Yellow River Ranch Mitigation Area

Santa Rosa County, Florida

Hydrologic – Hydraulic Study

Revised: February 22, 2008

Prepared by:

81 Water Management Drive
Havana, Florida 32333
(850) 539-5999

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

I. INTRODUCTION

The Northwest Florida Water Management District (NWFWMD) acquired property in 2005 in the Yellow River Floodplain that was altered and requires restoration. This property is located northeast of State Road 87 (SR 87) in Santa Rosa County, Florida. **Figure 1** shows the study area, which consists of approximately 227 acres. This site is part of a Restoration and Mitigation Plan [(1)] to restore impacted wetland areas to offset or mitigate Florida Department of Transportation projects performed on the SR 87. The study area has been designated the Yellow River Ranch Mitigation Area (YRRMA).

This report presents the findings associated with the development of a Hydrologic and Hydraulic Study (H & H) for the YRRMA. The objective of this study is to determine the flood levels in the mitigation area in order to establish a restoration and monitoring plan. **HDR Inc. [(2)] completed a detail study of the Yellow River in Okaloosa County, Florida to establish flood levels along the river. The hydrologic data of this study was used to complete the hydrologic analysis of the YRRMA in Santa Rosa County**.

II. SCOPE

The first part of this study covers the hydrologic analysis of the Yellow River drainage basin affecting the YRRMA. This included the review of historical information to compute the required hydrologic parameters and the use of the HDR hydrologic model results for the analysis of the YRRMA hydrologic characteristics. Discharge rates were modeled for storm events with return periods of 2, 10, 25, 50, 100 and 500 years with duration of 24 hours. These results help to determine the floodplain behavior and response in the YRRMA for major magnitude storm events. In addition, an analysis was performed using a 1 year, 3-hour storm event to obtain the lowest magnitude event affecting the study area. The second part of the analysis covers the hydraulic modeling of the existing and proposed conditions to determine the flood levels associated with the hydrologic model results.

Yellow River Ranch Mitigation Project

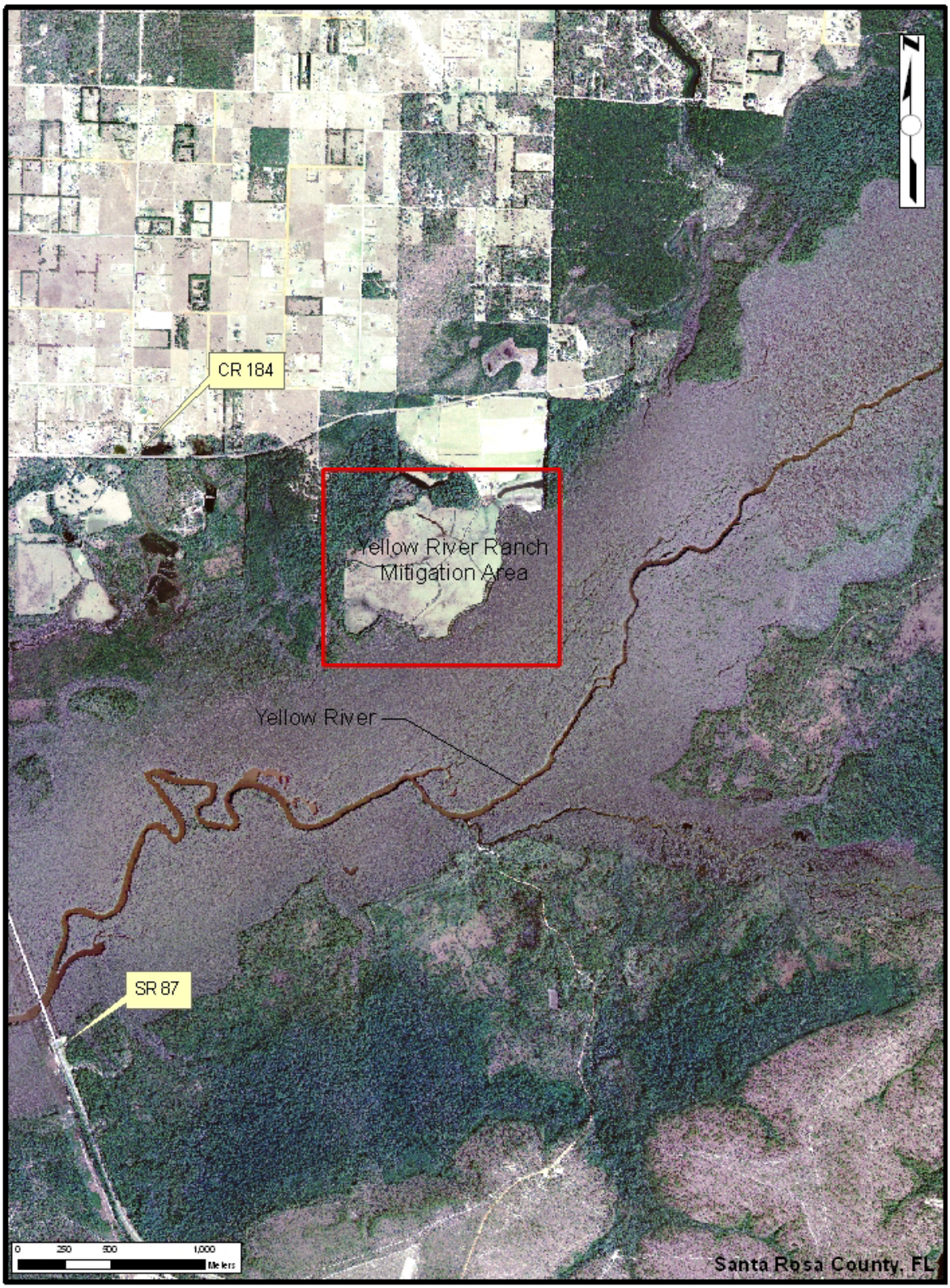


Figure 1 - Study Area

III. HYDROLOGY

a. Topography and Basin Characteristics

The initial hydrologic model parameters were obtained from the United States Geological Survey [(3)] (USGS) 7.5 minutes topographic quadrangles. A Geographic Information System (GIS) was used to represent all the digital topographic data. Using these tools the basin delineation and calculation of concentration, travel and lag times were performed. The Yellow River basin measures approximately 1,334 square miles at the outlet point in the study area, of which 65 square miles are within the Santa Rosa County. The other portions of the basin (1269 acres) extend into the Okaloosa and Walton Counties (Florida) and Alabama. The land elevations in the basin range from approximately 500 feet NVGD in Alabama to 3 feet NGVD at the outlet. The hydrologic analysis is limited to the area located at Santa Rosa, County. The rest of the hydrologic data was taken from the HDR Inc. model. **Figure 2** shows the Yellow River basin and sub-basins at Santa Rosa, County.

In addition, a Light Detection and Ranging (LIDAR) [(4)] analysis was performed to obtain digital elevation data in the YRRMA and in the Yellow River Floodplain. This analysis reflect elevations inside the YRRMA that range approximately from 4 to 8 feet NVGD (1.2 – 2.4 meters) for the land surface and from 4 to 12 feet NGVD (1.22 – 3.66 meters) for the berm. **Figure 3** shows the YRRMA topographic map with a 1 foot contour interval. A Break Lines [(5)] analysis was applied to the LIDAR data to define the flow paths in the study area. These highly accurate topographic data were then used with other digital information and field data to delineate floodplain boundaries.

b. Water Resources

The Yellow River, Shoal River and their tributaries are the major flow sources in the study area. The Yellow River generally runs from north to south, the Shoal River, (which runs from northeast to southwest) joins the Yellow River downstream of the I-10 highway. After the river junction, the Yellow River continues flowing to the southwest until it discharges into the East Bay.

Yellow River Ranch Mitigation Project

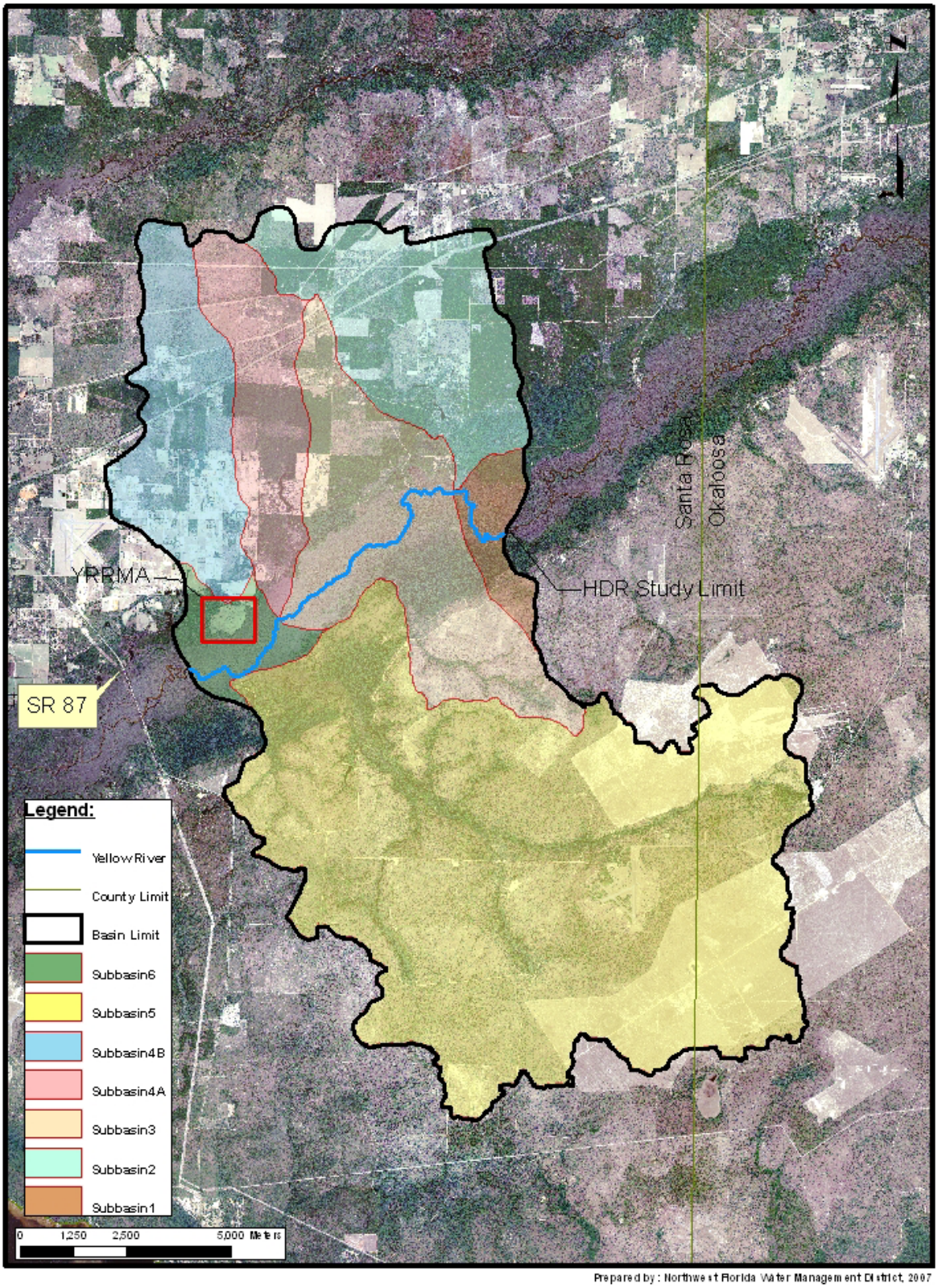


Figure 2 – Yellow River Basin

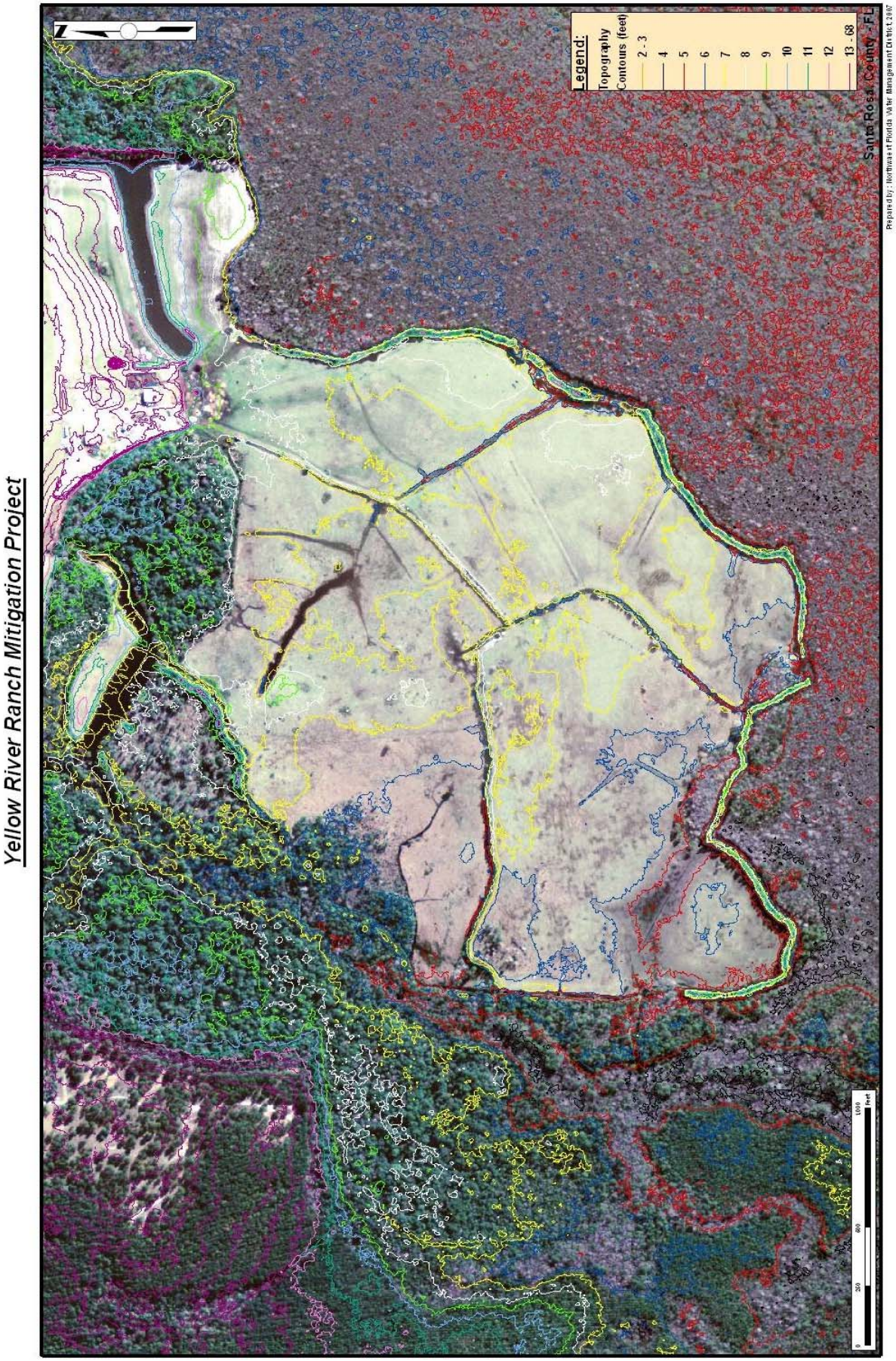


Figure 3 – Topographic Map

c. Soil Types

The soils types and associated infiltration capacities influence the runoff quantity generated by storm events in the watershed. The factors affecting the infiltration rate are: Hydrologic Soil Group (HSG), type of land cover, hydrologic condition and antecedent moisture condition (AMC), and agricultural practics for cultivated land. Soils are classified into four HSG's; A, B, C and D, according to their minimum infiltration rates, which range from well drained soils (HSG A) to poorly drained soils (HSG D). The Natural Resources Conservation Service [(6)] (NRCS, formerly the Soil Conservation Service) has established a system of curve numbers (CN), which are assigned based on the combination of the factors above. The AMC is an index of watershed wetness at the beginning of a storm. This index will be used to correct the weighted CN value obtained for each sub-basin. A condition of AMC II, average conditions, was used for this analysis. The AMC II represents the basin's state when the calibration storm event occurred, in which the conditions fall between dry soils (AMC I) and saturated soils (AMC III).

This study used the soil types located in Santa Rosa County for the CN calculations. **Figure 4** shows the Santa Rosa County soils map. Soils data were obtained through the Soil Survey Geographic (SSURGO) database, which is a digital version of the 1:24,000 scale soil survey maps created by the NRCS.

d. Land Use

Land use, land cover, and soil type control the quantity and quality of intercepted and infiltrated rainfall and the runoff. The CN parameter reflects the combination of land use, cover and soils. Land use data was taken from the Florida Land Use, Cover, Forms, and Classification System (FLUCCS) [(7)] prepared by the NWFWMD in 1995. **Figure 5** shows the existing land use in the study area and the **Appendix A** provides the CN calculations.

Yellow River Ranch Mitigation Project

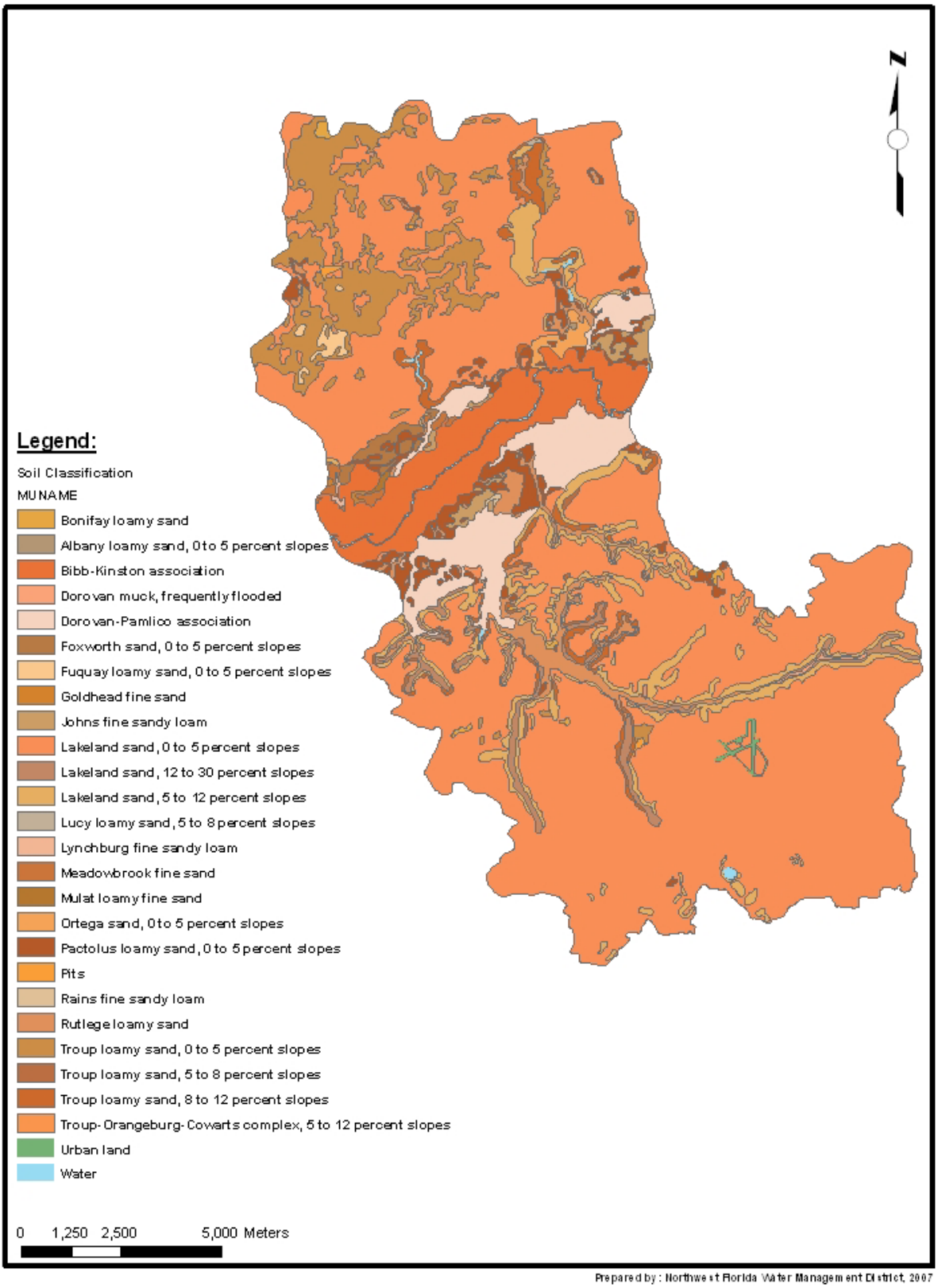


Figure 4 - Soil Types Classification

Yellow River Ranch Mitigation Project

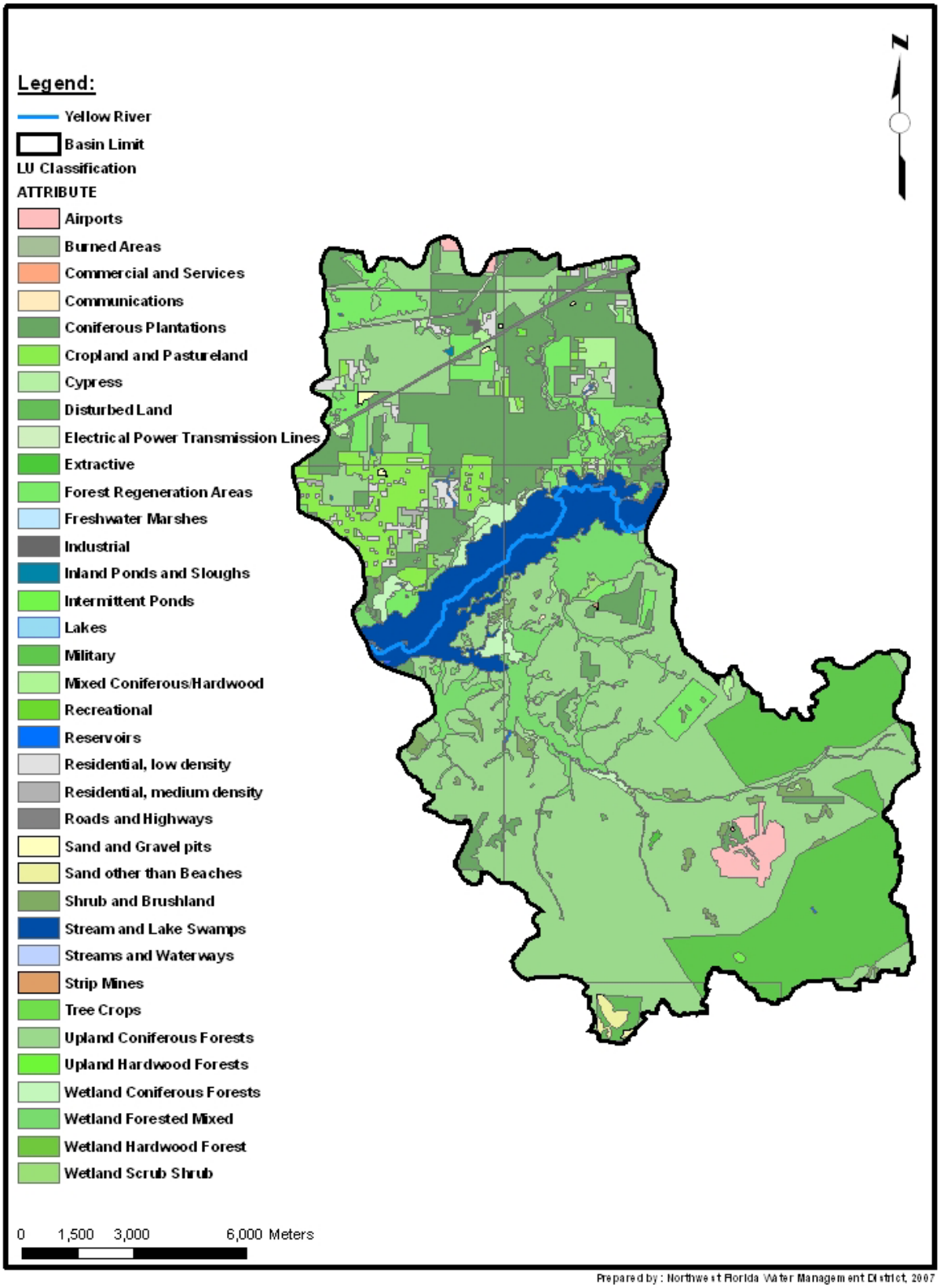


Figure 5 – Land Use Map

e. Precipitation Data

A storm event in March 1998 was the historical event used for the calibration of the model. This storm event was taken from the HDR study, in which the storm was reconstituted from radar reflectivity, hourly radar-estimated rainfall data, and upper air atmospheric soundings and surface observation data available from the National Weather Service (NWS). **Appendix B** shows the historical storm event used for the calibration.

