.87
              PT (        )          255+46.52     890663.01     544090.06
                     Radius:             500.00
                      Delta:           2^56'05" Right
  Degree of Curvature(Arc):           11^27'33"
                     Length:              25.61
                    Tangent:              12.81
                      Chord:              25.61
           Middle Ordinate:                0.16
                   External:               0.16
         Tangent Direction:      N  1^20'00" W
          Radial Direction:      N 88^40'00" E
           Chord Direction:      N  0^08'02" E
          Radial Direction:      S 88^23'55" E
         Tangent Direction:      N  1^36'05" E

Element: Linear
              PT (        )          255+46.52     890663.01     544090.06
              PI (        )          258+71.73     890988.10     544099.15
         Tangent Direction:      N  1^36'05" E
            Tangent Length:             325.21

Element: Linear
              PI (        )          258+71.73     890988.10     544099.15
              PI (        )          259+21.79     891038.11     544097.00
         Tangent Direction:      N  2^27'24" W
            Tangent Length:              50.06

Element: Linear
              PI (        )          259+21.79     891038.11     544097.00
              PI (        )          260+01.79     891118.11     544097.40
         Tangent Direction:      N  0^17'12" E
            Tangent Length:              80.00

Element: Linear
              PI (        )          260+01.79     891118.11     544097.40
              PI (        )          260+51.93     891168.09     544101.39
         Tangent Direction:      N  4^33'23" E
            Tangent Length:              50.14

Element: Linear
              PI (        )          260+51.93     891168.09     544101.39
              PC (        )          261+98.69     891314.84     544099.34
         Tangent Direction:      N  0^47'52" W
            Tangent Length:             146.76

Element: Circular
              PC (        )          261+98.69     891314.84     544099.34
              PI (        )          262+25.24     891341.38     544098.97
              CC (        )                        891300.92     543099.44
              PT (        )          262+51.77     891367.87     544097.20
                     Radius:            1000.00
                      Delta:          3^02'28" Left
  Degree of Curvature(Arc):           5^43'46"
                     Length:              53.08
                    Tangent:              26.55
```

```
                  Chord:                53.07
     Middle Ordinate:                    0.35
            External:                    0.35
   Tangent Direction:        N  0^47'52" W
    Radial Direction:        N 89^12'08" E
     Chord Direction:        N  2^19'06" W
    Radial Direction:        N 86^09'40" E
   Tangent Direction:        N  3^50'20" W

Element: Linear
        PT (        )            262+51.77     891367.87     544097.20
        PI (        )            263+42.41     891458.30     544091.13
   Tangent Direction:        N  3^50'20" W
      Tangent Length:                90.64

Element: Linear
        PI (        )            263+42.41     891458.30     544091.13
        PI (        )            263+97.06     891506.71     544065.76
   Tangent Direction:        N 27^39'09" W
      Tangent Length:                54.65

Element: Linear
        PI (        )            263+97.06     891506.71     544065.76
        PI (        )            265+64.36     891673.99     544063.10
   Tangent Direction:        N  0^54'50" W
      Tangent Length:               167.30

Element: Linear
        PI (        )            265+64.36     891673.99     544063.10
        PI (        )            266+35.12     891744.00     544073.44
   Tangent Direction:        N  8^24'26" E
      Tangent Length:                70.76

Element: Linear
        PI (        )            266+35.12     891744.00     544073.44
        PI (        )            268+25.63     891933.87     544057.99
   Tangent Direction:        N  4^39'14" W
      Tangent Length:               190.50

Element: Linear
        PI (        )            268+25.63     891933.87     544057.99
        PI (        )            268+79.42     891987.66     544058.23
   Tangent Direction:        N  0^15'53" E
      Tangent Length:                53.79

Element: Linear
        PI (        )            268+79.42     891987.66     544058.23
        PI (        )            268+99.42     892007.60     544056.65
   Tangent Direction:        N  4^32'02" W
      Tangent Length:                20.00

Element: Linear
        PI (        )            268+99.42     892007.60     544056.65
        PI (        )            269+39.42     892047.47     544053.49
   Tangent Direction:        N  4^32'02" W
      Tangent Length:                40.00

