RECLAMATION
Managing Water in the West

Trends of Aggradation and Degradation Along the Central Platte River: 1985 to 2005

U.S. Department of the Interior
Bureau of Reclamation
Technical Service Center
Denver, Colorado

February 2006

Mission Statements

The mission of the Department of the Interior is to protect and provide access to our Nation's natural and cultural heritage and honor our trust responsibilities to Indian Tribes and our commitments to island communities.

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

Trends of Aggradation and Degradation Along the Central Platte River: 1985 to 2005

Report Prepared by:

Elaina R. Holburn, M.S. Hydraulic Engineer
Sedimentation and River Hydraulics Group, Technical Service Center

Lisa M. Fotherby, Ph.D., P.E., Hydraulic Engineer
Sedimentation and River Hydraulics Group, Technical Service Center

Timothy J. Randle, M.S., P.E., Group Manager
Sedimentation and River Hydraulics Group, Technical Service Center

David E. Carlson, Fish and Wildlife Biologist
U.S. Fish and Wildlife Service

Report Peer Reviewed by:

Ronald L. Ferrari, Hydraulic Engineer
Sedimentation and River Hydraulics Group, Technical Service Center

U.S. Department of the Interior
Bureau of Reclamation
Technical Service Center
Denver, Colorado

February 2006

Acknowledgements

Several individuals greatly contributed to the development of this report. Craig Schwieger (Reclamation, Wyoming Area Office, Mills, Wyoming), Ron Sutton (Reclamation, Technical Service Center, Denver, Colorado), and Glenn Howard (DJ&A, P.C., Missoula, Montana) were instrumental in maintaining and providing key data used in the analysis. Dr. Mohammed Samad (Reclamation, Technical Service Center, Denver, Colorado) initiated the collection and quantitative evaluation of data sets from multiple sources. Joyce Lewallen (USDOI, Platte River EIS Office, Lakewood, Colorado) provided GIS mapping expertise. Efforts by all individuals were greatly appreciated.

Table of Contents

Page

I. EXECUTIVE SUMMARY V

1.0 BRIEF HISTORY OF THE CENTRAL PLATTE RIVER 1

2.0 STUDY BACKGROUND AND OBJECTIVES 5

3.0 SURVEYS 6

3.1 1983-1988 HABITAT SITE SURVEYS BY RECLAMATION 29
3.2 1989 CROSS-SECTION SURVEYS BY RECLAMATION 34
3.2.1 Cross-Section Locations 34
3.2.2 Survey Procedure 35
3.3 1998, 2000 & 2001 HABITAT SITE SURVEYS BY DJ&A, P.C. 37
3.4 1998 & 2002 CROSS-SECTION SURVEYS BY DJ&A, P.C. 38
3.5 2005 HABITAT SITE SURVEYS BY EISENBRAUN AND ASSOCIATES, INC. 39

4.0 VERTICAL TRANSFORMATIONS OF DATA 40

4.1 VERTICAL ADJUSTMENTS TO 1985 AND 1989 REPEAT SURVEYS 40
4.2 VERTICAL ADJUSTMENTS TO THE 1989 NON-REPEAT SURVEYS 40

5.0 DEVELOPMENT OF PLOTS OF REPEAT CROSS SECTIONS AND HABITAT TRANSECTS 43

6.0 CALCULATIONS OF AGGRADATION AND DEGRADATION 46

6.1 DOWNSTREAM OF NORTH PLATTE 46
6.2 NEAR LEXINGTON 47
6.3 HABITAT REACH 47
6.3.1 Main Channel 47
6.3.2 Bridge Sites on Main Channel 50
6.3.3 2005 Surveys 50
6.3.4 Side Channel 1 51
6.3.5 Side Channel 2 51

7.0 TRENDS OF AGGRADATION AND DEGRADATION 51

7.1 DOWNSTREAM OF NORTH PLATTE 53
7.2 NEAR LEXINGTON 53
7.3 HABITAT REACH 54
7.3.1 Main Channel 55
7.3.2 Bridge Sites on Main Channel 57
7.3.3 2005 Surveys 57
7.3.4 Side Channel 1 57
7.3.5 Side Channel 2 58

8.0 LIMITATIONS OF STUDY FINDINGS AND FUTURE DIRECTIONS 58

8.1 STUDY LIMITATIONS 58
8.1.1 Habitat Sites 58
8.1.2 Gaps in Repeat Cross Sections 58
8.1.3 Bridge Data 58
8.1.4 Labels of Degradation, Aggradation, and Stable 59
8.1.5 River Bed Profile 60
8.2 RECOMMENDATIONS FOR FUTURE RESEARCH 60

9.0 REFERENCES 62

APPENDIX A: PLOTS OF REPEAT CROSS SECTIONS 68

APPENDIX A: PLOTS OF REPEAT CROSS SECTIONS 68

A.1 DOWNSTREAM OF NORTH PLATTE 69
A.2 NEAR LEXINGTON 73
A.3 HABITAT REACH 78
A.3.1 Main Channel 78
A.3.2 Bridges Sites on Main Channel 127
A.3.3 2005 Surveys 139
A.3.4 Side Channel 1 151
A.3.5 Side Channel 2 157

APPENDIX B: CONTROL POINTS SUMMARY TABLE 159

APPENDIX C: FLOW ON DATE OF SURVEY TABLE 169

APPENDIX D: ELECTRONIC FORM OF 1989 USBR SURVEY DATA AND PHOTOGRAPHS 178

APPENDIX E: ELECTRONIC FORM OF ALL OTHER SURVEY DATA USED 179

APPENDIX F: ELECTRONIC FORM OF 1989 USBR SEDIMENT SAMPLE DATA 180

Index of Figures

Page

FIGURE 1.1. A COMPARISON OF AERIAL PHOTOGRAPHS OF THE CENTRAL PLATTE RIVER NEAR RIVER MILE 218. The BLACK AND WHITE PHOTO WAS TAKEN IN 1938 AND THE INFRARED WAS TAKEN IN 1998... 2