The design storms were taken from the U.S. Weather Bureau [8] TP-40 using return periods of 2, 10, 25, 50, 100 and 500 years with a 24 hour storm duration. A precipitation value equal to 2.8 inches was used for the 1 year, 3-hour storm event. **Table 1** shows the precipitation data for each return period with a storm duration of 24 hours.

Table 1
Yellow River Ranch Watershed @ Santa Rosa County
Design Storms

Drainage Area (mi^2)	Precipitation (in) by Return Period					
	2-yr	10-yr	25-yr	50-yr	100-yr	500-yr
1334	5.4	8.5	9.8	11.1	12.1	14.5

f. Streamflow Data

The calibrated hydrograph obtained by HDR at the Okaloosa County outlet was used as the observed streamflow data for the analysis of the YRRMA (see **Appendix C**). A flow-area relationship was applied to ungaged areas to obtain the total streamflow in the study area. This relationship is represented by the following equation:

$$Q_y = \frac{Q_x}{A_x} A_y \qquad (1)$$

where

Q_y = flow at ungaged site, cfs

Q_x = flow at gaged site, cfs

A_y = drainage area at ungaged site, mi^2

A_x = drainage area at gaged site, mi^2

g. Methodology

The hydrologic model for the YRRMA was developed and calibrated using the Hydrologic Engineering Center – Hydrologic Modeling System [(9)] (HEC-HMS), the CN and time of concentration techniques presented in the SCS Technical Release No. 55 [(10)]. This model is designed to simulate the precipitation – runoff processes of dendritic watershed systems.

The SCS method estimates precipitation excess as a function of cumulative precipitation, soil type, land use, and antecedent moisture using the following equation:

$$P_e = \frac{(P - 0.2S)^2}{P + 0.8S} \qquad (2)$$

$$S = \left(\frac{1000}{CN}\right) - 10 \qquad (3)$$

where

P_e = accumulated precipitation excess, in

S = potential maximum retention watershed water after runoff begins, in

CN = curve number

The SCS unit hydrograph transformation was used to convert the excess precipitation into direct runoff. The following equations describe the parameters used in this method:

$$Q_p = \left(\frac{484A}{t_p}\right) \qquad (4)$$

where

Q_p = unit hydrograph peak discharge, cfs

A = basin area, mi^2

t_p = time to peak, hr

The basin time to peak is the time from the beginning of the rainfall event to the time at which the peak runoff rate is observed at the drainage outlet.

$$t_p = \left(\frac{\Delta t}{2}\right) + t_{lag} \qquad (5)$$

where

Δt = duration of excess precipitation, hr

t_{lag} = lag time, hr

The lag time is the time difference between the center of mass of rainfall excess and the peak of the unit hydrograph.

Appendix D shows the time of concentration and channel routing calculations. In addition, a recession baseflow method was used to approximate the typical base flow behavior observed in the basin using 3.0 cubic feet per second per square mile. The routing of the hydrographs through the channel was performed using the Lag Route method, which represents the transition of flood waves. Finally, the meteorological model selected was the SCS design storm method for the different return periods using a Type III rainfall distribution. The **Table 2** shows the main hydrologic parameters.

Table 2
Yellow River Ranch Watershed @ Santa Rosa County
Main Hydrologic Parameters

Sub-basin ID	Drainage Area (mi^2)	CN	Lag Time (min)	Optimized Lag Time (min)
1	1.77	77	111	106
2	8.62	45	344	1167
3	10.64	64	392	1330
4A	5.33	43	334	210
4B	6.87	43	279	946
5	29.55	51	810	1233
6	2.22	91	125	115

h. Calibration

The calibration was performed following the process called optimization, which begins from initial parameter estimates and adjusts them so that the simulated results match the observed streamflow as closely as possible. The univariate gradient method was the optimization algorithm selected.

The objective function is the quantitative measure of the goodness of fit between the computed result from the model and the observed flow. This function measures the degree of variation between computed and observed hydrographs. The selected objective function was the peak-weighted RMS error, which is a modification of the standard root mean square error that gives greatly increased weight to flows above average and less weight to flows below average. The SCS lag was the parameter selected to be calibrated using the objective function. **Appendix E** shows the results of the optimization process.

i. Results

All the hydrologic input data is in the U.S. Customary System (English units). Discharge results were converted into International (Metric units) to perform the hydraulic analysis. **Table 3** shows the peak discharges obtained from the hydrologic model for the 2, 10, 25, 50, 100 and 500 year return periods with a 24 hour storm duration. A discharge equal to 52.70 cubic meters per second (m^3/s) was obtained for a 1 year, 3-hour event. **Figure 6** and **Appendix F** show the Yellow River basin model layout and the complete hydrologic computer model results, respectively.

Table 3
Yellow River Ranch Watershed @ Santa Rosa County
Peak Discharge Summary

Node ID	Drainage Area (mi^2)	Peak Flows (m^3/s) by Return Period					
		2-yr	10-yr	25-yr	50-yr	100-yr	500-yr
J3	1295	377	883	1451	2123	2700	4403
J4	1325	381	887	1456	2127	2704	4407
Outlet	1334	383	888	1457	2129	2705	4408

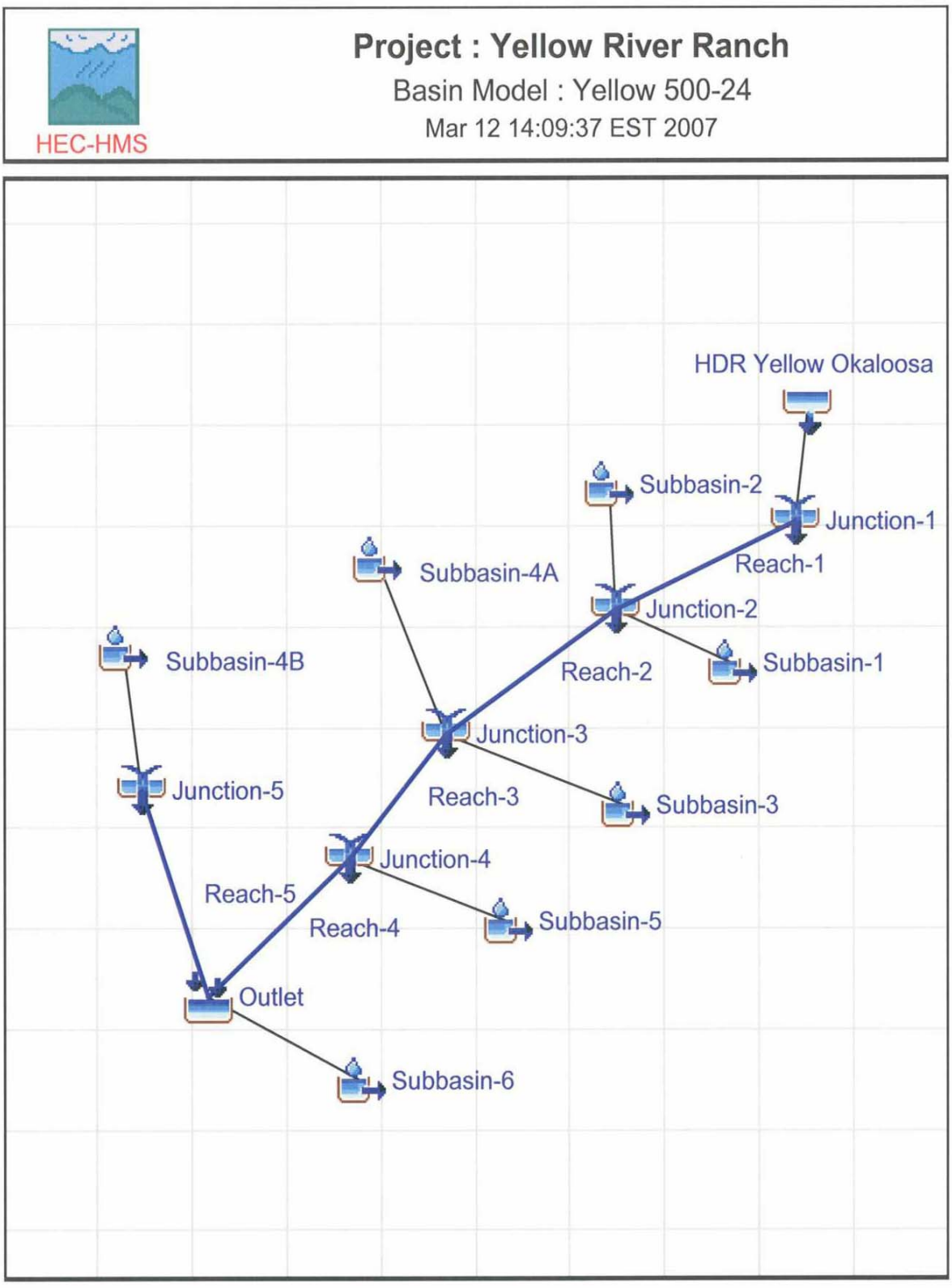


Figure 6 – Yellow River Basin Model Layout

IV. HYDRAULICS

The hydraulic analysis was performed using the Hydrologic Engineering Center – River Analysis System [(11)] (HEC-RAS) software with one-dimensional steady flow. The model used the peak discharges developed by the hydrologic model and other parameters described in the following sections to generate the flood elevations in the study area. The metric units were used for the hydraulics simulation.

a. Previous Studies

The segment under study is located within Flood Zone AE according to the Flood Insurance Rate Map of the Federal Emergency Management Agency (FEMA). [(12)] The water surface elevations presented in this study was used for the hydraulic model calibration.

b. Existing Conditions

The main channel of the Yellow River was simulated in the YRRMA hydraulic model. Main Channel. All the geometry data was taken from the HEC-GeoRAS [(13)] using the LIDAR data as a Digital Terrain Model (DTM) in a form of a Triangular Irregular Network (TIN). HEC-GeoRAS is a set of ArcGIS tools specifically designed to process geospatial data for use with HEC-RAS. Eighteen (18) cross sections were established for the hydraulic model. The river channel profile was taken from the FEMA study because LIDAR cannot accurately delineate streams channels. The Manning roughness coefficients were determined from field inspections and aerial photographs. **Appendix G** shows photographs taken during the field inspection. A coefficient of 0.12 was assigned to the heavily forested floodplains and 0.035 was assigned to main channel and pasture areas. [(14)]

The YRRMA contains a berm along the south and east boundary, which contains two openings and ditches at both sides. This analysis will determine the effect of these structures with respect to the flood elevations. **Figure 7** and **Figure 8** show the Yellow River cross sections layout and the existing hydraulic conditions in the study area based on a TIN, respectively.

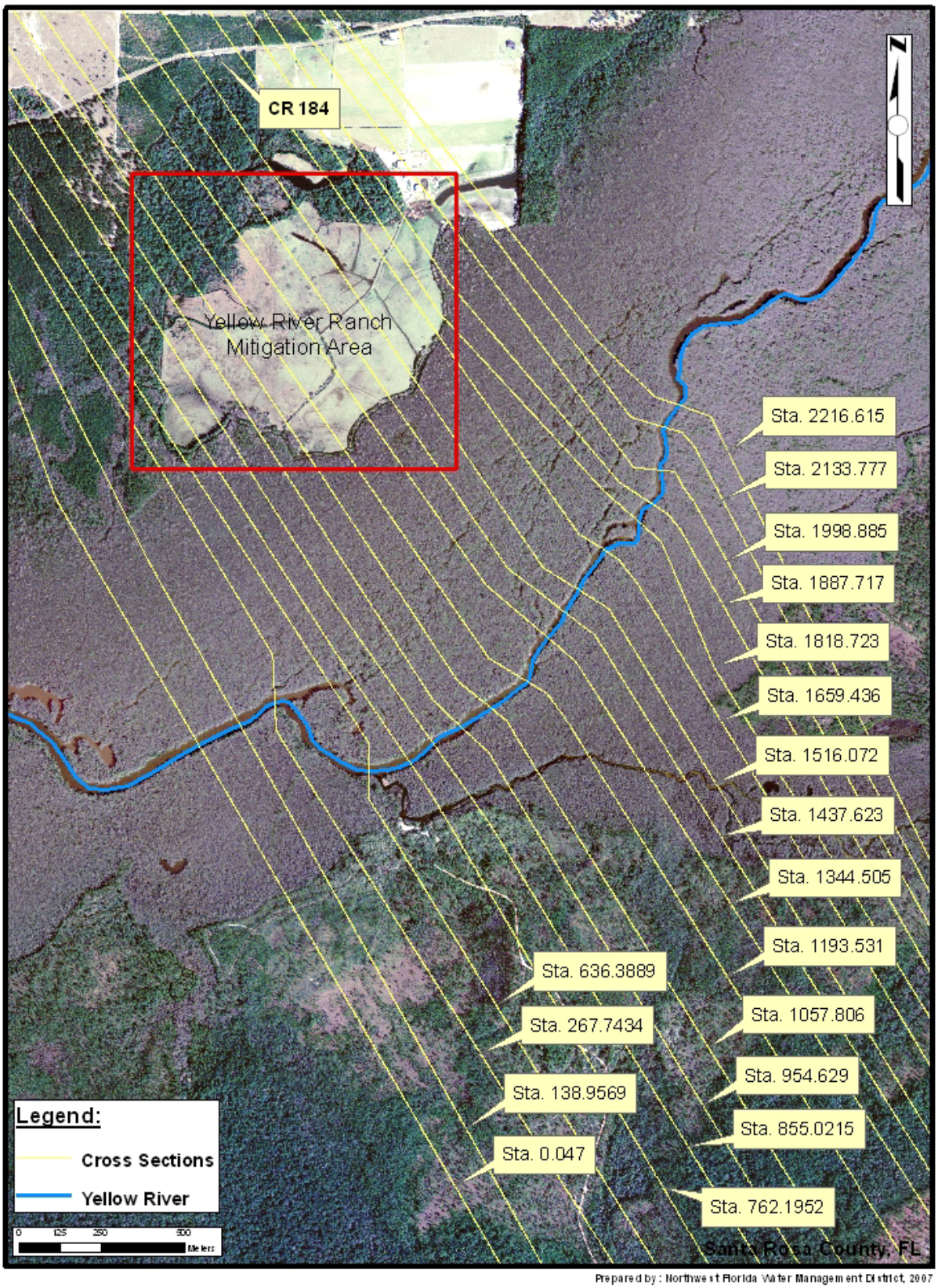


Figure 7 – Yellow River Cross Sections Layout

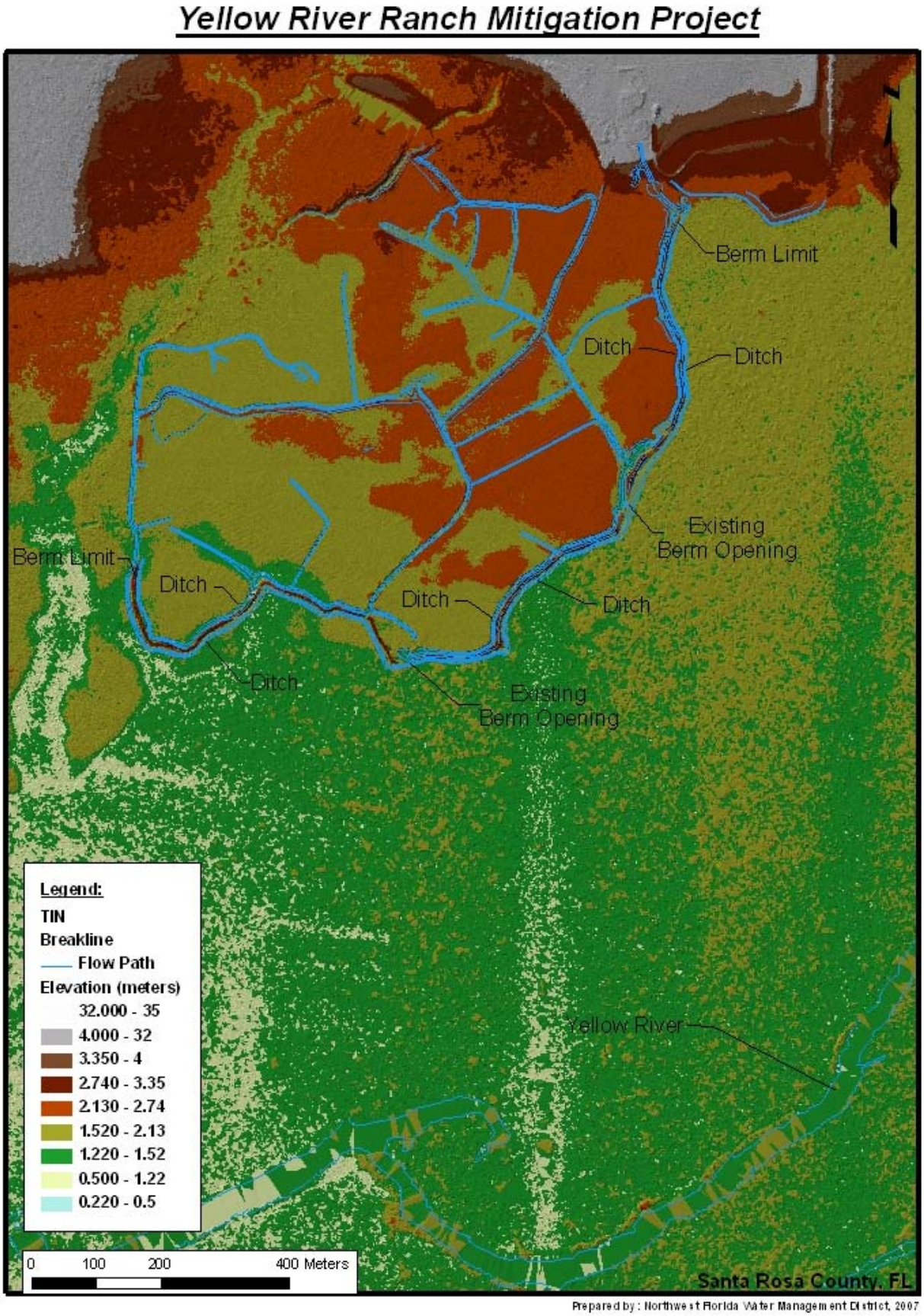


Figure 8 – Existing Hydraulic Conditions

c. Proposed Conditions

Two analyses were performed under proposed conditions in order to compare and select the simulation that best represents the hydraulic behavior in the study area. The first analyzes the flood elevations after creating new openings in the berm, filling the ditches and restoring the YRRMA. The second considers only the existing openings in the berm with the YRRMA completely restored. With the exception of the changes applied to these hydraulic structures and the use of a roughness coefficient equal to 0.12 for the restored area, all the existing conditions parameters remain the same. **Figure 9** shows the proposed hydraulic conditions in the study area.

d. Methodology

A water surface elevation (WSEL) of 4.73 meters, recorded downstream of the YRRMA from the FEMA flood maps at Yellow River, was used as the downstream boundary condition in the hydraulic model for the 100-year return period. A normal depth with a slope equal to the energy grade line slope of the 100-year storm was used as the downstream boundary condition in the hydraulic models to obtain the WSEL for the 2, 10, 25, 50 and 500 year return periods. The HEC-RAS computer model was simulated in a subcritical flow regime. In addition, a normal depth condition was used as the downstream boundary for the 1 year, 3-hour storm event.

e. Results

The HEC-RAS results of the hydraulic analyses for the existing and proposed conditions are included in Appendices H and I, respectively. Figure 10 shows the proposed floodplain limit for the 2, 10, 25, 50, 100 and 500 year return periods with a 24 hour storm duration, including the floodplain limit for the 1 year, 3-hour storm event. The berm located to the south and to the east of the study area does not totally cover its perimeter. This allows the flood flows from the Yellow River floodplain to enter into the YRRMA through the two berm openings shown in Figure 8.