Element: Linear
        PI (        )            269+39.42     892047.47     544053.49
       POE (        )            270+24.42     892132.21     544046.77
   Tangent Direction:        N  4^32'02" W
      Tangent Length:                85.00
```

End Area Volume Report

Report Created: 2/15/2012
Time: 4:43pm

Cross Section Set Name: Channel CCL HZ Alignment_6

Alignment Name: Channel CCL HZ Alignment

Input Grid Factor: 1.000000 **Note:** All units in this report are in feet, square feet and cubic yards unless specified otherwise.

	Station Quantities								Added Quantities						
	Cut				Fill				Cut			Fill			
Baseline Station	Factor	Area	Volume	Adjusted	Factor	Area	Volume	Adjusted	Factor	Volume	Adjusted	Factor	Volume	Adjusted	Mass Ordinate
8+00.00	1.00	528.9	0.0	0.0	1.00	21.7	0.0	0.0	1.00	0.0	0.0	1.00	0.0	0.0	0.0
9+00.00	1.00	205.0	1359.2	1359.2	1.00	199.5	409.6	409.6	1.00	0.0	0.0	1.00	0.0	0.0	949.6
10+00.00	1.00	258.8	859.0	859.0	1.00	229.2	793.9	793.9	1.00	0.0	0.0	1.00	0.0	0.0	1014.6
11+00.00	1.00	264.2	968.5	968.5	1.00	178.9	755.8	755.8	1.00	0.0	0.0	1.00	0.0	0.0	1227.3
12+00.00	1.00	228.1	911.6	911.6	1.00	145.6	601.0	601.0	1.00	0.0	0.0	1.00	0.0	0.0	1537.9
13+00.00	1.00	205.7	803.3	803.3	1.00	113.0	479.0	479.0	1.00	0.0	0.0	1.00	0.0	0.0	1862.3
14+00.00	1.00	221.8	791.6	791.6	1.00	100.7	395.7	395.7	1.00	0.0	0.0	1.00	0.0	0.0	2258.2
15+00.00	1.00	223.8	825.1	825.1	1.00	81.4	337.1	337.1	1.00	0.0	0.0	1.00	0.0	0.0	2746.1
16+00.00	1.00	243.0	864.3	864.3	1.00	88.1	313.9	313.9	1.00	0.0	0.0	1.00	0.0	0.0	3296.6
17+00.00	1.00	213.1	844.6	844.6	1.00	65.9	285.3	285.3	1.00	0.0	0.0	1.00	0.0	0.0	3855.9
18+00.00	1.00	195.5	756.7	756.7	1.00	71.6	254.6	254.6	1.00	0.0	0.0	1.00	0.0	0.0	4358.0
19+00.00	1.00	179.3	694.1	694.1	1.00	112.2	340.4	340.4	1.00	0.0	0.0	1.00	0.0	0.0	4711.7
20+00.00	1.00	242.4	781.0	781.0	1.00	49.6	299.6	299.6	1.00	0.0	0.0	1.00	0.0	0.0	5193.0
21+00.00	1.00	276.1	960.1	960.1	1.00	136.5	344.6	344.6	1.00	0.0	0.0	1.00	0.0	0.0	5808.6
22+00.00	1.00	316.8	1097.9	1097.9	1.00	185.2	595.6	595.6	1.00	0.0	0.0	1.00	0.0	0.0	6310.9
23+00.00	1.00	340.1	1216.5	1216.5	1.00	165.4	649.1	649.1	1.00	0.0	0.0	1.00	0.0	0.0	6878.3
24+00.00	1.00	331.9	1244.4	1244.4	1.00	139.0	563.5	563.5	1.00	0.0	0.0	1.00	0.0	0.0	7559.2
25+00.00	1.00	301.8	1173.5	1173.5	1.00	109.2	459.6	459.6	1.00	0.0	0.0	1.00	0.0	0.0	8273.1
26+00.00	1.00	296.9	1108.8	1108.8	1.00	77.0	344.9	344.9	1.00	0.0	0.0	1.00	0.0	0.0	9037.0
27+00.00	1.00	269.7	1049.3	1049.3	1.00	122.3	369.2	369.2	1.00	0.0	0.0	1.00	0.0	0.0	9717.1
28+00.00	1.00	249.5	961.5	961.5	1.00	93.5	399.6	399.6	1.00	0.0	0.0	1.00	0.0	0.0	10279.0
29+00.00	1.00	228.8	885.7	885.7	1.00	70.1	303.0	303.0	1.00	0.0	0.0	1.00	0.0	0.0	10861.8
30+00.00	1.00	233.4	855.9	855.9	1.00	71.8	262.7	262.7	1.00	0.0	0.0	1.00	0.0	0.0	11455.0
31+00.00	1.00	231.9	861.7	861.7	1.00	36.9	201.3	201.3	1.00	0.0	0.0	1.00	0.0	0.0	12115.4
32+00.00	1.00	320.0	1021.9	1021.9	1.00	46.8	155.1	155.1	1.00	0.0	0.0	1.00	0.0	0.0	12982.2
33+00.00	1.00	254.1	1063.1	1063.1	1.00	0.0	86.7	86.7	1.00	0.0	0.0	1.00	0.0	0.0	13958.5
34+00.00	1.00	260.9	953.6	953.6	1.00	0.0	0.0	0.0	1.00	0.0	0.0	1.00	0.0	0.0	14912.2
35+00.00	1.00	271.0	984.9	984.9	1.00	0.0	0.0	0.0	1.00	0.0	0.0	1.00	0.0	0.0	15897.1
36+00.00	1.00	273.1	1007.6	1007.6	1.00	4.0	7.4	7.4	1.00	0.0	0.0	1.00	0.0	0.0	16897.2
37+00.00	1.00	415.9	1275.9	1275.9	1.00	0.0	7.4	7.4	1.00	0.0	0.0	1.00	0.0	0.0	18165.7
38+00.00	1.00	399.6	1510.1	1510.1	1.00	0.0	0.0	0.0	1.00	0.0	0.0	1.00	0.0	0.0	19675.8
39+00.00	1.00	416.1	1510.5	1510.5	1.00	0.0	0.0	0.0	1.00	0.0	0.0	1.00	0.0	0.0	21186.3
40+00.00	1.00	329.4	1380.5	1380.5	1.00	0.8	1.5	1.5	1.00	0.0	0.0	1.00	0.0	0.0	22565.3
41+00.00	1.00	741.3	1982.7	1982.7	1.00	0.0	1.5	1.5	1.00	0.0	0.0	1.00	0.0	0.0	24546.5
42+00.00	1.00	953.9	3139.1	3139.1	1.00	0.0	0.0	0.0	1.00	0.0	0.0	1.00	0.0	0.0	27685.6
43+00.00	1.00	523.9	2736.5	2736.5	1.00	0.0	0.0	0.0	1.00	0.0	0.0	1.00	0.0	0.0	30422.2
44+00.00	1.00	309.0	1542.4	1542.4	1.00	0.0	0.0	0.0	1.00	0.0	0.0	1.00	0.0	0.0	31964.6
45+00.00	1.00	313.8	1153.5	1153.5	1.00	6.7	12.5	12.5	1.00	0.0	0.0	1.00	0.0	0.0	33105.6
46+00.00	1.00	335.6	1202.6	1202.6	1.00	4.0	19.9	19.9	1.00	0.0	0.0	1.00	0.0	0.0	34288.4
47+00.00	1.00	351.2	1271.7	1271.7	1.00	1.1	9.5	9.5	1.00	0.0	0.0	1.00	0.0	0.0	35550.6
48+00.00	1.00	357.7	1312.7	1312.7	1.00	0.0	2.1	2.1	1.00	0.0	0.0	1.00	0.0	0.0	36861.2
49+00.00	1.00	327.0	1267.8	1267.8	1.00	0.2	0.3	0.3	1.00	0.0	0.0	1.00	0.0	0.0	38128.7
50+00.00	1.00	285.6	1134.3	1134.3	1.00	2.3	4.6	4.6	1.00	0.0	0.0	1.00	0.0	0.0	39258.5
51+00.00	1.00	291.2	1068.1	1068.1	1.00	2.1	8.1	8.1	1.00	0.0	0.0	1.00	0.0	0.0	40318.5
52+00.00	1.00	304.1	1102.4	1102.4	1.00	0.0	3.9	3.9	1.00	0.0	0.0	1.00	0.0	0.0	41417.0
53+00.00	1.00	210.4	952.7	952.7	1.00	24.3	45.1	45.1	1.00	0.0	0.0	1.00	0.0	0.0	42324.6
54+00.00	1.00	268.6	887.0	887.0	1.00	12.9	68.9	68.9	1.00	0.0	0.0	1.00	0.0	0.0	43142.7
55+00.00	1.00	251.3	962.8	962.8	1.00	3.1	29.7	29.7	1.00	0.0	0.0	1.00	0.0	0.0	44075.8
56+00.00	1.00	246.4	921.7	921.7	1.00	0.0	5.7	5.7	1.00	0.0	0.0	1.00	0.0	0.0	44991.8
57+00.00	1.00	227.9	878.2	878.2	1.00	0.0	0.0	0.0	1.00	0.0	0.0	1.00	0.0	0.0	45869.9
58+00.00	1.00	270.4	922.6	922.6	1.00	2.7	5.0	5.0	1.00	0.0	0.0	1.00	0.0	0.0	46787.6
59+00.00	1.00	254.0	971.1	971.1	1.00	1.1	7.1	7.1	1.00	0.0	0.0	1.00	0.0	0.0	47751.6
60+00.00	1.00	263.5	958.3	958.3	1.00	1.2	4.2	4.2	1.00	0.0	0.0	1.00	0.0	0.0	48705.7
61+00.00	1.00	250.9	952.5	952.5	1.00	0.6	3.3	3.3	1.00	0.0	0.0	1.00	0.0	0.0	49654.9
62+00.00	1.00	237.6	904.5	904.5	1.00	3.1	7.0	7.0	1.00	0.0	0.0	1.00	0.0	0.0	50552.4

Baseline Station	Station Quantities Cut Factor	Area	Volume	Adjusted	Fill Factor	Area	Volume	Adjusted	Added Quantities Cut Factor	Volume	Adjusted	Fill Factor	Volume	Adjusted	Mass Ordinate
63+00.00	1.00	231.2	868.1	868.1	1.00	4.2	13.6	13.6	1.00	0.0	0.0	1.00	0.0	0.0	51407.0
64+00.00	1.00	238.6	870.1	870.1	1.00	15.7	36.9	36.9	1.00	0.0	0.0	1.00	0.0	0.0	52240.2
65+00.00	1.00	246.0	897.4	897.4	1.00	1.8	32.3	32.3	1.00	0.0	0.0	1.00	0.0	0.0	53105.3
66+00.00	1.00	203.4	832.1	832.1	1.00	0.6	4.3	4.3	1.00	0.0	0.0	1.00	0.0	0.0	53933.1
67+00.00	1.00	213.6	772.1	772.1	1.00	11.2	21.9	21.9	1.00	0.0	0.0	1.00	0.0	0.0	54683.3
68+00.00	1.00	223.8	810.0	810.0	1.00	7.7	35.1	35.1	1.00	0.0	0.0	1.00	0.0	0.0	55458.2
69+00.00	1.00	222.3	826.1	826.1	1.00	0.0	14.3	14.3	1.00	0.0	0.0	1.00	0.0	0.0	56270.0
70+00.00	1.00	192.4	767.8	767.8	1.00	12.3	22.9	22.9	1.00	0.0	0.0	1.00	0.0	0.0	57014.9
71+00.00	1.00	190.6	709.2	709.2	1.00	9.5	40.4	40.4	1.00	0.0	0.0	1.00	0.0	0.0	57683.8
72+00.00	1.00	181.1	688.4	688.4	1.00	11.2	38.3	38.3	1.00	0.0	0.0	1.00	0.0	0.0	58333.9
73+00.00	1.00	178.8	666.5	666.5	1.00	13.4	45.5	45.5	1.00	0.0	0.0	1.00	0.0	0.0	58954.9
74+00.00	1.00	114.7	543.5	543.5	1.00	69.0	152.5	152.5	1.00	0.0	0.0	1.00	0.0	0.0	59345.8
75+00.00	1.00	141.2	473.8	473.8	1.00	7.6	141.8	141.8	1.00	0.0	0.0	1.00	0.0	0.0	59677.8
76+00.00	1.00	420.2	1039.7	1039.7	1.00	0.0	14.1	14.1	1.00	0.0	0.0	1.00	0.0	0.0	60703.4
77+00.00	1.00	131.2	1021.3	1021.3	1.00	36.1	67.0	67.0	1.00	0.0	0.0	1.00	0.0	0.0	61657.7
78+00.00	1.00	142.3	506.6	506.6	1.00	6.8	79.5	79.5	1.00	0.0	0.0	1.00	0.0	0.0	62084.8
79+00.00	1.00	174.2	586.2	586.2	1.00	0.0	12.6	12.6	1.00	0.0	0.0	1.00	0.0	0.0	62658.3
80+00.00	1.00	180.7	657.2	657.2	1.00	0.0	0.0	0.0	1.00	0.0	0.0	1.00	0.0	0.0	63315.5
81+00.00	1.00	183.4	674.2	674.2	1.00	0.0	0.0	0.0	1.00	0.0	0.0	1.00	0.0	0.0	63989.7
82+00.00	1.00	188.8	689.2	689.2	1.00	0.0	0.0	0.0	1.00	0.0	0.0	1.00	0.0	0.0	64678.9
83+00.00	1.00	195.2	711.0	711.0	1.00	0.0	0.0	0.0	1.00	0.0	0.0	1.00	0.0	0.0	65389.9
84+00.00	1.00	186.3	706.4	706.4	1.00	0.0	0.0	0.0	1.00	0.0	0.0	1.00	0.0	0.0	66096.3
85+00.00	1.00	178.4	675.3	675.3	1.00	0.0	0.0	0.0	1.00	0.0	0.0	1.00	0.0	0.0	66771.6
86+00.00	1.00	195.3	692.1	692.1	1.00	0.0	0.0	0.0	1.00	0.0	0.0	1.00	0.0	0.0	67463.7
87+00.00	1.00	186.7	707.5	707.5	1.00	0.0	0.0	0.0	1.00	0.0	0.0	1.00	0.0	0.0	68171.2
88+00.00	1.00	193.8	704.8	704.8	1.00	0.0	0.0	0.0	1.00	0.0	0.0	1.00	0.0	0.0	68876.0
89+00.00	1.00	198.7	726.9	726.9	1.00	2.9	5.3	5.3	1.00	0.0	0.0	1.00	0.0	0.0	69597.5
90+00.00	1.00	206.9	751.1	751.1	1.00	0.1	5.6	5.6	1.00	0.0	0.0	1.00	0.0	0.0	70343.1
91+00.00	1.00	207.6	767.6	767.6	1.00	0.2	0.6	0.6	1.00	0.0	0.0	1.00	0.0	0.0	71110.1
92+00.00	1.00	205.9	765.8	765.8	1.00	14.2	26.7	26.7	1.00	0.0	0.0	1.00	0.0	0.0	71849.2
93+00.00	1.00	224.4	796.8	796.8	1.00	12.8	50.0	50.0	1.00	0.0	0.0	1.00	0.0	0.0	72596.0
94+00.00	1.00	305.9	982.0	982.0	1.00	10.0	42.3	42.3	1.00	0.0	0.0	1.00	0.0	0.0	73535.6
95+00.00	1.00	259.2	1046.6	1046.6	1.00	0.8	20.0	20.0	1.00	0.0	0.0	1.00	0.0	0.0	74562.2
96+00.00	1.00	131.8	724.1	724.1	1.00	4.9	10.5	10.5	1.00	0.0	0.0	1.00	0.0	0.0	75275.7
97+00.00	1.00	160.6	541.3	541.3	1.00	16.8	40.2	40.2	1.00	0.0	0.0	1.00	0.0	0.0	75776.9
98+00.00	1.00	169.8	611.9	611.9	1.00	46.8	117.7	117.7	1.00	0.0	0.0	1.00	0.0	0.0	76271.0
99+00.00	1.00	156.1	603.6	603.6	1.00	45.2	170.3	170.3	1.00	0.0	0.0	1.00	0.0	0.0	76704.4
100+00.00	1.00	187.7	636.6	636.6	1.00	2.8	88.8	88.8	1.00	0.0	0.0	1.00	0.0	0.0	77252.1
101+00.00	1.00	201.6	720.9	720.9	1.00	0.0	5.2	5.2	1.00	0.0	0.0	1.00	0.0	0.0	77967.8
102+00.00	1.00	164.9	678.7	678.7	1.00	6.2	11.4	11.4	1.00	0.0	0.0	1.00	0.0	0.0	78635.1
103+00.00	1.00	166.9	614.4	614.4	1.00	1.9	15.0	15.0	1.00	0.0	0.0	1.00	0.0	0.0	79234.5
104+00.00	1.00	181.5	645.2	645.2	1.00	0.6	4.6	4.6	1.00	0.0	0.0	1.00	0.0	0.0	79875.0
105+00.00	1.00	179.1	667.7	667.7	1.00	0.0	1.0	1.0	1.00	0.0	0.0	1.00	0.0	0.0	80541.7
106+00.00	1.00	168.3	643.3	643.3	1.00	5.0	9.2	9.2	1.00	0.0	0.0	1.00	0.0	0.0	81175.8
107+00.00	1.00	175.8	637.3	637.3	1.00	2.1	13.1	13.1	1.00	0.0	0.0	1.00	0.0	0.0	81800.0
108+00.00	1.00	185.3	668.7	668.7	1.00	0.0	3.8	3.8	1.00	0.0	0.0	1.00	0.0	0.0	82464.8
109+00.00	1.00	233.0	774.6	774.6	1.00	3.6	6.6	6.6	1.00	0.0	0.0	1.00	0.0	0.0	83232.7
110+00.00	1.00	255.7	905.0	905.0	1.00	0.0	6.7	6.7	1.00	0.0	0.0	1.00	0.0	0.0	84131.0
111+00.00	1.00	214.0	869.8	869.8	1.00	0.3	0.6	0.6	1.00	0.0	0.0	1.00	0.0	0.0	85000.3
112+00.00	1.00	196.2	759.6	759.6	1.00	0.0	0.5	0.5	1.00	0.0	0.0	1.00	0.0	0.0	85759.4
113+00.00	1.00	198.4	730.8	730.8	1.00	15.2	28.2	28.2	1.00	0.0	0.0	1.00	0.0	0.0	86462.0
114+00.00	1.00	372.0	1056.4	1056.4	1.00	0.0	28.2	28.2	1.00	0.0	0.0	1.00	0.0	0.0	87490.3
115+00.00	1.00	325.2	1291.1	1291.1	1.00	0.0	0.0	0.0	1.00	0.0	0.0	1.00	0.0	0.0	88781.4
116+00.00	1.00	255.3	1074.9	1074.9	1.00	4.7	8.8	8.8	1.00	0.0	0.0	1.00	0.0	0.0	89847.5
117+00.00	1.00	276.1	984.1	984.1	1.00	3.9	16.0	16.0	1.00	0.0	0.0	1.00	0.0	0.0	90815.5
118+00.00	1.00	264.4	1001.0	1001.0	1.00	0.0	7.3	7.3	1.00	0.0	0.0	1.00	0.0	0.0	91809.3
119+00.00	1.00	191.7	844.6	844.6	1.00	0.5	0.9	0.9	1.00	0.0	0.0	1.00	0.0	0.0	92653.0
120+00.00	1.00	161.9	654.7	654.7	1.00	0.0	0.9	0.9	1.00	0.0	0.0	1.00	0.0	0.0	93306.8
121+00.00	1.00	205.0	679.3	679.3	1.00	0.0	0.0	0.0	1.00	0.0	0.0	1.00	0.0	0.0	93986.1
122+00.00	1.00	169.6	693.6	693.6	1.00	2.2	4.1	4.1	1.00	0.0	0.0	1.00	0.0	0.0	94675.6
123+00.00	1.00	171.2	631.1	631.1	1.00	2.6	8.9	8.9	1.00	0.0	0.0	1.00	0.0	0.0	95297.8
124+00.00	1.00	181.2	652.5	652.5	1.00	0.0	4.7	4.7	1.00	0.0	0.0	1.00	0.0	0.0	95945.6
125+00.00	1.00	206.0	717.1	717.1	1.00	0.0	0.0	0.0	1.00	0.0	0.0	1.00	0.0	0.0	96662.7
126+00.00	1.00	176.0	707.4	707.4	1.00	0.0	0.0	0.0	1.00	0.0	0.0	1.00	0.0	0.0	97370.1

Baseline Station	Station Quantities								Added Quantities						Mass Ordinate
	Cut				Fill				Cut			Fill			
	Factor	Area	Volume	Adjusted	Factor	Area	Volume	Adjusted	Factor	Volume	Adjusted	Factor	Volume	Adjusted	
	1.00	185.8	670.0	670.0	1.00	1.9	3.6	3.6	1.00	0.0	0.0	1.00	0.0	0.0	98036.5
128+00.00	1.00	142.0	607.1	607.1	1.00	1.4	6.2	6.2	1.00	0.0	0.0	1.00	0.0	0.0	98637.4
129+00.00	1.00	99.5	447.1	447.1	1.00	15.0	30.5	30.5	1.00	0.0	0.0	1.00	0.0	0.0	99054.1
130+00.00	1.00	94.6	359.4	359.4	1.00	7.7	42.1	42.1	1.00	0.0	0.0	1.00	0.0	0.0	99371.4
131+00.00	1.00	209.5	563.1	563.1	1.00	15.5	42.9	42.9	1.00	0.0	0.0	1.00	0.0	0.0	99891.6
132+00.00	1.00	124.0	617.5	617.5	1.00	91.9	198.8	198.8	1.00	0.0	0.0	1.00	0.0	0.0	100310.3
133+00.00	1.00	178.5	560.2	560.2	1.00	1.2	172.4	172.4	1.00	0.0	0.0	1.00	0.0	0.0	100698.1
134+00.00	1.00	187.1	677.0	677.0	1.00	5.0	11.5	11.5	1.00	0.0	0.0	1.00	0.0	0.0	101363.6
135+00.00	1.00	193.6	704.9	704.9	1.00	0.2	9.7	9.7	1.00	0.0	0.0	1.00	0.0	0.0	102058.7
136+00.00	1.00	214.0	754.8	754.8	1.00	0.5	1.3	1.3	1.00	0.0	0.0	1.00	0.0	0.0	102812.2
137+00.00	1.00	168.3	708.0	708.0	1.00	0.1	1.1	1.1	1.00	0.0	0.0	1.00	0.0	0.0	103519.1
138+00.00	1.00	172.7	631.4	631.4	1.00	2.2	4.3	4.3	1.00	0.0	0.0	1.00	0.0	0.0	104146.2
139+00.00	1.00	204.6	698.6	698.6	1.00	2.7	9.2	9.2	1.00	0.0	0.0	1.00	0.0	0.0	104835.7
140+00.00	1.00	242.0	827.1	827.1	1.00	0.0	5.0	5.0	1.00	0.0	0.0	1.00	0.0	0.0	105657.7
141+00.00	1.00	253.2	917.1	917.1	1.00	0.0	0.0	0.0	1.00	0.0	0.0	1.00	0.0	0.0	106574.9
142+00.00	1.00	302.9	1029.9	1029.9	1.00	0.0	0.0	0.0	1.00	0.0	0.0	1.00	0.0	0.0	107604.8
143+00.00	1.00	402.3	1306.1	1306.1	1.00	0.1	0.1	0.1	1.00	0.0	0.0	1.00	0.0	0.0	108910.8