FIGURE 1.2. END RESULT OF MECHANICAL CLEARING OF VEGETATION. 4

FIGURE 1.3. CONSTRUCTION OF A SIDE CHANNEL ON THE LEFT BANK OF HABITAT SITE 6.. 4

FIGURE 3.1. KEYMAP FOR CROSS SECTION LOCATIONS ALONG THE CENTRAL PLATTE RIVER……………………………………………………………………...13

FIGURE 3.2. CROSS SECTION LOCATIONS: SHEET 1………………………………………14

FIGURE 3.3. CROSS SECTION LOCATIONS: SHEET 2………………………………………15

FIGURE 3.4. CROSS SECTION LOCATIONS: SHEET 3………………………………………16

FIGURE 3.5. CROSS SECTION LOCATIONS: SHEET 4………………………………………17

FIGURE 3.6. CROSS SECTION LOCATIONS: SHEET 5………………………………………18

FIGURE 3.7. CROSS SECTION LOCATIONS: SHEET 6………………………………………19

FIGURE 3.8. CROSS SECTION LOCATIONS: SHEET 7………………………………………20

FIGURE 3.9. CROSS SECTION LOCATIONS: SHEET 8………………………………………21

FIGURE 3.10. CROSS SECTION LOCATIONS: SHEET 9……………………………………..22

FIGURE 3.11. CROSS SECTION LOCATIONS: SHEET 10……………………………………23

FIGURE 3.12. CROSS SECTION LOCATIONS: SHEET 11……………………………………24

FIGURE 3.13. CROSS SECTION LOCATIONS: SHEET 12……………………………………25

FIGURE 3.14. CROSS SECTION LOCATIONS: SHEET 13……………………………………26

FIGURE 3.15. CROSS SECTION LOCATIONS: SHEET 14……………………………………27

FIGURE 3.16. CROSS SECTION LOCATIONS: SHEET 15……………………………………28

FIGURE 4.1. DATA AND REGRESSION EQUATIONS USED IN THE DETERMINATION OF VERTICAL ADJUSTMENTS FOR ALL 1989 SURVEYS THAT WERE NOT SELECTED FOR REPEAT MEASUREMENTS. 42

FIGURE 5.1. EXAMPLE OF A REPEAT CROSS SECTION THAT WAS NOT CONSIDERED FOR ANALYSIS DUE TO EITHER A SKEWED ANGLE OR POSSIBLE DIFFERENT LOCATION THAN THE ORIGINAL SURVEY. 43

FIGURE 5.2. PHOTOGRAPH DEMONSTRATING OCCURRENCES OF BANK EROSION. 44

FIGURE 6.1. AVERAGE ANNUAL CHANGE IN CROSS-SECTIONAL AREA ON MAIN CHANNEL. RED POINTS INDICATE CHANGE IN CROSS-SECTIONAL AREA CALCULATED USING MEASURED VERTICAL TRANSFORMATIONS. GREEN AND BLUE BARS REPRESENT CALCULATED CHANGES IN CROSS-SECTIONAL AREA FOLLOWING A 10% INCREASE AND DECREASE IN THE VALUE OF THE VERTICAL TRANSFORMATION, RESPECTIVELY. 49

FIGURE 7.1. AVERAGE ANNUAL CHANGE IN CROSS-SECTIONAL AREA OF POINTS ALONG THE MAIN CHANNEL OF THE HABITAT REACH. A 3RD ORDER POLYNOMIAL TRENDLINE WAS FIT TO THE DATA. 54

FIGURE 7.2. AVERAGE ANNUAL CHANGE IN CROSS-SECTIONAL AREA FOR THE MAIN CHANNEL, BRIDGE SITES ON MAIN CHANNEL, AND 2005 SURVEYS. 55

FIGURE 8.1. EXAMPLE OF BRIDGE PROTECTION ON THE CENTRAL PLATTE RIVER, NEBRASAKA... 59

Index of Tables

Page

TABLE I.1. TRENDS OF DEGRADING, STABLE OR AGGRADING RIVER CHANNEL. ... VI
TABLE 3.1. ALL CROSS SECTIONS AND TRANSECTS CONSIDERED FOR ANALYSIS OF AGGRADATION AND DEGRADATION AND ALL CROSS SECTIONS SURVEYED IN 1989 BY THE BUREAU OF RECLAMATION (SECTION 3.1). 7
TABLE 3.2. INFORMATION ABOUT RECLAMATION NEBRASKA-KANSAS PROJECT OFFICE CHANNEL CROSS SECTIONS SURVEYS, 1983-1988. 31
TABLE 3.3. IDENTIFICATION NUMBER AND DATE OF CHANNEL CROSS-SECTION SURVEYS PERFORMED BY RECLAMATION'S NEBRASKA-KANSAS PROJECT OFFICE, 1983-1988, AND UNDER TECHNICAL SERVICE CENTER CONTRACTS, 1998-2001 32
TABLE 6.1. CALCULATED CHANGES IN CROSS-SECTIONAL AREAS FOR THE REACH DOWNSTREAM OF NORTH PLATTE. STABLE = + OR – 10 FT^2/YR OR LESS. 46
TABLE 6.2. CALCULATED CHANGES IN CROSS-SECTIONAL AREAS FOR THE REACH NEAR LEXINGTON. STABLE = + OR – 10 FT^2/YR OR LESS. 47
TABLE 6.3. CALCULATED CHANGES IN CROSS-SECTIONAL AREAS FOR THE MAIN CHANNEL OF THE HABITAT REACH. STABLE = + OR – 10 FT^2/YR OR LESS. 47
TABLE 6.4. CALCULATED CHANGES IN CROSS-SECTIONAL AREAS FOR BRIDGE SITES ON THE MAIN CHANNEL OF THE HABITAT REACH. STABLE = + OR – 10 FT^2/YR OR LESS. 50
TABLE 6.5. CALCULATED CHANGES IN CROSS-SECTIONAL AREAS FOR 2005 SURVEYS OF THE HABITAT REACH. STABLE = + OR – 10 FT^2/YR OR LESS. 50
TABLE 6.6. CALCULATED CHANGES IN CROSS-SECTIONAL AREAS FOR SIDE CHANNEL 1 OF THE HABITAT REACH. STABLE = + OR – 10 FT^2/YR OR LESS. ... 51
TABLE 6.7. CALCULATED CHANGES IN CROSS-SECTIONAL AREAS FOR SIDE CHANNEL 2 OF THE HABITAT REACH. STABLE = + OR – 10 FT^2/YR OR LESS. ... 51
TABLE 7.1. SUMMARY OF TRENDS OF AGGRADATION AND DEGRADATION ALONG THE CENTRAL PLATTE RIVER 52
TABLE B.1. SUMMARY OF CONTROL POINTS, INCLUDING HEADPINS, ESTABLISHED FOR ALL SURVEYS.................................... 160
TABLE C.1. USGS STREAMFLOW GAGES WITHIN PROJECT VICINITY AND CORRESPONDING RANGE OF REPRESENTATION.................................... 170
TABLE C.2. MEAN DAILY DISCHARGE VALUES ON THE DAY OF EACH SURVEY. .. 171