The table that summarizes the hydraulic results, shown in Appendix J, indicates a maximum difference in WSEL of 0.01 between the proposed condition with new openings in each

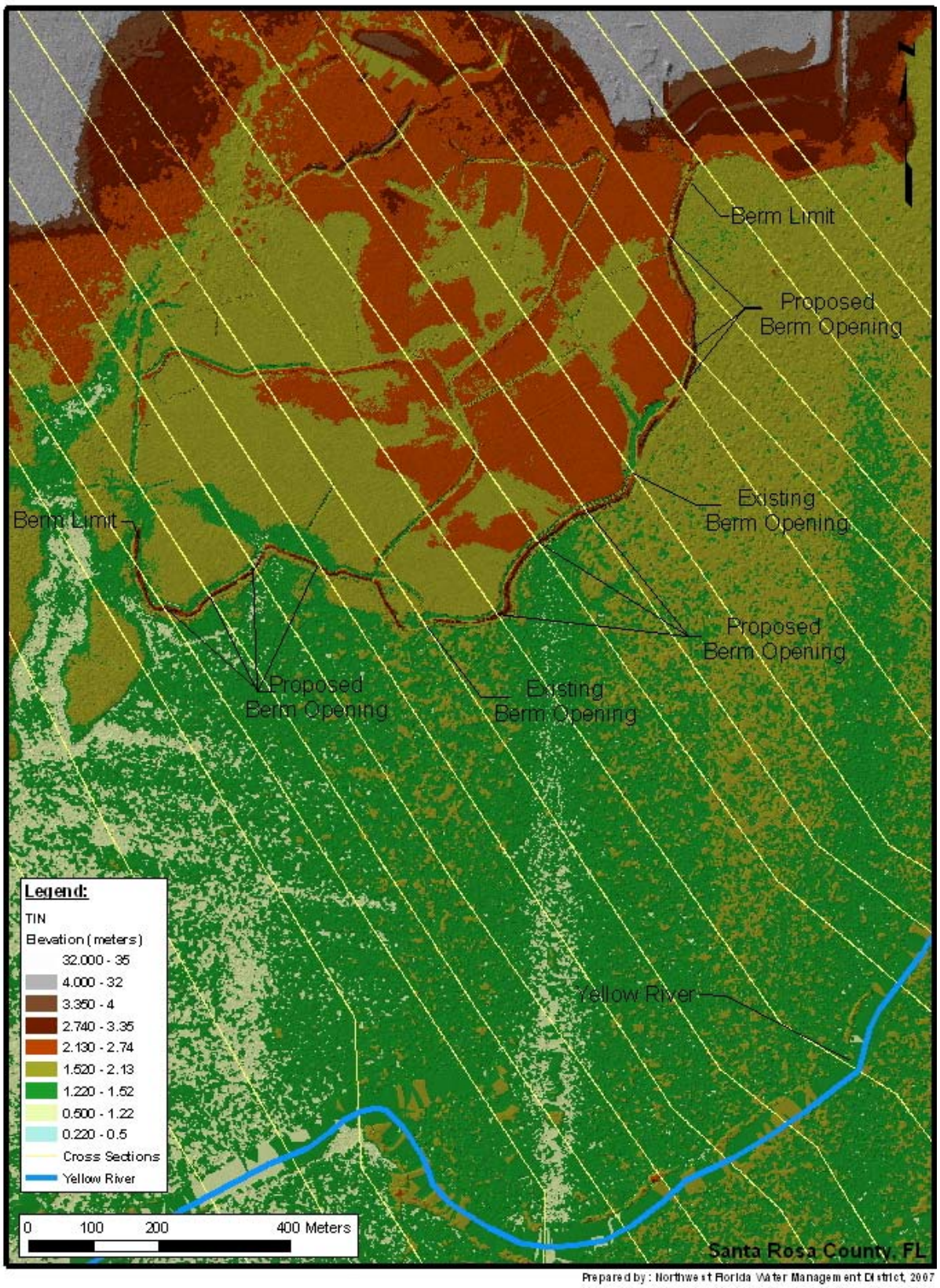


Figure 9 – Proposed Hydraulic Conditions

Yellow River Ranch Mitigation Project

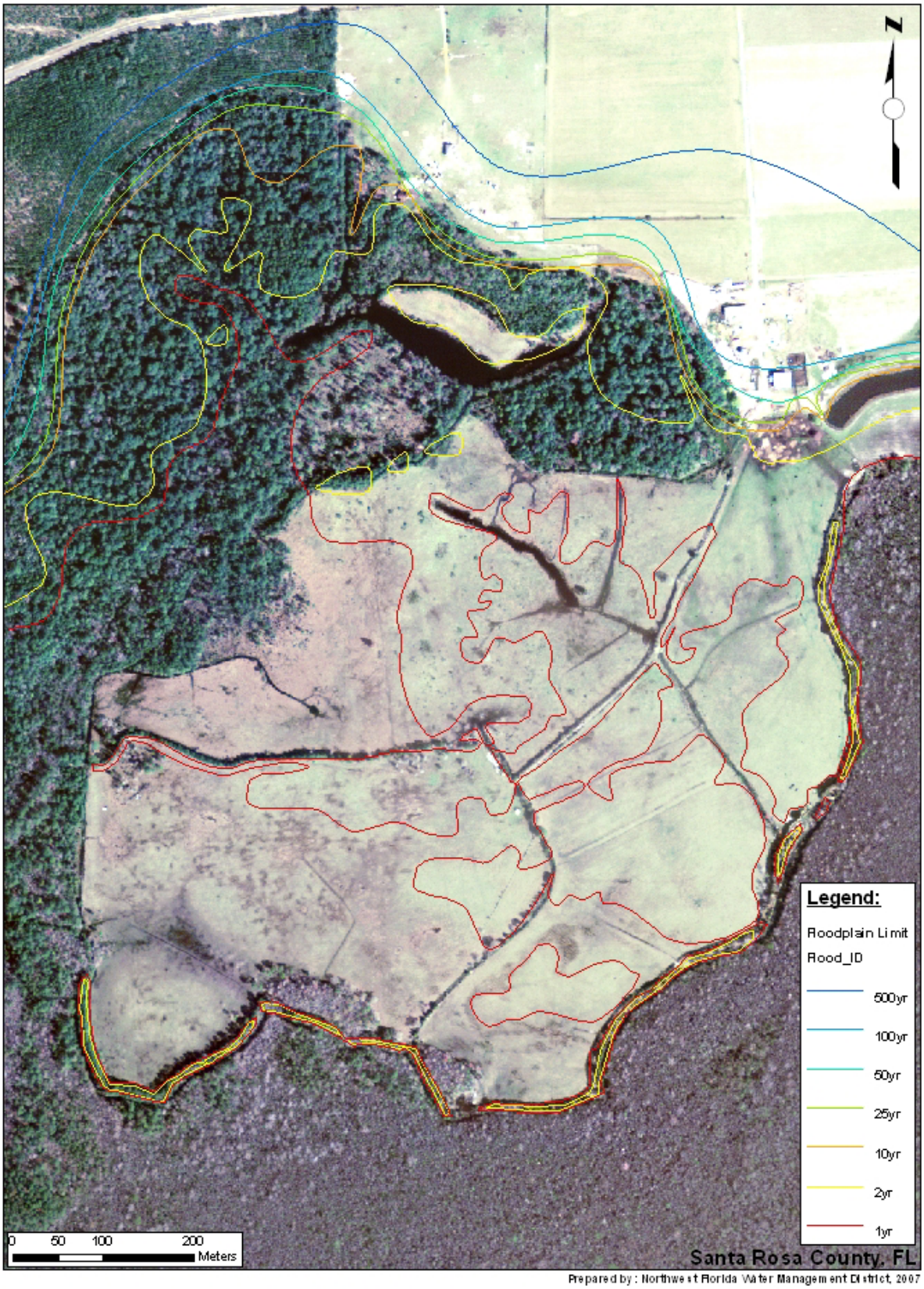


Figure 10 – Floodplain Limit

berm section (labeled PropA3 in the hydraulic model) and the proposed condition that consider only the existing openings in the berm (labeled PropA5 in the hydraulic model). This results does not represent a significant change in the flood levels between the two simulations. Therefore, the simulation PropA3 was rejected and the simulation PropA5 was selected as the final proposed model conditions. The hydraulic model demonstrates that the YRRMA receives flood flows for the 1, 2, 10, 25, 50, 100 and 500 year storm events. Finally, the tables that summarize the hydraulic results, shown in Appendices H and I, indicate a maximum difference between the existing and proposed conditions of 0.12 meters (0.39 feet) in the WSEL for the 500 year, 24 hours storm event. This increase in flood elevation is result of the decrease in flow velocities caused by the restoration of the study area. The floodplain segment of the Yellow River that is currently used for cattle operations will be restored to its original condition.

V. CONCLUSIONS and RECOMMENDATIONS

1. This study demonstrates that the berm and ditches maintain an effective hydrologic interconnection between the Yellow River floodplain and the YRRMA during storm events.
2. The changes in WSEL due to the mitigation improvements do not represent an adverse impact in the flood pattern of the area.

3. In order to restore the hydrologic regime, and to stop the artificial drainage effect caused by the ditches the following alternatives are recommended:

    a. Plug the ditches and breach the berms in different locations as shown in **Figure 11**. (Refer to **Appendix K** for plug and breach schematic details.) The ditches fill material shall be the extracted soil from the berm.

    b. As an alternative to ditch plugs, fill all the ditches with soil on the berm side as shown in **Figure 12**.

4. According to the hydraulic model, planting of native wetland trees onsite will increase water detention within the Yellow River Ranch Mitigation Area and the adjacent floodplain area.

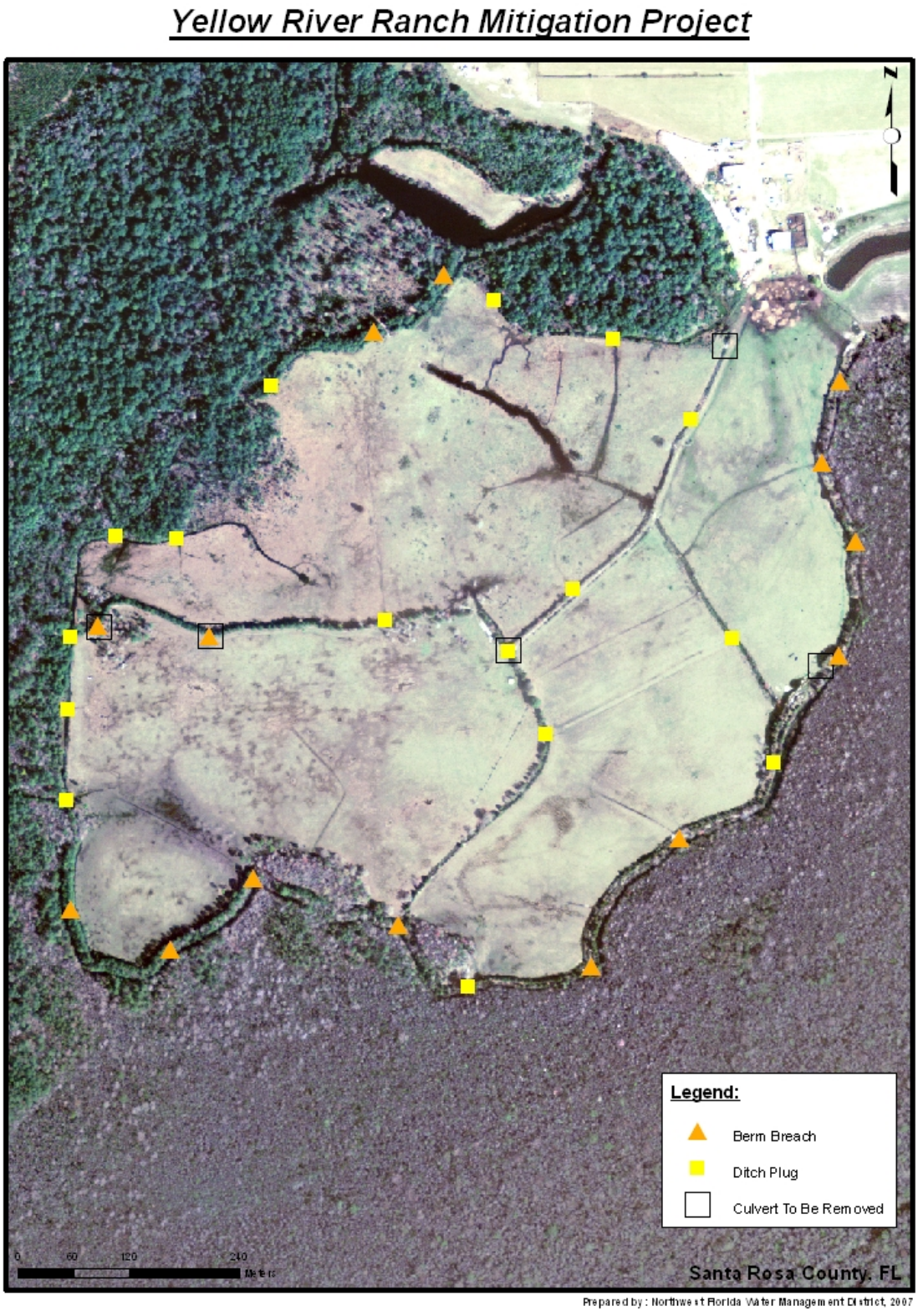


Figure 11 – Ditch Plug and Berm Breach Location – Alternative A

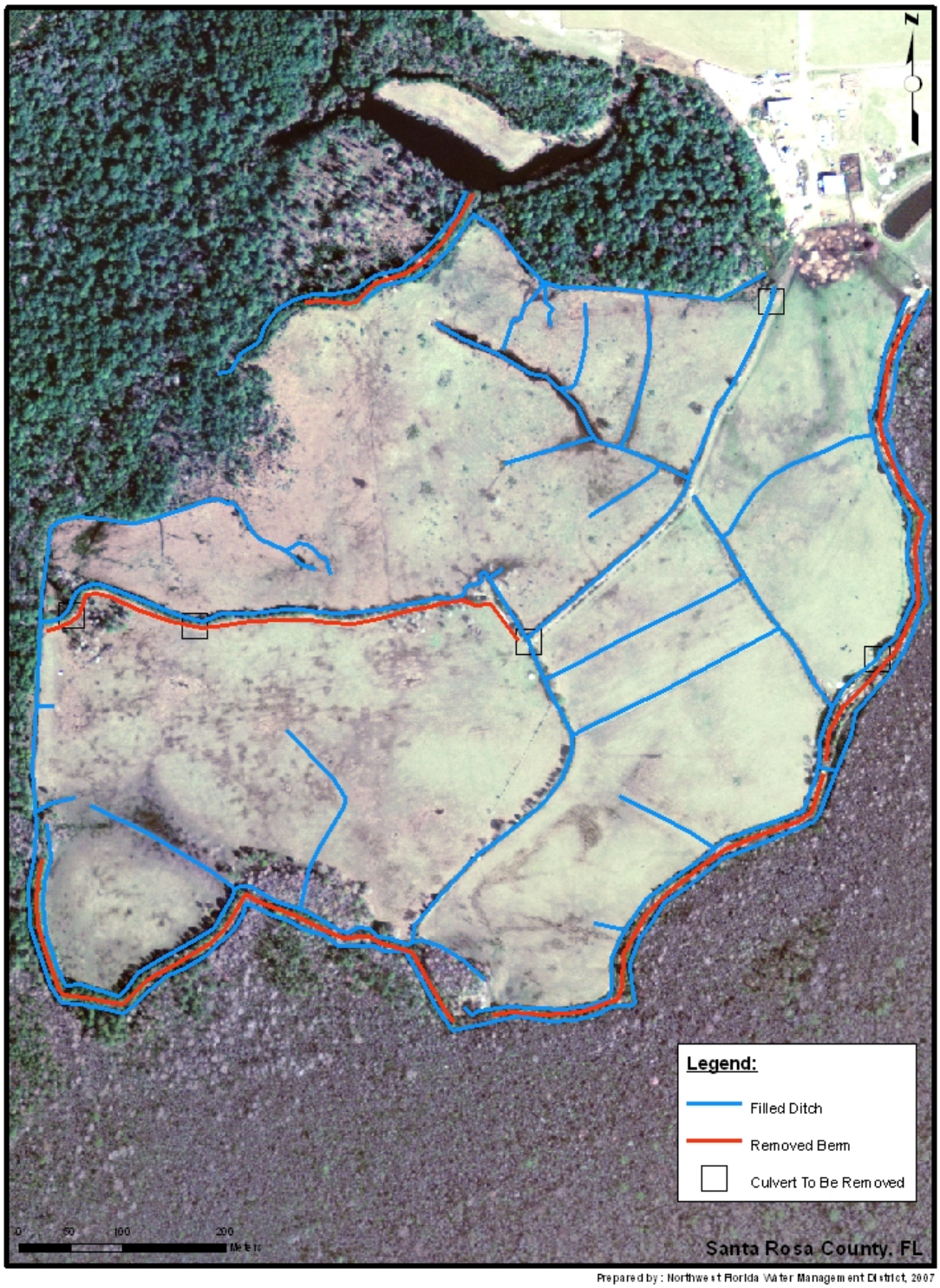


Figure 12 – Filled Ditch and Removed Berm Location – Alternative B

VI. BIBLIOGRAPHY

1. Wilson Miller Inc., June 2006. Restoration and Monitoring Plan for Yellow River Ranch Mitigation Area. Santa Rosa, County – FL.

2. HDR Inc., April 2003. Master Stormwater Management Plan – Okaloosa County, FL.

3. United States Geological Survey, 1994. Ward Basin Topographic Quadrangle – 7.5 minutes series. Santa Rosa Co., FL.

4. Photo Science – Geospatial Solutions, 2006. Light Detection and Ranging for the Yellow River Ranch Mitigation Area.

5. SimWright Inc., 2007. Break Lines Analysis for the Yellow River Ranch Mitigation Area.

6. U.S. Department of Agriculture, Soil Conservation Service, 1995. Soil Survey – Santa Rosa Co. Soil Survey Geographic (SSURGO) Database.

7. Northwests Florida Water Management District, 1995. Florida Land Use, Cover, Forms, and Classification System (FLUCCS).

8. U. S. Department of Commerce, National Weather Bureau, 1961. Rainfall - Frequency Atlas of the United States. Technical Paper No. 40

9. U.S. Army Corp of Engineers, December 2003. Hydrologic Engineering Center – Hydrologic Modeling System. Ver.3.0.0

10. United States Department of Agriculture, Soil Conservation Service, 1986. Urban Hydrology for Small Watersheds. Technical Release No. 55

11. U.S. Army Corp of Engineers, May 2005. Hydrologic Engineering Center – River Analysis System. Ver.3.1.1

12. U. S. Federal Emergency Management Agency, September 30, 2005. Flood Insurance Rate Map – Santa Rosa County, FL. Panel 460

13. U.S. Army Corp of Engineers, September 2005. Hydrologic Engineering Center – GeoRAS. Ver. 4.0

14. Chow, V. T., 1988. Open Channel Hydraulics. McGraw-Hill, New York

VII. APPENDICES

Appendix A

Curve Number Calculation

Subbasin 1				
Land Use	**Hydrologic Soil Group**	**Area (ac)**	**CN**	**CN*Area**
Coniferous Plantations	D	0.54	79	42.96
Coniferous Plantations	C	159.52	73	11644.67
Coniferous Plantations	A	19.17	36	690.11
Forest Regeneration Areas	D	36.48	83	3027.57
Forest Regeneration Areas	C	25.71	77	1979.47
Forest Regeneration Areas	A	12.36	45	556.38
Freshwater Marshes	C	1.73	100	172.86
Mixed Coniferous/Hardwood	C	3.29	30	98.57
Reservoirs	D	1.12	100	111.69
Stream and Lake Swamps	D	384.99	100	38499.03
Stream and Lake Swamps	C	3.10	100	310.09
Streams and Waterways	D	37.91	100	3791.33
Streams and Waterways	C	1.67	100	167.05
Upland Coniferous Forests	D	31.44	77	2420.73
Upland Coniferous Forests	A	239.74	30	7192.09
Upland Coniferous Forests	C	11.86	70	830.50
Wetland Forested Mixed	D	130.28	100	13027.77
Wetland Forested Mixed	C	21.77	100	2176.64
Wetland Forested Mixed	A	2.69	100	268.95
		1125.36		87008.45

CN	**77**

Subbasin 2				
Land Use	**Hydrologic Soil Group**	**Area (ac)**	**CN**	**CN*Area**
Airports	A	66.86	89	5950.27
Commercial and Services	A	4.29	89	381.58
Coniferous Plantations	A	2728.69	36	98232.69
Coniferous Plantations	D	19.54	79	1544.00
Coniferous Plantations	C	95.60	73	6978.93
Cropland and Pastureland	A	58.14	49	2848.79
Electrical Power Transmission Lines	A	83.06	49	4070.06
Forest Regeneration Areas	A	518.01	45	23310.40
Forest Regeneration Areas	C	82.36	77	6341.73
Forest Regeneration Areas	D	8.57	45	385.58
Freshwater Marshes	C	0.70	100	70.07
Mixed Coniferous/Hardwood	A	253.13	30	7594.00
Mixed Coniferous/Hardwood	C	23.15	70	1620.57
Mixed Coniferous/Hardwood	D	1.81	77	139.74
Recreational	A	1.15	39	44.72
Reservoirs	A	11.37	100	1137.26
Residential, low density	A	156.68	54	8460.71
Residential, low density	C	0.09	80	7.59
Residential, medium density	C	0.14	81	10.95
Residential, medium density	D	0.61	86	52.58
Roads and Highways	A	82.52	98	8086.68
Sand and Gravel pits	A	6.01	49	294.27
Shrub and Brushland	A	3.77	35	132.10
Stream and Lake Swamps	D	21.74	100	2174.46
Streams and Waterways	D	0.13	100	12.73
Upland Coniferous Forests	A	839.45	30	25183.44
Wetland Coniferous Forests	A	7.56	100	756.03
Wetland Coniferous Forests	D	8.89	100	888.69
Wetland Coniferous Forests	C	1.75	100	174.61
Wetland Forested Mixed	A	138.27	100	13827.42
Wetland Forested Mixed	C	27.24	100	2723.91
Wetland Forested Mixed	D	185.56	100	18555.53
Wetland Hardwood Forest	D	2.39	100	239.14
Wetland Hardwood Forest	C	1.68	100	167.78
Wetland Scrub Shrub	A	0.24	100	24.36
Wetland Scrub Shrub	D	59.49	100	5948.59
Wetland Scrub Shrub	C	8.05	100	804.64
		5508.68		249176.59

CN	**45**

Subbasin 3				
Land Use	**Hydrologic Soil Group**	**Area (ac)**	**CN**	**CN*Area**
Coniferous Plantations	D	1.56	79	123.52
Coniferous Plantations	A	1484.03	36	53425.02
Coniferous Plantations	C	23.31	73	1701.77
Cropland and Pastureland	D	0.62	84	52.48
Cropland and Pastureland	A	224.41	49	10995.94
Cropland and Pastureland	C	5.75	79	454.15
Extractive	A	0.13	68	9.05
Forest Regeneration Areas	D	4.24	83	351.62
Forest Regeneration Areas	A	409.47	45	18425.98
Forest Regeneration Areas	C	57.59	77	4434.61
Industrial	A	17.91	81	1450.86
Mixed Coniferous/Hardwood	D	27.46	77	2114.34
Mixed Coniferous/Hardwood	A	92.50	30	2774.98
Mixed Coniferous/Hardwood	C	17.37	70	1215.64
Residential, low density	D	0.90	85	76.58
Residential, low density	A	39.50	54	2132.82
Residential, low density	C	2.25	80	180.34
Residential, medium density	D	0.14	86	12.35
Residential, medium density	C	2.34	81	189.40
Roads and Highways	A	10.09	98	988.96
Sand and Gravel pits	A	29.31	49	1436.29
Shrub and Brushland	C	24.17	70	1692.10
Shrub and Brushland	D	3.42	77	263.27
Stream and Lake Swamps	D	1544.32	100	154431.54
Stream and Lake Swamps	C	3.31	100	330.69
Stream and Lake Swamps	A	8.74	100	874.47
Streams and Waterways	D	14.30	100	1429.71
Streams and Waterways	A	44.00	100	4400.28
Strip Mines	A	4.03	81	326.54
Upland Coniferous Forests	D	32.10	77	2471.79
Upland Coniferous Forests	A	1421.43	30	42642.84
Upland Coniferous Forests	C	123.79	70	8665.50
Wetland Coniferous Forests	D	157.37	100	15737.26
Wetland Coniferous Forests	C	43.02	100	4301.69
Wetland Coniferous Forests	A	8.63	100	862.86
Wetland Forested Mixed	A	162.02	100	16202.16
Wetland Forested Mixed	C	25.11	100	2510.62
Wetland Forested Mixed	D	668.28	100	66828.10
Wetland Scrub Shrub	D	60.51	100	6050.70
Wetland Scrub Shrub	A	1.56	100	155.77
		6800.99		432724.57

CN	**64**

Subbasin 4A				
Land Use	**Hydrologic Soil Group**	**Area (ac)**	**CN**	**CN*Area**
Coniferous Plantations	A	1142.69	36	41136.75
Coniferous Plantations	D	8.36	79	660.71
Coniferous Plantations	C	31.04	73	2265.98
Cropland and Pastureland	A	252.62	49	12378.39
Cropland and Pastureland	C	11.56	79	913.54
Cropland and Pastureland	D	0.01	84	0.49
Disturbed Land	A	3.35	68	227.58
Electrical Power Transmission Lines	A	44.34	49	2172.87
Forest Regeneration Areas	A	439.94	45	19797.13
Industrial	A	4.56	81	369.53
Inland Ponds and Sloughs	A	10.24	100	1024.30
Mixed Coniferous/Hardwood	A	21.00	30	630.11
Mixed Coniferous/Hardwood	D	0.38	77	29.12
Reservoirs	A	20.24	100	2023.94
Residential, low density	A	189.76	54	10247.29
Residential, medium density	A	2.91	57	166.05
Roads and Highways	A	25.54	98	2502.68
Stream and Lake Swamps	D	81.91	100	8191.32
Upland Coniferous Forests	A	981.34	30	29440.31
Upland Coniferous Forests	D	20.88	77	1607.45
Upland Coniferous Forests	C	16.10	70	1126.87
Wetland Coniferous Forests	D	20.00	100	1999.81
Wetland Coniferous Forests	C	11.53	100	1152.57
Wetland Forested Mixed	A	24.47	100	2446.72
Wetland Forested Mixed	D	39.10	100	3909.76
Wetland Forested Mixed	C	1.49	100	148.59
		3405.36		146569.86