144+00.00	1.00	364.8	1420.6	1420.6	1.00	0.1	0.2	0.2	1.00	0.0	0.0	1.00	0.0	0.0	110331.2
145+00.00	1.00	272.7	1180.5	1180.5	1.00	13.3	24.8	24.8	1.00	0.0	0.0	1.00	0.0	0.0	111486.9
146+00.00	1.00	261.8	989.7	989.7	1.00	3.9	31.8	31.8	1.00	0.0	0.0	1.00	0.0	0.0	112444.7
147+00.00	1.00	332.7	1100.8	1100.8	1.00	1.4	9.9	9.9	1.00	0.0	0.0	1.00	0.0	0.0	113535.6
148+00.00	1.00	283.1	1140.3	1140.3	1.00	1.8	6.0	6.0	1.00	0.0	0.0	1.00	0.0	0.0	114669.8
149+00.00	1.00	293.8	1068.3	1068.3	1.00	1.0	5.1	5.1	1.00	0.0	0.0	1.00	0.0	0.0	115733.1
150+00.00	1.00	285.1	1072.1	1072.1	1.00	6.9	14.5	14.5	1.00	0.0	0.0	1.00	0.0	0.0	116790.7
151+00.00	1.00	274.7	1036.7	1036.7	1.00	1.0	14.6	14.6	1.00	0.0	0.0	1.00	0.0	0.0	117812.8
152+00.00	1.00	278.4	1024.2	1024.2	1.00	0.4	2.6	2.6	1.00	0.0	0.0	1.00	0.0	0.0	118834.4
153+00.00	1.00	298.7	1068.6	1068.6	1.00	0.0	0.7	0.7	1.00	0.0	0.0	1.00	0.0	0.0	119902.4
154+00.00	1.00	270.6	1054.1	1054.1	1.00	1.6	3.0	3.0	1.00	0.0	0.0	1.00	0.0	0.0	120953.5
155+00.00	1.00	252.7	969.0	969.0	1.00	2.2	7.0	7.0	1.00	0.0	0.0	1.00	0.0	0.0	121915.5
156+00.00	1.00	258.8	947.3	947.3	1.00	0.0	4.1	4.1	1.00	0.0	0.0	1.00	0.0	0.0	122858.7
157+00.00	1.00	262.8	965.9	965.9	1.00	0.0	0.0	0.0	1.00	0.0	0.0	1.00	0.0	0.0	123824.6
158+00.00	1.00	190.2	838.7	838.7	1.00	0.7	1.3	1.3	1.00	0.0	0.0	1.00	0.0	0.0	124662.0
159+00.00	1.00	213.3	747.1	747.1	1.00	7.5	15.3	15.3	1.00	0.0	0.0	1.00	0.0	0.0	125393.9
159+96.95	1.00	60.2	491.0	491.0	1.00	19.0	47.7	47.7	1.00	0.0	0.0	1.00	0.0	0.0	125837.2
Grand Total:			138357.0	138357.0			12519.8	12519.8		0.0	0.0		0.0	0.0	

END AREA VOLUME REPORT
LOOP 303 OUTFALL

2.17.12

	Station Quantities								Added Quantities						
	Cut				Fill				Cut			Fill			
Baseline Station	Factor	Area	Volume	Adjusted	Factor	Area	Volume	Adjusted	Factor	Volume	Adjusted	Factor	Volume	Adjusted	Mass Ordinate
160+52	1.00	141.0	0.0	0.0	1.00	32.6	0.0	0.0	1.00	0.0	0.0	1.00	0.0	0.0	0.0
161+00	1.00	152.0	262.2	262.2	1.00	0.0	29.2	29.2	1.00	0.0	0.0	1.00	0.0	0.0	233.1
161+78.76	1.00	152.0	443.4	443.4	1.00	0.0	0.0	0.0	1.00	0.0	0.0	1.00	0.0	0.0	676.5
162+00	1.00	242.1	155.0	155.0	1.00	0.0	0.0	0.0	1.00	0.0	0.0	1.00	0.0	0.0	831.5
162+48.93	1.00	298.8	490.1	490.1	1.00	104.4	94.6	94.6	1.00	0.0	0.0	1.00	0.0	0.0	1227.0
163+00	1.00	285.0	552.1	552.1	1.00	246.6	332.0	332.0	1.00	0.0	0.0	1.00	0.0	0.0	1447.1
164+00	1.00	250.5	991.5	991.5	1.00	246.6	913.3	913.3	1.00	0.0	0.0	1.00	0.0	0.0	1525.3
165+00	1.00	194.7	824.4	824.4	1.00	218.6	861.3	861.3	1.00	0.0	0.0	1.00	0.0	0.0	1488.3
166+00	1.00	176.5	687.4	687.4	1.00	143.7	670.9	670.9	1.00	0.0	0.0	1.00	0.0	0.0	1504.9
167+00	1.00	203.4	703.5	703.5	1.00	61.6	380.2	380.2	1.00	0.0	0.0	1.00	0.0	0.0	1828.2
168+00	1.00	171.0	693.1	693.1	1.00	2.0	117.6	117.6	1.00	0.0	0.0	1.00	0.0	0.0	2403.7
169+00	1.00	160.3	613.4	613.4	1.00	0.2	4.0	4.0	1.00	0.0	0.0	1.00	0.0	0.0	3013.1
169+50	1.00	166.7	302.7	302.7	1.00	0.2	0.4	0.4	1.00	0.0	0.0	1.00	0.0	0.0	3315.4
170+00	1.00	248.8	384.7	384.7	1.00	1.1	1.2	1.2	1.00	0.0	0.0	1.00	0.0	0.0	3699.0
170+50	1.00	195.2	411.1	411.1	1.00	0.2	1.1	1.1	1.00	0.0	0.0	1.00	0.0	0.0	4108.9
171+00	1.00	202.6	368.3	368.3	1.00	18.3	17.1	17.1	1.00	0.0	0.0	1.00	0.0	0.0	4460.1
172+00	1.00	207.9	760.2	760.2	1.00	0.0	33.9	33.9	1.00	0.0	0.0	1.00	0.0	0.0	5186.4
173+00	1.00	242.9	834.8	834.8	1.00	0.0	0.0	0.0	1.00	0.0	0.0	1.00	0.0	0.0	6021.1
174+00	1.00	272.6	954.5	954.5	1.00	0.0	0.0	0.0	1.00	0.0	0.0	1.00	0.0	0.0	6975.7
175+00	1.00	272.6	1009.7	1009.7	1.00	0.0	0.0	0.0	1.00	0.0	0.0	1.00	0.0	0.0	7985.4
176+00	1.00	265.6	996.7	996.7	1.00	0.0	0.0	0.0	1.00	0.0	0.0	1.00	0.0	0.0	8982.0
176+50	1.00	262.1	488.6	488.6	1.00	0.0	0.0	0.0	1.00	0.0	0.0	1.00	0.0	0.0	9470.6
177+00	1.00	205.1	432.6	432.6	1.00	0.0	0.0	0.0	1.00	0.0	0.0	1.00	0.0	0.0	9903.3
177+50	1.00	207.8	382.4	382.4	1.00	0.0	0.0	0.0	1.00	0.0	0.0	1.00	0.0	0.0	10285.6
178+00	1.00	215.9	392.3	392.3	1.00	18.3	17.0	17.0	1.00	0.0	0.0	1.00	0.0	0.0	10661.0
178+34	1.00	185.7	250.9	250.9	1.00	15.6	21.2	21.2	1.00	0.0	0.0	1.00	0.0	0.0	10890.6
178+94	1.00	155.8	379.4	379.4	1.00	11.1	29.7	29.7	1.00	0.0	0.0	1.00	0.0	0.0	11240.3
179+00	1.00	156.2	36.2	36.2	1.00	11.8	2.7	2.7	1.00	0.0	0.0	1.00	0.0	0.0	11273.9
179+75	1.00	158.6	437.3	437.3	1.00	0.0	16.3	16.3	1.00	0.0	0.0	1.00	0.0	0.0	11694.8
180+00	1.00	183.6	158.4	158.4	1.00	0.0	0.0	0.0	1.00	0.0	0.0	1.00	0.0	0.0	11853.2
180+25	1.00	126.4	143.5	143.5	1.00	0.0	0.0	0.0	1.00	0.0	0.0	1.00	0.0	0.0	11996.8
181+00	1.00	144.9	376.8	376.8	1.00	0.0	0.0	0.0	1.00	0.0	0.0	1.00	0.0	0.0	12373.5
182+00	1.00	158.5	561.7	561.7	1.00	0.0	0.0	0.0	1.00	0.0	0.0	1.00	0.0	0.0	12935.2
183+00	1.00	173.7	615.1	615.1	1.00	0.0	0.0	0.0	1.00	0.0	0.0	1.00	0.0	0.0	13550.4
184+00	1.00	160.0	618.1	618.1	1.00	0.0	0.0	0.0	1.00	0.0	0.0	1.00	0.0	0.0	14168.4
185+00	1.00	134.2	544.9	544.9	1.00	0.0	0.0	0.0	1.00	0.0	0.0	1.00	0.0	0.0	14713.3
186+00	1.00	164.2	552.7	552.7	1.00	13.5	25.0	25.0	1.00	0.0	0.0	1.00	0.0	0.0	15241.0
186+59.44	1.00	175.4	373.8	373.8	1.00	0.0	14.9	14.9	1.00	0.0	0.0	1.00	0.0	0.0	15600.0
187+00	1.00	179.0	266.2	266.2	1.00	0.0	0.0	0.0	1.00	0.0	0.0	1.00	0.0	0.0	15866.2
187+19.44	1.00	209.5	139.8	139.8	1.00	0.0	0.0	0.0	1.00	0.0	0.0	1.00	0.0	0.0	16006.0
188+00	1.00	230.7	656.6	656.6	1.00	0.0	0.0	0.0	1.00	0.0	0.0	1.00	0.0	0.0	16662.6
189+00	1.00	228.7	850.6	850.6	1.00	0.0	0.0	0.0	1.00	0.0	0.0	1.00	0.0	0.0	17513.2
189+55.25	1.00	226.8	466.0	466.0	1.00	0.0	0.0	0.0	1.00	0.0	0.0	1.00	0.0	0.0	17979.2
190+00	1.00	231.5	379.8	379.8	1.00	0.0	0.0	0.0	1.00	0.0	0.0	1.00	0.0	0.0	18359.0
190+15	1.00	198.4	119.4	119.4	1.00	0.0	0.0	0.0	1.00	0.0	0.0	1.00	0.0	0.0	18478.4
191+00	1.00	110.4	486.0	486.0	1.00	13.7	21.6	21.6	1.00	0.0	0.0	1.00	0.0	0.0	18942.8
191+50	1.00	132.7	225.1	225.1	1.00	0.0	12.7	12.7	1.00	0.0	0.0	1.00	0.0	0.0	19155.2
192+00	1.00	145.5	257.6	257.6	1.00	0.0	0.0	0.0	1.00	0.0	0.0	1.00	0.0	0.0	19412.8
193+00	1.00	154.5	555.6	555.6	1.00	0.0	0.0	0.0	1.00	0.0	0.0	1.00	0.0	0.0	19968.4

	Station Quantities								Added Quantities						
	Cut				Fill				Cut			Fill			
Baseline Station	Factor	Area	Volume	Adjusted	Factor	Area	Volume	Adjusted	Factor	Volume	Adjusted	Factor	Volume	Adjusted	Mass Ordinate
194+00	1.00	167.0	595.4	595.4	1.00	0.0	0.0	0.0	1.00	0.0	0.0	1.00	0.0	0.0	20563.8
195+00	1.00	174.9	633.1	633.1	1.00	0.0	0.0	0.0	1.00	0.0	0.0	1.00	0.0	0.0	21196.9
196+00	1.00	186.2	668.8	668.8	1.00	0.0	0.0	0.0	1.00	0.0	0.0	1.00	0.0	0.0	21865.7
196+50	1.00	178.8	338.0	338.0	1.00	0.0	0.0	0.0	1.00	0.0	0.0	1.00	0.0	0.0	22203.7
197+00	1.00	222.2	371.3	371.3	1.00	0.0	0.0	0.0	1.00	0.0	0.0	1.00	0.0	0.0	22575.0
198+00	1.00	154.2	696.9	696.9	1.00	0.0	0.0	0.0	1.00	0.0	0.0	1.00	0.0	0.0	23272.0
199+00	1.00	264.0	774.4	774.4	1.00	0.0	0.0	0.0	1.00	0.0	0.0	1.00	0.0	0.0	24046.4
200+00	1.00	192.6	845.6	845.6	1.00	0.0	0.0	0.0	1.00	0.0	0.0	1.00	0.0	0.0	24892.1
200+96.04	1.00	121.7	559.0	559.0	1.00	0.0	0.0	0.0	1.00	0.0	0.0	1.00	0.0	0.0	25451.1
201+00	1.00	121.8	17.9	17.9	1.00	0.0	0.0	0.0	1.00	0.0	0.0	1.00	0.0	0.0	25468.9
201+21.61	1.00	144.1	106.4	106.4	1.00	41.4	16.6	16.6	1.00	0.0	0.0	1.00	0.0	0.0	25558.8
202+00	1.00	152.0	429.8	429.8	1.00	36.5	113.1	113.1	1.00	0.0	0.0	1.00	0.0	0.0	25875.5
203+00	1.00	152.0	563.0	563.0	1.00	18.0	100.9	100.9	1.00	0.0	0.0	1.00	0.0	0.0	26337.5
204+00	1.00	152.0	563.0	563.0	1.00	1.0	35.1	35.1	1.00	0.0	0.0	1.00	0.0	0.0	26865.4
205+00	1.00	152.0	563.0	563.0	1.00	0.0	1.8	1.8	1.00	0.0	0.0	1.00	0.0	0.0	27426.6
206+00	1.00	152.0	563.0	563.0	1.00	87.1	161.2	161.2	1.00	0.0	0.0	1.00	0.0	0.0	27828.3
207+00	1.00	152.0	563.0	563.0	1.00	62.3	276.5	276.5	1.00	0.0	0.0	1.00	0.0	0.0	28114.8
208+00	1.00	152.0	563.0	563.0	1.00	64.8	235.4	235.4	1.00	0.0	0.0	1.00	0.0	0.0	28442.4
209+00	1.00	152.0	563.0	563.0	1.00	45.0	203.4	203.4	1.00	0.0	0.0	1.00	0.0	0.0	28801.9
210+00	1.00	152.0	563.0	563.0	1.00	40.6	158.5	158.5	1.00	0.0	0.0	1.00	0.0	0.0	29206.4
211+00	1.00	152.0	563.0	563.0	1.00	79.3	221.9	221.9	1.00	0.0	0.0	1.00	0.0	0.0	29547.5
212+00	1.00	152.0	563.0	563.0	1.00	66.5	270.0	270.0	1.00	0.0	0.0	1.00	0.0	0.0	29840.5
213+00	1.00	152.0	563.0	563.0	1.00	23.5	166.8	166.8	1.00	0.0	0.0	1.00	0.0	0.0	30236.7
Grand Total			**35815.5**	**35815.5**			**5578.8**	**5578.8**		**0.0**	**0.0**		**0.0**	**0.0**	

End Area Volume Report

Report Created: 6/21/2012
Time: 2:07pm

Cross Section Set Name: Segment A Meandering_1
Alignment Name: Segment A Meandering
Input Grid Factor: 1.000000 **Note:** All units in this report are in feet, square feet and cubic yards unless specified otherwise.

	Station Quantities								Added Quantities						
	Cut				Fill				Cut			Fill			
Baseline Station	Factor	Area	Volume	Adjusted	Factor	Area	Volume	Adjusted	Factor	Volume	Adjusted	Factor	Volume	Adjusted	Mass Ordinate
213+00.00	1.00	130.75	0.00	0.00	1.00	6.20	0.00	0.00	1.00	0.00	0.00	1.00	0.00	0.00	0.00
214+00.00	1.00	178.00	571.77	571.77	1.00	0.00	11.48	11.48	1.00	0.00	0.00	1.00	0.00	0.00	560.29
215+00.00	1.00	204.77	708.84	708.84	1.00	0.40	0.75	0.75	1.00	0.00	0.00	1.00	0.00	0.00	1268.39
216+00.00	1.00	221.32	789.05	789.05	1.00	5.60	11.11	11.11	1.00	0.00	0.00	1.00	0.00	0.00	2046.32
217+00.00	1.00	260.73	892.68	892.68	1.00	0.00	10.37	10.37	1.00	0.00	0.00	1.00	0.00	0.00	2928.64
218+00.00	1.00	201.73	856.41	856.41	1.00	0.72	1.33	1.33	1.00	0.00	0.00	1.00	0.00	0.00	3783.72
219+00.00	1.00	119.65	595.16	595.16	1.00	4.14	9.00	9.00	1.00	0.00	0.00	1.00	0.00	0.00	4369.87
220+00.00	1.00	126.54	455.92	455.92	1.00	2.82	12.88	12.88	1.00	0.00	0.00	1.00	0.00	0.00	4812.91
221+00.00	1.00	140.67	494.84	494.84	1.00	0.00	5.22	5.22	1.00	0.00	0.00	1.00	0.00	0.00	5302.53
222+00.00	1.00	154.15	545.97	545.97	1.00	0.31	0.57	0.57	1.00	0.00	0.00	1.00	0.00	0.00	5847.92
223+00.00	1.00	166.23	593.31	593.31	1.00	0.22	0.98	0.98	1.00	0.00	0.00	1.00	0.00	0.00	6440.25
224+00.00	1.00	115.96	522.58	522.58	1.00	1.68	3.51	3.51	1.00	0.00	0.00	1.00	0.00	0.00	6959.32
225+00.00	1.00	132.45	460.03	460.03	1.00	0.12	3.33	3.33	1.00	0.00	0.00	1.00	0.00	0.00	7416.02
226+00.00	1.00	233.08	676.92	676.92	1.00	7.05	13.29	13.29	1.00	0.00	0.00	1.00	0.00	0.00	8079.65
227+00.00	1.00	165.37	737.87	737.87	1.00	6.84	25.73	25.73	1.00	0.00	0.00	1.00	0.00	0.00	8791.79
228+00.00	1.00	145.29	575.29	575.29	1.00	0.00	12.67	12.67	1.00	0.00	0.00	1.00	0.00	0.00	9354.41
229+00.00	1.00	192.95	626.36	626.36	1.00	11.06	20.48	20.48	1.00	0.00	0.00	1.00	0.00	0.00	9960.29
230+00.00	1.00	240.64	802.94	802.94	1.00	1.60	23.44	23.44	1.00	0.00	0.00	1.00	0.00	0.00	10739.79
231+00.00	1.00	219.74	852.57	852.57	1.00	0.09	3.12	3.12	1.00	0.00	0.00	1.00	0.00	0.00	11589.24
232+00.00	1.00	161.48	705.97	705.97	1.00	0.00	0.17	0.17	1.00	0.00	0.00	1.00	0.00	0.00	12295.03
233+00.00	1.00	182.26	636.55	636.55	1.00	0.00	0.01	0.01	1.00	0.00	0.00	1.00	0.00	0.00	12931.58
234+00.00	1.00	196.51	701.42	701.42	1.00	0.00	0.00	0.00	1.00	0.00	0.00	1.00	0.00	0.00	13633.00
235+00.00	1.00	205.16	743.82	743.82	1.00	0.00	0.00	0.00	1.00	0.00	0.00	1.00	0.00	0.00	14376.82
236+00.00	1.00	209.82	768.48	768.48	1.00	0.35	0.65	0.65	1.00	0.00	0.00	1.00	0.00	0.00	15144.65
237+00.00	1.00	215.55	787.73	787.73	1.00	0.04	0.73	0.73	1.00	0.00	0.00	1.00	0.00	0.00	15931.65
238+00.00	1.00	148.45	674.06	674.06	1.00	0.57	1.14	1.14	1.00	0.00	0.00	1.00	0.00	0.00	16604.57
239+00.00	1.00	204.79	654.14	654.14	1.00	8.85	17.45	17.45	1.00	0.00	0.00	1.00	0.00	0.00	17241.26
240+00.00	1.00	172.10	697.93	697.93	1.00	11.63	37.93	37.93	1.00	0.00	0.00	1.00	0.00	0.00	17901.27
241+00.00	1.00	205.80	699.80	699.80	1.00	0.00	21.54	21.54	1.00	0.00	0.00	1.00	0.00	0.00	18579.53
242+00.00	1.00	193.47	739.38	739.38	1.00	11.19	20.72	20.72	1.00	0.00	0.00	1.00	0.00	0.00	19298.19
243+00.00	1.00	360.53	1025.93	1025.93	1.00	1.45	23.41	23.41	1.00	0.00	0.00	1.00	0.00	0.00	20300.72
244+00.00	1.00	213.89	1063.75	1063.75	1.00	1.50	5.46	5.46	1.00	0.00	0.00	1.00	0.00	0.00	21359.01
245+00.00	1.00	230.96	823.80	823.80	1.00	0.03	2.83	2.83	1.00	0.00	0.00	1.00	0.00	0.00	22179.98
246+00.00	1.00	241.27	874.51	874.51	1.00	0.00	0.06	0.06	1.00	0.00	0.00	1.00	0.00	0.00	23054.43
247+00.00	1.00	168.65	759.12	759.12	1.00	0.28	0.51	0.51	1.00	0.00	0.00	1.00	0.00	0.00	23813.04
248+00.00	1.00	175.06	636.50	636.50	1.00	1.82	3.89	3.89	1.00	0.00	0.00	1.00	0.00	0.00	24445.65
249+00.00	1.00	196.44	687.96	687.96	1.00	0.13	3.62	3.62	1.00	0.00	0.00	1.00	0.00	0.00	25129.99
250+00.00	1.00	222.96	776.67	776.67	1.00	0.00	0.24	0.24	1.00	0.00	0.00	1.00	0.00	0.00	25906.42
251+00.00	1.00	154.57	699.13	699.13	1.00	1.45	2.68	2.68	1.00	0.00	0.00	1.00	0.00	0.00	26602.87
252+00.00	1.00	163.00	588.09	588.09	1.00	2.69	7.66	7.66	1.00	0.00	0.00	1.00	0.00	0.00	27183.31
253+00.00	1.00	172.17	620.69	620.69	1.00	0.71	6.29	6.29	1.00	0.00	0.00	1.00	0.00	0.00	27797.71
254+00.00	1.00	183.60	658.84	658.84	1.00	2.31	5.60	5.60	1.00	0.00	0.00	1.00	0.00	0.00	28450.95
255+00.00	1.00	205.47	720.51	720.51	1.00	0.22	4.69	4.69	1.00	0.00	0.00	1.00	0.00	0.00	29166.78
256+00.00	1.00	230.01	806.44	806.44	1.00	0.00	0.40	0.40	1.00	0.00	0.00	1.00	0.00	0.00	29972.81