I. Executive Summary

The Platte River Recovery Implementation Program (Colorado, Nebraska, Wyoming, and the U. S. Department of the Interior (USDOI), 1997) seeks to restore habitat for the threatened and endangered species: whooping crane, interior least tern, piping plover and pallid sturgeon. Desirable habitat for the whooping crane, interior least tern and piping plover is a wide shallow river with mid-channel sand bars. These are characteristics of a braided river, a river plan form that is less prevalent today than in 1938 or in 1900. Braided plan form conditions are unlikely to occur if an insufficient supply of flow and sediment exists.

Objectives of the present study are to increase present understanding of sediment transport processes that affect the desired river plan form and habitat through an investigation of the patterns of degradation and aggradation that have occurred in the Central Platte River over the last twenty years. Degrading river, the condition in which the river bed and banks are eroding, occurs when an insufficient supply of sediment is transported from upstream. Aggrading river channel, the condition in which sediment deposits on the bed of the river, occurs when an oversupply of sediment is transported from upstream. Pronounced degradation can result in decreased width to depth channel ratios, while marked aggradation can result in increased width to depth channel ratios.

More specifically, the aim of this study is to identify and quantitatively evaluate temporal and spatial changes in cross sections that have been repeatedly surveyed across the last two decades. Data are presented for 90 repeat cross-section surveys in the Central Platte River between North Platte (river mile (RM) 310) and Chapman, Nebraska (RM 157). In addition, all data from the 1989 Reclamation cross-section surveys and sediment-sample collections are provided in the appendices. Measured changes in cross-sectional area were used to determine the aggrading, stable or degrading condition for each cross section. Subsequently, a series of cross sections were reviewed by river reach to determine notable trends.

Repeat survey sites were divided into three major reaches: Downstream of North Platte, Near Lexington and the Habitat Reach. Survey data in the Habitat Reach were further categorized as main channel, side channel 1, side channel 2, bridge sites on main channel, and 2005 surveys. Noted trends are summarized in Table I.1. The general trend indicates the overall pattern identified in the river segment, while the localized trend indicates patterns identified in the segment that differed from the general trend and were limited to one or two cross sections.

Results of the analysis suggest that aggradation is occurring in the reach Downstream of North Platte, and a stable condition exists in the reach Near

Lexington. In the Habitat Reach, from the Johnson-2 Return at RM 247 to 225, a pronounced trend of degradation diminishing in the downstream direction is apparent. Between RM 211 and RM 195, reaches of both aggradation and degradation are noted. In the downstream segment of the Habitat Reach, between RM 195 and 157, the river is generally stable. No repeat surveys were performed between RM 225 and 211. Analysis of the side channels, bridge sites on main channel, and 2005 surveys generally indicate similar trends to those occurring along the main channel. The 2005 survey data were used to compare surveys performed in 1998, 2000, and 2001 with surveys performed in 2005. Results of the analysis suggest higher rates of aggradation occurred during the dry period between 2001 and 2005.

Table I.1. Trends of Degrading, Stable or Aggrading River Channel.

Reach	Category	River Mile	General Trend	Localized Trend
Downstream of North Platte		310 to 297	Aggradation	Stable
Near Lexington		258 to 244	Stable	Degradation & Aggradation
Habitat Reach	**Main Channel**	**247 to 225**	**Degradation**	
		225 to 211	***No Data***	
		211 to 195	**Aggradation & Degradation**	Stable
		195 to 157	**Stable**	
	Bridge Sites on Main Channel	239 to 157	*Consistent with main channel data*	
	2005 Survey	227 to 158	Aggradation	Stable
	Side Channel 1	210 to 201	Aggradation	Degradation
	Side Channel 2	170 to 169	Aggradation/Stable	

1.0 Brief History of the Central Platte River

The Central Platte River, a reach of the Platte River located between North Platte and Chapman, Nebraska, has been the focus of several biological, geomorphic, and engineering studies since the late 1970s. While each study has been individual in purpose, all research of the Central Platte River improves understanding of key processes acting in the system with relation to ecology, geomorphology, and hydrology. A brief description of the current understanding of the river system and its evolution provides a framework from which the goals of the present research have been developed.