CN	**43**

Subbasin 4B				
Land Use	**Hydrologic Soil Group**	**Area (ac)**	**CN**	**CN*Area**
Airports	A	0.10	89	9.03
Burned Areas	A	17.34	68	1179.34
Coniferous Plantations	A	667.90	36	24044.30
Coniferous Plantations	B	12.76	60	765.89
Coniferous Plantations	C	15.21	73	1110.17
Cropland and Pastureland	A	1054.04	49	51648.11
Cropland and Pastureland	B	56.32	69	3886.39
Cropland and Pastureland	C	23.46	79	1853.00
Cropland and Pastureland	D	4.17	84	350.16
Cypress	A	8.84	100	884.20
Electrical Power Transmission Lines	A	32.11	49	1573.34
Forest Regeneration Areas	A	590.54	45	26574.42
Forest Regeneration Areas	B	4.48	66	295.60
Forest Regeneration Areas	C	50.04	77	3853.36
Inland Ponds and Sloughs	A	8.48	100	848.04
Inland Ponds and Sloughs	C	1.64	100	163.82
Mixed Coniferous/Hardwood	A	54.86	30	1645.71
Mixed Coniferous/Hardwood	C	4.49	70	314.54
Reservoirs	A	0.28	100	27.63
Reservoirs	C	0.96	100	96.24
Reservoirs	D	2.45	100	244.65
Residential, low density	A	292.55	54	15797.70
Residential, medium density	A	38.24	57	2179.71
Roads and Highways	A	38.87	98	3809.50
Sand and Gravel pits	A	29.89	49	1464.47
Sand and Gravel pits	B	4.53	69	312.89
Tree Crops	A	3.09	43	132.72
Upland Coniferous Forests	A	1270.90	30	38126.88
Upland Coniferous Forests	B	54.66	55	3006.09
Wetland Coniferous Forests	A	0.81	100	81.16
Wetland Coniferous Forests	B	0.84	100	83.92
Wetland Coniferous Forests	D	15.02	100	1501.60
Wetland Coniferous Forests	C	1.00	100	99.93
Wetland Forested Mixed	C	7.89	100	789.13
Wetland Forested Mixed	A	15.18	100	1517.71
Wetland Scrub Shrub	A	3.02	100	302.48
Wetland Scrub Shrub	C	1.85	100	184.60
		4388.81		190758.43

CN	**43**

Subbasin 5				
Land Use	**Hydrologic Soil Group**	**Area (ac)**	**CN**	**CN*Area**
Airports	A	531.88	89	47336.98
Communications	C	6.37	89	567.27
Coniferous Plantations	A	439.66	36	15827.67
Cypress	D	5.06	100	505.80
Disturbed Land	A	212.03	68	14418.18
Extractive	A	23.06	68	1568.20
Forest Regeneration Areas	A	250.42	45	11268.90
Forest Regeneration Areas	C	9.30	77	716.40
Intermittent Ponds	A	16.23	100	1623.15
Military	A	6393.04	81	517836.24
Military	C	7.23	91	657.75
Mixed Coniferous/Hardwood	A	89.90	30	2697.00
Mixed Coniferous/Hardwood	C	21.31	70	1491.58
Reservoirs	A	11.82	100	1181.54
Sand other than Beaches	A	129.68	30	3890.26
Shrub and Brushland	A	412.75	35	14446.42
Shrub and Brushland	C	36.18	70	2532.44
Stream and Lake Swamps	A	0.24	100	23.92
Stream and Lake Swamps	C	3.93	100	393.05
Stream and Lake Swamps	D	245.27	100	24527.14
Streams and Waterways	A	24.80	100	2480.23
Upland Coniferous Forests	D	176.12	77	13561.30
Upland Coniferous Forests	C	516.00	70	36119.93
Upland Coniferous Forests	A	14621.93	30	438657.99
Wetland Coniferous Forests	C	9.97	100	996.53
Wetland Coniferous Forests	D	142.31	100	14230.99
Wetland Coniferous Forests	A	45.69	100	4568.85
Wetland Forested Mixed	C	60.31	100	6031.27
Wetland Forested Mixed	A	726.91	100	72691.06
Wetland Forested Mixed	D	639.67	100	63967.34
Wetland Scrub Shrub	D	21.93	100	2193.27
Wetland Scrub Shrub	C	7.05	100	705.40
Wetland Scrub Shrub	A	31.61	100	3161.45
		25869.67		1322875.50

CN	**51**

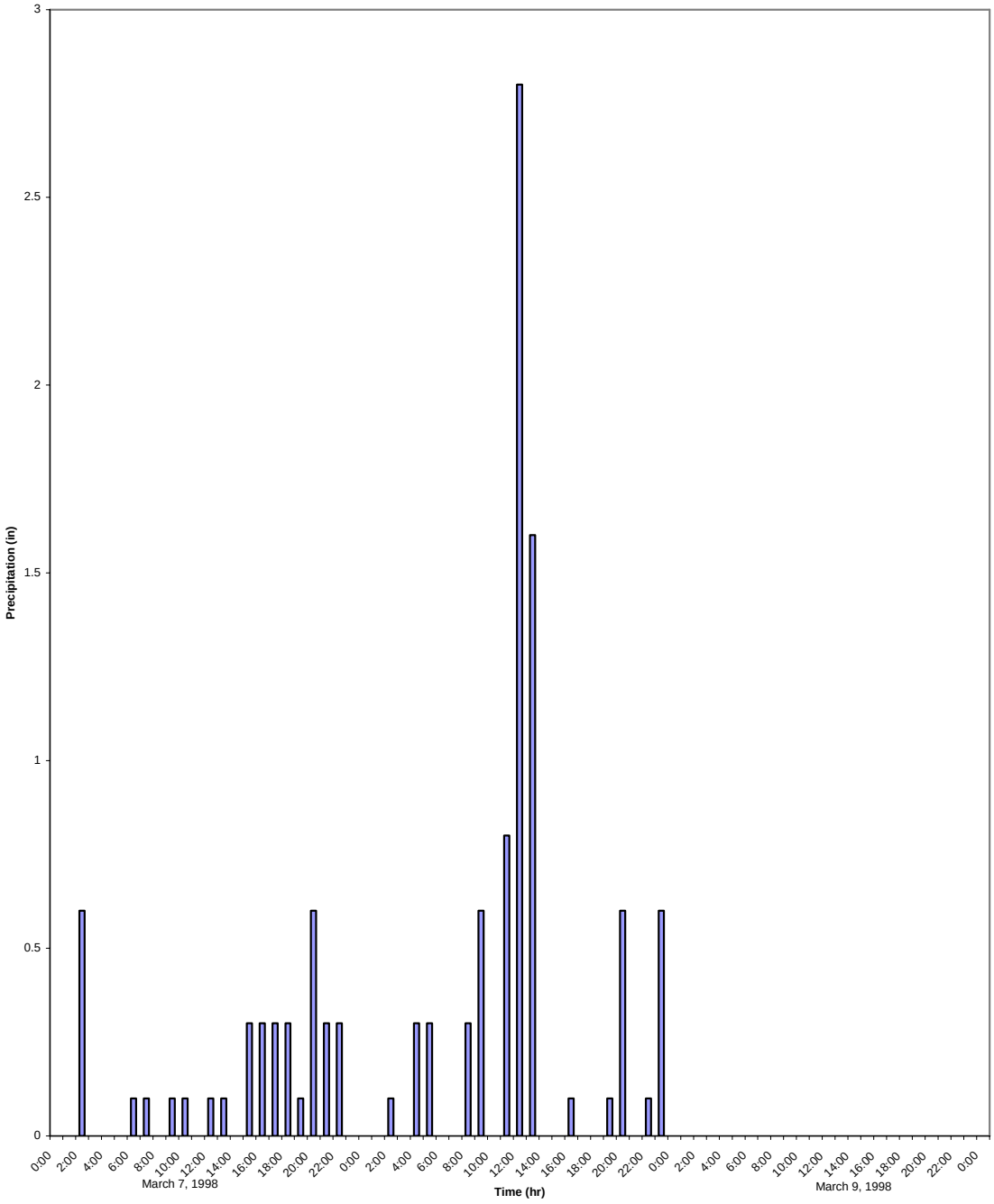
Subbasin 6				
Land Use	**Hydrologic Soil Group**	**Area (ac)**	**CN**	**CN*Area**
Coniferous Plantations	A	19.36	36	696.84
Coniferous Plantations	C	41.92	73	3060.17
Coniferous Plantations	D	54.83	79	4331.53
Cropland and Pastureland	A	76.38	49	3742.47
Cropland and Pastureland	C	9.98	79	788.16
Cropland and Pastureland	D	18.11	89	1611.88
Forest Regeneration Areas	D	116.48	83	9668.00
Freshwater Marshes	D	0.83	100	82.73
Lakes	D	1.13	100	113.16
Reservoirs	D	6.10	100	609.71
Residential, low density	A	4.84	54	261.30
Shrub and Brushland	A	18.24	35	638.23
Shrub and Brushland	D	13.29	77	1023.26
Stream and Lake Swamps	D	762.86	100	76286.47
Stream and Lake Swamps	C	3.36	100	336.14
Streams and Waterways	D	38.47	100	3847.43
Upland Coniferous Forests	D	3.42	77	263.40
Upland Coniferous Forests	C	44.55	70	3118.19
Upland Coniferous Forests	A	2.79	30	83.75
Wetland Coniferous Forests	D	83.29	100	8328.82
Wetland Coniferous Forests	C	6.20	100	620.41
Wetland Coniferous Forests	A	7.38	100	737.90
Wetland Forested Mixed	D	84.44	100	8443.60
		1418.24		128693.57

CN	**91**

Appendix B

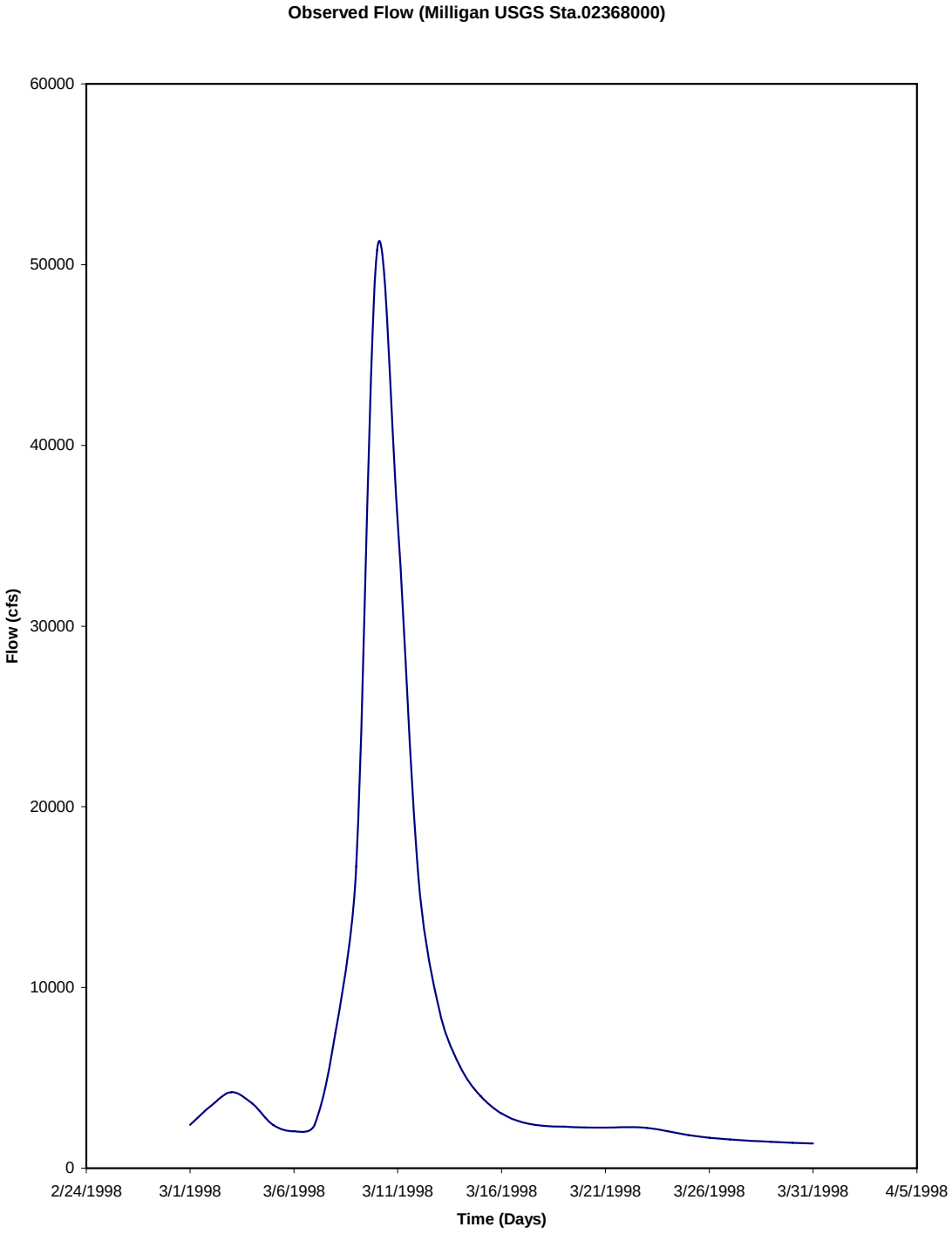
Calibration Storm Event

Calibration Storm Event (from HDR)



Appendix C

Streamflow Hydrograph


Observed Flow (Milligan USGS Sta.02368000)
60000
50000
40000
30000
20000
10000
0
Flow (cfs)
2/24/1998
3/1/1998
3/6/1998
3/11/1998
3/16/1998
3/21/1998
3/26/1998
3/31/1998
4/5/1998
Time (Days)

Appendix D

Time of Concentration & Channel Routing Calculation

Subbasin 1

NRCS TR-55 TIME OF CONCENTRATION CALCULATION					
Sheet Flow:		Segment	1		
1. Surface Description		----------	Dense Grass		
2. Upstream Elevation		ft	160		
3. Downstream Elevation		ft	158		
4. Manning's roughness coefficient, n		----------	0.24		
5. Flow length, L (< 300 ft)		ft	300		
6. 2 Yr, 24 hr Rainfall, P		in	5.5		
7. Slope, s	Compute s =	ft/ft	0.0067		
8. $T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5} s^{0.4}}$	Compute T_t =	hr	0.68		
				Subtotal =	**0.68**
Shallow Concentrated Flow:		Segment	2		
1. Surface Description (Paved or Unpaved)		----------	Unpaved		
2. Upstream Elevation		ft	158		
3. Downstream Elevation		ft	5		
4. Flow length, L		ft	10191.27		
5. Slope, s	Compute s =	ft/ft	0.0150		
6. Average velocity, V	Compute V =	ft/s	1.98		
7. $T_t = \frac{L}{3600\ V}$	Compute T_t =	hr	1.43		
				Subtotal =	**1.43**
Channel Flow:		Segment	3		
1. Cross Sectional Flow Area, a		ft^2	30554.6		
2. Upstream Elevation		ft	5		
3. Downstream Elevation		ft	4		
4. Wetted Perimeter, p_w		ft	2306.5		
5. Hydraulic Radius, r = a / p_w	Compute r =	ft	13.25		
6. Channel slope, s	Compute s =	ft/ft	0.0002		
7. Manning's Roughness Coefficient, n		----------	0.065		
6. $V = \frac{1.49}{n} r^{2/3} s^{1/2}$	Compute V =	ft/s	1.67		
8. Flow Length, L		ft	5892.4		
9. $T_t = \frac{L}{3600\ V}$	Compute T_t =	hr	0.98		
				Subtotal =	**0.98**
				Total Tc (hr) =	**3.09**
				Total Tc (min) =	**185**
				L (min) =	**111**

Subbasin 2

NRCS TR-55 TIME OF CONCENTRATION CALCULATION					
Sheet Flow:		Segment	1		
1. Surface Description		----------	Woods		
2. Upstream Elevation		ft	150		
3. Downstream Elevation		ft	140		
4. Manning's roughness coefficient, n		----------	0.8		
5. Flow length, L (< 300 ft)		ft	300		
6. 2 Yr, 24 hr Rainfall, P		in	5.5		
7. Slope, s	Compute s =	ft/ft	0.0333		
8. $T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5} s^{0.4}}$	Compute T_t =	hr	0.93		
				Subtotal =	**0.93**
Shallow Concentrated Flow:		Segment	2		
1. Surface Description (Paved or Unpaved)		----------	Unpaved		
2. Upstream Elevation		ft	140		
3. Downstream Elevation		ft	4		
4. Flow length, L		ft	32423.56		
5. Slope, s	Compute s =	ft/ft	0.0042		
6. Average velocity, V	Compute V =	ft/s	1.04		
7. $T_t = \frac{L}{3600\ V}$	Compute T_t =	hr	8.62		
				Subtotal =	**8.62**
				Total Tc (hr) =	**9.55**
				Total Tc (min) =	**573**

L (min) =	**344**

Subbasin 3

NRCS TR-55 TIME OF CONCENTRATION CALCULATION					
Sheet Flow:		Segment	1		
1. Surface Description		----------	Dense Grass		
2. Upstream Elevation		ft	200		
3. Downstream Elevation		ft	195		
4. Manning's roughness coefficient, n		----------	0.24		
5. Flow length, L (< 300 ft)		ft	300		
6. 2 Yr, 24 hr Rainfall, P		in	5.5		
7. Slope, s	Compute s =	ft/ft	0.0167		
8. $T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5} s^{0.4}}$	Compute T_t =	hr	0.47		
				Subtotal =	**0.47**
Shallow Concentrated Flow:		Segment	2		
1. Surface Description (Paved or Unpaved)		----------	Unpaved		
2. Upstream Elevation		ft	195		
3. Downstream Elevation		ft	4		
4. Flow length, L		ft	29590.94		
5. Slope, s	Compute s =	ft/ft	0.0065		
6. Average velocity, V	Compute V =	ft/s	1.30		
7. $T_t = \frac{L}{3600\ V}$	Compute T_t =	hr	6.34		
				Subtotal =	**6.34**
Channel Flow:		Segment	3		
1. Cross Sectional Flow Area, a		ft^2	48863.11		
2. Upstream Elevation		ft	4		
3. Downstream Elevation		ft	3		
4. Wetted Perimeter, p_w		ft	3197.3		
5. Hydraulic Radius, r = a / p_w	Compute r =	ft	15.28		
6. Channel slope, s	Compute s =	ft/ft	0.0001		
7. Manning's Roughness Coefficient, n		----------	0.065		
6. $V = \frac{1.49}{n} r^{2/3} s^{1/2}$	Compute V =	ft/s	1.11		
8. Flow Length, L		ft	16230.31		
9. $T_t = \frac{L}{3600\ V}$	Compute T_t =	hr	4.07		
				Subtotal =	**4.07**
				Total Tc (hr) =	**10.88**
				Total Tc (min) =	**653**
				L (min) =	**392**

Subbasin 4A

NRCS TR-55 TIME OF CONCENTRATION CALCULATION					
Sheet Flow:		Segment	1		
1. Surface Description		----------	Woods		
2. Upstream Elevation		ft	160		
3. Downstream Elevation		ft	150		
4. Manning's roughness coefficient, n		----------	0.4		
5. Flow length, L (< 300 ft)		ft	300		
6. 2 Yr, 24 hr Rainfall, P		in	5.5		
7. Slope, s	Compute s =	ft/ft	0.0333		
8. $T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5} s^{0.4}}$	Compute T_t=	hr	0.54		
				Subtotal =	**0.54**
Shallow Concentrated Flow:		Segment	2		
1. Surface Description (Paved or Unpaved)		----------	Unpaved		
2. Upstream Elevation		ft	150		
3. Downstream Elevation		ft	5		
4. Flow length, L		ft	33470.47		
5. Slope, s	Compute s =	ft/ft	0.0043		
6. Average velocity, V	Compute V =	ft/s	1.06		
7. $T_t = \frac{L}{3600\ V}$	Compute T_t=	hr	8.75		
				Subtotal =	**8.75**
				Total Tc (hr) =	**9.29**
				Total Tc (min) =	**557**

L (min) =	**334**

Subbasin 4B

NRCS TR-55 TIME OF CONCENTRATION CALCULATION					
Sheet Flow:		Segment	1		
1. Surface Description		----------	Woods		
2. Upstream Elevation		ft	150		
3. Downstream Elevation		ft	140		
4. Manning's roughness coefficient, n		----------	0.4		
5. Flow length, L (< 300 ft)		ft	300		
6. 2 Yr, 24 hr Rainfall, P		in	5.5		
7. Slope, s	Compute s =	ft/ft	0.0333		
8. $T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5} s^{0.4}}$	Compute T_t=	hr	0.54		
				Subtotal =	**0.54**
Shallow Concentrated Flow:		Segment	2		
1. Surface Description (Paved or Unpaved)		----------	Unpaved		
2. Upstream Elevation		ft	140		
3. Downstream Elevation		ft	7		
4. Flow length, L		ft	28570.87		
5. Slope, s	Compute s =	ft/ft	0.0047		
6. Average velocity, V	Compute V =	ft/s	1.10		
7. $T_t = \frac{L}{3600\ V}$	Compute T_t=	hr	7.21		
				Subtotal =	**7.21**
				Total Tc (hr) =	**7.75**
				Total Tc (min) =	**465**

L (min) =	**279**

Subbasin 5

NRCS TR-55 TIME OF CONCENTRATION CALCULATION					
Sheet Flow:		Segment	1		
1. Surface Description		----------	Woods		
2. Upstream Elevation		ft	195		
3. Downstream Elevation		ft	180		
4. Manning's roughness coefficient, n		----------	0.4		
5. Flow length, L (< 300 ft)		ft	300		
6. 2 Yr, 24 hr Rainfall, P		in	5.5		
7. Slope, s	Compute s =	ft/ft	0.0500		
8. $T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5} s^{0.4}}$	Compute T_t =	hr	0.46		
				Subtotal =	**0.46**
Shallow Concentrated Flow:		Segment	2		
1. Surface Description (Paved or Unpaved)		----------	Unpaved		
2. Upstream Elevation		ft	180		
3. Downstream Elevation		ft	4		
4. Flow length, L		ft	66076.12		
5. Slope, s	Compute s =	ft/ft	0.0027		
6. Average velocity, V	Compute V =	ft/s	0.83		
7. $T_t = \frac{L}{3600\ V}$	Compute T_t =	hr	22.04		
				Subtotal =	**22.04**
				Total Tc (hr) =	**22.50**
				Total Tc (min) =	**1350**

L (min) =	**810**

Subbasin 6

NRCS TR-55 TIME OF CONCENTRATION CALCULATION					
Sheet Flow:		Segment	1		
1. Surface Description		----------	Woods		
2. Upstream Elevation		ft	28		
3. Downstream Elevation		ft	24		
4. Manning's roughness coefficient, n		----------	0.4		
5. Flow length, L (< 300 ft)		ft	300		
6. 2 Yr, 24 hr Rainfall, P		in	5.5		
7. Slope, s	Compute s =	ft/ft	0.0133		
8. $T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5} s^{0.4}}$	Compute T_t =	hr	0.77		
				Subtotal =	**0.77**
Shallow Concentrated Flow:		Segment	2		
1. Surface Description (Paved or Unpaved)		----------	Unpaved		
2. Upstream Elevation		ft	24		
3. Downstream Elevation		ft	3		
4. Flow length, L		ft	7523.62		
5. Slope, s	Compute s =	ft/ft	0.0028		
6. Average velocity, V	Compute V =	ft/s	0.85		
7. $T_t = \frac{L}{3600\ V}$	Compute T_t =	hr	2.45		
				Subtotal =	**2.45**
Channel Flow:		Segment	3		
1. Cross Sectional Flow Area, a		ft^2	47265		
2. Upstream Elevation		ft	3		
3. Downstream Elevation		ft	2		
4. Wetted Perimeter, p_w		ft	4722		
5. Hydraulic Radius, r = a / p_w	Compute r =	ft	10.01		
6. Channel slope, s	Compute s =	ft/ft	0.0005		
7. Manning's Roughness Coefficient, n		----------	0.065		
6. $V = \frac{1.49}{n} r^{2/3} s^{1/2}$	Compute V =	ft/s	2.30		
8. Flow Length, L		ft	2139		
9. $T_t = \frac{L}{3600\ V}$	Compute T_t =	hr	0.26		
				Subtotal =	**0.26**
				Total Tc (hr) =	**3.48**
				Total Tc (min) =	**209**
				L (min) =	**125**