257+00.00	1.00	253.44	895.27	895.27	1.00	0.12	0.23	0.23	1.00	0.00	0.00	1.00	0.00	0.00	30867.85
258+00.00	1.00	264.87	959.83	959.83	1.00	0.00	0.23	0.23	1.00	0.00	0.00	1.00	0.00	0.00	31827.45

Baseline Station	Station Quantities - Cut Factor	Area	Volume	Adjusted	Fill Factor	Area	Volume	Adjusted	Added Quantities - Cut Factor	Volume	Adjusted	Fill Factor	Volume	Adjusted	Mass Ordinate
259+00.00	1.00	261.77	975.27	975.27	1.00	0.00	0.00	0.00	1.00	0.00	0.00	1.00	0.00	0.00	32802.72
260+00.00	1.00	220.48	893.07	893.07	1.00	0.22	0.41	0.41	1.00	0.00	0.00	1.00	0.00	0.00	33695.37
261+00.00	1.00	289.46	944.33	944.33	1.00	3.63	7.13	7.13	1.00	0.00	0.00	1.00	0.00	0.00	34632.57
262+00.00	1.00	283.27	1060.60	1060.60	1.00	5.75	17.36	17.36	1.00	0.00	0.00	1.00	0.00	0.00	35675.82
263+00.00	1.00	277.74	1038.90	1038.90	1.00	7.83	25.14	25.14	1.00	0.00	0.00	1.00	0.00	0.00	36689.58
264+00.00	1.00	206.51	896.76	896.76	1.00	1.98	18.16	18.16	1.00	0.00	0.00	1.00	0.00	0.00	37568.18
265+00.00	1.00	289.25	918.08	918.08	1.00	2.36	8.04	8.04	1.00	0.00	0.00	1.00	0.00	0.00	38478.22
266+00.00	1.00	301.40	1093.79	1093.79	1.00	0.00	4.38	4.38	1.00	0.00	0.00	1.00	0.00	0.00	39567.64
267+00.00	1.00	220.80	967.04	967.04	1.00	0.00	0.00	0.00	1.00	0.00	0.00	1.00	0.00	0.00	40534.68
268+00.00	1.00	274.18	916.64	916.64	1.00	0.00	0.00	0.00	1.00	0.00	0.00	1.00	0.00	0.00	41451.31
269+00.00	1.00	225.76	925.82	925.82	1.00	0.35	0.64	0.64	1.00	0.00	0.00	1.00	0.00	0.00	42376.49
270+00.00	1.00	50.92	512.38	512.38	1.00	0.00	0.64	0.64	1.00	0.00	0.00	1.00	0.00	0.00	42888.23
270+24.42	1.00	16.86	30.65	30.65	1.00	0.00	0.00	0.00	1.00	0.00	0.00	1.00	0.00	0.00	42918.88
Grand Total:			43338.17	43338.17			419.29	419.29		0.00	0.00		0.00	0.00	

APPENDIX E

Structural Calculations

PROJECT Loop 303 No. 103484
CALC'D BY SMS CHK'D BY
SHEET 1 OF DATE 9-29-11

Channel Lining Design per ADOT Highway Drainage Design Manual Hydraulics, 2007 Apperaix 7H

SLAB Thickness

Bottom: Mean Water Velocity < 10 fps, maintenance vehicles present
Required - 6"
Provided - 6" ✓

Side Slopes: Mean Water Velocity < 15 fps, maintenance vehicles present
Required - 6"
Provided - 6" ✓

Reinforcement

Longitudinal Reinforcement: $\rho = 0.30\%$

Required: $A_{ST} = (0.003)(6'' \times 12'') = 0.216$ in²/ft

Provided: #5 @ 12" OC = 0.307 in²/ft ✓

Transverse Reinforcement: $\ell = 0.20\%$ < 65', = 0.25% 65'-100'

Required: $A_{ST} = (0.002)(6'' \times 12'') = 0.144$ in²/ft

$A_{ST} = (0.0025)(6'' \times 12'') = 0.18$ in²/ft

Provided: #4 @ 12" OC = 0.196 in²/ft ✓

Appendix 7-H Concrete Lined Channels

Presented are some general guidelines for concrete channel lining design including minimums where appropriate. The channel lining designer should consult with the appropriate materials engineer regarding lining thicknesses, side slopes, concrete mix design, concrete shrinkage criteria, weephole requirements, and required subgrade treatment.

Thickness:
The channel lining thickness and reinforcement shall be designed for the soil conditions at the project site and should consider any negative pressures that might occur and any collapsing or expansive soils. The minimum thickness for trapezoidal channels should be as shown in the table below.

Minimum Channel Lining Thickness

Mean Water Velocity (ft/sec)	Slab Thickness (in.) Bottom Slab	Side Slope Slab
Less than 10	5	5
10 to 15	6	5.5
15 to 20	7.5	6
more than 20	8	

Note: 6-inch minimum with tied reinforcement or when bottom slab width is 8 or more feet (required to support vehicles).

Joints:
Concrete channel linings should be continuously reinforced Portland cement without expansion or tooled joints. Longitudinal construction joints should be located as required for construction but within the low flow area of the bottom slab. The bottom slab pours should extend a minimum of 1 foot up the side slope. Transverse construction joints should be provided only when concrete placement stops for more than 45 minutes. The reinforcing shall be continuous through the construction joints and through joints with culverts and other hydraulic structures. **Sealed expansion joints with load transfer devices shall be provided at bridge piers, abutments, and other fixed structures.**

Side slopes:
Side slopes on main channels should be designed for soil conditions at the site but should not exceed a desirable slope of 2:1 with an absolute minimum of 1.5:1. If steeper slopes are required, the lining shall be designed as a retaining wall for appropriate lateral earth pressures.

Subgrade treatment should be on a site-specific basis as recommend by the geotechnical engineer. Pressure relief of channel linings should be provided by geotextile or geocomposite drainage strips and 4-inch diameter PVC weepholes through the lining 12 inches above the channel. The spacing of weepholes should be based on subsurface investigation; potential future changes in ground water levels, any structural backfill and any parallel or crossing futilities.

Appendix 7-H Concrete Lined Channels (continued)

Reinforcing:
Reinforcing steel shall be mild steel of either bars or welded wire fabric uniformly distributed. Longitudinal reinforcement should be a minimum of 0.3 percent of the concrete area. The minimum percentage of transverse reinforcement is dependent upon the top width of the channel with 0.20 percent for widths less than 65 feet, 0.25 percent for widths from 65 to 100 feet and 0.30 percent for widths greater than 100 feet.

Clearance:
Reinforcing shall have a minimum of 3-inch clearance to grade and a minimum of 2-inch clearance to exposed surfaces.

Cutoff walls:
Cutoff walls will be required:

- Where new lining abuts an existing concrete or other type of lining which is not continuously reinforced; (a sealed expansion joint should be provided between the new and existing linings)
- At the beginning (upstream end) of a transition section
- At breaks in the channel profile of more than 0.9 percent; and
- At existing structures where the new lining cannot realistically be made continuous with the existing lining.

Cutoff walls are not required to prevent progressive failure in continuously reinforced channels; however, stability of sloped wall lining at transitions where the cross-section shape changes, or at locations where channel slopes change must be evaluated. The change in directions will result in unbalanced force action away from the supporting earth. To prevent local buckling at these locations, cutoff walls rigidly attached to the paving, should be installed to stiffen the lining.

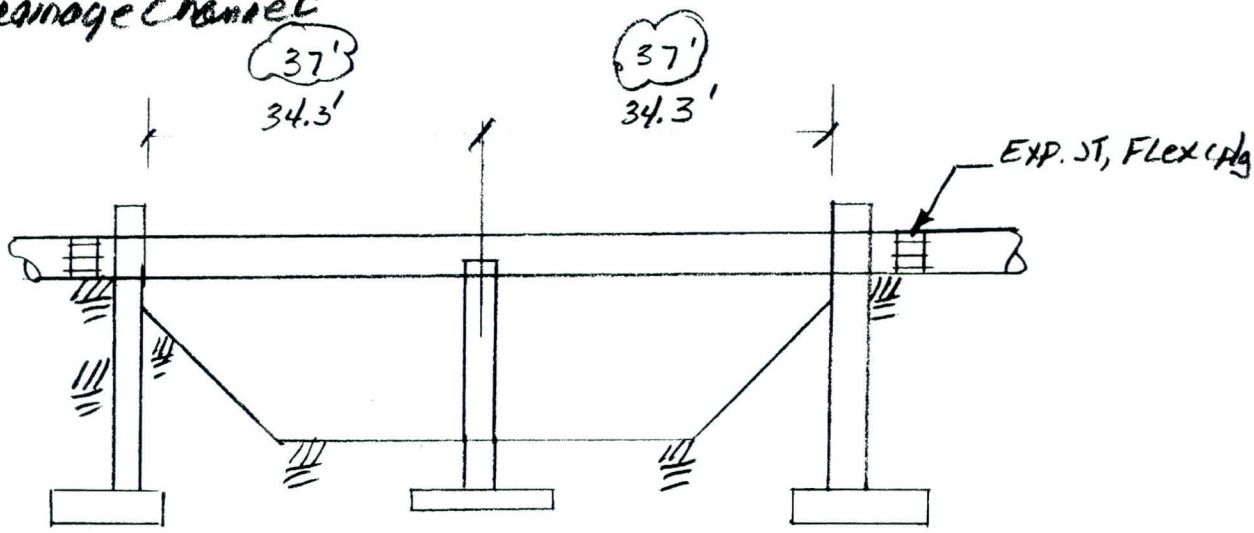
WOOD/PATEL
MISSION: CLIENT SERVICE™

CIVIL ENGINEERS • HYDROLOGISTS • LAND SURVEYORS • CONSTRUCTION MANAGERS

= Revision 1-14-12

PROJECT 103484 437F NO.
CALC'D BY KLK CHK'D BY
SHEET 1 OF 2 DATE 1-17-12

Steel Pipe Crossing near STA 3+00 (MC85) and 53+00 along drainage channel



MAX. HGL = pipe flowing full
Avg. HGL = half full pipe

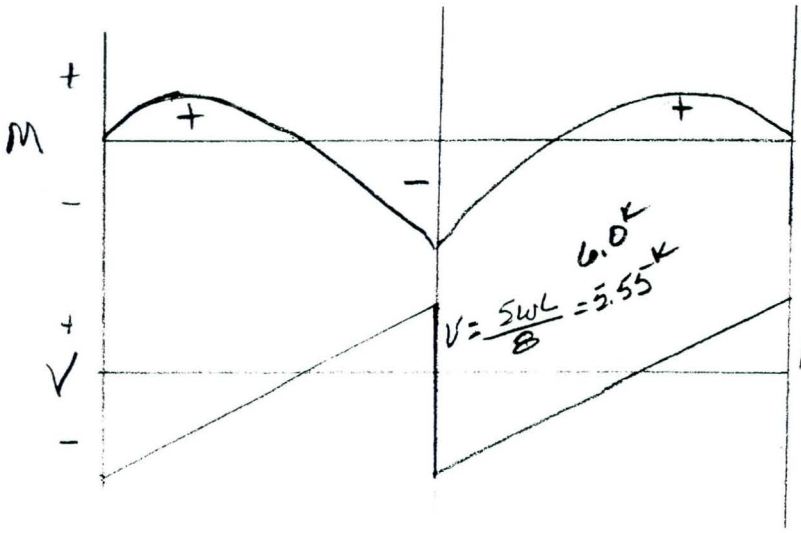
Try A53 GR.B - 1/4" wall.

WT. Pipe + Water = 259
$S = 109.61\ IN^3$
$I = 1,315.4\ IN^4$

$-M = 44.3^{'K}$

$+M = 24.9$

$R = 3.6^K$



$-M = \frac{wL^2}{8} = 38^{'K}$

$+M = \frac{9}{128} wL^2 = 21.4^{'K}$

$R = \frac{3\,wL}{8} = \frac{3 \times .259 \times 34.3}{8}$
$= 3.33\ K$

= Revision 1-14-12

PROJECT NO.

CALC'D BY KLK CHK'D BY

SHEET 2 OF DATE 1-17-12

Estimate circumferential stress at support:

$$S_{cs} = k \frac{P}{t^2} \log_e \left(\frac{R}{t}\right)$$

$k = .02 - .00012\,(A - 90)$ $\qquad A = 120^\circ$

$= .0164$

$P = 5.55 \times 2 = 11.1^K$ $\qquad = 6.0 \times 2 = 12^K$

$R = 24''$

$t = 1/4''$

$$S_{cs} = .0164 \times \frac{11{,}100}{.25^2} \log_e\left(\frac{24}{.25}\right) =$$

$= 13{,}294$ psi $\qquad = 14{,}372$ psi

ASTM A53 GD.B

$F_{all} = 17{,}500$ psi

$F_y = 35{,}000$ psi

Flexural stress:

$M_{max} = 38'^K$ $\qquad 44.3'^K$

$S = 109.61\ in^3$

$\frac{M}{F} = S$

$F = \frac{38{,}000'^{\#} \times 12}{109.61} = 4{,}160$ psi $< 17{,}500$ psi $\qquad = 4{,}850 < 17{,}500$

= Revision 1-14-12

PROJECT NO.
CALC'D BY KLK CHK'D BY
SHEET 3 OF DATE 1-17-12

Deflection

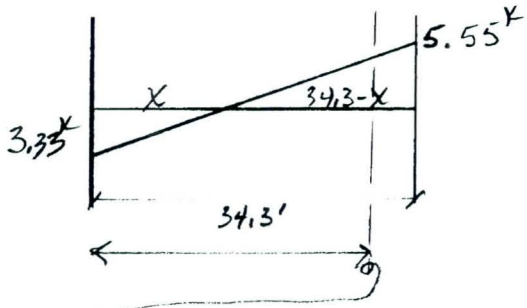
$$y = 22.5 \frac{WL^3}{EI} \qquad W = 259^{\#/'} \times 34.3' = 8{,}884.$$

$$= \frac{22.5 \times 8{,}884 \times 34.3^3}{30{,}000{,}000 \times 1315.4}$$

$$= 0.20'' = \frac{l}{2{,}014} < \frac{l}{360}$$

Estimate Inflection points. OCCUR @ $V = \phi$
MAX. M

$V_L = 3.33^k$ $= 3.6^k$



$$\frac{x}{3.33} = \frac{34.3-x}{5.55}$$

$5.55x = 114.2 - 3.33x$

$8.89x = 114.2$

$x = 12.86'$

USE 13' - point of MAX. M

$$\frac{x}{3.6} = \frac{37-x}{6}$$

$6x = 133.2 - 3.6x$

$x = 13.9 \rightarrow 14'$

Point of inflection = 26'

$$\text{AREA} = .785(d^2 - d_1^2) \qquad d_1 = 23.5, \; d = 24$$

$$= 18.6 \text{ IN}^2$$

Coeff. of expansion - 6.1×10^{-6}

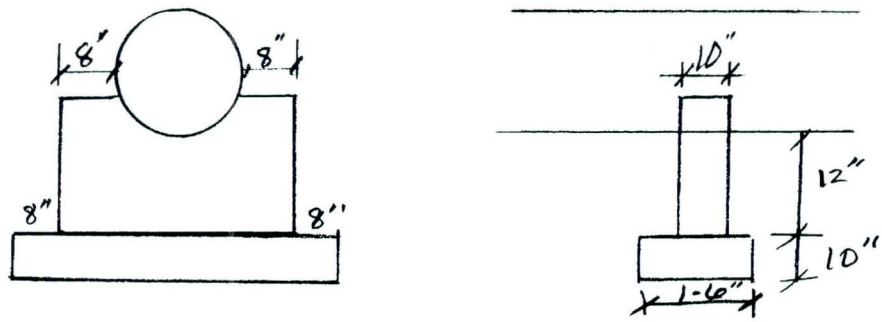
$\Delta L = \alpha L \Delta T$ $\Delta T = 80°F$

$\Delta L = .40''$

PROJECT _____ NO.
CALC'D BY _____ CHK'D BY
SHEET 4 OF DATE 2-14-12

End support

$R = 3.33^k$
Try footing - use 1,500 psf soil P.



WT. wall $\approx .15 \times 1.5 \times \frac{10}{12} \times 3.33 = 0.62^k$

WT. Ftg $\approx .15 \times 4.67 \times \frac{10}{12} \times 1.5 = .88$

$\Sigma = 1.5^k$

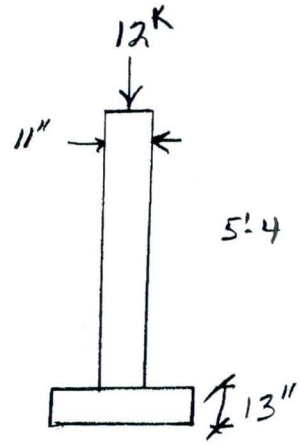
Pipe + support $= 3.33 + 1.5 = 4.83^k$

Ftg. Area $= \frac{4.83}{1.5} = 3.2\ ft^2$

USE 1.5×4.83 FTG Area $= 7.2\ ft^2 > 3.2\ ft^2$

PROJECT NO.
CALC'D BY KLK CHK'D BY
SHEET 5 OF DATE 1-15-12

Center Wall Extension at Box Culvert



WT. wall = $5.33 \times \frac{11}{12} \times .15 = 0.73^{K/'}$

Point Load = $\frac{12^K}{10.7} = 1.12^{K/'}$

FTG = $\frac{13}{12} \times .15 = .16$

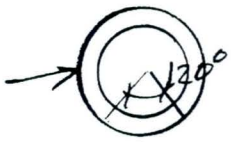
$2^{K/'}$

USE 1.5 ksf Allowable P

FTG W = $\frac{2}{1.5} = 1.33'$

<u>Use 3'0 wide Ftg.</u>

Bearing at MH



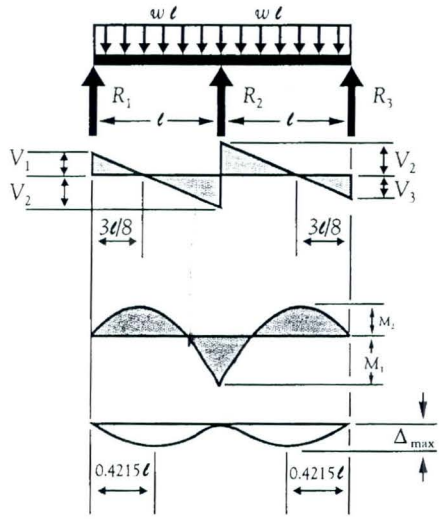
Brg area in 8" wall:

$\frac{\pi D}{\frac{120}{360}} = 25"$ A = 25" x 8" = 201 IN²

R = 3.6K

Brg P = $\frac{3.6 \times 10^3}{201} = 18$ psi O.K.

Figure 29 Continuous Beam – Two Equal Spans – Uniformly Distributed Load



$R_1 = V_1 = R_3 = V_3 \quad = \dfrac{3w\ell}{8}$

$R_2 \quad = \dfrac{10w\ell}{8}$

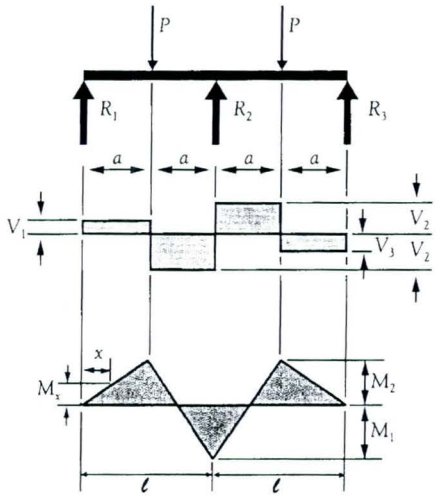
$V_2 = V_{max} \quad = \dfrac{5w\ell}{8}$

$M_1 \quad = \dfrac{w\ell^2}{8}$

$M_2 \left(\text{at } \dfrac{3\ell}{8}\right) \quad = \dfrac{9w\ell^2}{128}$

Δ_{max} (at $0.4215\,\ell$, approx. from R_1 and R_3) $\quad = \dfrac{w\ell^4}{185EI}$

Figure 30 Continuous Beam – Two Equal Spans – Two Equal Concentrated Loads Symmetrically Placed



$R_1 = V_1 = R_3 = V_3 \quad = \dfrac{5P}{16}$

$R_2 = 2V_2 \quad = \dfrac{11P}{8}$

$V_2 = P - R_1 \quad = \dfrac{11P}{16}$

$V_{max} \quad = V_2$

$M_1 \quad = -\dfrac{3P\ell}{16}$

$M_2 \quad = \dfrac{5P\ell}{32}$

M_x (when $x < a$) $\quad = R_1 x$

Job : Loop 303 Page 1

CASE Frame (c) 1986,87,88,89

System Parameters

Number of Nodes _____ 3
Number of Elements _____ 2

Node Coordinates

Node Symbol	X Coordinate(IN)	Y Coordinate(IN)
A	0.0000	0.0000
B	411.6000	0.0000
C	823.2000	0.0000

Support Constraints

Node Symbol	X Translation (IN)	Y Translation (IN)	Rotation (Rad)
A	0.0000	0.0000	Free
B	Free	0.0000	Free
C	Free	0.0000	Free

Property Set Data

Set Symbol	Area (IN^2)	Elastic Modulus (LB/IN^2)	Inertia (IN^4)
PIPE	18.6000	30000000.0000	1315.4000

Element Connectivity

Element Symbol	Origin Node	Terminal Node	Property Symbol	Moment Releases Origin	Terminal
1	A	B	PIPE	No	No
2	B	C	PIPE	No	No

Global Uniform Element Loads

Element Symbol	Primary Loading	X Uniform Load (LB/IN)	Y Uniform Load (LB/IN)
1	W	0.0000	-21.5800
2	W	0.0000	-21.5800

SuperImposed Load Case Specifications

Load Case	Specification
1 ==>	W

Nodal Displacements

Node Symbol	Load Case	X Translation (IN)	Y Translation (IN)	Rotation (Rad)
A	1	0.0000	0.0000	-0.0008
B	1	0.0000	0.0000	-0.0000
C	1	0.0000	0.0000	0.0008

Nodal Reactions

Node Symbol	Load Case	X Reaction (LB)	Y Reaction (LB)	Moment (IN-LB)
A	1	0.0000	3330.8730	0.0000
B	1	0.0000	11102.9102	0.0000
C	1	0.0000	3330.8730	0.0000

Element Forces

Element Symbol	Load Case	Node Symbol	Axial (LB)	Shear (LB)	Moment (IN-LB)	Deflection (IN)
1	1	A	0.000	3330.873	-0.016	
		MID	0.000	-1110.291	228497.886	-0.0817
		B	0.000	-5551.455	-456995.805	
2	1	B	0.000	5551.455	-456995.805	
		MID	0.000	1110.291	228497.886	-0.0817
		C	0.000	-3330.873	-0.016	

ElmCheck (TM) version 1.0
(C) 1989 Fujitsu America Inc

Orientation: Y I Z

PIPE MEMBER 0 PASS SHAPE

AISC STRESS CHECK ON CRITICAL SECTION 34.300 FT FROM END i

1.5.1.1 Tension
ft (Ft) .00 (21.60) pass

1.5.1.2 Shear
fv (Fv) .01 (14.40) pass

1.5.1.3 Compression
fa (Fa) .00 (18.44) pass
fas(Fas) .00 (18.44)
Kl/r 49 (200)

1.5.1.4 Bending - Major Axis
fbx(Fbx) .97 (23.38) pass
max unbraced dist .00 ft

1.5.1.4 Bending - Minor Axis
fby(Fby) 4.16 (23.38) pass