Two major tributaries of the Central Platte River converge near North Platte, Nebraska: the North and South Platte Rivers, both of whose headwaters lie along the eastern slope of the Rocky Mountains in Colorado. Since regional settlement began in the mid-nineteenth century, the need for water for human consumption, irrigation of farm lands, and industrial and commercial purposes has greatly increased. Numerous reservoirs, diversion dams, and irrigation canals were constructed, and intricate water rights systems were developed to distribute needed supplies of water throughout Colorado, Wyoming, and Nebraska. Today, flows from the North Platte River predominantly supply irrigation and municipal water throughout Wyoming and to parts of Colorado and Nebraska, in addition to providing power generation for Wyoming and Nebraska. Prior to entering Nebraska, flows from the South Platte River supply over 2.0 million acre-feet of water for irrigation in Colorado and provide a major municipal and industrial water source for many of Colorado's heavily populated Front Range cities, including Denver (Colorado Water Conservation Board, 2002).

Anthropogenic activities combined with naturally occurring processes have resulted in alterations to the natural flow and sediment regimes of the Platte River system. The central Platter River has slowly progressed from a once consistently wide, braided channel with few anastamosed segments to a narrower, more sinuous channel composed of meandering and anastamosed reaches in addition to braided river channel (Williams, 1978; USDOI, 2006). Changes in geomorphic channel characteristics of the Central Platte River are clearly indicated by a comparison of U.S. Fish and Wildlife Service (FWS) aerial photographs from 1938 and aerial photographs taken in 1998 (e.g. Figure 1.1; FWS, 1938; Friesen *et al.*, 2000). Temporal changes to flow and sediment in the Central Platte River are presented by Randle and Samad (2003). Murphy *et al*. (2004) documents the historic setting of the Central Platte River and introduces some channel processes. Historical changes in the river plan form and the processes of dominant channel change under present conditions are described by the USDOI (2006).

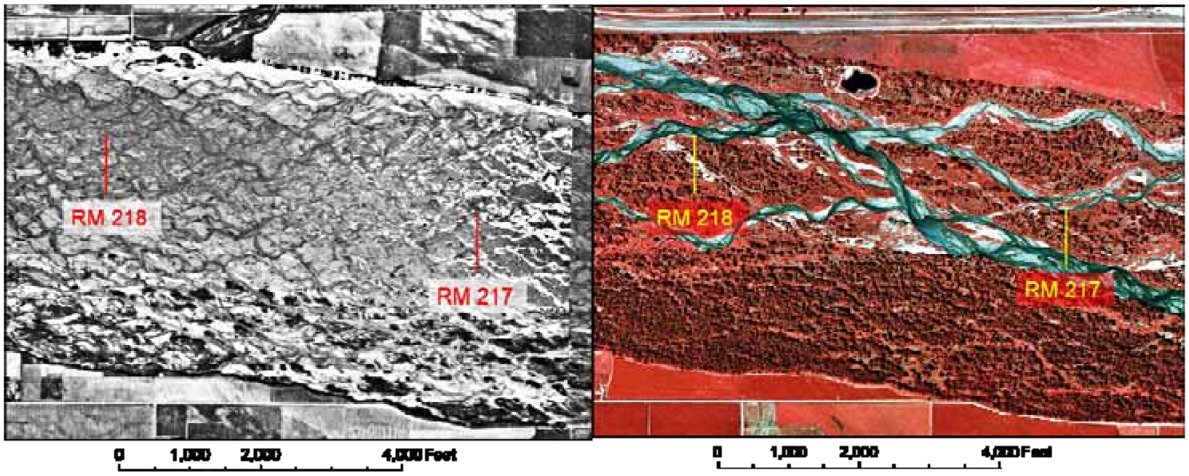


Figure 1.1. A comparison of aerial photographs of the Central Platte River near RM 218. The black and white photo was taken in 1938 and the infrared was taken in 1998.

Accompanying changes in geomorphic channel characteristics were steady declines in the availability of habitat for several species of birds and fish, including four federally threatened or endangered species: the interior least tern, piping plover, whooping crane, and pallid sturgeon. Pallid sturgeon habitat on the Platte River is limited to the Lower Platte River. Ideal habitat for the three bird species consists of a wide, shallow channel with sparsely vegetated sand bars for roosting (whooping crane) and nesting (piping plover and interior least tern) (USDOI, 2006). Research documenting temporal changes in characteristics of river plan form (reduction in river width and expansion of vegetation) in the Platte River and its effects on critical habitat of the target species are presented by Eschner *et al*. (1983), Sidle *et al.* (1989), Currier (1997), Johnson (1997), and Simons & Associates, Inc. (2000) and are summarized by the National Research Council (2005) and the USDOI (2006).

Desirable habitat conditions of the whooping crane, interior least tern, and piping plover are characteristics of a braided river plan form. However, less braided river is present in the Central Platte River today than in 1938 or in 1900 (USDOI, 2006). Flow storage structures and major supply canals reduce flow in the river and promote the establishment of vegetation in locations that were historically inundated by flows of sufficient magnitude, duration, and frequency to preclude prolonged vegetal establishment. Clear water discharges from the Tri-County Supply Canal at the Johnson-2 Return increase the erosive capacity of flows at the upstream end of the habitat area. Reductions in flow and sediment and the influence of topographic features formed under historic flow conditions have reduced the occurrence of braided plan form in the Central Platte River.

Rehabilitation of the desirable habitat conditions entails reestablishment of a braided river plan form. The occurrence of a braided river plan form requires a sufficient source of sediment (Leopold and Wolman, 1957). Channel degradation indicates an insufficient supply of sediment from upstream, while aggradation indicates a surplus of sediment. A braided river is unlikely to occur in degrading river reaches. Ideal habitat conditions in the Central Platte River consist of a stable, braided river with consistent transport and no reaches of pronounced degradation or aggradation.