Reach Routing Calculations										
ID	**US IE (ft)**	**DS IE (ft)**	**Channel L (ft)**	**Slope**	**XS Area (ft^2)**	**Pw (ft)**	**Hydraulics R (ft)**	**Manning n**	**V (ft/s)**	**Lag Time (min)**
Reach 1	5	4	8132.22	0.000123	30554.6	2306.5	13.25	0.065	1.42	95.24
Reach 2	4	3	21191	4.719E-05	48863.1	3197.3	15.28	0.065	0.97	364.20
Reach 3	3	2	5995.4	0.0001668	47265	4722	10.01	0.065	1.38	72.67
Reach 4	2	1	4785.1	0.000209	53055	4766.2	11.13	0.065	1.65	48.27
Reach 5	1	0	6772.31	0.0001477	n/a	n/a	n/a	0.065	0.20	575.70

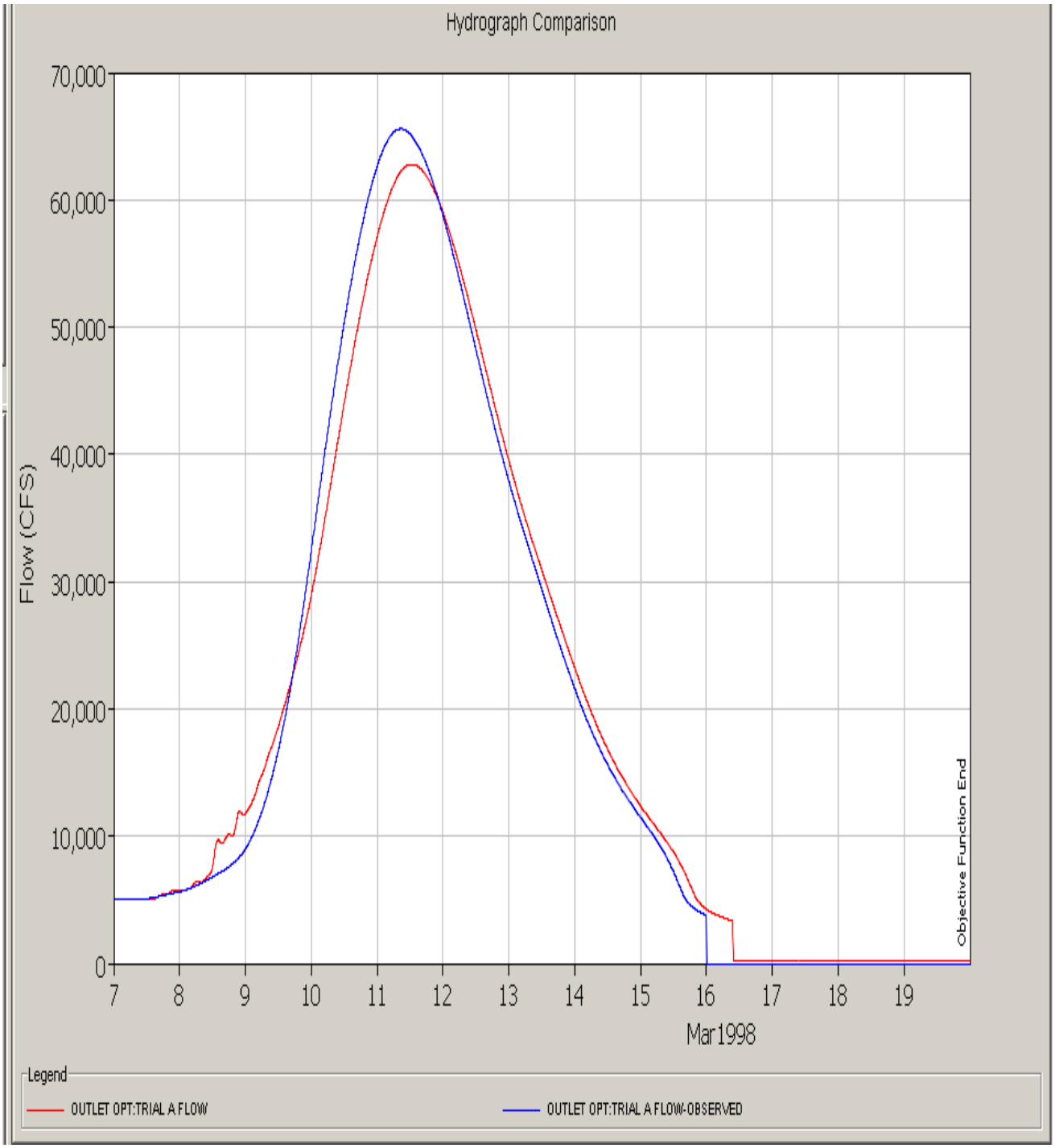
$$V = \frac{1.49}{n} r^{2/3} s^{1/2}$$

Appendix E

Optimization Process Results

Project: Yellow River Ranch		**Optimization Trial: Trial A**		
Start of Trial: 07Mar1998, 00:00 End of Trial: 20Mar1998, 00:00 Compute Time: 26Mar2007, 07:28:43		Basin Model: Yellow Calibration Meteorologic Model: Met for Calibration Control Specifications: Control 1		
Measure	Simulated	Observed	Difference	% Difference
Volume (IN)	6.86	6.81	0.05	0.7
Peak Flow (CFS)	62806	65585	-2780	-4.2
Time of Peak	11Mar1998, 12:35	11Mar1998, 08:35		
Time of Center of Mass	11Mar1998, 19:54	11Mar1998, 17:33		

Project: Yellow River Ranch				Optimization Trial: Trial A	
Start of Trial: 07Mar1998, 00:00 End of Trial: 20Mar1998, 00:00 Compute Time: 26Mar2007, 07:28:43				Basin Model: Yellow Calibration Meteorologic Model: Met for Calibration Control Specifications: Control 1	
Element	**Parameter**	**Units**	**Initial Value**	**Optimized Value**	**Objective Function Sensitivity**
Subbasin-1	SCS Lag	MIN	111	106	0.00
Subbasin-2	SCS Lag	MIN	344	1167	-0.07
Subbasin-3	SCS Lag	MIN	392	1330	-0.15
Subbasin-4A	SCS Lag	MIN	334	210	0.00
Subbasin-4B	SCS Lag	MIN	279	946	-0.05
Subbasin-5	SCS Lag	MIN	810	1233	-0.28
Subbasin-6	SCS Lag	MIN	125	115	0.00


Hydrograph Comparison
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
Flow (CFS)
7
8
9
10
11
12
13
14
15
16
17
18
19
Mar1998
Objective Function End
Legend
OUTLET OPT:TRIAL A FLOW
OUTLET OPT:TRIAL A FLOW-OBSERVED

Appendix F

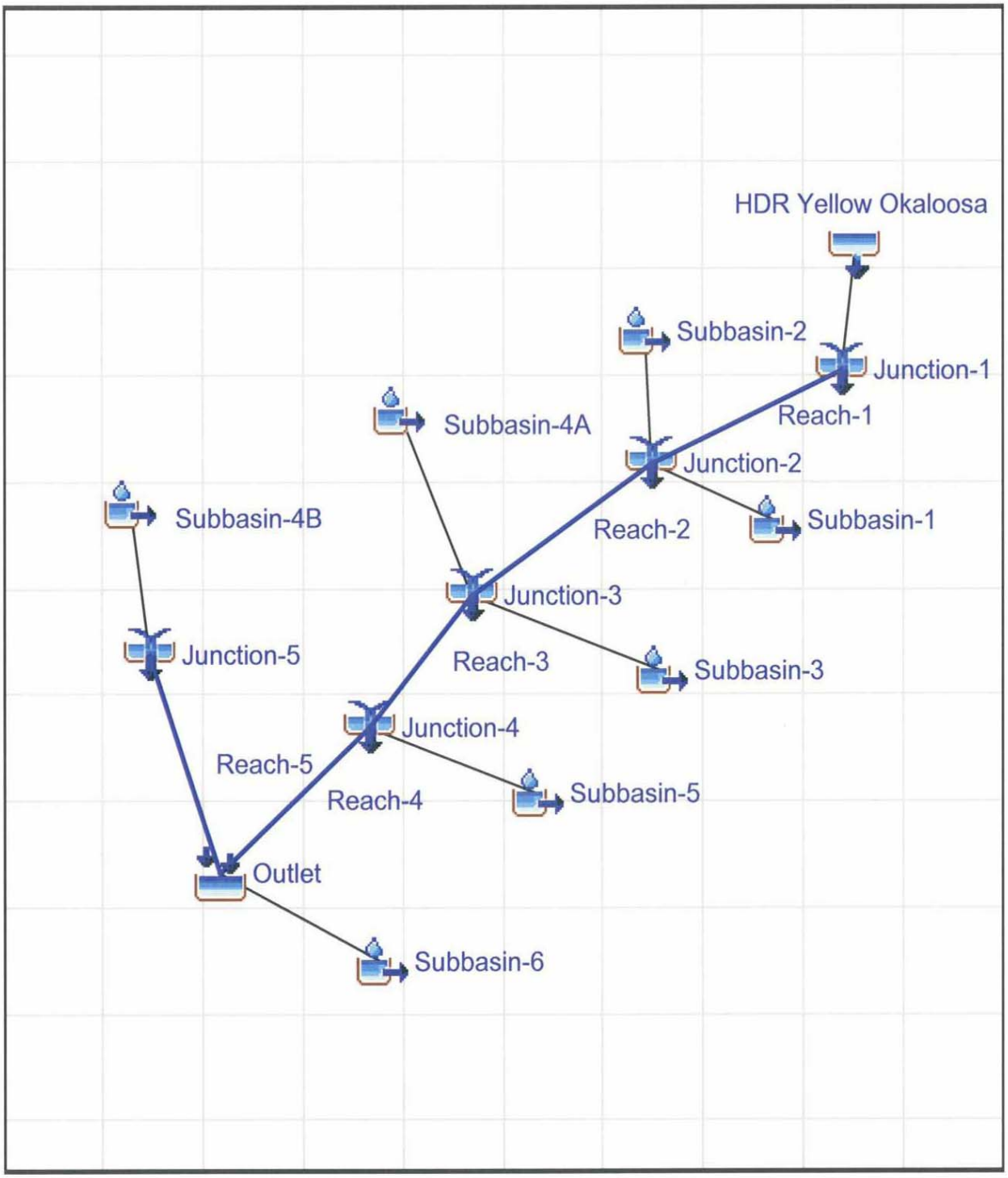
Hydrologic Computer Model Results

HEC-HMS

Project : Yellow River Ranch

Basin Model : Yellow 500-24

Mar 12 14:09:37 EST 2007



F.1

500 yr – 24 hr Event

Project: Yellow River Ranch Simulation Run: 500yr-24hr

Start of Run: 07Mar1998, 00:00 Basin Model: Yellow 500-24
End of Run: 20Mar1998, 00:00 Meteorologic Model: 500-24
Compute Time: 26Mar2007, 09:41:13 Control Specifications: Control 1

Volume Units: (•) IN ( ) AC-FT

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
HDR Yellow ...	1269.00	155336.2	12Mar1998, 15:40	13.64
Junction-1	1269.00	155336.2	12Mar1998, 15:40	13.64
Junction-2	1279.39	155388.2	12Mar1998, 17:15	13.61
Junction-3	1295.36	155467.8	12Mar1998, 23:20	13.59
Junction-4	1324.91	155615.4	13Mar1998, 00:30	13.50
Junction-5	6.87	1124.2	08Mar1998, 05:45	8.01
Outlet	1334.00	155660.6	13Mar1998, 01:20	13.48
Reach-1	1269.00	155336.2	12Mar1998, 17:15	13.64
Reach-2	1279.39	155388.0	12Mar1998, 23:20	13.62
Reach-3	1295.36	155467.6	13Mar1998, 00:30	13.59
Reach-4	1324.91	155615.1	13Mar1998, 01:20	13.50
Reach-5	6.87	1124.2	08Mar1998, 15:20	8.01
Subbasin-1	1.77	3041.1	07Mar1998, 13:50	13.86
Subbasin-2	8.62	1263.8	08Mar1998, 09:30	8.40
Subbasin-3	10.64	2159.4	08Mar1998, 12:10	11.83
Subbasin-4A	5.33	2697.8	07Mar1998, 16:05	8.01
Subbasin-4B	6.87	1124.2	08Mar1998, 05:45	8.01
Subbasin-5	29.55	4897.6	08Mar1998, 10:40	9.55
Subbasin-6	2.22	4024.7	07Mar1998, 14:00	15.79

F.2

100 yr – 24 hr Event

Project: Yellow River Ranch Simulation Run: 100yr-24hr

Start of Run: 07Mar1998, 00:00 Basin Model: Yellow 100-24
End of Run: 20Mar1998, 00:00 Meteorologic Model: 100-24
Compute Time: 26Mar2007, 10:30:33 Control Specifications: Control 1

Volume Units: (•) IN ( ) AC-FT

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
HDR Yellow ...	1269.00	95196.9	12Mar1998, 14:50	10.40
Junction-1	1269.00	95196.9	12Mar1998, 14:50	10.40
Junction-2	1279.39	95248.9	12Mar1998, 16:25	10.38
Junction-3	1295.36	95328.7	12Mar1998, 22:30	10.38
Junction-4	1324.91	95476.2	12Mar1998, 23:40	10.32
Junction-5	6.87	798.3	08Mar1998, 05:55	6.35
Outlet	1334.00	95521.7	13Mar1998, 00:30	10.31
Reach-1	1269.00	95196.9	12Mar1998, 16:25	10.41
Reach-2	1279.39	95248.8	12Mar1998, 22:30	10.40
Reach-3	1295.36	95328.5	12Mar1998, 23:40	10.38
Reach-4	1324.91	95476.2	13Mar1998, 00:30	10.32
Reach-5	6.87	798.3	08Mar1998, 15:30	6.35
Subbasin-1	1.77	2443.0	07Mar1998, 13:55	11.55
Subbasin-2	8.62	910.7	08Mar1998, 09:40	6.68
Subbasin-3	10.64	1677.0	08Mar1998, 12:15	9.67
Subbasin-4A	5.33	1862.2	07Mar1998, 16:15	6.35
Subbasin-4B	6.87	798.3	08Mar1998, 05:55	6.35
Subbasin-5	29.55	3632.8	08Mar1998, 10:40	7.65
Subbasin-6	2.22	3333.1	07Mar1998, 14:00	13.41

F.3

50 yr – 24 hr Event

Project: Yellow River Ranch Simulation Run: 50yr-24hr

Start of Run: 07Mar1998, 00:00 Basin Model: Yellow 50-24
End of Run: 20Mar1998, 00:00 Meteorologic Model: 50-24
Compute Time: 26Mar2007, 10:36:33 Control Specifications: Control 1

Volume Units: (•) IN ( ) AC-FT

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
HDR Yellow ...	1269.00	74843.4	12Mar1998, 19:45	8.58
Junction-1	1269.00	74843.4	12Mar1998, 19:45	8.58
Junction-2	1279.39	74895.3	12Mar1998, 21:20	8.57
Junction-3	1295.36	74975.1	13Mar1998, 03:25	8.58
Junction-4	1324.91	75122.8	13Mar1998, 04:35	8.55
Junction-5	6.87	672.3	08Mar1998, 06:05	5.71
Outlet	1334.00	75168.2	13Mar1998, 05:25	8.54
Reach-1	1269.00	74843.4	12Mar1998, 21:20	8.59
Reach-2	1279.39	74895.3	13Mar1998, 03:25	8.59
Reach-3	1295.36	74975.0	13Mar1998, 04:35	8.59
Reach-4	1324.91	75122.7	13Mar1998, 05:25	8.55
Reach-5	6.87	672.3	08Mar1998, 15:40	5.71
Subbasin-1	1.77	2194.4	07Mar1998, 13:55	10.59
Subbasin-2	8.62	773.0	08Mar1998, 09:45	6.01
Subbasin-3	10.64	1480.6	08Mar1998, 12:20	8.80
Subbasin-4A	5.33	1540.8	07Mar1998, 16:15	5.71
Subbasin-4B	6.87	672.3	08Mar1998, 06:05	5.71
Subbasin-5	29.55	3131.0	08Mar1998, 10:45	6.90
Subbasin-6	2.22	3044.0	07Mar1998, 14:00	12.41

F4

25 yr – 24 hr Event

Project: Yellow River Ranch Simulation Run: 25yr-24hr

Start of Run: 07Mar1998, 00:00 Basin Model: Yellow 25-24
End of Run: 20Mar1998, 00:00 Meteorologic Model: 25-24
Compute Time: 26Mar2007, 10:40:29 Control Specifications: Control 1

Volume Units: (•) IN ( ) AC-FT

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
HDR Yellow ...	1269.00	51120.9	13Mar1998, 01:20	6.49
Junction-1	1269.00	51120.9	13Mar1998, 01:20	6.49
Junction-2	1279.39	51172.8	13Mar1998, 02:55	6.49
Junction-3	1295.36	51252.6	13Mar1998, 09:00	6.51
Junction-4	1324.91	51400.3	13Mar1998, 10:10	6.50
Junction-5	6.87	513.4	08Mar1998, 06:20	4.89
Outlet	1334.00	51445.7	13Mar1998, 11:00	6.50
Reach-1	1269.00	51120.9	13Mar1998, 02:55	6.50
Reach-2	1279.39	51172.8	13Mar1998, 09:00	6.51
Reach-3	1295.36	51252.6	13Mar1998, 10:10	6.51
Reach-4	1324.91	51400.3	13Mar1998, 11:00	6.50
Reach-5	6.87	513.4	08Mar1998, 15:55	4.89
Subbasin-1	1.77	1859.3	07Mar1998, 13:55	9.32
Subbasin-2	8.62	598.2	08Mar1998, 09:50	5.15
Subbasin-3	10.64	1221.6	08Mar1998, 12:20	7.64
Subbasin-4A	5.33	1139.5	07Mar1998, 16:25	4.89
Subbasin-4B	6.87	513.4	08Mar1998, 06:20	4.89
Subbasin-5	29.55	2483.8	08Mar1998, 10:45	5.93
Subbasin-6	2.22	2652.6	07Mar1998, 14:00	11.07

F.5

10 yr – 24 hr Event

Project: Yellow River Ranch Simulation Run: 10yr-24hr

Start of Run: 07Mar1998, 00:00 Basin Model: Yellow 10-24
End of Run: 20Mar1998, 00:00 Meteorologic Model: 10-24
Compute Time: 26Mar2007, 10:46:37 Control Specifications: Control 1

Volume Units: (•) IN ( ) AC-FT

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
HDR Yellow ...	1269.00	31043.3	13Mar1998, 05:30	4.56
Junction-1	1269.00	31043.3	13Mar1998, 05:30	4.56
Junction-2	1279.39	31095.2	13Mar1998, 07:05	4.57
Junction-3	1295.36	31175.0	13Mar1998, 13:10	4.60
Junction-4	1324.91	31322.7	13Mar1998, 14:20	4.62
Junction-5	6.87	380.0	08Mar1998, 06:40	4.21
Outlet	1334.00	31368.2	13Mar1998, 15:10	4.62
Reach-1	1269.00	31043.3	13Mar1998, 07:05	4.56
Reach-2	1279.39	31095.2	13Mar1998, 13:10	4.59
Reach-3	1295.36	31175.0	13Mar1998, 14:20	4.60
Reach-4	1324.91	31322.7	13Mar1998, 15:10	4.62
Reach-5	6.87	380.0	08Mar1998, 16:15	4.21
Subbasin-1	1.77	1550.2	07Mar1998, 13:55	8.15
Subbasin-2	8.62	449.8	08Mar1998, 10:05	4.42
Subbasin-3	10.64	989.4	08Mar1998, 12:20	6.60
Subbasin-4A	5.33	807.5	07Mar1998, 16:35	4.21
Subbasin-4B	6.87	380.0	08Mar1998, 06:40	4.21
Subbasin-5	29.55	1922.6	08Mar1998, 10:50	5.09
Subbasin-6	2.22	2288.8	07Mar1998, 14:00	9.84

F.6

2 yr – 24 hr Event

Project: Yellow River Ranch Simulation Run: 2yr-24hr

Start of Run: 07Mar1998, 00:00 Basin Model: Yellow 2-24
End of Run: 20Mar1998, 00:00 Meteorologic Model: 2-24
Compute Time: 26Mar2007, 10:50:06 Control Specifications: Control 1

Volume Units: (•) IN ( ) AC-FT

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
HDR Yellow ...	1269.00	13183.6	13Mar1998, 07:35	2.52
Junction-1	1269.00	13183.6	13Mar1998, 07:35	2.52
Junction-2	1279.39	13235.5	13Mar1998, 09:10	2.54
Junction-3	1295.36	13315.4	13Mar1998, 15:15	2.57
Junction-4	1324.91	13463.1	13Mar1998, 16:30	2.59
Junction-5	6.87	124.9	08Mar1998, 07:50	2.89
Outlet	1334.00	13508.5	13Mar1998, 17:15	2.60
Reach-1	1269.00	13183.6	13Mar1998, 09:10	2.53
Reach-2	1279.39	13235.5	13Mar1998, 15:15	2.55
Reach-3	1295.36	13315.4	13Mar1998, 16:30	2.57
Reach-4	1324.91	13463.1	13Mar1998, 17:15	2.59
Reach-5	6.87	124.9	08Mar1998, 17:25	2.89
Subbasin-1	1.77	800.7	07Mar1998, 13:55	5.38
Subbasin-2	8.62	159.2	08Mar1998, 11:10	2.99
Subbasin-3	10.64	465.5	08Mar1998, 12:30	4.26
Subbasin-4A	5.33	204.4	07Mar1998, 17:20	2.89
Subbasin-4B	6.87	124.9	08Mar1998, 07:50	2.89
Subbasin-5	29.55	758.3	08Mar1998, 11:30	3.34
Subbasin-6	2.22	1379.3	07Mar1998, 14:00	6.79

F.7

1 yr – 3 hr Event

Project: Yellow River Ranch Simulation Run: 1yr-3hr

Start of Run: 07Mar1998, 00:00 Basin Model: Yellow 1-3
End of Run: 20Mar1998, 00:00 Meteorologic Model: 1-3
Compute Time: 26Mar2007, 10:53:44 Control Specifications: Control 1

Volume Units: (•) IN ( ) AC-FT

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
HDR Yellow ...	1269.00	1402.6	08Mar1998, 07:35	0.13
Junction-1	1269.00	1402.6	08Mar1998, 07:35	0.13
Junction-2	1279.39	1456.1	08Mar1998, 09:10	0.15
Junction-3	1295.36	1620.3	08Mar1998, 15:15	0.18
Junction-4	1324.91	1815.8	08Mar1998, 16:25	0.23
Junction-5	6.87	34.7	08Mar1998, 13:55	2.42
Outlet	1334.00	1861.4	08Mar1998, 17:15	0.25
Reach-1	1269.00	1402.6	08Mar1998, 09:10	0.13
Reach-2	1279.39	1456.1	08Mar1998, 15:15	0.15
Reach-3	1295.36	1620.2	08Mar1998, 16:25	0.18
Reach-4	1324.91	1815.7	08Mar1998, 17:15	0.23
Reach-5	6.87	34.7	08Mar1998, 23:30	2.42
Subbasin-1	1.77	243.0	07Mar1998, 14:05	3.35
Subbasin-2	8.62	45.2	08Mar1998, 15:45	2.43
Subbasin-3	10.64	138.5	08Mar1998, 13:25	2.80
Subbasin-4A	5.33	27.7	08Mar1998, 02:05	2.42
Subbasin-4B	6.87	34.7	08Mar1998, 13:55	2.42
Subbasin-5	29.55	196.5	08Mar1998, 14:10	2.49
Subbasin-6	2.22	611.7	07Mar1998, 14:05	4.30

Appendix G

Field Inspection Photographs

Yellow River Ranch: ditch adjacent to perimeter berm

Yellow River Ranch: ditch adjacent to perimeter berm

Yellow River Ranch: connection to floodplain (Berm Opening)