1.6.2 Axial Tension & Bending
form. 1.6-1b .220 (1.0) pass

shear stress maximum .01 ksi occurs .000 ft from end i

----------LOADS ACTING ON CRITICAL SECTION----------

FX	.000	kip	MX .000	kip-ft
FY	.259		MY -38.0	
FZ	.000		MZ -8.88	

----------APPLIED LOADS----------

---- end i ----					---- end j ----				
FX	.000	kip	MX .000	kip-ft	FX	.000	kip	MX .000	kip-ft
FY	-.259		MY 38.0		FY	.259		MY -38.0	
FZ	.000		MZ .000		FZ	.000		MZ -8.88	

---- distributed load ----					---- concentrated load ----				
fy	.000	kip/ft	@	.000 ft	FY	.000	kip	@	.000 ft
fy	.000			.000					
fz	.000			.000	FZ	.000			.000
fz	.000			.000					

----------STABILITY PARAMETERS----------

Ky	1.00	rgy	8.3974 in	Fey	62.156 ksi	Cby	1.0000
Kz	1.00	rgz	8.3974	Fez	62.156	Cbz	1.0000

----------STRESS PARAMETERS----------

AREA	18.653 in2	Iy	1315.343 in4	Sy	109.612 in3	YLD	36.00 ksi
LEN	34.300 ft	Iz	1315.343	Sz	109.612	ULT	58.00
						E	29000.00

----------SHAPE DIMENSIONS----------

OD 24.0000 in ID 23.5000 in

All specifications comply with the AISC Manual of Steel Construction, Eighth Edition, Copyright 1980.

Maxi-Joint®

Single (1) Wide Arch Expansion Joints

Style 1101

Features:

- Versatile hand-built construction. Made in the U.S.A.
- Standard or custom face to face dimensions
- Wide flowing arch design
- Exceptional all directional movement capability
- Virtually eliminates sediment buildup
- Higher pressure rating than conventional expansion joints
- Excellent chemical and abrasion resistance
- Full vacuum rating (30" Hg) in all sizes
- 250°F continuous service standard, 400°F available
- Filled arch design available
- Hot dip galvanized retaining rings standard
- Absorbs noise, vibration and shock
- Compensates for minor misalignment and offset
- Low stiffness and deflection forces
- Integrally flanged design, no gaskets required
- Simple to install and high strength
- Provides easy access to piping and equipment
- Other standard drilling available, including ASA 300, DIN, PN, JIS, API, and Navy
- Wide variety of tube and cover elastomers available, including Pure Gum Rubber, EPDM, Neoprene, Butyl, Nitrile, Hypalon®, Viton®, Teflon®, Food Grade, and more

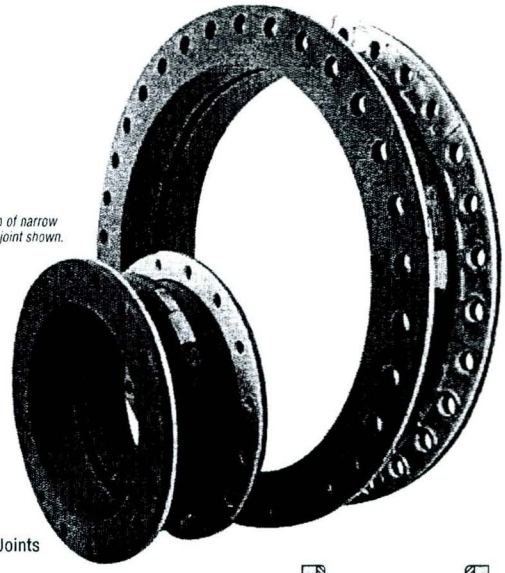
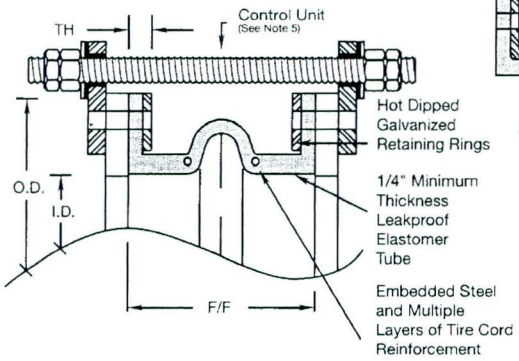
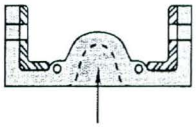


Photo of narrow arch joint shown.

Style 1101
Single (1) Wide Arch,
Spool Type, Expansion Joints





Optional Filled Arch Construction Also Typical for Other Styles

SIZE	LENGTH	MAX	VACUUM	FLANGES – 125/150 LB. (NOTE 8)					MOVEMENTS					SPRING RATE			GROSS
I.D. (inch)	F/F (inch)	Pressure (PSIG)	Rating (inch Hg)	O.D. (inch)	B.C. (inch)	Hole (no.)	Hole (inch)	TH. (inch)	Comp. (inch)	Ext. (inch)	Lateral (inch)	Angular (degree)	Torsional (degree)	Comp. (lbs/in)	Ext. (lbs/in)	Lateral (lbs/in)	Weight (lbs)
2	6	220	30	6	4-3/4	4	3/4	7/8	1 3/4	7/8	1	39	4	270	340	450	7
2-1/2	6	220	30	7	5-1/2	4	3/4	7/8	1 3/4	7/8	1	33	3.8	340	420	480	8
3	6	220	30	7-1/2	6	4	3/4	7/8	1 3/4	7/8	1	28	3.7	400	510	540	10
4	6	220	30	9	7-1/2	8	3/4	7/8	1 3/4	7/8	1	22	3.6	550	710	590	14
5	6	220	30	10	8-1/2	8	7/8	7/8	1 3/4	7/8	1	18	3.4	670	880	710	17
6	6	220	30	11	9-1/2	8	7/8	7/8	1 3/4	7/8	1	15	3.2	820	1050	790	20
8	6	220	30	13-1/2	11-3/4	8	7/8	7/8	1 3/4	7/8	1	12	3.1	990	1160	960	29
10	8	220	30	16	14-1/4	12	1	7/8	2	1	1 1/4	17	3	960	1170	820	39
12	8	220	30	19	17	12	1	7/8	2	1	1 1/4	14	2.9	1,010	1,250	970	58
14	8	220	30	21	18-3/4	12	1-1/8	1	2 1/4	1 1/8	1 1/4	12	2.8	1,080	1,300	1,140	65
16	8	160	30	23-1/2	21-1/4	16	1-1/8	1	2 1/4	1 1/8	1 1/4	11	2.7	1,150	1,390	1,320	80
18	8	160	30	25	22-3/4	16	1-1/4	1	2 1/4	1 1/8	1 1/4	10	2.6	1,220	1,570	1,450	90
20	8	130	30	27-1/2	25	20	1-1/4	1	2 1/4	1 1/8	1 1/4	9	2.5	1,280	1,750	1,620	101
24	10	130	30	32	29-1/2	20	1-3/8	1 1/8	2 1/2	1 1/4	1 3/8	8	2.4	1,730	2,100	1,740	120
30	10	100	30	38-3/4	36	28	1-3/8	1 1/8	2 1/2	1 1/4	1 3/8	7	2.3	2,180	2,660	2,190	172
36	10	90	30	46	42-3/4	32	1-5/8	1 1/8	2 1/2	1 1/4	1 3/8	6	2.2	2,660	3,250	2,680	219
42	12	90	30	53	49-1/2	36	1-5/8	1 1/8	2 1/2	1 1/4	1 1/2	4.8	2.1	3,030	3,650	3,020	290
48	12	90	30	59-1/2	56	44	1-5/8	1 1/8	2 1/2	1 1/4	1 1/2	4.2	2	3,390	4,150	3,410	342
54	12	85	30	66-1/4	62-3/4	44	2	1 1/8	2 1/2	1 1/4	1 1/2	3.8	1.9	4,120	5,020	4,140	405
60	12	85	30	73	69-1/4	52	2	1 1/8	2 1/2	1 1/4	1 1/2	3.6	1.8	4,520	5,560	4,580	500
66	12	85	30	80	76	52	2	1 1/8	2 1/2	1 1/4	1 1/2	3.3	1.7	5,250	6,390	5,270	580
72	12	85	30	86-1/2	82-1/2	60	2	1 1/4	2 1/2	1 1/4	1 1/2	3	1.6	5,900	7,180	5,920	650
78	12	80	30	93	89	64	2-1/8	1 1/4	2 1/2	1 1/4	1 1/2	2.6	1.5	6,420	7,850	6,570	715
84	12	80	30	99-3/4	95-1/2	64	2-1/4	1 1/4	2 1/2	1 1/4	1 1/2	2.3	1.4	6,950	8,670	7,400	780
90	12	80	30	106-1/2	102	68	2-3/8	1 1/4	2 1/2	1 1/4	1 1/2	2.1	1.3	7,270	9,200	8,080	880
96	12	80	30	113-1/4	108-1/2	68	2-1/2	1 1/4	2 1/2	1 1/4	1 1/2	2	1.2	7,650	10,100	9,070	1,010
102	12	60	30	120	114-1/2	72	2-5/8	1 3/8	2 1/2	1 1/4	1 1/2	1.6	0.8	8,128	10,730	9,640	1,073
108	12	60	30	126-3/4	120-3/4	72	2-5/8	1 3/8	2 1/2	1 1/4	1 1/2	1.5	0.7	8,606	11,360	10,200	1,136

Notes:

1.) All parts listed are designed for 30" Hg (full vacuum) and have a maximum test at 26" Hg due to facility altitude and equipment limitations.

2.) Maximum operating temperature of 250 deg F for EPDM, Butyl, Hypalon, and Viton; 225 deg F for Neoprene; 210 deg F for Nitrile; 180 deg F for Pure Gum Rubber; 300 deg F for EPDM and Butyl in air service at 25 PSI maximum; higher pressure and temperature ratings available.

3.) All sizes can be supplied with a filled arch reducing their movements by 50% and increasing the spring rates fourfold.

4.) For full product specifications and installation instructions, see SPEC 1101-1 and ININ 1101-1. Gross weights include retaining rings.

5.) **WARNING:** Control units (sold separately) must be used when piping is not properly anchored. Number of rods are dependent upon maximum field test pressures. Expansion joints may operate in pipelines carrying fluids at elevated temperatures and pressures, so precaution should be taken to ensure proper installation and regular inspection. Care is required to protect personnel in the event of leakage or splash. Adequate floor drains are always recommended.

6.) Movements are non-concurrent. Contact General Rubber for concurrent movements, and for sizes not shown up to 144" I.D.

7.) Series 1100 and 1200 replace styles 1025, 1050 and 1075.

8.) Standard 125/150 lb. drilling includes, 1"-24" with ANSI B16.1 Class 125 lb./B16.5 Class 150 lb., 30"-60" with ANSI B16.1 Class 125 lb./ B16.47 series A, Class 150 lb., 72"- 108" with ANSI B16.1 Class 125 lb./ AWWA C207 Class B.

Toll Free: 800-233-6294
Web: www.general-rubber.com

general rubber corporation

Fax: 201-935-1915
sales@general-rubber.com

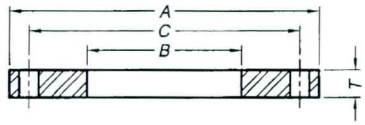


Table 2 AWWA standard steel-ring flanges, class B* (86 psi) and class D† (175–150 psi)

Nominal Pipe Size *in.*	OD of Flange (*A*) *in.*	ID of Flange (*B*‡) *in.*	Number of Bolts	Diam. of Bolt Circle (*C*) *in.*	Diam. of Bolts§ *in.*	Thickness of Flange — *in.* Class B (*T*)	Thickness of Flange — *in.* Class D (*T*)
4	9.00	4.57	8	7.50	0.625	0.625	0.625
5	10.00	5.66	8	8.50	0.750	0.625	0.625
6	11.00	6.72	8	9.50	0.750	0.688	0.688
8	13.50	8.72	8	11.75	0.750	0.688	0.688
10	16.00	10.88	12	14.25	0.875	0.688	0.688
12	19.00	12.88	12	17.00	0.875	0.688	0.812
14	21.00	14.19	12	18.75	1.000	0.688	0.938
16	23.50	16.19	16	21.25	1.000	0.688	1.000
18	25.00	18.19	16	22.75	1.125	0.688	1.062
20	27.50	20.19	20	25.00	1.125	0.688	1.125
22	29.50	22.19	20	27.25	1.250	0.750	1.188
24	32.00	24.19	20	29.50	1.250	0.750	1.250
26	34.25		24	31.75	1.250	0.812	1.312
28	36.50		28	34.00	1.250	0.875	1.312
30	38.75		28	36.00	1.250	0.875	1.375
32	41.75		28	38.50	1.500	0.938	1.500
34	43.75		32	40.50	1.500	0.938	1.500
36	46.00		32	42.75	1.500	1.000	1.625
38	48.75		32	45.25	1.500	1.000	1.625
40	50.75		36	47.25	1.500	1.000	1.625
42	53.00		36	49.50	1.500	1.125	1.750

NOTES:

1. Ring flanges may be overbored or counterbored to accommodate larger outside-diameter pipe than shown as nominal. This is done to allow a clear inside diameter after cement–mortar lining. Wrench clearance between the pipe OD and bolt circle must be maintained as well as sufficient gasket seating area.

2. Metric conversion: nominal pipe size: in. × 25 = mm; dimensions: in. × 25.4 = mm; psi × 6.895 = kPa

*Pressure rating at atmospheric temperature is 86 psi. These flanges have the same OD and drilling as class 125 cast-iron flanges (ASME B16.1). In sizes 24 in. and smaller, they also match ASME B16.5 class 150 psi drilling for steel flanges.

†Pressure rating at atmospheric temperature: sizes 4–12 in. inclusive, 175 psi; sizes larger than 12 in., 150 psi. These flanges have the same diameter and drilling as class 125 cast-iron flanges (ASME B16.1). In sizes 24 in. and smaller, they also match ASME B16.5 class 150-psi standard for steel flanges.

‡The purchaser shall specify the ID of the flange, dimension B, for nominal pipe sizes 26 in. and larger. The diameter of the flange bore shall not exceed the pipe OD by more than 0.25 in.

§Bolt holes shall be drilled 1/8-in. larger in diameter than the nominal diameter of the bolt except as stated in Sec. 4.2.3.

Table continued next page.

Copyright ©2007 American Water Works Association

FIG. 46 ADJUSTABLE PIPE SADDLE SUPPORT

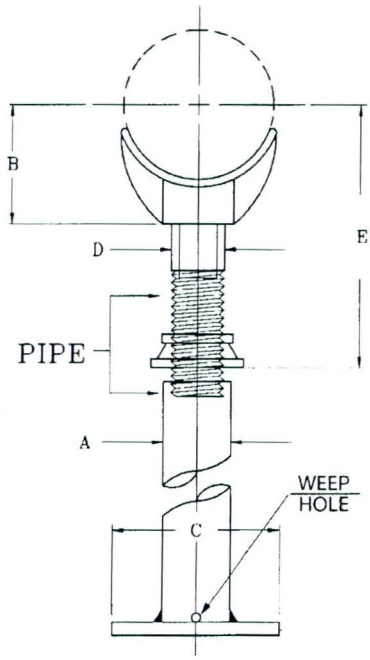
www.pipingtech.com/fig46

MATERIAL: Carbon steel saddle, locknut nipple, and special cast iron reducer, assembled. Base is not included - supplied as extra.

SERVICE: Stanchion type support where vertical adjustment is required.

INSTALLATION: Adjustment is obtained by turning the locknut nipple, the lower end of the nipple, and coupling during adjustment.

ORDERING: Specify pipe size, figure number, description and finish.



28 1/4

PIPE SIZE	APPROX. WEIGHT (lb. per 100)		A	B	C	D	E	
	COMPLETE	SADDLE ONLY			SQUARE		MIN.	MAX.
2 1/2	900	480	2 1/2	3 1/2	9	1 1/2	8	13
3	920	500	2 1/2	3 3/4	9	1 1/2	8 1/4	13 1/4
3 1/2	940	520	2 1/2	4	9	1 1/2	8 1/2	13 1/2
4	1,500	760	3	4 1/4	9	2 1/2	9 1/4	14
5	1,665	925	3	4 7/8	9	2 1/2	10	14 3/4
6	1,765	1,025	3	5 1/2	9	2 1/2	10 1/2	15 1/4
8	2,020	1,280	3	6 7/8	9	2 1/2	11 3/4	16 1/2
10	2,515	1,775	3	8 1/2	9	2 1/2	13 1/2	18 1/4
12	2,900	2,160	3	9 15/16	9	2 1/2	15	19 3/4
14	4,920	3,800	4	10 15/16	11	3	16 1/4	20 3/4
16	5,320	4,200	4	12 3/8	11	3	17 3/4	22 1/4
18	7,080	5,100	6	13 7/8	13 1/2	3 1/2	19 1/2	24
20	10,480	8,500	6	15 3/8	13 1/2	3 1/2	21	25 1/2
24	13,000	11,000	6	17 15/16	13 1/2	4	23 3/4	28 1/4
30	17,000	15,000	6	21 5/16	13 1/2	4	27	31 1/2
32	18,100	16,100	6	22 1/2	13 1/2	4	28 1/4	32 3/4
36	24,900	22,900	6	24 1/2	13 1/2	4	30 1/4	34 3/4

SCOMPONENTS05.XLS-08/31/09

APPENDIX F

Inventory of Utilities

Loop 303 Outfall Drainage System Design

UTILITY TRACKING REPORT

AZTEC Project No.: AZE1009

Last Updated: 10-24-2011

Pothole #	Utility Company	Utility	Utility Size & Type	General Location	Channel Stationing	Prior Rights Document Received	Disposition	Remarks
	APS	Overhead Power	12 KV	158' South of Buckeye Canal	041+18.42	Yes	Conflict	Conflict with proposed Buckeye Canal Shoo-Fly (There is telephone on this pole also) Need to relocate power line south within a new easement.
	APS	Overhead Power	12 KV	64' North of MC85 (Near Pump)	054+71.31	No	Conflict	Power Pole is in conflict with construction of new RCBC. Need to relocate powerpole and powerline. APS discussing several alternatives.
	APS	Overhead Power	12 KV	West side of 175th Ave	113+36.91	Yes	Conflict	Power Pole may only require bracing during construction. Construction equipment should be able to stay outside clear zone. APS considering options.
	APS	Overhead Power	12 KV	South side of Lower Buckeye Rd	160+88.00	No	Conflict	APS plans to underground OH powerline from pole at SW corner of intersection west to next power pole.
52	APS	Underground Power	4" PVC	North side of Lower Buckeye Rd	161+50.00	No	Remove Power to Pump Station	City of Goodyear has provided APS a letter allowing them to abandon power to the Lift Station
56 & 57	APS	Underground Power	UG PB & Conduit	700' South of Moose Lodge	195+20.00	Yes	Conflict	Design underway
	Moose Lodge power	Overhead Power	12 KV	1200' South of Yuma Rd	202+00.00	No	Conflict	Need to discuss temporarily disconnecting power to light/RV pole during construction with Moose Lodge.
30	APS	Underground Power	12 KV	1100' South of Yuma	202+86.00	Yes	Conflict	APS UG elec needs relocation (possibly within new easement direct from Cell tower to pole)
31	APS	Underground Power	2- 4" PVC	South side of Yuma Rd	213+41.89	No	Conflict	Design underway
	APS	Overhead Light Pole	12 KV	South side of Yuma Rd	213+50.00	No	Conflict	Conflict with street light pole. Slight change due to realignment of box at LA Fitness