In response to the Endangered Species Act (ESA) and the National Environmental Policy Act (NEPA) requirements, a cooperative agreement was established between federal and state agencies to improve and maintain habitat for the four target species through the implementation of a series of actions outlined in the Recovery Implementation Program (Colorado, Nebraska, Wyoming, and the USDOI, 1997). Subsequently, the Bureau of Reclamation (Reclamation) and the FWS combined in an effort to develop a programmatic Environmental Impact Statement (EIS). The EIS consists of a comprehensive evaluation of the environmental effects that may result from realization of actions outlined in the Recovery Implementation Program. A Draft EIS was published in 2003 (USDOI, 2003), and a Final EIS was published in 2006 (USDOI, 2006).

In addition, several non-governmental organizations, including the Nature Conservancy, The Platte River Whooping Crane Trust, and the Audubon Society, have implemented actions intended to benefit the target species and other species, by reducing vegetation in the flood plain (Figure 1.2) and restoring side channels (Figure 1.3). Their activities have included public outreach and education, land acquisition and management, and mechanical modifications of the river.

Figure 1.2. End result of mechanical clearing of vegetation.

Figure 1.3. Construction of a side channel on the left bank of habitat site 6.

2.0 Study Background and Objectives

Field surveys of the Central Platter River have been conducted since the early 1980s for various purposes. The 1985 survey data, referred to as transects, were initially collected as part of an ongoing investigation of specific habitat sites. The 1989 survey data, referred to as cross sections, were collected for analysis of hydraulic and geomorphic processes, and for numerically modeling sediment transport in the Central Platte River system. More recent surveys were conducted at the same locations as several early surveys, providing an ideal opportunity to quantitatively evaluate long-term changes to river geometry and sediment transport.

Habitat recovery planning initiated by interagency forums in the early 1980s called for periodic surveys of channel transects to monitor long-term channel changes affecting riverine habitat (Carlson *et al.*, 1990; Platte River Management Joint Study Hydrology Workgroup, 1989) and to help explain channel-forming processes (Johnson, 1997). Simons *et al.* (2000) were unable to detect channel elevations changes on a transect network for several years of data (1984-1986), but cautioned that the short time period represented by the data may not be indicative of long term trends. Williams (1978), Chen *et al.* (1999), and the FWS (1997) reported long-term trends at U.S. Geological Survey (USGS) streamflow gages. In addition, the USGS streamflow gage on the Platte River near Overton, Nebraska (gage # 06768000) was recently lowered by 2 feet due to continued degradation of the channel bed (USGS, 2005). Although there may be limitations associated with data from streamflow gages at bridge sites, these investigations suggest possible river trends.

The present study aimed to expand upon these previous investigations. A detailed assessment of long-term trends specific to the Central Platte River was achieved through 1) exploring changes at 82 survey locations extending across 150 miles of river channel, 2) evaluating temporal differences in cross-sectional areas at each site, 3) identifying patterns within localized river segments, and 4) interpreting identified trends.

Objectives of the research were to increase understanding of sediment transport processes that affect desired river plan form and habitat through an investigation of the patterns of degradation and aggradation that have occurred in the Central Platte River over the last twenty years. More specifically, the goal was to identify and quantitatively evaluate temporal and spatial changes in cross sections that have been repeatedly surveyed across the last two decades. An improved understanding of patterns related to channel morphology and sediment transport processes will aid future management efforts in recovering habitat of the target species. A supplementary objective of this report was to document all cross sections surveyed and sediment samples collected in the Central Platte River by Reclamation in 1989.

3.0 Surveys

Locations of cross sections and transects surveyed throughout the last twenty years are shown in the subsequent maps in figures 3.1 to 3.15. Black and white digital orthophoto quarter quadrangles are displayed from North Platte to Lexington, Nebraska (Nebraska Department of Natural Resources, 2000). Infrared aerial photographs are displayed from Lexington to Chapman, Nebraska (Friesen *et al*., 2000). Although the locations of all 1989 cross sections are displayed, only 1985 habitat transects that were resurveyed between 1998 and 2001 are included in the maps. Transects surveyed at several additional habitat sites in the 1980's were not included in the present study and have previously been documented (USDOI, 1989; Farmer *et al*., 2000). Surveys conducted between 1998 and 2005 that are re-measurements of original surveys are referred to as *repeat surveys*.

Cross sections and transects considered for analysis of patterns of aggradation and degradation and all 1989 cross sections are listed in Table 3.1. File names correspond to survey data provided in Appendices D and E. Note that habitat transects surveyed in 1985 are named according to the site number followed by the transect number (e.g. 4-TR2 = site 4, transect 2). Cross sections originally surveyed in 1989 are named according to river mile followed by a letter designating the channel segment surveyed, if more than one channel exists at the location of survey (e.g. 225_1N = RM 225.1, north channel). Table 3.1 also indicates which surveys were used in the analysis of aggradation and degradation and the reach to which they have been designated (Section 5.0). An explanation for the exclusion of cross sections not used in the analysis is provided.

Control points established in each survey, including headpins for each cross section and transect, have been compiled into a uniform data log (Appendix B). At each survey site considered in this analysis, flow measured at the nearest upstream or downstream USGS streamflow gage was recorded for the corresponding date(s) of survey (Appendix C). Only streamflow gages with daily records between water years 1983 and 2004 were considered for use. Sections 3.1 through 3.5 provide an overview of field surveys used in the analysis of this report.

Table 3.1. All cross sections and transects considered for analysis of aggradation and degradation and all cross sections surveyed in 1989 by Reclamation (Section 3.1).