Yellow River Ranch: Internal ditch system

Yellow River Ranch: pasture without grazing

Appendix H

Hydraulic Computer Model Results – Existing Conditions

H.1

2, 10, 25, 50, 100 & 500 yr – 24 hr Simulation

HEC-RAS Plan: ExAlt3 River: Yellow River Reach: Main

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	E.G. Elev	E.G. Slope	Vel Chnl	Top Width	Froude
			(m3/s)	(m)	(m)	(m)	(m/m)	(m/s)	(m)	
Main	2216.615	2-yr	377	-1.1	2.9	2.91	0.000239	0.92	2628.22	0.15
Main	2216.615	10-yr	883	-1.1	3.68	3.68	0.0002	0.94	2947.54	0.14
Main	2216.615	25-yr	1451	-1.1	4.26	4.26	0.000202	1.02	3063.19	0.14
Main	2216.615	50-yr	2123	-1.1	4.87	4.88	0.000184	1.05	3063.76	0.14
Main	2216.615	100-yr	2700	-1.1	5.24	5.25	0.000205	1.15	3233.93	0.15
Main	2216.615	500-yr	4403	-1.1	6.19	6.2	0.000235	1.36	3539.3	0.16
Main	2133.777	2-yr	377	-1.1	2.88	2.89	0.00024	0.95	2567.45	0.15
Main	2133.777	10-yr	883	-1.1	3.66	3.66	0.000213	1.01	2896.46	0.15
Main	2133.777	25-yr	1451	-1.1	4.24	4.25	0.000223	1.12	3070.31	0.15
Main	2133.777	50-yr	2123	-1.1	4.86	4.86	0.000204	1.15	3073.53	0.15
Main	2133.777	100-yr	2700	-1.1	5.22	5.23	0.000227	1.26	3234.53	0.16
Main	2133.777	500-yr	4403	-1.1	6.17	6.18	0.000257	1.47	3531.4	0.17
Main	1998.885	2-yr	377	-1.11	2.85	2.86	0.000225	0.93	2573.71	0.15
Main	1998.885	10-yr	883	-1.11	3.63	3.64	0.000209	1	2957.34	0.15
Main	1998.885	25-yr	1451	-1.11	4.21	4.22	0.000221	1.12	3077.71	0.15
Main	1998.885	50-yr	2123	-1.11	4.83	4.84	0.000204	1.16	3089.4	0.15
Main	1998.885	100-yr	2700	-1.11	5.19	5.2	0.000231	1.28	3301.84	0.16
Main	1998.885	500-yr	4403	-1.11	6.13	6.14	0.000257	1.48	3609.33	0.18
Main	1887.717	2-yr	377	-1.11	2.83	2.83	0.000225	0.86	2580.4	0.14
Main	1887.717	10-yr	883	-1.11	3.61	3.61	0.000192	0.89	3161.16	0.13
Main	1887.717	25-yr	1451	-1.11	4.19	4.19	0.00019	0.96	3253.64	0.13
Main	1887.717	50-yr	2123	-1.11	4.81	4.81	0.000174	0.99	3254.95	0.13
Main	1887.717	100-yr	2700	-1.11	5.17	5.17	0.000192	1.08	3390.3	0.14
Main	1887.717	500-yr	4403	-1.11	6.11	6.12	0.000214	1.26	3613.74	0.15
Main	1818.723	2-yr	377	-1.12	2.81	2.82	0.000168	0.84	2398.57	0.14
Main	1818.723	10-yr	883	-1.12	3.59	3.6	0.000166	0.94	3232.81	0.14
Main	1818.723	25-yr	1451	-1.12	4.17	4.18	0.000162	1	3285.23	0.14
Main	1818.723	50-yr	2123	-1.12	4.79	4.8	0.000146	1.03	3287.69	0.13
Main	1818.723	100-yr	2700	-1.12	5.15	5.16	0.000161	1.12	3422.88	0.14
Main	1818.723	500-yr	4403	-1.12	6.09	6.1	0.000175	1.28	3728.72	0.15
Main	1659.436	2-yr	377	-1.12	2.79	2.79	0.000149	0.76	2679.59	0.12
Main	1659.436	10-yr	883	-1.12	3.57	3.57	0.00013	0.81	3330.2	0.12
Main	1659.436	25-yr	1451	-1.12	4.15	4.16	0.000128	0.86	3470.85	0.12
Main	1659.436	50-yr	2123	-1.12	4.77	4.78	0.000116	0.89	3476.53	0.12
Main	1659.436	100-yr	2700	-1.12	5.13	5.14	0.00013	0.97	3672.37	0.12
Main	1659.436	500-yr	4403	-1.12	6.07	6.08	0.000143	1.12	3778.92	0.13
Main	1516.072	2-yr	377	-1.13	2.77	2.78	0.000096	0.63	2629.59	0.1
Main	1516.072	10-yr	883	-1.13	3.55	3.56	0.000088	0.68	3445.08	0.1
Main	1516.072	25-yr	1451	-1.13	4.13	4.14	0.000093	0.76	3586.16	0.11
Main	1516.072	50-yr	2123	-1.13	4.76	4.77	0.000085	0.79	3588.19	0.1
Main	1516.072	100-yr	2700	-1.13	5.12	5.12	0.000094	0.86	3706.63	0.11
Main	1516.072	500-yr	4403	-1.13	6.05	6.06	0.000105	1	3816.64	0.12

Main	1437.623	2-yr	377	-1.13	2.76	2.77	0.00009	0.62	2622.8	0.1
Main	1437.623	10-yr	883	-1.13	3.55	3.55	0.000086	0.68	3438.77	0.1
Main	1437.623	25-yr	1451	-1.13	4.13	4.13	0.00009	0.75	3603.28	0.1
Main	1437.623	50-yr	2123	-1.13	4.75	4.76	0.000082	0.77	3605.54	0.1
Main	1437.623	100-yr	2700	-1.13	5.11	5.12	0.000091	0.85	3723.72	0.11
Main	1437.623	500-yr	4403	-1.13	6.04	6.05	0.000102	0.98	3812.67	0.12
Main	1344.505	2-yr	377	-1.14	2.76	2.76	0.000069	0.54	2508.09	0.09
Main	1344.505	10-yr	883	-1.14	3.54	3.54	0.000073	0.63	3216.13	0.09
Main	1344.505	25-yr	1451	-1.14	4.12	4.12	0.000083	0.73	3489.74	0.1
Main	1344.505	50-yr	2123	-1.14	4.75	4.75	0.000079	0.76	3502.08	0.1
Main	1344.505	100-yr	2700	-1.14	5.1	5.11	0.000088	0.84	3665.84	0.11
Main	1344.505	500-yr	4403	-1.14	6.03	6.04	0.0001	0.98	3778.49	0.12
Main	1193.531	2-yr	377	-1.14	2.74	2.75	0.000077	0.56	2475.64	0.09
Main	1193.531	10-yr	883	-1.14	3.53	3.53	0.000083	0.65	3036.63	0.1
Main	1193.531	25-yr	1451	-1.14	4.1	4.11	0.000095	0.76	3428.86	0.11
Main	1193.531	50-yr	2123	-1.14	4.73	4.74	0.000089	0.79	3429.91	0.1
Main	1193.531	100-yr	2700	-1.14	5.09	5.09	0.0001	0.87	3606.57	0.11
Main	1193.531	500-yr	4403	-1.14	6.02	6.02	0.000113	1.02	3776.83	0.12
Main	1057.806	2-yr	377	-1.15	2.73	2.74	0.000067	0.54	2404.67	0.09
Main	1057.806	10-yr	883	-1.15	3.51	3.52	0.000083	0.68	2938.66	0.1
Main	1057.806	25-yr	1451	-1.15	4.09	4.1	0.000097	0.79	3189.52	0.11
Main	1057.806	50-yr	2123	-1.15	4.72	4.73	0.000095	0.84	3193.74	0.11
Main	1057.806	100-yr	2700	-1.15	5.07	5.08	0.00011	0.94	3424.88	0.12
Main	1057.806	500-yr	4403	-1.15	6	6.01	0.000124	1.1	3455.86	0.13
Main	954.629	2-yr	377	-1.15	2.73	2.73	0.000104	0.64	2129.01	0.1
Main	954.629	10-yr	883	-1.15	3.5	3.51	0.000123	0.78	2758.2	0.12
Main	954.629	25-yr	1451	-1.15	4.08	4.08	0.000142	0.91	3049.8	0.13
Main	954.629	50-yr	2123	-1.15	4.71	4.71	0.000135	0.95	3068.88	0.13
Main	954.629	100-yr	2700	-1.15	5.06	5.07	0.000156	1.07	3348.73	0.14
Main	954.629	500-yr	4403	-1.15	5.98	5.99	0.000173	1.23	3364.78	0.15
Main	855.0215	2-yr	377	-1.16	2.72	2.72	0.000075	0.57	1991.39	0.09
Main	855.0215	10-yr	883	-1.16	3.49	3.5	0.000101	0.74	2660.58	0.11
Main	855.0215	25-yr	1451	-1.16	4.06	4.07	0.000129	0.9	3128.94	0.13
Main	855.0215	50-yr	2123	-1.16	4.69	4.7	0.000127	0.96	3153.5	0.13
Main	855.0215	100-yr	2700	-1.16	5.04	5.05	0.000148	1.08	3498.69	0.14
Main	855.0215	500-yr	4403	-1.16	5.96	5.98	0.000165	1.26	3532.02	0.15
Main	762.1925	2-yr	377	-1.16	2.71	2.71	0.000095	0.63	1898.32	0.1
Main	762.1925	10-yr	883	-1.16	3.48	3.49	0.000137	0.85	2245.93	0.13
Main	762.1925	25-yr	1451	-1.16	4.04	4.06	0.000189	1.08	3239.4	0.15
Main	762.1925	50-yr	2123	-1.16	4.68	4.69	0.000181	1.14	3254.54	0.15
Main	762.1925	100-yr	2700	-1.16	5.02	5.03	0.000215	1.29	3666.83	0.17
Main	762.1925	500-yr	4403	-1.16	5.94	5.96	0.000226	1.45	3670.92	0.17
Main	636.3889	2-yr	381	-1.16	2.7	2.7	0.000126	0.71	1912.09	0.11
Main	636.3889	10-yr	887	-1.16	3.46	3.47	0.000191	0.98	2469.65	0.15
Main	636.3889	25-yr	1456	-1.16	4.02	4.03	0.000273	1.26	3184.73	0.18
Main	636.3889	50-yr	2127	-1.16	4.65	4.67	0.000249	1.31	3228.84	0.17

Main	636.3889	100-yr	2704	-1.16	4.99	5.01	0.000273	1.42	3252.58	0.18
Main	636.3889	500-yr	4407	-1.16	5.91	5.93	0.000312	1.66	3698.8	0.2
Main	267.4734	2-yr	383	-1.18	2.64	2.65	0.000141	0.75	1984.54	0.12
Main	267.4734	10-yr	888	-1.18	3.38	3.4	0.000203	1.01	2519.27	0.15
Main	267.4734	25-yr	1457	-1.18	3.92	3.93	0.000247	1.2	2525.13	0.17
Main	267.4734	50-yr	2129	-1.18	4.55	4.57	0.00027	1.36	3112.19	0.18
Main	267.4734	100-yr	2705	-1.18	4.88	4.9	0.000297	1.48	3125.3	0.19
Main	267.4734	500-yr	4408	-1.18	5.78	5.8	0.000345	1.75	3845.7	0.21
Main	138.9569	2-yr	383	-1.19	2.6	2.62	0.000267	1.04	1876.03	0.17
Main	138.9569	10-yr	888	-1.19	3.33	3.36	0.00035	1.34	2134.14	0.2
Main	138.9569	25-yr	1457	-1.19	3.86	3.89	0.000414	1.57	2166.24	0.22
Main	138.9569	50-yr	2129	-1.19	4.47	4.51	0.000485	1.83	3088.61	0.25
Main	138.9569	100-yr	2705	-1.19	4.8	4.84	0.000498	1.93	3094.21	0.25
Main	138.9569	500-yr	4408	-1.19	5.7	5.75	0.000513	2.15	3695.77	0.26
Main	0.047244	2-yr	383	-1.19	2.51	2.57	0.000592	1.49	1864.85	0.25
Main	0.047244	10-yr	888	-1.19	3.25	3.29	0.000594	1.68	2339.89	0.26
Main	0.047244	25-yr	1457	-1.19	3.78	3.82	0.000592	1.81	2365.46	0.26
Main	0.047244	50-yr	2129	-1.19	4.4	4.44	0.000587	1.95	3111.18	0.26
Main	0.047244	100-yr	2705	-1.19	4.73	4.77	0.000588	2.03	3121.63	0.27
Main	0.047244	500-yr	4408	-1.19	5.63	5.67	0.000586	2.23	3714.12	0.27

H.2

1 yr – 3 hr Simulation

HEC-RAS Plan: ExAlt4 River: Yellow River Reach: Main Profile: 1 yr

Reach	River Sta	Profile	Q	Min Ch El	W.S. Elev	E.G. Elev	E.G. Slope	Vel Chnl	Top Width	Froude
			(m3/s)	(m)	(m)	(m)	(m/m)	(m/s)	(m)	
Main	2216.615	1 yr	52.7	-1.1	2.07	2.09	0.000229	0.77	2615.89	0.14
Main	2133.777	1 yr	52.7	-1.1	2.06	2.08	0.000142	0.63	2556.21	0.11
Main	1998.885	1 yr	52.7	-1.11	2.05	2.06	0.000111	0.56	2555.46	0.1
Main	1887.717	1 yr	52.7	-1.11	2.03	2.04	0.000211	0.71	2540.32	0.13
Main	1818.723	1 yr	52.7	-1.12	2.03	2.03	0.000038	0.34	2391.51	0.06
Main	1659.436	1 yr	52.7	-1.12	2.02	2.03	0.000071	0.45	2621.26	0.08
Main	1516.072	1 yr	52.7	-1.13	2.01	2.02	0.00003	0.31	2582.94	0.06
Main	1437.623	1 yr	52.7	-1.13	2.01	2.01	0.000026	0.29	2580.22	0.05
Main	1344.505	1 yr	52.7	-1.14	2.01	2.01	0.000015	0.22	2491.85	0.04
Main	1193.531	1 yr	52.7	-1.14	2.01	2.01	0.000017	0.23	2458.47	0.04
Main	1057.806	1 yr	52.7	-1.15	2.01	2.01	0.00001	0.18	2380.88	0.03
Main	954.629	1 yr	52.7	-1.15	2.01	2.01	0.000019	0.24	2107.18	0.04
Main	855.0215	1 yr	52.7	-1.16	2	2.01	0.000009	0.18	1960.44	0.03
Main	762.1925	1 yr	52.7	-1.16	2	2	0.000011	0.18	1880.64	0.03
Main	636.3889	1 yr	52.7	-1.16	2	2	0.000014	0.21	1895.11	0.04
Main	267.4734	1 yr	52.7	-1.18	2	2	0.000011	0.18	1259.39	0.03
Main	138.9569	1 yr	52.7	-1.19	1.99	2	0.00002	0.26	507.15	0.05
Main	0.047244	1 yr	52.7	-1.19	1.99	1.99	0.00004	0.35	329.41	0.06

Appendix I

Hydraulic Computer Model Results – Proposed Conditions

I.1

2, 10, 25, 50, 100 & 500 yr – 24 hr Simulation

HEC-RAS Plan: PropA5 River: Yellow River Reach: Main

Reach	River Sta	Profile	Q	Ch El	W.S. Elev	E.G. Elev	E.G. Slope	Vel	Top Width	Froude
			(m3/s)	(m)	(m)	(m)	(m/m)	(m/s)	(m)	
Main	2216.62	2-yr	377	-1.1	2.94	2.95	0.000213	0.87	2628.78	0.14
Main	2216.62	10-yr	883	-1.1	3.73	3.74	0.000179	0.9	2948.14	0.13
Main	2216.62	25-yr	1451	-1.1	4.33	4.34	0.000181	0.98	3063.26	0.13
Main	2216.62	50-yr	2123	-1.1	4.95	4.95	0.000168	1.01	3063.83	0.13
Main	2216.62	100-yr	2700	-1.1	5.33	5.34	0.000186	1.11	3234.13	0.14
Main	2216.62	500-yr	4403	-1.1	6.29	6.3	0.000213	1.3	3540.68	0.15
Main	2133.78	2-yr	377	-1.1	2.92	2.93	0.000213	0.9	2568.01	0.14
Main	2133.78	10-yr	883	-1.1	3.71	3.72	0.00019	0.96	2896.59	0.14
Main	2133.78	25-yr	1451	-1.1	4.31	4.32	0.000199	1.06	3070.7	0.15
Main	2133.78	50-yr	2123	-1.1	4.93	4.94	0.000186	1.1	3073.92	0.14
Main	2133.78	100-yr	2700	-1.1	5.31	5.32	0.000205	1.21	3235.24	0.15
Main	2133.78	500-yr	4403	-1.1	6.27	6.28	0.000233	1.41	3532.68	0.17
Main	1998.89	2-yr	377	-1.11	2.89	2.9	0.000199	0.88	2574.72	0.14
Main	1998.89	10-yr	883	-1.11	3.69	3.7	0.000186	0.96	2959.91	0.14
Main	1998.89	25-yr	1451	-1.11	4.29	4.29	0.000196	1.06	3079.19	0.15
Main	1998.89	50-yr	2123	-1.11	4.9	4.91	0.000187	1.11	3090.85	0.15
Main	1998.89	100-yr	2700	-1.11	5.28	5.29	0.000209	1.23	3303.25	0.15
Main	1998.89	500-yr	4403	-1.11	6.24	6.25	0.000232	1.42	3609.58	0.17
Main	1887.72	2-yr	377	-1.11	2.87	2.88	0.000238	0.26	2582.79	0.04
Main	1887.72	10-yr	883	-1.11	3.67	3.67	0.000188	0.26	3161.48	0.04
Main	1887.72	25-yr	1451	-1.11	4.27	4.27	0.000182	0.28	3253.81	0.04
Main	1887.72	50-yr	2123	-1.11	4.89	4.89	0.000169	0.29	3255.11	0.04
Main	1887.72	100-yr	2700	-1.11	5.26	5.27	0.000183	0.31	3391.31	0.04
Main	1887.72	500-yr	4403	-1.11	6.22	6.22	0.000203	0.36	3615.1	0.04
Main	1818.72	2-yr	377	-1.12	2.86	2.86	0.000257	0.3	2399.03	0.05
Main	1818.72	10-yr	883	-1.12	3.66	3.66	0.000195	0.3	3233.02	0.04
Main	1818.72	25-yr	1451	-1.12	4.25	4.26	0.000176	0.31	3285.57	0.04
Main	1818.72	50-yr	2123	-1.12	4.88	4.88	0.000156	0.31	3288.02	0.04
Main	1818.72	100-yr	2700	-1.12	5.25	5.26	0.000167	0.34	3423.59	0.04
Main	1818.72	500-yr	4403	-1.12	6.21	6.21	0.000178	0.38	3730.38	0.04

Main	1659.44	2-yr	377	-1.12	2.81	2.82	0.000192	0.87	2681.69	0.14
Main	1659.44	10-yr	883	-1.12	3.62	3.63	0.000185	0.97	3330.36	0.14
Main	1659.44	25-yr	1451	-1.12	4.22	4.23	0.000188	1.06	3471.5	0.15
Main	1659.44	50-yr	2123	-1.12	4.85	4.85	0.000175	1.1	3477.17	0.14
Main	1659.44	100-yr	2700	-1.12	5.22	5.23	0.000197	1.21	3673.39	0.15
Main	1659.44	500-yr	4403	-1.12	6.17	6.18	0.000219	1.4	3779.22	0.17
Main	1516.07	2-yr	377	-1.13	2.79	2.8	0.000142	0.77	2630.83	0.12
Main	1516.07	10-yr	883	-1.13	3.6	3.61	0.000148	0.89	3448.48	0.13
Main	1516.07	25-yr	1451	-1.13	4.19	4.2	0.000166	1.03	3586.35	0.14
Main	1516.07	50-yr	2123	-1.13	4.82	4.83	0.000157	1.07	3588.38	0.14
Main	1516.07	100-yr	2700	-1.13	5.19	5.2	0.000174	1.18	3706.82	0.15
Main	1516.07	500-yr	4403	-1.13	6.14	6.15	0.000196	1.37	3817.4	0.16
Main	1437.62	2-yr	377	-1.13	2.78	2.79	0.000133	0.75	2623.75	0.12
Main	1437.62	10-yr	883	-1.13	3.58	3.59	0.000148	0.9	3440.19	0.13
Main	1437.62	25-yr	1451	-1.13	4.18	4.19	0.000164	1.02	3603.47	0.14
Main	1437.62	50-yr	2123	-1.13	4.81	4.82	0.000155	1.07	3605.73	0.14
Main	1437.62	100-yr	2700	-1.13	5.18	5.19	0.000172	1.17	3724.21	0.15
Main	1437.62	500-yr	4403	-1.13	6.12	6.14	0.000194	1.37	3813.4	0.16
Main	1344.51	2-yr	377	-1.14	2.77	2.78	0.000099	0.65	2508.39	0.11
Main	1344.51	10-yr	883	-1.14	3.57	3.58	0.000129	0.84	3217.68	0.12
Main	1344.51	25-yr	1451	-1.14	4.16	4.17	0.000157	1.01	3490.63	0.14
Main	1344.51	50-yr	2123	-1.14	4.79	4.8	0.000152	1.07	3502.96	0.14
Main	1344.51	100-yr	2700	-1.14	5.16	5.17	0.000171	1.18	3666.83	0.15
Main	1344.51	500-yr	4403	-1.14	6.1	6.12	0.000197	1.39	3778.76	0.16
Main	1193.53	2-yr	377	-1.14	2.75	2.76	0.000113	0.68	2475.86	0.11
Main	1193.53	10-yr	883	-1.14	3.55	3.56	0.000152	0.89	3037.42	0.13
Main	1193.53	25-yr	1451	-1.14	4.14	4.15	0.000184	1.06	3428.92	0.15
Main	1193.53	50-yr	2123	-	4.77	4.78	0.000173	1.1	3429.96	0.15

				1.14						
Main	1193.53	100-yr	2700	- 1.14	5.13	5.14	0.000195	1.22	3607.22	0.16
Main	1193.53	500-yr	4403	- 1.14	6.07	6.08	0.000225	1.44	3777.22	0.17
Main	1057.81	2-yr	377	- 1.15	2.74	2.75	0.000088	0.62	2404.86	0.1
Main	1057.81	10-yr	883	- 1.15	3.53	3.54	0.000134	0.86	2938.84	0.13
Main	1057.81	25-yr	1451	- 1.15	4.11	4.12	0.000164	1.03	3189.67	0.14
Main	1057.81	50-yr	2123	- 1.15	4.74	4.75	0.000163	1.1	3193.88	0.15
Main	1057.81	100-yr	2700	- 1.15	5.1	5.11	0.000192	1.25	3425.9	0.16
Main	1057.81	500-yr	4403	- 1.15	6.03	6.05	0.000239	1.52	3733.61	0.18
Main	954.63	2-yr	377	- 1.15	2.73	2.74	0.000136	0.73	2129.11	0.12
Main	954.63	10-yr	883	- 1.15	3.51	3.52	0.000184	0.96	2758.41	0.14
Main	954.63	25-yr	1451	- 1.15	4.09	4.1	0.000224	1.14	3050.26	0.16
Main	954.63	50-yr	2123	- 1.15	4.72	4.73	0.000214	1.2	3069.33	0.16
Main	954.63	100-yr	2700	- 1.15	5.08	5.09	0.000254	1.36	3349.12	0.17
Main	954.63	500-yr	4403	- 1.15	6	6.02	0.000331	1.71	3889.89	0.2
Main	855.02	2-yr	377	- 1.16	2.72	2.72	0.000099	0.65	1991.41	0.11
Main	855.02	10-yr	883	- 1.16	3.5	3.51	0.000152	0.91	2660.65	0.13
Main	855.02	25-yr	1451	- 1.16	4.07	4.08	0.000203	1.13	3129.14	0.16
Main	855.02	50-yr	2123	- 1.16	4.7	4.71	0.000198	1.21	3153.71	0.16
Main	855.02	100-yr	2700	- 1.16	5.05	5.07	0.000246	1.4	3499	0.18
Main	855.02	500-yr	4403	- 1.16	5.97	5.99	0.000266	1.59	3532.3	0.19
Main	762.19	2-yr	377	- 1.16	2.71	2.71	0.000108	0.67	1898.32	0.11
Main	762.19	10-yr	883	- 1.16	3.48	3.49	0.000174	0.96	2245.92	0.14
Main	762.19	25-yr	1451	- 1.16	4.04	4.06	0.000254	1.25	3239.39	0.17
Main	762.19	50-yr	2123	- 1.16	4.68	4.69	0.00024	1.31	3254.55	0.17
Main	762.19	100-yr	2700	- 1.16	5.02	5.04	0.000305	1.54	3666.83	0.2
Main	762.19	500-yr	4403	- 1.16	5.94	5.97	0.000308	1.69	3670.92	0.2
Main	636.39	2-yr	381	-	2.7	2.7	0.000126	0.71	1912.09	0.11