	APS	Overhead Power	69 KV	South side of Yuma Rd	213+51.28	No	Conflict	Issue with vertical clearance with 69 KV lines during construction
40	APS	Underground Power	6-2"+2-3"+1-4" PVC	North side of Lilac Street	241+12.41	Yes	Conflict	Design underway
17	City of Goodyear	Force Main Sewer	8" DIP & 10" DIP	1300' South of Elwood Road to 100' south of Elwood Road	118+00 to 130+00	No	Conflict	Abandon and remove existing 8" and 10" Sewer Forcemains and install new 8" & 10" Sewer Forcemains on new alignment from Station 118+00 to 130+00.
18	City of Goodyear	Force Main Sewer	8" DIP & 10" DIP	60' South of Elwood Road (50' west to 150' east)	130+50	No	Conflict	Install new 30" sewer forcemain along south side of Elwood Road from 50' west to 150 ' east.
21 and 22	City of Goodyear	Water	16" ACP	Under WAPA Lines (North)	146+00.80	No	Conflict	Need to drop waterline under channel
26	City of Goodyear	Water	24" DIP	North side of Lower Buckeye Rd	161+36.84	No	Conflict	Need to dip waterline under channel
	City of Goodyear	Water	Fire Hydrant	North side of Lower Buckeye Rd	161+45.75	No	Potential Conflict	May have to Relocate Fire Hydrant
	City of Goodyear	Sewer	12" PVC/MH	North of Lower Buckeye Rd	161+30.00	No	Conflict	Remove abandoned 12" sewer lines and manhole
	City of Goodyear	Sewer	24" PVC	South side of Lower Buckeye Rd	161+20.00	No	No Conflict	Tie new 21" PVC sewer line into manhole
28	City of Goodyear	Force Main Sewer	8" PVC	North side of Lower Buckeye Rd	162+07.00	No	Conflict	Abandon and remove existing 8" Sewer Forcemain
	City of Goodyear	Sewer	24" VCP	Located West of Cotton Ln but not within 303 Outfall R/W	162+35.84	No	No Conflict	Deep sewer - Protect in Place
	City of Goodyear	Sewer	24" VCP	Located West of Cotton Ln but not within 303 Outfall R/W	178+45.00	No	No Conflict	Deep sewer - Protect in Place
	City of Goodyear	Sewer	24" PVC & 15" VCP	North side of Yuma Rd	214+40.00	No	No Conflict	Deep sewer - Protect in Place
37	City of Goodyear	Water	24" DIP	North side of Yuma Rd	214+62.50	No	Conflict	Need to drop pipe under channel
38	City of Goodyear	Water	12" DIP	North side of Lilac Street	240+96.74	No	Conflict	Need to drop pipe under channel

UTILITY TRACKING REPORT

AZTEC Project No.: AZE1009

Last Updated: 10-24-2011

Pothole #	Utility Company	Utility	Utility Size & Type	General Location	Channel Stationing	Prior Rights Document Received	Disposition	Remarks
33	Cox	TV	3x2" + 1x1.5" PVC	South side of Yuma Rd	213+94.00	No	Conflict	Dip conduit under channel
39	Cox	TV	6x2" + 2x3" + 1x4" PVC	North side of Lilac Street	241+02.63	No	Conflict	Dip conduit under channel
8 and 9	Kinder Morgan	Gas	20" FBE Coated STL	44' South of UPRR	074+66.00	Within UPRR RW	Potential Conflict	Need Design Status
6 and 7	Level 3	Communication	2" PE - FO	52' South of UPRR	074+60.00	Within UPRR RW	Potential Conflict	Need Design Status
10 and 11	Level 3	Communication	FO - 8 x 1.5"	95' North of UPRR	076+06.62	No	Conflict	Need Design Status
23 and 24	MCI/ Verizon	Communication	OH - Fog Line	1287' North of Broadway Rd Alignment	143+02.00	No	No Conflict	No Level 3 facilities in requested location per Rob 480-205-1697, MCI line is OH on WAPA towers
2 and 3	Palo Verde Nuclear Generating Station Water Conveyance Pipeline (PVNGS)	Reclaimed Water	96" RCP	50' North of Buckeye Canal	043+41.48		Protect in Place	PROTECT IN PLACE- Special protection will be required for this line that will need to be designed by APS's consultant and constructed by APS. Construction to occur in Oct 2011
4 and 5	MCI Verizon	Communication	12" - FO	64' South of UPRR	074+46.55	Within UPRR RW	Conflict	Design complete and approved 10/24/11
59 & 60	Qwest	Communication	2-2" FO	75' South of UPRR	41+18	Within UPRR RW	Conflict	Design complete and approved Sept. 2011
27	Qwest	Telephone	2-4" PVC	North side of Lower Buckeye Rd	161+48.00	No	Conflict	Design currently underway
30A	Qwest	Telephone	4" PVC	1100' South of Yuma	202+86.00	No	Conflict	Design currently underway
35 &35A	Qwest	Telephone	1-2" + 2-1.5"	North side of Yuma Rd	214+51.72	No	Conflict	Design currently underway
36	Qwest	Telephone	1- 1.5"	North side of Yuma Rd	214+62.14	No	Conflict	Design currently underway
41	Qwest	Telephone	2" PE	South side of Van Buren St	267+12.85	No	No Conflict	Protect in place
32	Sprint	Telephone	4" BIP Steel	South side of Yuma Rd	213+86.92	No	Conflict	Need to relocate conduit
	SRP (APS) Palo Verde - Rudd	Overhead Power	500 kV	1200' North of Southern Ave	31+95	No	No UG Conflict	Checked vertical clearance of 500 KV lines.
	SRP (APS)	Overhead Power	230 kV	1200' North of Southern Ave	31+95	No	No UG Conflict	Checked vertical clearance of 230 KV lines.
54 & 55	SWG	Gas	4" Steel	In MC 85	054+10.00	No	Potential Conflict	Design complete. Scheduling relocation.
12	SWG	Gas	16" Steel	North side of Broadway Rd	094+19.00	No	Conflict	Design complete. Scheduling relocation.
34	SWG	Gas	3" Steel	South side of Yuma Rd	214+11.00	No	Conflict	Design complete. Scheduling relocation.
51	SWG	Gas	6" Steel	North side of Van Buren St	267+90.00	No	Conflict	Design complete. Scheduling relocation.
N/A	UPRR	Communications	OH	32' South of UPRR	074+78.77	No	Conflict	UPRR planning to underground communication lines at new channel location
N/A	WAPA (Liberty-Coolidge)	Overhead Power	230 kV	1256' North of Broadway Rd Alignment	146+70.29	No	No UG Conflict	New box structure will be installed here to address 50' buffer criteria
N/A	WAPA (Liberty-Estrella)	Overhead Power	230 kV	1350' North of Southern Ave	033+50.00	No	No UG Conflict	Checked vertical clearance with 69 KV pole or lines.

Notes:
1. This inventory is based on the following:
a) The existing utility file provided by Wood Patel Dated on Jan 4, 2011
b) 96" PVNG As-builts
c) GIS exhibit provided by WAPA
d) Irrigation exhibit provided by Wood Patel
e) WAPA overhead lines were confirmed by Jo

Loop 303 Outfall Drainage System Design

IRRIGATION TRACKING REPORT

AZTEC Project No.: AZE1009

Updated 8/09/11

	Owner/Irrigation Company	Facility	Type	General Location	Station	Disposition	Remarks
1	BIC	BIC Wasteway	Earth Channel	East side of 303 Outfall Channel Alignment	7+75 to 30+50 Right	Conflict	Abandon and fill in the existing BWCDD Wasteway Outfall ditch from the river north to new wasteway spillway into channel at Station 30+26
2	Private	Tailwater	Spillway	East side of 303 Outfall Channel Alignment	19+85 Rt	Needs review	Confirm use of new concrete spillway to outlet irrigation tailwater at SW corner of APN 502-49-008. Need to confirm TCE requirements.
3	Private	Tailwater	Pipe and outlet	West side of 303 Outfall Channel Alignment	20+50 Lt	Needs design	Tailwater ditch at SE corner of APN 502-49-006 on west side of future outfall channel will tie directly into west side of future channel. Confirm TCE requirements.
4	Private	Tailwater	Pipe and outlet	East side of 303 Outfall Channel Alignment	25+50 Rt	Needs design	Tailwater ditch at SW corner of APN 502-49-008 will connect south under farm road and then west to tie into new 303 outfall channel via pipe and new concrete spillway
6	BWCDD	Irrigation	Tailwater Ditch	1200' south of BWCDD Main Canal	30+95 Rt	No Conflict	Tailwater ditch/pipe will tie directly into BWCDD Wasteway
	BWCDD	Irrigation	Tailwater Ditch	1150' south of BWCDD Main Canal	31+50 Rt	No Conflict	Tailwater ditch/pipe will tie directly into BWCDD Wasteway
	BWCDD	Irrigation	Tailwater Ditch	1050' south of BWCDD Main Canal	32+25 Rt	Needs Design	Tailwater ditch/pipe will tie south directly into BWCDD Wasteway
8	BWCDD	Irrigation	Tailwater Ditch	550' South of Buckeye Canal	36+50	Needs design	Irrigation will be maintained on both east and west side of future Outfall Channel. Tailwater on east side of the channel will tie directly into the Channel.
10	BWCDD	Irrigation	Tailwater Ditch	60' South of Buckeye Canal	41+90	Needs design	New Irr ditches & pipes along east side of channel and new Junction boxes, ditches and pipes on west side. No Irrigation ditch crossing channel.
11	BWCDD	Irrigation	Delivery Ditch	40' South of Buckeye Canal	42+15	Needs design	New Irr ditches & pipes along east side of channel and new Junction boxes, ditches and pipes on west side. No Irrigation ditch crossing channel.
12	BWCDD Irrigation Canal	Irrigation	BWCDD Canal	1343' South of MC85	42+60	Needs design	New alignment for canal (Permanent Shoe-Fly)
13	Private	Irrigation	Tailwater Ditch	North side of BWCDD canal	43+20 Rt	Needs design	Tailwater ditch located on east side of Outfall Channel north of BCWDD canal will need to tie directly into north side of BWCDD canal.
15	Private	Irrigation	Delivery Ditch	South side of MC85	53+55	Needs design	Private Facility - New Pipe connection proposed Wood Patel to design.
16	Private	Runoff/Tailwater	Spillway	Along east side of 303 channel north of MC 85 - 980' south of UPRR	58+00 Rt	Needs review and/or design	Confirm use of new concrete spillway for tailwater runoff from SW corner of APN 502-49-014F into the channel.
18	BWCDD	Well	N/A	South of UPRR - west side of channel	56+15 Lt	No Conflict	Protect in place
19	RID	Irrigation	Earthen Channel	100' South of UPRR	74+10	Needs design	Replacement of the existing Irrigation ditch will be required here. New pipe proposed.

IRRIGATION TRACKING REPORT

AZTEC Project No.: AZE1009

Updated 8/09/11

	Owner/Irrigation Company	Facility	Type	General Location	Station	Disposition	Remarks
20	RID	Irrigation	Tailwater Ditch	41' North of UPRR	75+75 to 76+30	Needs design	Replacement of the existing Irrigation ditches will be required here on both east and west sides of new channel. New pipes south to RID Tailwater ditch are proposed.
23	Private	Irrigation	Delivery Ditch	South side of Broadway Road	92+90	Needs design	New Flume is proposed here.
24	Private	Irrigation	Tailwater Ditch	North side of Broadway Road to east of corridor	98+00, 200' Rt	Needs design	Tailwater ditch on east side of future outfall channel will need to tie directly into existing ditch on south side of Broadway Road.
	Private	Irrigation	Delivery Ditch	East side of new channel corridor	95+00 to 109+00 Rt	Need design for new delivery ditch	Need new irrigation delivery ditch on east side of future outfall channel
25	Private	Irrigation	Delivery Ditch	450' SW of 175th Avenue	109+50	Needs design	New Irrigation pipe proposed here
	Private	Irrigation	Delivery Ditch	West side of corridor between existing irr ditch and 175th Ave	109+00 to 114+00 Lt	Needs design	New Irrigation ditch proposed here
26	RID	Irrigation	Delivery Ditch	West side of 175th Avenue	113+90	Conflict	New Irrigation pipe is proposed here
27	Private	Irrigation	Delivery Ditch	South side of Elwood Street	130+80	No Conflict remove ditch	Private irrigation ditch has not been used for 20 years. No plans to replace this existing irrigation ditch.
28	Private	Irrigation	Delivery Ditch	1200' North of Elwood Street	143+10	No Conflict remove ditch	Private irrigation ditch has not been used for 20 years. No plans to replace this existing irrigation ditch.
29	RID	Irrigation	Delivery Ditch	South side of Lower Buckeye	161+00	No Conflict	Existing delivery ditch Lateral 6WL on south side of Lower Buckeye is abandoned. Stantec to verify.
30	RID	Irrigation	Tailwater Ditch	North side of Yuma Road	214+70	Needs design	The plan is to replace the existing tailwater ditch with a new conc lined ditch.
31	Private	Irrigation	Delivery Ditch	South side of Private Driveway	227+60	Needs design	Replace existing private delivery ditch with a new 12" irrigation pipe along the south side of access road.
32	Private	Irrigation	Delivery Ditch	South side of Lilac Street	240+45	Needs design	New RCBC has been extended further south to allow room for a new pipe to be constructed on the south side of the Lilac Road.
33	Private	Irrigation	Tailwater Ditch	North side of Lilac Street	241+10	No Conflict	The existing tailwater ditch on north side of Lilac will not be maintained across the new corridor. The tailwater west of corridor will cross south under Lilac in a new pipe to TW ditch on south side of Lilac. Tailwater east will flow east.
34	Private	Irrigation	Delivery Ditch	130' South of Van Buren Road	265+70	Conflict	New Irrigation pipe is proposed here (Solution Unclear). Stantec to investigate
35	Private	Irrigation	Delivery Ditch	South side of Van Buren Road	267+00	No Conflict	This delivery ditch has been abandoned and does not require any reconstruction.

Notes:

1. This inventory is based on the following:

a) Irrigation exhibit provided by Wood Patel

b) Existing RID Lateral Irrigation System exhibit provided by Stantec

c) Discussions in the Irrigation Coordination meetings

LOOP 303 OUTFALL CHANNEL
FCD CONTRACT NO. 2010C002

UtilityTeam Contact List

Aztec Engineering

Last Updated: 10/18/11

AGENCY	NAME	PROJECT ROLE	ADDRESS	PHONE	CELL	E-Mail Address
ADOT VPM	Velvet Mathew	ADOT Valley Proj. Management	1611 W. Jackson Street, MD EM01 Phoenix, AZ 85007	(602) 712-3062	(602) 712-7630	vmathew@azdot.gov