File Name	River Mile	Used for Analysis of Degradation and Aggradation?	Reach Designation[2]	Date of Survey 1	Date of Survey 2	Date of Survey 3
310_5	310.50	Not used- discrepancy in survey alignment		10/26/89	10/9/98	
310_2	310.20	Used	Downstream of North Platte	10/26/89	10/9/98	
310_0	310.00	Used	Downstream of North Platte	10/26/89	10/9/98	
309_0	309.00	Not used- no repeat survey		10/25/89		
307_5	307.50	Not used- no repeat survey		10/26/89		
305_4	305.40	Not used- no repeat survey		10/25/89		
304_0	304.00	Used	Downstream of North Platte	10/25/89	10/9/98	
302_0	302.00	Not used- no repeat survey		10/25/89		
298_5	298.50	Not used- no repeat survey		10/25/89		
297_0	297.00	Used	Downstream of North Platte	10/25/89	10/9/98	
288_1N	288.10	Not used- no repeat survey		10/25/89		
288_1S	288.10	Not used- no repeat survey		10/24/89		
287_7	287.70	Not used- no repeat survey		10/24/89		
284_9	284.90	Not used- no repeat survey		10/24/89		
281_8	281.80	Not used- no repeat survey		10/24/89		
277_3N	277.30	Not used- no repeat survey		10/23/89		
277_3S	277.30	Not used- no repeat survey		10/23/89		
276_8N	276.80	Not used- no repeat survey		10/23/89		
269_9N	269.90	Not used- no repeat survey		10/17/89		
269_9S	269.90	Not used- no repeat survey		10/17/89		
267_9N	267.90	Not used- no repeat survey		10/18/89		
267_9S	267.90	Not used- no repeat survey		10/17/89		
266_7	266.70	Not used- no repeat survey		10/16/89		
261_7	261.70	Not used- no repeat survey		10/16/89		
258_3	258.30	Not used- no repeat survey		10/15/89		
258_0N	258.00	Used	Near Lexington	10/15/89	10/10/98	
258_0S	258.00	Not used- sole cross section on side channel		10/15/89	10/10/98	

File Name	River Mile	Used for Analysis of Degradation and Aggradation?	Reach Designation[2]	Date of Survey 1	Date of Survey 2	Date of Survey 3
254_4	254.40	Not used- no repeat survey		10/15/89		
251_6	251.60	Used	Near Lexington	10/12/89	10/10/98	
250_5	250.50	Used	Near Lexington	10/14/89	10/10/98	3/13/02
249_8	249.80	Used	Near Lexington	10/15/89	3/24/02	
247_8	247.80	Not used- discrepancy in survey alignment		10/22/89	3/24/02	
246_5N	246.50	Not used- discrepancy in survey alignment		10/19/89	3/23/02	
246_5S	246.50	Used	Habitat Reach- Main Channel	10/22/89	3/24/02	
246_0S	246.00	Used	Habitat Reach- Main Channel	10/18/89	3/24/02	
244_0N	244.00	Used	Habitat Reach- Bridge Sites on Main Channel	10/19/89	3/23/02	
244_0S	244.00	Used	Habitat Reach- Main Channel	10/23/89	3/23/02	
2-TR8	244.00	Used	Habitat Reach- Main Channel	7/22/85	10/18/00	
2-TR7	243.90	Used	Habitat Reach- Main Channel	7/22/85	10/18/00	
2-TR6	243.80	Not used- discrepancy in survey alignment		7/22/85	10/18/00	
2-TR5	243.60	Not used- discrepancy in survey alignment		7/22/85	10/18/00	
2-TR4	243.50	Not used- discrepancy in survey alignment		7/22/85	10/18/00	
2-TR3	243.30	Used	Habitat Reach- Main Channel	7/22/85	10/18/00	
2-TR2	243.25	Used	Habitat Reach- Main Channel	7/22/85	10/18/00	
2-TR1	243.10	Used	Habitat Reach- Main Channel	7/22/85	10/18/00	
239_9	241.10	Used	Habitat Reach- Main Channel	10/14/89	3/23/02	
239_3	239.30	Used	Habitat Reach- Bridge Sites on Main Channel	10/13/89	10/8/98	3/22/02
239_0	239.00	Used	Habitat Reach- Main Channel	10/13/89	3/22/02	
237_5	237.50	Used	Habitat Reach- Main Channel	10/22/89	11/18/98	3/21/02
233_8	233.80	Used	Habitat Reach- Main Channel	10/21/89	11/18/98	3/21/02
231_5	231.50	Not used- no repeat survey		10/20/89		
230_8	230.80	Used	Habitat Reach- Bridge Sites on Main Channel	10/5/89	10/8/98	3/19/02
230_0	230.00	Not used- discrepancy in survey alignment		10/5/89	3/19/02	
228_7	228.70	Used	Habitat Reach- Main Channel	10/5/89	3/19/02	
4A-TR6	227.60	Not used- discrepancy in survey alignment		7/8/85	10/26/01	
4A-TR5	227.50	Not used- discrepancy in survey alignment		7/8/85	10/26/01	
4A-TR4	227.40	Used	Habitat Reach- Main Channel/ 2005 Surveys	7/8/85	10/26/01	9/28/05
4A-TR3	227.25	Used	Habitat Reach- 2005 Surveys	7/8/85	10/26/01	9/28/05