				1.16						
Main	636.39	10-yr	887	-1.16	3.46	3.47	0.000191	0.98	2469.65	0.15
Main	636.39	25-yr	1456	-1.16	4.02	4.03	0.000273	1.26	3184.73	0.18
Main	636.39	50-yr	2127	-1.16	4.65	4.67	0.000249	1.31	3228.84	0.17
Main	636.39	100-yr	2704	-1.16	4.99	5.01	0.000273	1.42	3252.58	0.18
Main	636.39	500-yr	4407	-1.16	5.91	5.93	0.000312	1.66	3698.8	0.2
Main	267.47	2-yr	383	-1.18	2.64	2.65	0.000141	0.75	1984.54	0.12
Main	267.47	10-yr	888	-1.18	3.38	3.4	0.000203	1.01	2519.27	0.15
Main	267.47	25-yr	1457	-1.18	3.92	3.93	0.000247	1.2	2525.13	0.17
Main	267.47	50-yr	2129	-1.18	4.55	4.57	0.00027	1.36	3112.19	0.18
Main	267.47	100-yr	2705	-1.18	4.88	4.9	0.000297	1.48	3125.3	0.19
Main	267.47	500-yr	4408	-1.18	5.78	5.8	0.000345	1.75	3845.7	0.21
Main	138.96	2-yr	383	-1.19	2.6	2.62	0.000267	1.04	1876.03	0.17
Main	138.96	10-yr	888	-1.19	3.33	3.36	0.00035	1.34	2134.14	0.2
Main	138.96	25-yr	1457	-1.19	3.86	3.89	0.000414	1.57	2166.24	0.22
Main	138.96	50-yr	2129	-1.19	4.47	4.51	0.000485	1.83	3088.61	0.25
Main	138.96	100-yr	2705	-1.19	4.8	4.84	0.000498	1.93	3094.21	0.25
Main	138.96	500-yr	4408	-1.19	5.7	5.75	0.000513	2.15	3695.77	0.26
Main	0.05	2-yr	383	-1.19	2.51	2.57	0.000592	1.49	1864.85	0.25
Main	0.05	10-yr	888	-1.19	3.25	3.29	0.000594	1.68	2339.89	0.26
Main	0.05	25-yr	1457	-1.19	3.78	3.82	0.000592	1.81	2365.46	0.26
Main	0.05	50-yr	2129	-1.19	4.4	4.44	0.000587	1.95	3111.18	0.26
Main	0.05	100-yr	2705	-1.19	4.73	4.77	0.000588	2.03	3121.63	0.27
Main	0.05	500-yr	4408	-1.19	5.63	5.67	0.000586	2.23	3714.12	0.27

I.2

1 yr – 3 hr Simulation

HEC-RAS Plan: PropA6 River: Yellow River Reach: Main Profile: 1 yr

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	E.G. Elev	E.G. Slope	Vel Chnl	Top Width	Froude
			(m3/s)	(m)	(m)	(m)	(m/m)	(m/s)	(m)	
Main	2216.615	1 yr	52.7	-1.1	2.1	2.12	0.000194	0.71	2616.31	0.13
Main	2133.777	1 yr	52.7	-1.1	2.09	2.1	0.000124	0.59	2556.61	0.11
Main	1998.885	1 yr	52.7	-1.11	2.08	2.09	0.000096	0.52	2556.16	0.09
Main	1887.717	1 yr	52.7	-1.11	2.06	2.06	0.000497	0.32	2542.21	0.06
Main	1818.723	1 yr	52.7	-1.12	2.04	2.04	0.000201	0.23	2391.63	0.04
Main	1659.436	1 yr	52.7	-1.12	2.02	2.03	0.000072	0.46	2621.28	0.08
Main	1516.072	1 yr	52.7	-1.13	2.01	2.02	0.00003	0.31	2582.95	0.06
Main	1437.623	1 yr	52.7	-1.13	2.01	2.02	0.000026	0.29	2580.23	0.05
Main	1344.505	1 yr	52.7	-1.14	2.01	2.01	0.000015	0.22	2491.85	0.04
Main	1193.531	1 yr	52.7	-1.14	2.01	2.01	0.000017	0.23	2458.47	0.04
Main	1057.806	1 yr	52.7	-1.15	2.01	2.01	0.00001	0.18	2380.89	0.03
Main	954.629	1 yr	52.7	-1.15	2.01	2.01	0.00002	0.24	2107.18	0.04
Main	855.0215	1 yr	52.7	-1.16	2	2.01	0.00001	0.18	1960.44	0.03
Main	762.1925	1 yr	52.7	-1.16	2	2	0.000011	0.19	1880.64	0.03
Main	636.3889	1 yr	52.7	-1.16	2	2	0.000014	0.21	1895.11	0.04
Main	267.4734	1 yr	52.7	-1.18	2	2	0.000011	0.18	1259.39	0.03
Main	138.9569	1 yr	52.7	-1.19	1.99	2	0.00002	0.26	507.15	0.05
Main	0.047244	1 yr	52.7	-1.19	1.99	1.99	0.00004	0.35	329.41	0.06

Appendix J

Hydraulic Computer Model Results

Simulation Prop3 & Prop5 Comparison

Simulation Prop3 & Prop5 Comparison

HEC-RAS River: Yellow River Reach: Main

Reach	River Sta	Profile	Plan	Q	Ch El	W.S. Elev	E.G. Elev	E.G. Slope	Vel	Top Width	Froude
				(m3/s)	(m)	(m)	(m)	(m/m)	(m/s)	(m)	
Main	2216.615	2-yr	PropA5	377	-1.1	2.94	2.95	0.000213	0.87	2628.78	0.14
Main	2216.615	2-yr	PropA3	377	-1.1	2.94	2.95	0.000212	0.87	2628.81	0.14
Main	2216.615	10-yr	PropA5	883	-1.1	3.73	3.74	0.000179	0.9	2948.14	0.13
Main	2216.615	10-yr	PropA3	883	-1.1	3.73	3.74	0.000179	0.9	2948.14	0.13
Main	2216.615	25-yr	PropA5	1451	-1.1	4.33	4.34	0.000181	0.98	3063.26	0.13
Main	2216.615	25-yr	PropA3	1451	-1.1	4.33	4.34	0.00018	0.98	3063.26	0.13
Main	2216.615	50-yr	PropA5	2123	-1.1	4.95	4.95	0.000168	1.01	3063.83	0.13
Main	2216.615	50-yr	PropA3	2123	-1.1	4.95	4.96	0.000167	1.01	3063.84	0.13
Main	2216.615	100-yr	PropA5	2700	-1.1	5.33	5.34	0.000186	1.11	3234.13	0.14
Main	2216.615	100-yr	PropA3	2700	-1.1	5.34	5.34	0.000185	1.11	3234.15	0.14
Main	2216.615	500-yr	PropA5	4403	-1.1	6.29	6.3	0.000213	1.3	3540.68	0.15
Main	2216.615	500-yr	PropA3	4403	-1.1	6.3	6.31	0.000212	1.3	3540.78	0.15
Main	2133.777	2-yr	PropA5	377	-1.1	2.92	2.93	0.000213	0.9	2568.01	0.14
Main	2133.777	2-yr	PropA3	377	-1.1	2.92	2.93	0.000209	0.89	2564.06	0.14
Main	2133.777	10-yr	PropA5	883	-1.1	3.71	3.72	0.00019	0.96	2896.59	0.14
Main	2133.777	10-yr	PropA3	883	-1.1	3.71	3.72	0.000188	0.96	2896.59	0.14
Main	2133.777	25-yr	PropA5	1451	-1.1	4.31	4.32	0.000199	1.06	3070.7	0.15
Main	2133.777	25-yr	PropA3	1451	-1.1	4.32	4.32	0.000196	1.06	3070.71	0.14
Main	2133.777	50-yr	PropA5	2123	-1.1	4.93	4.94	0.000186	1.1	3073.92	0.14
Main	2133.777	50-yr	PropA3	2123	-1.1	4.93	4.94	0.000183	1.1	3073.94	0.14
Main	2133.777	100-yr	PropA5	2700	-1.1	5.31	5.32	0.000205	1.21	3235.24	0.15
Main	2133.777	100-yr	PropA3	2700	-1.1	5.32	5.33	0.000202	1.2	3235.28	0.15
Main	2133.777	500-yr	PropA5	4403	-1.1	6.27	6.28	0.000233	1.41	3532.68	0.17
Main	2133.777	500-yr	PropA3	4403	-1.1	6.28	6.29	0.000229	1.4	3532.78	0.16
Main	1998.885	2-yr	PropA5	377	-1.11	2.89	2.9	0.000199	0.88	2574.72	0.14
Main	1998.885	2-yr	PropA3	377	-1.11	2.9	2.91	0.000197	0.87	2561.38	0.14
Main	1998.885	10-yr	PropA5	883	-1.11	3.69	3.7	0.000186	0.96	2959.91	0.14
Main	1998.885	10-yr	PropA3	883	-1.11	3.69	3.7	0.000184	0.95	2959.94	0.14
Main	1998.885	25-yr	PropA5	1451	-1.11	4.29	4.29	0.000196	1.06	3079.19	0.15
Main	1998.885	25-yr	PropA3	1451	-1.11	4.29	4.3	0.000193	1.06	3079.24	0.15
Main	1998.885	50-yr	PropA5	2123	-1.11	4.9	4.91	0.000187	1.11	3090.85	0.15
Main	1998.885	50-yr	PropA3	2123	-1.11	4.91	4.92	0.000183	1.1	3090.93	0.14
Main	1998.885	100-yr	PropA5	2700	-1.11	5.28	5.29	0.000209	1.23	3303.25	0.15
Main	1998.885	100-yr	PropA3	2700	-1.11	5.29	5.3	0.000205	1.22	3303.35	0.15
Main	1998.885	500-yr	PropA5	4403	-1.11	6.24	6.25	0.000232	1.42	3609.58	0.17
Main	1998.885	500-yr	PropA3	4403	-1.11	6.25	6.26	0.000228	1.41	3609.6	0.17

Main	1887.717	2-yr	PropA5	377	-1.11	2.87	2.88	0.000238	0.26	2582.79	0.04
Main	1887.717	2-yr	PropA3	377	-1.11	2.87	2.88	0.000281	0.28	2561.26	0.05
Main	1887.717	10-yr	PropA5	883	-1.11	3.67	3.67	0.000188	0.26	3161.48	0.04
Main	1887.717	10-yr	PropA3	883	-1.11	3.67	3.67	0.000227	0.29	3161.47	0.04
Main	1887.717	25-yr	PropA5	1451	-1.11	4.27	4.27	0.000182	0.28	3253.81	0.04
Main	1887.717	25-yr	PropA3	1451	-1.11	4.27	4.27	0.000221	0.31	3253.81	0.04
Main	1887.717	50-yr	PropA5	2123	-1.11	4.89	4.89	0.000169	0.29	3255.11	0.04
Main	1887.717	50-yr	PropA3	2123	-1.11	4.89	4.89	0.000204	0.32	3255.12	0.04
Main	1887.717	100-yr	PropA5	2700	-1.11	5.26	5.27	0.000183	0.31	3391.31	0.04
Main	1887.717	100-yr	PropA3	2700	-1.11	5.27	5.27	0.000222	0.34	3391.35	0.04
Main	1887.717	500-yr	PropA5	4403	-1.11	6.22	6.22	0.000203	0.36	3615.1	0.04
Main	1887.717	500-yr	PropA3	4403	-1.11	6.22	6.23	0.000247	0.4	3615.17	0.05
Main	1818.723	2-yr	PropA5	377	-1.12	2.86	2.86	0.000257	0.3	2399.03	0.05
Main	1818.723	2-yr	PropA3	377	-1.12	2.86	2.86	0.000217	0.28	2785.91	0.04
Main	1818.723	10-yr	PropA5	883	-1.12	3.66	3.66	0.000195	0.3	3233.02	0.04
Main	1818.723	10-yr	PropA3	883	-1.12	3.65	3.66	0.000186	0.29	3233.01	0.04
Main	1818.723	25-yr	PropA5	1451	-1.12	4.25	4.26	0.000176	0.31	3285.57	0.04
Main	1818.723	25-yr	PropA3	1451	-1.12	4.25	4.26	0.000188	0.32	3285.57	0.04
Main	1818.723	50-yr	PropA5	2123	-1.12	4.88	4.88	0.000156	0.31	3288.02	0.04
Main	1818.723	50-yr	PropA3	2123	-1.12	4.88	4.88	0.000179	0.33	3288.02	0.04
Main	1818.723	100-yr	PropA5	2700	-1.12	5.25	5.26	0.000167	0.34	3423.59	0.04
Main	1818.723	100-yr	PropA3	2700	-1.12	5.25	5.26	0.0002	0.37	3423.6	0.05
Main	1818.723	500-yr	PropA5	4403	-1.12	6.21	6.21	0.000178	0.38	3730.38	0.04
Main	1818.723	500-yr	PropA3	4403	-1.12	6.21	6.21	0.000228	0.43	3730.42	0.05
Main	1659.436	2-yr	PropA5	377	-1.12	2.81	2.82	0.000192	0.87	2681.69	0.14
Main	1659.436	2-yr	PropA3	377	-1.12	2.82	2.83	0.000184	0.85	2754.92	0.14
Main	1659.436	10-yr	PropA5	883	-1.12	3.62	3.63	0.000185	0.97	3330.36	0.14
Main	1659.436	10-yr	PropA3	883	-1.12	3.62	3.63	0.000177	0.95	3330.36	0.14

Main	1659.436	25-yr	PropA5	1451	-1.12	4.22	4.23	0.000188	1.06	3471.5	0.15
Main	1659.436	25-yr	PropA3	1451	-1.12	4.22	4.23	0.000182	1.04	3471.49	0.14
Main	1659.436	50-yr	PropA5	2123	-1.12	4.85	4.85	0.000175	1.1	3477.17	0.14
Main	1659.436	50-yr	PropA3	2123	-1.12	4.84	4.85	0.000171	1.08	3477.16	0.14
Main	1659.436	100-yr	PropA5	2700	-1.12	5.22	5.23	0.000197	1.21	3673.39	0.15
Main	1659.436	100-yr	PropA3	2700	-1.12	5.22	5.23	0.000192	1.2	3673.38	0.15
Main	1659.436	500-yr	PropA5	4403	-1.12	6.17	6.18	0.000219	1.4	3779.22	0.17
Main	1659.436	500-yr	PropA3	4403	-1.12	6.17	6.18	0.000215	1.39	3779.21	0.16
Main	1516.072	2-yr	PropA5	377	-1.13	2.79	2.8	0.000142	0.77	2630.83	0.12
Main	1516.072	2-yr	PropA3	377	-1.13	2.79	2.8	0.000137	0.76	2699.96	0.12
Main	1516.072	10-yr	PropA5	883	-1.13	3.6	3.61	0.000148	0.89	3448.48	0.13
Main	1516.072	10-yr	PropA3	883	-1.13	3.6	3.6	0.000142	0.88	3453	0.13
Main	1516.072	25-yr	PropA5	1451	-1.13	4.19	4.2	0.000166	1.03	3586.35	0.14
Main	1516.072	25-yr	PropA3	1451	-1.13	4.19	4.2	0.00016	1.01	3586.35	0.14
Main	1516.072	50-yr	PropA5	2123	-1.13	4.82	4.83	0.000157	1.07	3588.38	0.14
Main	1516.072	50-yr	PropA3	2123	-1.13	4.82	4.83	0.000152	1.06	3588.37	0.14
Main	1516.072	100-yr	PropA5	2700	-1.13	5.19	5.2	0.000174	1.18	3706.82	0.15
Main	1516.072	100-yr	PropA3	2700	-1.13	5.19	5.2	0.00017	1.16	3706.82	0.15
Main	1516.072	500-yr	PropA5	4403	-1.13	6.14	6.15	0.000196	1.37	3817.4	0.16
Main	1516.072	500-yr	PropA3	4403	-1.13	6.14	6.15	0.000192	1.36	3817.4	0.16
Main	1437.623	2-yr	PropA5	377	-1.13	2.78	2.79	0.000133	0.75	2623.75	0.12
Main	1437.623	2-yr	PropA3	377	-1.13	2.78	2.79	0.000129	0.74	2704.89	0.12
Main	1437.623	10-yr	PropA5	883	-1.13	3.58	3.59	0.000148	0.9	3440.19	0.13
Main	1437.623	10-yr	PropA3	883	-1.13	3.58	3.59	0.000143	0.88	3441.65	0.13
Main	1437.623	25-yr	PropA5	1451	-1.13	4.18	4.19	0.000164	1.02	3603.47	0.14
Main	1437.623	25-yr	PropA3	1451	-1.13	4.18	4.19	0.000158	1	3603.47	0.14
Main	1437.623	50-yr	PropA5	2123	-1.13	4.81	4.82	0.000155	1.07	3605.73	0.14
Main	1437.623	50-yr	PropA3	2123	-1.13	4.81	4.82	0.00015	1.05	3605.73	0.14
Main	1437.623	100-yr	PropA5	2700	-	5.18	5.19	0.000172	1.17	3724.21	0.15

					1.13						
Main	1437.623	100-yr	PropA3	2700	-1.13	5.18	5.19	0.000167	1.15	3724.21	0.15
Main	1437.623	500-yr	PropA5	4403	-1.13	6.12	6.14	0.000194	1.37	3813.4	0.16
Main	1437.623	500-yr	PropA3	4403	-1.13	6.12	6.13	0.000189	1.35	3813.4	0.16
Main	1344.505	2-yr	PropA5	377	-1.14	2.77	2.78	0.000099	0.65	2508.39	0.11
Main	1344.505	2-yr	PropA3	377	-1.14	2.78	2.78	0.000097	0.65	2656.79	0.1
Main	1344.505	10-yr	PropA5	883	-1.14	3.57	3.58	0.000129	0.84	3217.68	0.12
Main	1344.505	10-yr	PropA3	883	-1.14	3.57	3.58	0.000119	0.81	3217.75	0.12
Main	1344.505	25-yr	PropA5	1451	-1.14	4.16	4.17	0.000157	1.01	3490.63	0.14
Main	1344.505	25-yr	PropA3	1451	-1.14	4.16	4.17	0.000147	0.98	3490.65	0.14
Main	1344.505	50-yr	PropA5	2123	-1.14	4.79	4.8	0.000152	1.07	3502.96	0.14
Main	1344.505	50-yr	PropA3	2123	-1.14	4.79	4.8	0.000144	1.04	3502.98	0.14
Main	1344.505	100-yr	PropA5	2700	-1.14	5.16	5.17	0.000171	1.18	3666.83	0.15
Main	1344.505	100-yr	PropA3	2700	-1.14	5.16	5.17	0.000163	1.15	3666.85	0.15
Main	1344.505	500-yr	PropA5	4403	-1.14	6.1	6.12	0.000197	1.39	3778.76	0.16
Main	1344.505	500-yr	PropA3	4403	-1.14	6.1	6.12	0.00019	1.37	3778.76	0.16
Main	1193.531	2-yr	PropA5	377	-1.14	2.75	2.76	0.000113	0.68	2475.86	0.11
Main	1193.531	2-yr	PropA3	377	-1.14	2.76	2.77	0.000118	0.69	2479.91	0.11
Main	1193.531	10-yr	PropA5	883	-1.14	3.55	3.56	0.000152	0.89	3037.42	0.13
Main	1193.531	10-yr	PropA3	883	-1.14	3.55	3.56	0.000151	0.88	3037.49	0.13
Main	1193.531	25-yr	PropA5	1451	-1.14	4.14	4.15	0.000184	1.06	3428.92	0.15
Main	1193.531	25-yr	PropA3	1451	-1.14	4.14	4.15	0.000183	1.05	3428.92	0.15
Main	1193.531	50-yr	PropA5	2123	-1.14	4.77	4.78	0.000173	1.1	3429.96	0.15
Main	1193.531	50-yr	PropA3	2123	-1.14	4.77	4.78	0.000172	1.1	3429.97	0.14
Main	1193.531	100-yr	PropA5	2700	-1.14	5.13	5.14	0.000195	1.22	3607.22	0.16
Main	1193.531	100-yr	PropA3	2700	-1.14	5.13	5.14	0.000194	1.22	3607.23	0.16
Main	1193.531	500-yr	PropA5	4403	-1.14	6.07	6.08	0.000225	1.44	3777.22	0.17
Main	1193.531	500-yr	PropA3	4403	-1.14	6.07	6.08	0.000224	1.44	3777.23	0.17
Main	1057.806	2-yr	PropA5	377	-	2.74	2.75	0.000088	0.62	2404.86	0.1

					1.15						
Main	1057.806	2-yr	PropA3	377	-1.15	2.74	2.75	0.000094	0.63	2411.15	0.1
Main	1057.806	10-yr	PropA5	883	-1.15	3.53	3.54	0.000134	0.86	2938.84	0.13
Main	1057.806	10-yr	PropA3	883	-1.15	3.53	3.54	0.000135	0.86	2938.86	0.13
Main	1057.806	25-yr	PropA5	1451	-1.15	4.11	4.12	0.000164	1.03	3189.67	0.14
Main	1057.806	25-yr	PropA3	1451	-1.15	4.11	4.13	0.000165	1.03	3189.68	0.14
Main	1057.806	50-yr	PropA5	2123	-1.15	4.74	4.75	0.000163	1.1	3193.88	0.15
Main	1057.806	50-yr	PropA3	2123	-1.15	4.74	4.75	0.000163	1.1	3193.89	0.15
Main	1057.806	100-yr	PropA5	2700	-1.15	5.1	5.11	0.000192	1.25	3425.9	0.16
Main	1057.806	100-yr	PropA3	2700	-1.15	5.1	5.12	0.000192	1.25	3425.94	0.16
Main	1057.806	500-yr	PropA5	4403	-1.15	6.03	6.05	0.000239	1.52	3733.61	0.18
Main	1057.806	500-yr	PropA3	4403	-1.15	6.03	6.05	0.000238	1.52	3733.62	0.18
Main	954.629	2-yr	PropA5	377	-1.15	2.73	2.74	0.000136	0.73	2129.11	0.12
Main	954.629	2-yr	PropA3	377	-1.15	2.73	2.74	0.000155	0.78	2136.25	0.13
Main	954.629	10-yr	PropA5	883	-1.15	3.51	3.52	0.000184	0.96	2758.41	0.14
Main	954.629	10-yr	PropA3	883	-1.15	3.51	3.52	0.000195	0.99	2758.42	0.15
Main	954.629	25-yr	PropA5	1451	-1.15	4.09	4.1	0.000224	1.14	3050.26	0.16
Main	954.629	25-yr	PropA3	1451	-1.15	4.09	4.11	0.000233	1.16	3050.28	0.16
Main	954.629	50-yr	PropA5	2123	-1.15	4.72	4.73	0.000214	1.2	3069.33	0.16
Main	954.629	50-yr	PropA3	2123	-1.15	4.72	4.73	0.000221	1.22	3069.35	0.16
Main	954.629	100-yr	PropA5	2700	-1.15	5.08	5.09	0.000254	1.36	3349.12	0.17
Main	954.629	100-yr	PropA3	2700	-1.15	5.08	5.09	0.000261	1.38	3349.13	0.18
Main	954.629	500-yr	PropA5	4403	-1.15	6	6.02	0.000331	1.71	3889.89	0.2
Main	954.629	500-yr	PropA3	4403	-1.15	6	6.02	0.000337	1.72	3889.89	0.21
Main	855.0215	2-yr	PropA5	377	-1.16	2.72	2.72	0.000099	0.65	1991.41	0.11
Main	855.0215	2-yr	PropA3	377	-1.16	2.72	2.73	0.000109	0.68	1994.17	0.11
Main	855.0215	10-yr	PropA5	883	-1.16	3.5	3.51	0.000152	0.91	2660.65	0.13
Main	855.0215	10-yr	PropA3	883	-1.16	3.5	3.51	0.000158	0.92	2660.65	0.14
Main	855.0215	25-yr	PropA5	1451	-1.16	4.07	4.08	0.000203	1.13	3129.14	0.16