ADOT Utility/RR	Robert Travis	ADOT Utility R/R, RR liason re; Loop 303	205 S. 17th Ave. MD618E Phoenix, AZ 85007	(602) 712-6193	(602) 712-3229	rtravis@azdot.gov
APS	John Rael	APS Contact	For Deliveries: 2133 W. Peoria Ave, Phoenix, AZ 85021 For US Mail: P.O. Box 53933, Mail Station 3876 Phoenix, AZ 85072-3933	(602) 371-6945	(602) 361-7817	John.Rael@aps.com
APS	Mike Bouche	APS Contact		(602) 371-7033		Mike.Bouche@aps.com
APS	Bobby Garza	APS Project Manager (69Kv & under)	P.O.Box 53999 Mail Sta. 3162, Phx, AZ 85072-3933	(602) 371-7989	(602) 371-6600	baldemar.garza@aps.com
APS	Paul Richards	APS, West Area Proj. Manager (Transmission)	PO Box 53933 Station 3040 Phoenix, AZ 85072-3933	(602) 371-6186 (602) 371-7621	(602) 316-5152	Paul.Richards@aps.com
APS - PVNGS	Moe Afzai	Arizona Public Service (Palo Verde Reclaimed Water)		(623) 393-3675		mafzai@apsc.com

LOOP 303 OUTFALL CHANNEL
FCD CONTRACT NO. 2010C002

UtilityTeam Contact List

Aztec Engineering

Last Updated: 10/18/11

AGENCY	NAME	PROJECT ROLE	ADDRESS	PHONE	CELL	E-Mail Address
APS - PVNGS	Randy Butler	Arizona Public Service (Palo Verde Reclaimed Water)	Palo Verde Nuclear Generating Station, Station 6215, PO Box 52034 Phoenix, Az. 85072	(623) 393-3003	(623) 393-1688	randy.butler@aps.com
APS	Edmund Ramirez	APS, Sr. Public Safety Consultant	400 N. 5th Street, M.S. 9718, Phoenix, AZ, 85004	(602) 250-3415	(602) 694-4181	edmund.ramirez@aps.com
AZTEC	Dave Goos	Utility Coordinator	4561 E. McDowell Rd, Phoenix, AZ 85008	(602) 454-0402 (602) 659-9329	(480) 236-0018	dgoos@aztec.us
AZTEC	Robert Lyons	Utility Manager	4561 E. McDowell Rd, Phoenix, AZ 85008	(602) 454-0402 (602) 659-9325	(480) 241-0159	rlyons@aztec.us
AZTEC	Tony Bokich	Project Manager	4561 E. McDowell Rd, Phoenix, AZ 85008	(602) 454-0402 (602) 458-7487	(480) 459-0771	tbokich@aztec.us
BWCDD	Ed Gerak	General Manager	205 Roosevelt Ave. PO Box 1726 Buckeye AZ 85326	(623) 386-2196	(602) 722-7251	dneese@bwcdd.com
City of Goodyear	Darren Farar	Civil Engineer	3075 N. Litchfield Rd. Goodyear, AZ 85338	(623) 882-7990		darren.farar@goodyearaz.gov
City of Goodyear	Keith Brown	Manager	195 N 145th Ave Goodyear, AZ 85338	(623) 882-7956	(623) 932 - 3010	keith.brown@goodyearaz.gov
COX	Mike McNeal	COX	1231 West University Dr. Mesa AZ 85201	(480) 827-6048		mmcneal@cox.net
Cox-Fiber	Ben Baich	COX	1550 W. Deer Valley Rd. Phoenix, AZ 85027			ben.baich@cox.com

LOOP 303 OUTFALL CHANNEL
FCD CONTRACT NO. 2010C002

UtilityTeam Contact List

Aztec Engineering

Last Updated: 10/18/11

AGENCY	NAME	PROJECT ROLE	ADDRESS	PHONE	CELL	E-Mail Address
Cox-Fiber	Randy Sims	COX	1425 W. 14th St Tempe, AZ 85281	(623) 328-4500	(602) 694-1783	randy.sims@cox.com
FCDMC	Gary Maiers	Utility Coordinator FCDMC	2801 W. Durango St., Phoenix, AZ 85009	(602) 506-0562	(602) 525-3439	gsm@mail.maricopa.gov
FCDMC	Michael Duncan	Project Manager FCDMC	2801 W. Durango St., Phoenix, AZ 85009	(602) 506-4732		mwd@mail.maricopa.gov
FCDMC	Robert Sachs	Right of Way Agent FCDMC	2801 W. Durango St., Phoenix, AZ 85009	(602) 506-4744		res@mail.maricopa.gov
J2 Design	James Philbin	Project Designer		(602) 438-2221		jphilbin@j2design.us
Kinder Morgan Energy	Dan Tarango	Contact	Phoenix, AZ 85043	(602) 278 - 2320	(480) 797-4567	tarangod@kindermorgan.com
Kinder Morgan Energy	Dave Andries	Designer	Country Rd. Orange, CA 92868-4600	(714) 560-4717		dave_andries@kindermorgan.com
Kinder Morgan Energy	James Pigg	Contact		(602) 278 - 8564		
Kinder Morgan Energy	Scott Davis	Contact		(714) 493 - 1278		scott_davis@kindermorgan.com
Level 3	Carlos Muniz (Supervisor)	Contact	811 S. 16th street Phoenix, AZ 85034	(623) 215-5129	(602) 322-2162	carlos.muniz@level3.com
Level 3	John Trujillo	Design Representative				john.trujillo@level3.com

LOOP 303 OUTFALL CHANNEL
FCD CONTRACT NO. 2010C002

UtilityTeam Contact List

Aztec Engineering

Last Updated: 10/18/11

AGENCY	NAME	PROJECT ROLE	ADDRESS	PHONE	CELL	E-Mail Address
MCI	Dan Garden	Contact	157 South Lilac Ave Rialto, CA 92376	(909) 421-3316	(951) 536-1200	dan.garden@verizonbusiness.com
Parsons Brinkerhoff	Paul Bolster	Utility Coordinator for 303 Project	350 W. Washington St Suite 300 Tempe, AZ 85281	(480) 449-4932	(480) 231 3327	bolster@pbworld.com
Parsons Brinkerhoff	Tom O'Reilly	Project Manger for 303 Design	350 W. Washington St Suite 300 Tempe, AZ 85281	(480) 966-8295		oreilly@pbworld.com
PEC	Mike Heaton	Project Manager	2310 W. Mission Lane, Suite 4, Phoenix, AZ 85021	(602) 906-1901		mheaton@pec.us.com
PEC	Ying Xu	Project Engineer	2310 W. Mission Lane, Suite 4, Phoenix, AZ 85021	(602) 906-1901		yxu@pec.us.com
Century Link/Qwest	Eric Hitchcock	Century Link (Qwest)- Senior Design Engineer	135 W. Orion St. Tempe, AZ 85283	(602) 630-5474	(602) 460-1233	eric.hitchcock@qwest.com
Century Link/Qwest	Matt Phillips	Century Link (Qwest)- Senior Design Engineer	135 W. Orion St. Tempe, AZ 85283	(602) 630-1393	(602) 234-2032	matthew.phillips@qwest.com
Century Link/Qwest (National)	Mike Mullins	Century Link (Qwest) Communications, (Area Manager)	6894 N. Camino Martin, Suite 120 Tucson, AZ 85741	(520) 572-4736 (520) 617-0496	(520) 971-7256	Mike.mullins@qwest.com
RID	Donovan Neese	RID - Superintendent	103 W. Baseline Rd. Buckeye, AZ 85326	(623) 386 - 2046		dneese@rooseveltirrigation.org
Sprint	Colin Sword	Sprint Rep	401 W. Harrison St., Phoenix, AZ 85003	(602) 417-0970	(602) 430-3615	colin.sword@sprint.com

LOOP 303 OUTFALL CHANNEL
FCD CONTRACT NO. 2010C002

UtilityTeam Contact List						Aztec Engineering
						Last Updated: 10/18/11
AGENCY	**NAME**	**PROJECT ROLE**	**ADDRESS**	**PHONE**	**CELL**	**E-Mail Address**
Sprint	Wendell McGehee	Sprint Rep	401 W. Harrison Street Phoenix, Arizona 85003	(602) 417-0970	(602) 740-3969	Wendell.P.McGehee@sprint.com
SRP	Wayne Darby	SRP Rep	SRP Central Mail Receiving Station 2727 E. Washington St. Phoenix, AZ 85034-1403 Delivery address only	(602) 236-4882		Wayne.Darby@srpnet.com
SRP	Michael Watson	Land Agent	SRP Mail Station PAB350 P.O. Box 52025 Phoenix, AZ 85072-2025	(602) 236-8176		michael.watson@srpnet.com
Stantec	Zane Hoit	Manager	8211 S. 48th St. Phoenix, AZ 85044	(602) 438-2200	(602) 791-2988	zane.hoit@stantec.com
Stantec	Jared Grandy	Engineer - Stantec/BID	8211 S. 48th St. Phoenix, AZ 85044	(602) 438-2200	(602) 919-1562	jared.grandy@stantec.com
SWG	Carlos Flores	Design Representative	9 South 43rd Avenue Phoenix, AZ 85009-4633	(602) 484-5339	(602) 763-3941	carlos.florez@swgas.com
UPRR	Alex Popovici	Engineer	631 S. 7th Street Phoenix, AZ 85034	(602) 322-2510		apopovic@up.com
WAPA	Jessica Herndon	Design Representative	P.O. Box 6457 Phoenix AZ 85005		(602) 605-2727	Herndon@wapa.gov

LOOP 303 OUTFALL CHANNEL
FCD CONTRACT NO. 2010C002

UtilityTeam Contact List

Aztec Engineering

Last Updated: 10/18/11

AGENCY	NAME	PROJECT ROLE	ADDRESS	PHONE	CELL	E-Mail Address
Wood Patel	Steve Scinto	Project Engineer	2051 W. Northern, Suite 100, Phoenix, AZ 85021	(602) 335-8500 (602) 335-8518		sscinto@WoodPatel.com
Wood Patel	Jeff Minch	Project Manager	2051 W. Northern, Suite 100, Phoenix, AZ 85021	(602) 335-8500 (602) 335-8577	(602) 695-5487	jminch@WoodPatel.com

Testhole Data Summary

AZTEC
www.aztec.us TYPSA group

Date: 7/6/2011

Project Number: AZE1009-009

Project Name: SR 303L Outfall Drainage Channel

REGISTERED LAND SURVEYOR
CERTIFICATE NO.
35316
CHAD
HUBER
Date Signed
ARIZONA, U.S.A.

EXPIRES 09/30/2012

TH #	Location	Date of Excavation	Utility Owner	Utility Size	Utility Description	Coordinates		Stationing		Ground Elevation	Top Elevation	Bottom Elevation	Depth of Cover	Comments
						Northing	Easting	Stationing	Offset					
1	Southern Avenue & 175th Avenue Alignment	3/24/2011	Qwest Local Network	None	None	None	None	None	None					No facility in the requested location per Roy with ELM.
2	Buckeye Canal west of 175th Avenue Alignment	2/25/2011	Arizona Public Service	96"	RCP	872948.80	541505.83	None	None	897.33	891.39	881.76	5.94	
3	Buckeye Canal west of 175th Avenue Alignment	2/25/2011	Arizona Public Service	96"	RCP	872980.52	541579.55	None	None	897.37	891.51	881.88	5.86	
4	South side of UPRR tracks east of Citrus Rd Alignment	7/1/2011	MCI Fiber Optic	12"	STL	874651.09	539375.57	None	None	899.37	894.75	893.69	4.62	
5	South side of UPRR tracks east of Citrus Rd Alignment	7/1/2011	MCI Fiber Optic	12"	STL	874659.48	539435.44	None	None	898.90	894.70	893.64	4.20	
6	South side of UPRR tracks east of Citrus Rd Alignment	7/1/2011	Level 3 Fiber Optic	2"	PE	874637.48	539369.59	None	None	899.48	895.94	895.77	3.54	
7	South side of UPRR tracks east of Citrus Rd Alignment	7/1/2011	Level 3 Fiber Optic	2"	PE	874645.78	539437.44	None	None	899.12	895.30	895.13	3.82	
8	South side of UPRR tracks east of Citrus Rd Alignment	7/1/2011	Kinder Morgan	20"	FBE Coated STL	874659.02	539370.94	None	None	899.38	895.36	893.69	4.02	
9	South side of UPRR tracks east of Citrus Rd Alignment	7/1/2011	Kinder Morgan	20"	FBE coated STL	874667.86	539435.90	None	None	898.84	894.98	893.31	3.86	
10	North of RR Tracks east of Citrus Road Alignment	2/25/2011	Level 3 Fiber Optic	Eight 1.5"	PE	874794.76	539347.51	None	None	900.84	896.40	895.82	4.44	
11	North of RR Tracks east of Citrus Road Alignment	2/25/2011	Level 3 Fiber Optic	Eight 1.5"	PE	874803.92	539416.51	None	None	900.81	896.43	895.85	4.38	
12	Broadway Road east of Citrus Road	2/25/2011	Southwest Gas	16"	STL	876022.86	540323.98	None	None	904.57	899.97	898.64	4.60	
13	175th Avenue north of Broadway Road	3/24/2011	Qwest Local Network	None	None	None	None	None	None					No facility in the requested location per Roy with ELM.
14	175th Avenue north of Broadway Road	3/24/2011	Qwest Local Network	None	None	None	None	None	None					No facility in the requested location per Roy with ELM.

15	175th Avenue & Elwood Road	3/8/2011	City of Goodyear Sewer	8"	DIP	877974.85	542273.57	None	None	921.03	910.85	910.10	10.18	
16	175th Avenue & Elwood Road	3/8/2011	City of Goodyear Sewer	10"	DIP	877973.67	542275.69	None	None	921.03	910.81	909.88	10.22	
17	Southeast of 175th Avenue & Elwood Road	2/28/2011	City of Goodyear Sewer	8"	DIP	878246.88	542499.54	None	None	922.83	913.67	912.92	9.16	
18	Southeast of 175th Avenue & Elwood Road	2/28/2011	City of Goodyear Sewer	10"	DIP	878245.51	542501.80	None	None	922.82	913.82	912.89	9.00	
19	Southeast of 175th Avenue & Elwood Road	2/28/2011	City of Goodyear Sewer	10"	DIP	878489.82	542734.26	None	None	923.44	916.70	915.77	6.74	
20	Southeast of 175th Avenue & Elwood Road	2/28/2011	City of Goodyear Sewer	8"	DIP	878495.65	542740.46	None	None	923.43	916.61	915.86	6.82	
21	Lower Buckeye Road & Cotton Lane	3/8/2011	City of Goodyear Water	16"	DIP	879846.90	543710.21	None	None	935.18	929.80	928.35	5.38	
22	Lower Buckeye Road & Cotton Lane	3/8/2011	City of Goodyear Water	16"	DIP	879835.63	543744.65	None	None	934.95	929.69	928.24	5.26	
23	Southwest of Lower Buckeye Road & Cotton Lane	3/24/2011	Level 3	None	None	None	None	None	None					No Level 3 facilities in the requested location per Rob 480-205-1697.
24	Southwest of Lower Buckeye Road & Cotton Lane	3/24/2011	Level 3	None	None	None	None	None	None					No Level 3 facilities in the requested location per Rob 480-205-1697.
25	Lower Buckeye Road west of Cotton Lane	3/24/2011	Unknown Telephone	None	None	None	None	None	None					No facility in the requested location per bluestake markings.
26	Lower Buckeye Road west of Cotton Lane	3/16/2011	City of Goodyear Water	24"	DIP	881288.02	544154.06	None	None	940.13	936.13	933.98	4.00	
27	Lower Buckeye Road west of Cotton Lane	3/11/2011	Qwest Local Network	Two 4"	PVC	881302.34	544153.15	None	None	940.29	935.20	934.82	5.09	
28	Lower Buckeye Road west of Cotton Lane	3/16/2011	City of Goodyear Sewer	8"	PVC	881329.30	544159.06	None	None	941.12	932.72	932.00	8.40	
29	Lower Buckeye Road west of Cotton Lane	3/11/2011	City of Goodyear Sewer	8"	PVC	881335.71	544179.47	None	None	941.87	938.17	937.45	3.70	
30	1434 S. Cotton Lane	3/8/2011	Arizona Public Service	3"	PVC	885422.11	544203.02	None	None	961.73	957.85	957.56	3.88	
30A	1434 S. Cotton Lane	3/8/2011	Qwest Local Network	4"	PVC	885422.50	544204.45	None	None	961.72	957.96	957.58	3.76	
31	Yuma Road & Cotton Lane	3/18/2011	Arizona Public Service	See Note	PVC	886483.57	544208.47	None	None	965.92	959.42	959.92	6.50	Found two 4" and 3 smaller conduits.
32	Yuma Road & Cotton Lane	3/17/2011	Sprint	4"	Steel	886534.32	544204.04	None	None	966.09	961.23	960.86	4.86	

33	Yuma Road & Cotton Lane	3/17/2011	Cox Communications	See Note	PVC	886539.08	544203.94	None	None	966.15	962.05	961.33	4.10	Found three 2" and one 1.5" PVC conduits
34	Yuma Road & Cotton Lane	3/17/2011	SW Gas	3"	Steel	886542.51	544201.26	None	None	966.18	960.74	960.45	5.44	
35	Yuma Road & Cotton Lane	3/17/2011	Qwest Communications	2"	PE	886580.57	544194.08	None	None	966.24	962.96	962.79	3.28	