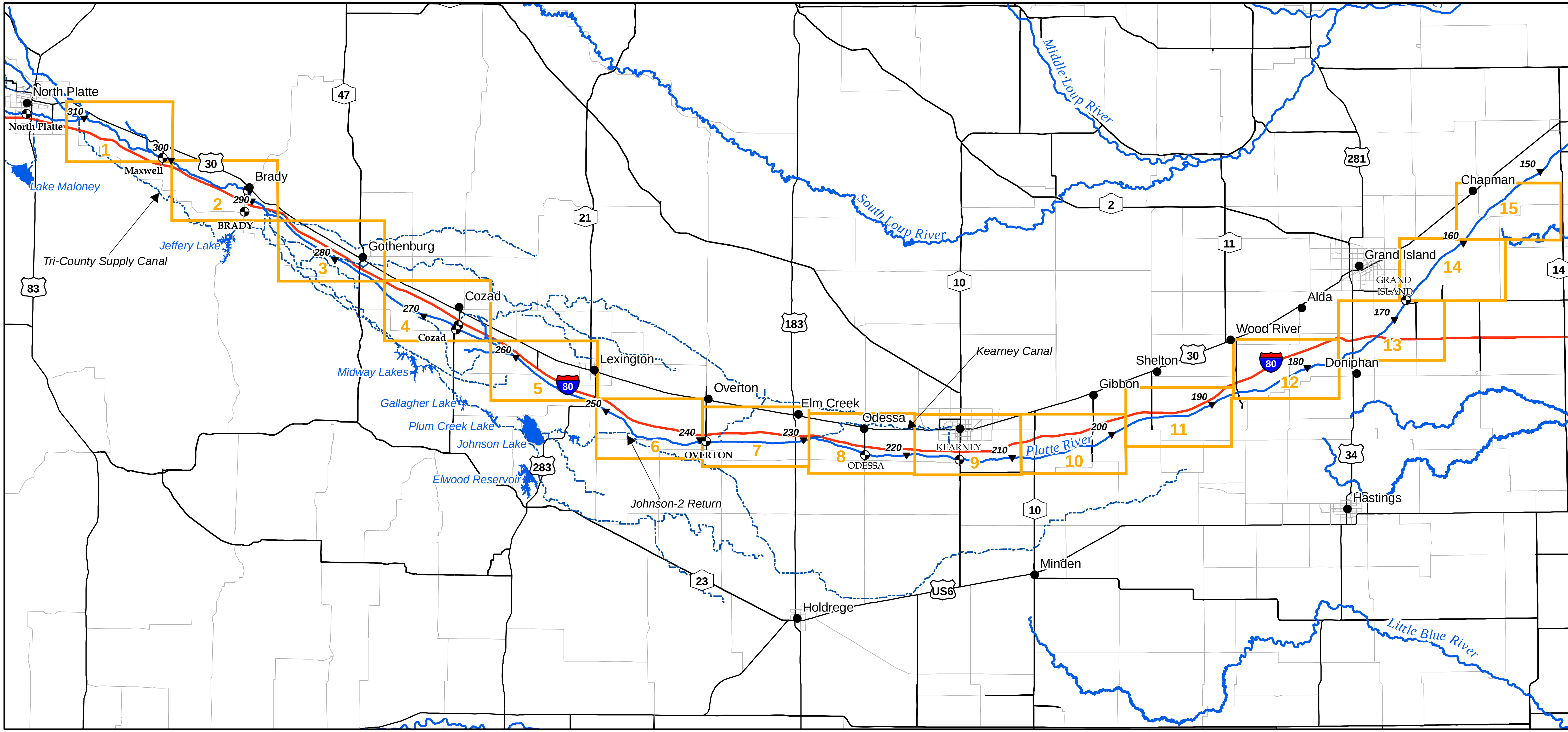
File Name	River Mile	Used for Analysis of Degradation and Aggradation?	Reach Designation[2]	Date of Survey 1	Date of Survey 2	Date of Survey 3
4A-TR2	227.20	Not used- discrepancy in survey alignment		7/8/85	10/26/01	
4A-TR1	227.00	Not used- no repeat survey		7/8/85		
225_1N	225.10	Used	Habitat Reach- Main Channel	10/4/89	3/18/02	
225_1S	225.10	Not used- no repeat survey		10/4/89		
224_3	224.30	Not used- discrepancy in survey alignment		10/4/89	3/18/02	
224_0	224.00	Used	Habitat Reach- Bridge Sites on Main Channel	10/4/89	10/8/98	
222_0N	222.00	Not used- sole cross section on side channel		10/2/89	3/17/02	
222_0S	222.00	Not used- discrepancy in survey alignment		10/2/89	3/17/02	
219_8	219.80	Not used- no repeat survey		10/2/89		
210_6N	210.60	Not used- discrepancy in survey alignment		9/28/89	3/16/02	
210_6S	210.60	Used	Habitat Reach- Main Channel	9/28/89	3/16/02	
209_8N	209.80	Used	Habitat Reach- Side Channel 1	9/27/89	11/18/98	
209_8S	209.80	Used	Habitat Reach- Bridge Sites on Main Channel	9/27/89	10/11/98	
208_6N	208.60	Not used- discrepancy in survey alignment		9/27/89	3/15/02	
208_6S	208.60	Not used- discrepancy in survey alignment		9/28/89	3/16/02	
207_9N	207.90	Used	Habitat Reach- Side Channel 1	9/27/89	10/7/98	
207_9S	207.90	Used	Habitat Reach- Bridge Sites on Main Channel	9/27/89	10/7/98	
6-TR9	207.20	Used	Habitat Reach- Main Channel	7/17/85	10/7/98	
6-TR8	207.00	Used	Habitat Reach- Main Channel	7/17/85	10/7/98	
6-TR7	206.80	Used	Habitat Reach- Main Channel	7/17/85	10/7/98	
206_6N	206.60	Used	Habitat Reach- Side Channel 1	9/27/89	3/15/02	
206_6S	206.60	Used	Habitat Reach- Main Channel	10/1/89	10/6/98	
6-TR6	206.60	Used	Habitat Reach- Main Channel	7/17/85	10/6/98	
6-TR5	206.50	Used	Habitat Reach- Main Channel	7/17/85	10/6/98	
6-TR4	206.40	Used	Habitat Reach- Main Channel	7/17/85	10/6/98	9/27/05
6-TR3	206.20	Used	Habitat Reach- Main Channel	7/17/85	10/6/98	9/27/05
6-TR2	206.00	Used	Habitat Reach- Main Channel	7/17/85	10/6/98	
6-TR1	205.90	Used	Habitat Reach- Main Channel	7/17/85	10/6/98	
203_3N	203.30	Used	Habitat Reach- Side Channel 1	9/30/89	3/14/02	
203_3S	203.30	Used	Habitat Reach- Main Channel	9/29/89	3/14/02	
202_2M[1]	202.20	Used	Habitat Reach- Main Channel	9/29/89	10/11/98	