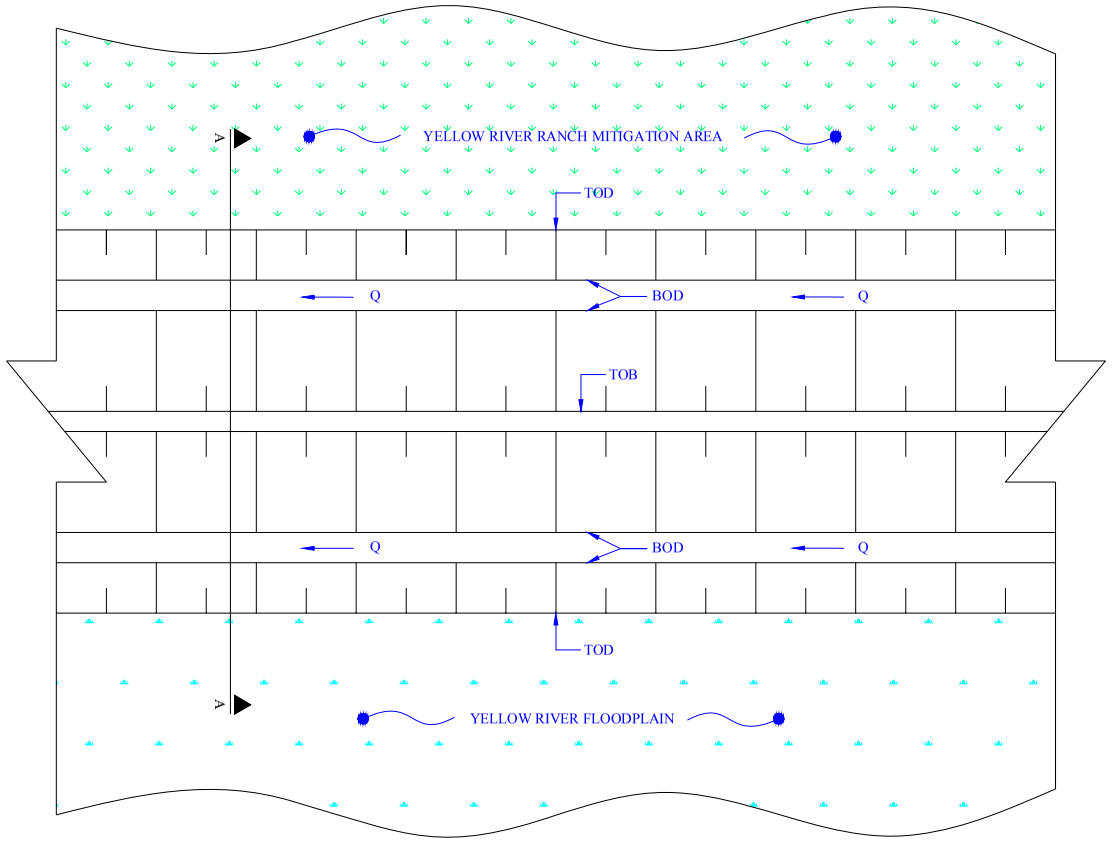
Main	855.0215	25-yr	PropA3	1451	-1.16	4.07	4.08	0.000209	1.15	3129.14	0.16
Main	855.0215	50-yr	PropA5	2123	-1.16	4.7	4.71	0.000198	1.21	3153.71	0.16
Main	855.0215	50-yr	PropA3	2123	-1.16	4.7	4.71	0.000203	1.22	3153.71	0.16
Main	855.0215	100-yr	PropA5	2700	-1.16	5.05	5.07	0.000246	1.4	3499	0.18
Main	855.0215	100-yr	PropA3	2700	-1.16	5.05	5.07	0.000251	1.41	3499	0.18
Main	855.0215	500-yr	PropA5	4403	-1.16	5.97	5.99	0.000266	1.59	3532.3	0.19
Main	855.0215	500-yr	PropA3	4403	-1.16	5.97	5.99	0.00027	1.61	3532.29	0.19
Main	762.1925	2-yr	PropA5	377	-1.16	2.71	2.71	0.000108	0.67	1898.32	0.11
Main	762.1925	2-yr	PropA3	377	-1.16	2.71	2.72	0.000112	0.68	1903.21	0.11
Main	762.1925	10-yr	PropA5	883	-1.16	3.48	3.49	0.000174	0.96	2245.92	0.14
Main	762.1925	10-yr	PropA3	883	-1.16	3.48	3.49	0.000175	0.96	2245.93	0.14
Main	762.1925	25-yr	PropA5	1451	-1.16	4.04	4.06	0.000254	1.25	3239.39	0.17
Main	762.1925	25-yr	PropA3	1451	-1.16	4.04	4.06	0.000255	1.25	3239.39	0.18
Main	762.1925	50-yr	PropA5	2123	-1.16	4.68	4.69	0.00024	1.31	3254.55	0.17
Main	762.1925	50-yr	PropA3	2123	-1.16	4.68	4.69	0.00024	1.31	3254.55	0.17
Main	762.1925	100-yr	PropA5	2700	-1.16	5.02	5.04	0.000305	1.54	3666.83	0.2
Main	762.1925	100-yr	PropA3	2700	-1.16	5.02	5.04	0.000306	1.54	3666.83	0.2
Main	762.1925	500-yr	PropA5	4403	-1.16	5.94	5.97	0.000308	1.69	3670.92	0.2
Main	762.1925	500-yr	PropA3	4403	-1.16	5.94	5.97	0.000308	1.69	3670.92	0.2
Main	636.3889	2-yr	PropA5	381	-1.16	2.7	2.7	0.000126	0.71	1912.09	0.11
Main	636.3889	2-yr	PropA3	381	-1.16	2.7	2.7	0.000132	0.72	1926.45	0.12
Main	636.3889	10-yr	PropA5	887	-1.16	3.46	3.47	0.000191	0.98	2469.65	0.15
Main	636.3889	10-yr	PropA3	887	-1.16	3.46	3.47	0.000191	0.98	2469.66	0.15
Main	636.3889	25-yr	PropA5	1456	-1.16	4.02	4.03	0.000273	1.26	3184.73	0.18
Main	636.3889	25-yr	PropA3	1456	-1.16	4.02	4.03	0.000273	1.27	3184.73	0.18
Main	636.3889	50-yr	PropA5	2127	-1.16	4.65	4.67	0.000249	1.31	3228.84	0.17
Main	636.3889	50-yr	PropA3	2127	-1.16	4.65	4.67	0.00025	1.31	3228.84	0.17
Main	636.3889	100-yr	PropA5	2704	-1.16	4.99	5.01	0.000273	1.42	3252.58	0.18
Main	636.3889	100-yr	PropA3	2704	-	4.99	5.01	0.000273	1.42	3252.58	0.18

					1.16						
Main	636.3889	500-yr	PropA5	4407	-1.16	5.91	5.93	0.000312	1.66	3698.8	0.2
Main	636.3889	500-yr	PropA3	4407	-1.16	5.91	5.93	0.000312	1.66	3698.8	0.2
Main	267.4734	2-yr	PropA5	383	-1.18	2.64	2.65	0.000141	0.75	1984.54	0.12
Main	267.4734	2-yr	PropA3	383	-1.18	2.64	2.65	0.000141	0.75	1984.54	0.12
Main	267.4734	10-yr	PropA5	888	-1.18	3.38	3.4	0.000203	1.01	2519.27	0.15
Main	267.4734	10-yr	PropA3	888	-1.18	3.38	3.4	0.000203	1.01	2519.27	0.15
Main	267.4734	25-yr	PropA5	1457	-1.18	3.92	3.93	0.000247	1.2	2525.13	0.17
Main	267.4734	25-yr	PropA3	1457	-1.18	3.92	3.93	0.000247	1.2	2525.13	0.17
Main	267.4734	50-yr	PropA5	2129	-1.18	4.55	4.57	0.00027	1.36	3112.19	0.18
Main	267.4734	50-yr	PropA3	2129	-1.18	4.55	4.57	0.00027	1.36	3112.19	0.18
Main	267.4734	100-yr	PropA5	2705	-1.18	4.88	4.9	0.000297	1.48	3125.3	0.19
Main	267.4734	100-yr	PropA3	2705	-1.18	4.88	4.9	0.000297	1.48	3125.3	0.19
Main	267.4734	500-yr	PropA5	4408	-1.18	5.78	5.8	0.000345	1.75	3845.7	0.21
Main	267.4734	500-yr	PropA3	4408	-1.18	5.78	5.8	0.000345	1.75	3845.7	0.21
Main	138.9569	2-yr	PropA5	383	-1.19	2.6	2.62	0.000267	1.04	1876.03	0.17
Main	138.9569	2-yr	PropA3	383	-1.19	2.6	2.62	0.000267	1.04	1876.03	0.17
Main	138.9569	10-yr	PropA5	888	-1.19	3.33	3.36	0.00035	1.34	2134.14	0.2
Main	138.9569	10-yr	PropA3	888	-1.19	3.33	3.36	0.00035	1.34	2134.14	0.2
Main	138.9569	25-yr	PropA5	1457	-1.19	3.86	3.89	0.000414	1.57	2166.24	0.22
Main	138.9569	25-yr	PropA3	1457	-1.19	3.86	3.89	0.000414	1.57	2166.24	0.22
Main	138.9569	50-yr	PropA5	2129	-1.19	4.47	4.51	0.000485	1.83	3088.61	0.25
Main	138.9569	50-yr	PropA3	2129	-1.19	4.47	4.51	0.000485	1.83	3088.61	0.25
Main	138.9569	100-yr	PropA5	2705	-1.19	4.8	4.84	0.000498	1.93	3094.21	0.25
Main	138.9569	100-yr	PropA3	2705	-1.19	4.8	4.84	0.000498	1.93	3094.21	0.25
Main	138.9569	500-yr	PropA5	4408	-1.19	5.7	5.75	0.000513	2.15	3695.77	0.26
Main	138.9569	500-yr	PropA3	4408	-1.19	5.7	5.75	0.000513	2.15	3695.77	0.26
Main	0.047244	2-yr	PropA5	383	-1.19	2.51	2.57	0.000592	1.49	1864.85	0.25
Main	0.047244	2-yr	PropA3	383	-	2.51	2.57	0.000592	1.49	1864.85	0.25

					1.19						
Main	0.047244	10-yr	PropA5	888	-1.19	3.25	3.29	0.000594	1.68	2339.89	0.26
Main	0.047244	10-yr	PropA3	888	-1.19	3.25	3.29	0.000594	1.68	2339.89	0.26
Main	0.047244	25-yr	PropA5	1457	-1.19	3.78	3.82	0.000592	1.81	2365.46	0.26
Main	0.047244	25-yr	PropA3	1457	-1.19	3.78	3.82	0.000592	1.81	2365.46	0.26
Main	0.047244	50-yr	PropA5	2129	-1.19	4.4	4.44	0.000587	1.95	3111.18	0.26
Main	0.047244	50-yr	PropA3	2129	-1.19	4.4	4.44	0.000587	1.95	3111.18	0.26
Main	0.047244	100-yr	PropA5	2705	-1.19	4.73	4.77	0.000588	2.03	3121.63	0.27
Main	0.047244	100-yr	PropA3	2705	-1.19	4.73	4.77	0.000588	2.03	3121.63	0.27
Main	0.047244	500-yr	PropA5	4408	-1.19	5.63	5.67	0.000586	2.23	3714.12	0.27
Main	0.047244	500-yr	PropA3	4408	-1.19	5.63	5.67	0.000586	2.23	3714.12	0.27

Appendix K

Ditch Plug and Berm Breach Schematic Details



PLAN VIEW
N.T.S.

LEGEND:

TOD	TOP OF DITCH
TOB	TOP OF BERM
Q	FLOW DIRECTION
BOD	BOTTOM OF DITCH
	SLOPE
	GRASS
	WETLAND

81 WATER MANAGEMENT DR
HAVANA, FL 32333-4712
P: (850) 539-5999
F: (850) 539-2777

YELLOW RIVER RANCH MITIGATION PROJECT

BERM AND DITCH - EXISTING CONDITIONS

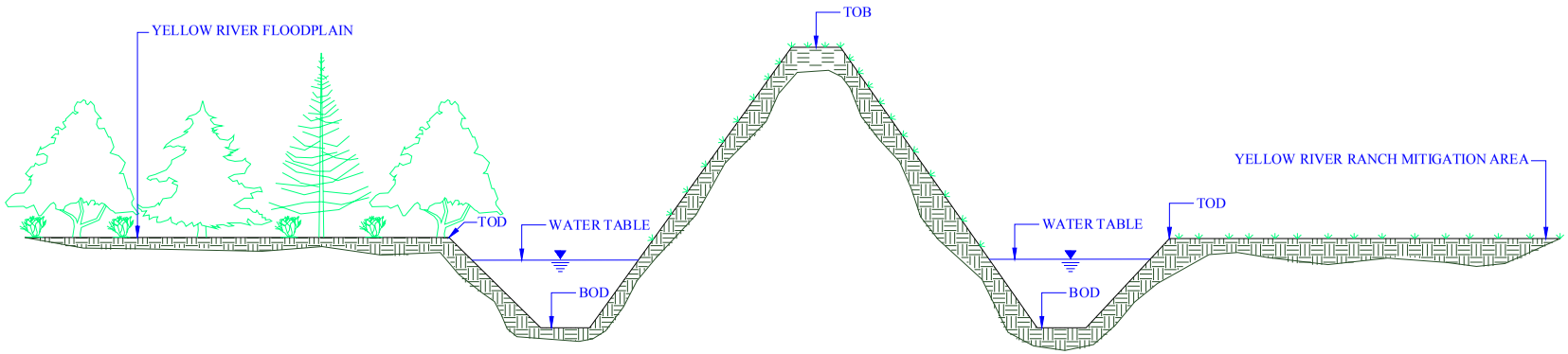
SANTA ROSA COUNTY, FLORIDA

JUNE 7, 2007

SCHEMATIC DETAIL

SCALE: N.T.S.

1 / 4



SECTION A-A
N.T.S.

LEGEND:

TOD	TOP OF DITCH
TOB	TOP OF BERM
BOD	BOTTOM OF DITCH
	GRASS

81 WATER MANAGEMENT DR
HAVANA, FL 32333-4712
P: (850) 539-5999
F: (850) 539-2777

YELLOW RIVER RANCH MITIGATION PROJECT

BERM AND DITCH - EXISTING CONDITIONS

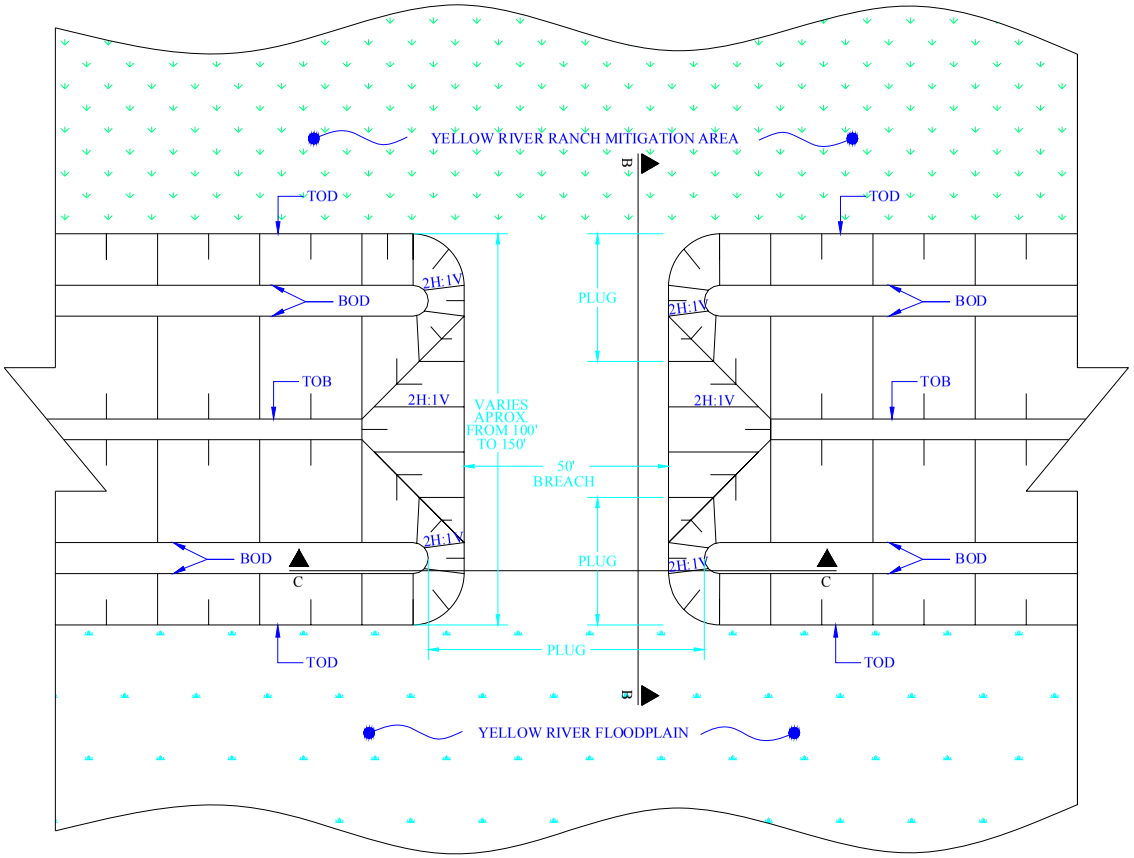
SANTA ROSA COUNTY, FLORIDA

JUNE 7, 2007

SCHEMATIC DETAIL

SCALE: N.T.S.

2 / 4



PLAN VIEW
N.T.S.

LEGEND:

TOD	TOP OF DITCH
TOB	TOP OF BERM
BOD	BOTTOM OF DITCH
	SLOPE
	GRASS
	WETLAND

81 WATER MANAGEMENT DR
HAVANA, FL 32333-4712
P: (850) 539-5999
F: (850) 539-2777

YELLOW RIVER RANCH MITIGATION PROJECT

DITCH PLUG AND BERM BREACH - PROPOSED CONDITIONS

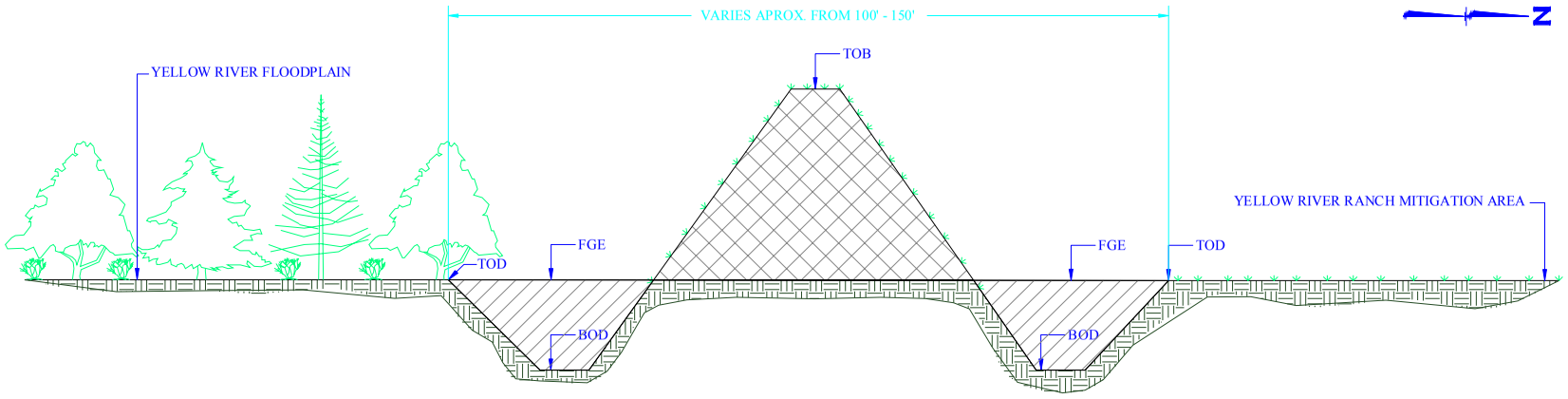
SANTA ROSA COUNTY, FLORIDA

JUNE 7, 2007

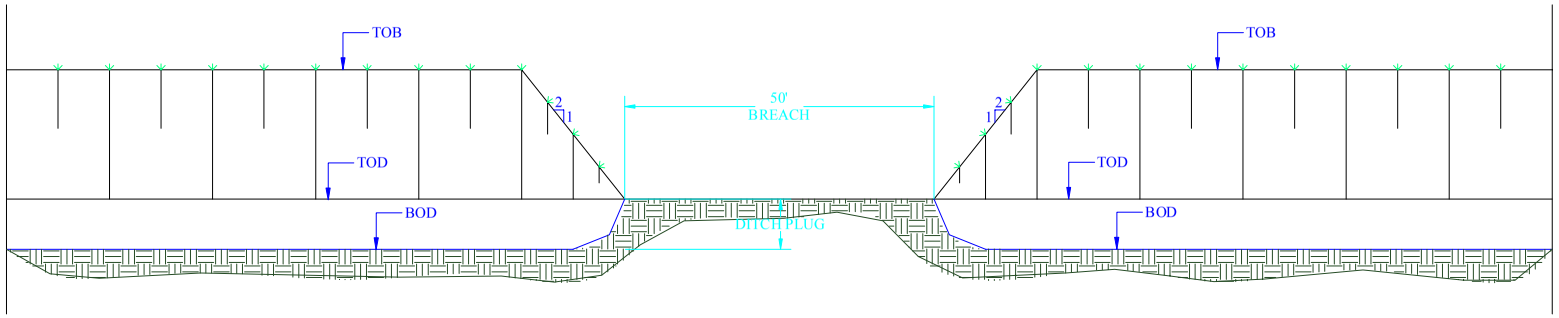
SCHEMATIC DETAIL

SCALE: N.T.S.

3/4



SECTION B-B
N.T.S.



SECTION C-C
N.T.S.

NOTE:

1. The ditches fill material shall be the extracted soil from the berm.

LEGEND:

TOD	TOP OF DITCH
TOB	TOP OF BERM
BOD	BOTTOM OF DITCH
FGE	FINISHED GROUND ELEVATION
	GRASS
	CUT
	FILL

81 WATER MANAGEMENT DR
HAVANA, FL 32333-4712
P: (850) 539-5999
F: (850) 539-2777

YELLOW RIVER RANCH MITIGATION PROJECT

DITCH PLUG AND BERM BREACH - PROPOSED CONDITIONS

SANTA ROSA COUNTY, FLORIDA

JUNE 7, 2007

SCHEMATIC DETAIL

SCALE: N.T.S.

4 / 4