35A	Yuma Road & Cotton Lane	3/17/2011	Qwest Communications	1.5"	PE	886577.68	544193.10	None	None	966.26	963.50	963.38	2.76	
36	Yuma Road & Cotton Lane	3/17/2011	Qwest Communications	1.5"	PE	866584.89	544193.25	None	None	966.02	964.08	963.96	1.94	
37	Yuma Road & Cotton Lane	3/18/2011	Goodyear Water	24"	DIP	886591.60	544193.38	None	None	965.73	961.88	959.74	3.85	
38	Lilac Street west of Cotton Lane	3/14/2011	Water	12"	DIP	889218.42	544151.67	None	None	981.59	976.43	975.33	5.16	
39	Lilac Street west of Cotton Lane	3/11/2011	Cox Communications	Six 2" Two 3" One 4"	PVC	889239.47	544151.04	None	None	981.70	977.62	975.50	4.08	
40	Lilac Street west of Cotton Lane	3/11/2011	Arizona Public Service	Six 2" Two 3" One 4"	PVC	889239.49	544150.93	None	None	981.73	977.65	975.53	4.08	
41	Van Buren Street west of Cotton Lane	3/16/2011	Qwest Local Network	2"	PE	891806.64	544067.02	None	None	991.91	990.05	989.85	1.86	
42	Buckeye Canal west of 175th Avenue Alignment	3/24/2011	Southwest Gas	None	None	None	None	None	None					No SWG facility in the requeasted location per Roy with ELM.
43	Lower Buckeye Road west of Cotton Lane	3/14/2011	Sewer	10"	PVC	881254.80	544228.91	None	None	939.94	930.64	929.74	9.30	
44	Lower Buckeye Road west of Cotton Lane	3/15/2011	Sewer	8"	PVC	881277.84	544248.65	None	None	939.66	919.80	919.08	19.86	
45	Lower Buckeye Road west of Cotton Lane	3/15/2011	Sewer	24"	PVC	881275.14	544296.05	None	None	939.49	920.11	918.11	19.38	
46	Lower Buckeye Road west of Cotton Lane	3/14/2011	Sewer	15"	PVC	881276.32	544326.57	None	None	939.28	922.14	920.89	17.14	
47	Lower Buckeye Road & Cotton Lane	6/24/2011	Level 3	Two 1.5"	PE	881278.03	544410.57	None	None	938.79	934.81	934.65	3.98	
48	Lower Buckeye Road east of Cotton Lane	3/14/2011	Irrigation	30"	RCP	881276.70	544513.81	None	None	939.09	937.89	934.81	1.20	
49	Lower Buckeye Road east of Cotton Lane	3/16/2011	Water	24"	DIP	881284.27	544609.79	None	None	939.45	935.27	933.12	4.18	
50	Van Buren Street west of Cotton Lane	3/18/2011	Goodyear Water	24"	DIP	891866.72	544061.55	None	None	992.50	987.44	985.30	5.06	

51	Van Buren Street west of Cotton Lane	3/16/2011	Southwest Gas	6"	PE	891883.06	544063.24	None	None	991.96	988.38	987.83	3.58	
52	Lower Buckeye Road west of Cotton Lane	3/11/2011	Arizona Public Service	4"	PVC	881240.94	544226.25	None	None	939.89	935.01	934.63	4.88	
53	Lower Buckeye Road west of Cotton Lane	5/18/2011	Goodyear Brine Water Line	None	None	None	None	None	None					Hole cancelled per Jeff Minch with Wood Patel.
54	MC 85 north of Southern Avenue	5/18/2011	Southwest Gas	4"	STL	873647.35	540845.97	None	None	899.27	894.82	894.44	4.45	
55	MC 85 north of Southern Avenue	5/18/2011	Southwest Gas	4"	STL	873685.37	540889.53	None	None	899.61	894.81	894.43	4.80	
56	Cotton Lane south of Pima Street	5/18/2011	Arizona Public Service	42" Wide	Concrete Cap	884656.69	544259.69	None	None	957.64	953.12	952.80	4.52	Unable to verify conduits under concrete cap.
57	Cotton Lane south of Pima Street	5/18/2011	Arizona Public Service	Two 5"	PVC	884657.00	544296.47	None	None	956.77	951.17	950.71	5.60	
58	Lower Buckeye Road & Cotton Lane	6/24/2011	Qwest Local Network	4"	PVC	881277.57	544462.89	None	None	938.45	935.35	934.97	3.10	
59	South side of UPRR tracks east of Citrus Rd Alignment	7/1/2011	Qwest Communications	Two 2"	PE	874633.48	539439.10	None	None	899.47	895.17	894.92	4.30	
60	South side of UPRR tracks east of Citrus Rd Alignment	7/1/2011	Qwest Communications	Two 2"	PE	874624.20	539371.49	None	None	899.60	895.58	895.33	4.02	
61	1434 S. Cotton Lane	6/1/2011	Unknown	N/A	Sewer Leach Field	885383.52	544239.24	None	None	961.33		952.33		0-3 ft = hard soil; 3-9 ft = soft soil; 9+ ft = hard soil

Testhole Data Summary

AZTEC
www.aztec.us TYPSA group

Date: 11/8/2011

Project Number: AZE1009

Project Name: Loop 303 Outfall Channel

REGISTERED LAND SURVEYOR
CERTIFICATE NO.
35316
CHAD
HUBER
Date Signed
ARIZONA, U.S.A.

EXPIRES 09/30/2012

TH #	Location	Date of Excavation	Utility Owner	Utility Size	Utility Description	Coordinates		Stationing		Ground Elevation	Top Elevation	Bottom Elevation	Depth of Cover	Comments
						Northing	Easting	Stationing	Offset					
101	175th Ave north of Broadway Rd	11/3/2011	City of Goodyear Sewer	10"	DIP	877365.34	541758.66	None	None	913.40	904.56	903.63	8.84	
102	175th Ave north of Broadway Rd	11/3/2011	City of Goodyear Sewer	8"	DIP	877363.13	541760.42	None	None	913.52	904.62	903.87	8.90	
103	Yuma Rd west of Cotton Ln.	11/3/2011	Century Link Communications	4"	PE	886614.77	544041.25	None	Npne	966.72	961.28	960.90	5.44	
104	Yuma Rd west of Cotton Ln	11/3/2011	Century Link Communications	4"	PE	886608.78	544233.17	None	None	966.49	962.51	962.13	3.98	
105	Yuma Rd and Cotton Ln	11/3/2011	City of Goodyear Water	18"	CIP	886604.84	544309.08	None	None	966.17	960.27	958.61	5.90	
106	North side of Buckeye Canal east of MC 85	11/3/2011	Arizona Public Service	96"	RCP	872554.20	540569.57	None	None	898.83	889.82	880.19	9.01	
107	North side of Buckeye Canal east of MC 85	11/4/2011	Arizona Public Service	96"	RCP	872595.59	540682.17	None	None	896.76	889.14	879.51	7.62	

Loop 303 Outfall Drainage System Design
RELOCATION SUMMARY

LEGEND
Utility conflict resolved
Utility in conflict to be relocated by utility company

4/16/2012

Utility ID	Utility	Description	Status	Comment	Design Complete Date	Relocation Complete Date
			APS			
U-1	12 Kv Overhead Power	158' South of Buckeye Canal 041+18.42	Conflict	Conflict with proposed Buckeye Canal Shoo-Fly (There is telephone on this pole also) Need to relocate power line south within a new easement.	4/15/2012	8/15/2012
U-2	12 Kv Overhead Power	64' North of MC85 (Near Pump) 054+71.31	Conflict	Power Pole is in conflict with construction of new RCBC. Need to relocate powerpole and powerline. APS discussing several alternatives.	4/15/2012	7/15/2012
U-3	12 Kv Overhead Power	West side of 175th Ave 113+36.91	Conflict	Power Pole may only require bracing during construction. Construction equipment should be able to stay outside clear zone. APS considering options.	4/15/2012	7/1/2012
U-4	12 Kv Overhead Power	South side of Lower Buckeye Rd 160+88.00	Conflict	Design complete	3/6/2012	6/1/2012
U-5	4" PVC Underground Power	North side of Lower Buckeye Rd 161+50.00	Remove Power to Pump Station	City of Goodyear has provided APS a letter allowing them to abandon power to the Lift Station	3/6/2012	6/1/2012
U-6	UG PB & Conduit Underground Power	700' South of Moose Lodge 195+20.00	Conflict	Design complete		6/1/2012
U-7	12 Kv Underground Power	1100' South of Yuma 202+86.00	Conflict	Design complete	3/6/2012	6/1/2012
U-8	2-4" PVC Underground Power	South side of Yuma Rd 213+41.89	Conflict	Design complete	3/6/2012	6/1/2012
U-9	12 Kv Overhead Light Pole	South side of Yuma Rd 213+50.00	Conflict	Design complete	3/6/2012	6/1/2012
U-10	69 Kv Overhead Power	South side of Yuma Rd 213+51.28	Conflict	Issue with vertical clearance with 69 KV lines during construction	N/A	N/A
U-11	6-2"+2-3"+1-4" PVC Underground Power	North side of Lilac Street 241+12.41	Conflict	Design complete	3/6/2012	6/1/2012
			City of Goodyear			
U-12	8" DIP & 10" DIP Force Main Sewer	1300' South of Elwood Road to 100' south of Elwood Road 118+00 to 130+00	Conflict	Abandon and remove existing 8" and 10" Sewer Forcemains and install new 8" & 10" Sewer Forcemains on new alignment from Station 118+00 to 130+00.	2/28/2012	With Project Const.
U-13	8" DIP & 10" DIP Force Main Sewer	60' South of Elwood Road (50' west to 150' east) 130+50	Conflict	Install new 30" sewer forcemain along south side of Elwood Road from 50' west to 150 ' east.	2/28/2012	With Project Const.
U-14	16" ACP Water	Under WAPA Lines (North) 146+00.80	Conflict	Need to drop waterline under channel	2/28/2012	With Project Const.
U-15	24" DIP Water	North side of Lower Buckeye Rd 161+36.84	Conflict	Need to dip waterline under channel	2/28/2012	With Project Const.
U-16	Fire Hydrant Water	North side of Lower Buckeye Rd 161+45.75	Potential Conflict	May have to Relocate Fire Hydrant	2/28/2012	With Project Const.
U-17	12" PVC/MH Sewer	North of Lower Buckeye Rd 161+30.00	Conflict	Remove abandoned 12" sewer lines and manhole	2/28/2012	With Project Const.
U-18	24" PVC Sewer	South side of Lower Buckeye Rd 161+20.00	No Conflict	Tie new 21" PVC sewer line into manhole	N/A	N/A
U-19	8" PVC Force Main Sewer	North side of Lower Buckeye Rd 162+07.00	Conflict	Abandon and remove existing 8" Sewer Forcemain	2/28/2012	With Project Const.
U-20	24" VCP Sewer	Located West of Cotton Ln but not within 303 Outfall R/W 162+35.84	No Conflict	Deep sewer - Protect in Place	N/A	N/A
U-21	24" VCP Sewer	Located West of Cotton Ln but not within 303 Outfall R/W 178+45.00	No Conflict	Deep sewer - Protect in Place	N/A	N/A
U-22	24" PVC & 15" VCP Sewer	North side of Yuma Rd 214+40.00	No Conflict	Deep sewer - Protect in Place	N/A	N/A
U-23	24" DIP Water	North side of Yuma Rd 214+62.50	Conflict	Need to drop pipe under channel	2/28/2012	With Project Const.
U-24	12" DIP Water	North side of Lilac Street 240+96.74	Conflict	Need to drop pipe under channel	2/28/2012	With Project Const.
			Cox			
U-25	3x2" + 1x1.5" PVC TV	South side of Yuma Rd 213+94.00	Conflict	Dip conduit under channel (Permit Obtained)	Design Complete	6/30/2012
U-26	6x2" + 2x3" + 1x4" PVC TV	North side of Lilac Street 241+02.63	Conflict	Dip conduit under channel in joint trench with APS	Coord with APS	6/1/2012
			Kinder Morgan			
U-27	20" FBE Coated STL Gas	44' South of UPRR 074+66.00	Conflict	Agreement Signed - Relocation Design Underway	4/16/2012	5/11/2012
			Level 3			
U-28	2" PE - FO Communication	52' South of UPRR 074+60.00	Conflict	Agreement Signed - Relocation Design Underway	Design Underway	5/31/2012
U-29	FO - 8 x 1.5" Communication	95' North of UPRR 076+06.62	Conflict	Agreement Signed - Relocation Design Underway	Design Underway	5/31/2012

MCI/Verizon						
U-30	OH - Fog Line Communication	1287' North of Broadway Rd Alignment 143+02.00	No Conflict	MCI line is OH on WAPA towers	N/A	N/A
U-31	2" - FO Communication	64' South of UPRR 074+46.55	Conflict	Relocation Complete	Complete	Complete
Palo Verde Nuclear Generating Station Water Conveyance Pipeline (PVNGS)						
U-32	96" RCP Reclaimed Water	50' North of Buckeye Canal 043+41.48	Protect in Place	PROTECT IN PLACE- Special protection was required for this line that was designed by APS's consultant and constructed by APS. Construction occurred in Oct 2011	Complete	Complete
Qwest/Century Link						
U-33	2-2" FO Communication (National)	75' South of UPRR 41+18	Conflict	Relocation Complete	Complete	Complete
U-34	2-4" PVC Telephone	North side of Lower Buckeye Rd 161+48.00	Conflict	Design currently underway	No date provided	?
U-35	4" PVC Telephone	1100' South of Yuma 202+86.00	Conflict	Design currently underway	No date provided	?
U-36	1-2" + 2-1.5" Telephone	North side of Yuma Rd 214+51.72	Conflict	Design currently underway	No date provided	?
U-37	1- 1.5" Telephone	North side of Yuma Rd 214+62.14	Conflict	Design currently underway	No date provided	?
U-38	2" PE Telephone	South side of Van Buren St 267+12.85	No Conflict	Protect in place	N/A	N/A
Sprint						
U-39	4" BIP Steel Telephone	South side of Yuma Rd 213+86.92	Conflict	Need to lower 4" BIP with FO cable - Needs Discussion of Schedule	Design not Started	?
SRP (APS) Palo Verde-Rudd						
U-40	500 kV Overhead Power	1200' North of Southern Ave 31+95	No UG Conflict	Agreement in process	N/A	N/A
U-41	230 kV Overhead Power	1200' North of Southern Ave 31+95	No UG Conflict	Agreement in process	N/A	N/A
Southwest Gas						
U-42	4" Steel Gas	In MC 85 054+10.00	Conflict	Design complete. Scheduling relocation.	11/30/2011	8/31/2012
U-43	16" Steel Gas	North side of Broadway Rd 094+19.00	Conflict	Design complete. Scheduling relocation.	11/30/2011	8/31/2012
U-44	3" Steel Gas	South side of Yuma Rd 214+11.00	Conflict	Design complete. Scheduling relocation.	11/30/2011	8/31/2012
U-45	6" Steel Gas	North side of Van Buren St 267+90.00	Conflict	Design underway. Scheduling relocation.	4/30/2012	8/31/2012
UPRR						
U-46	OH Communications	32' South of UPRR 074+78.77	Conflict	UPRR planning to underground communication lines at new channel location	No date provided	?
WAPA (Liberty-Coolidge)						
U-47	230 kV Overhead Power	1256' North of Broadway Rd Alignment 146+70.29	No UG Conflict	Agreement in process	N/A	N/A
WAPA (Liberty-Estrella)						
U-48	230 kV Overhead Power	1350' North of Southern Ave 033+50.00	No UG Conflict	Agreement in process	N/A	N/A
Moose Lodge Power						
U-49	12 KV Overhead Power	1200' South of Yuma Rd 202+00.00	Conflict	Relocation of private power will be addressed by contractor as part of construction contract		With Project Const.

APPENDIX G

CD with HEC-RAS, Plans, and Exhibits Electronic File