File Name	River Mile	Used for Analysis of Degradation and Aggradation?	Reach Designation[2]	Date of Survey 1	Date of Survey 2	Date of Survey 3
202_2N	202.20	Used	Habitat Reach- Side Channel 1	9/29/89	10/10/98	
202_2S[1]	202.20	Used	Habitat Reach- Main Channel	9/29/89	10/11/98	
201_2N	201.20	Used	Habitat Reach- Side Channel 1	9/30/89	10/11/98	
201_2S	201.20	Not used- no repeat survey		9/30/89		
199_5	199.50	Used	Habitat Reach- Main Channel	9/30/89	3/14/02	
197_4	197.40	Not used- no repeat survey		9/26/89		
8C-TR4	196.60	Used	Habitat Reach- Main Channel	7/19/85	10/25/01	
8C-TR3	196.50	Used	Habitat Reach- Main Channel	7/19/85	10/25/01	
8C-TR2	196.40	Used	Habitat Reach- Main Channel	7/19/85	10/25/01	
8C-TR1	196.30	Used	Habitat Reach- Main Channel	7/19/85	10/25/01	
195_8	195.80	Used	Habitat Reach- Bridge Sites on Main Channel	9/22/89	10/11/98	
194_9	194.90	Not used- no repeat survey		9/26/89		
193_9	193.90	Not used- no repeat survey		9/22/89		
8B-TR5	191.30	Not used- discrepancy in survey alignment		7/12/85	6/1/00	
8B-TR4	191.20	Used	Habitat Reach- Main Channel	7/12/85	6/1/00	
8B-TR3	191.10	Used	Habitat Reach- 2005 Surveys	7/12/85	6/1/00	9/27/05
8B-TR2	191.00	Used	Habitat Reach- 2005 Surveys	7/12/85	6/1/00	9/27/05
8B-TR1	190.90	Used	Habitat Reach- Main Channel	7/12/85	6/1/00	
189_3	189.30	Not used- no repeat survey		9/22/89		
188_3	188.30	Not used- no repeat survey		9/15/89		
187_4SN	187.40	Not used- no repeat survey		9/15/89		
187_4SS	187.40	Not used- no repeat survey		9/15/89		
187_3N	187.30	Not used- sole cross section on side channel		9/17/89	10/11/98	
187_3S	187.30	Used	Habitat Reach- Bridge Sites on Main Channel	9/15/89	10/12/98	
187_0SM	187.00	Not used- no repeat survey		9/15/89		
183_2N	183.20	Not used- no repeat survey		10/1/89		
183_2S	183.20	Not used- no repeat survey		10/1/89		
182_1N	182.10	Not used- no repeat survey		9/17/89		
182_1S	182.10	Not used- no repeat survey		9/17/89		
181_9S	181.90	Used	Habitat Reach- Bridge Sites on Main Channel	9/17/89	10/12/98	
181_85S	181.85	Not used- no repeat survey		10/1/89		

File Name	River Mile	Used for Analysis of Degradation and Aggradation?	Reach Designation[2]	Date of Survey 1	Date of Survey 2	Date of Survey 3
180_3N	180.30	Not used- no repeat survey		9/21/89		
180_3S	180.30	Not used- no repeat survey		9/21/89		
180_1	180.10	Not used- no repeat survey		9/17/89		
178_4M	178.40	Not used- no repeat survey		9/19/89		
178_4N	178.40	Not used- no repeat survey		9/20/89		
178_4S	178.40	Not used- no repeat survey		9/19/89		
9BW-TR5	178.38	Used	Habitat Reach- Main Channel	7/10/85	6/2/00	
9BW-TR4	178.32	Used	Habitat Reach- Main Channel/ 2005 Surveys	7/10/85	6/2/00	9/26/2005
9BW-TR3	178.27	Used	Habitat Reach- Main Channel	7/10/85	6/2/00	
9BW-TR2	178.23	Used	Habitat Reach- Main Channel/ 2005 Surveys	7/10/85	6/2/00	9/26/2005
9BW-TR1	178.18	Used	Habitat Reach- Main Channel	7/10/85	6/2/00	
9BE-TR7	177.40	Used	Habitat Reach- Main Channel	7/11/85	5/31/00	
9BE-TR6	177.35	Not used- discrepancy in survey alignment		7/11/85	5/31/00	
177_3M	177.30	Not used- no repeat survey		9/20/89		
177_3N	177.30	Not used- no repeat survey		9/20/89		
177_3S	177.30	Not used- no repeat survey		9/19/89		
9BE-TR5	177.30	Used	Habitat Reach- Main Channel	7/11/85	5/31/00	
9BE-TR4	177.25	Used	Habitat Reach- Main Channel	7/11/85	5/31/00	
9BE-TR3	177.20	Used	Habitat Reach- Main Channel/ 2005 Surveys	7/11/85	5/31/00	9/23/05
9BE-TR2	177.15	Used	Habitat Reach- Main Channel/ 2005 Surveys	7/11/85	5/31/00	9/23/05
9BE-TR1	177.10	Used	Habitat Reach- Main Channel	7/11/85	5/31/00	
175_5M	175.50	Not used- no repeat survey		9/18/89		
175_5N	175.50	Not used- no repeat survey		9/18/89		
175_5S	175.50	Not used- no repeat survey		9/18/89		
175_2S	175.20	Used	Habitat Reach- Bridge Sites on Main Channel	9/1/89	10/13/98	
174_65S	174.65	Not used- no repeat survey		9/1/89		
174_6N	174.60	Not used- no repeat survey		10/3/89		
174_6NM	174.60	Not used- no repeat survey		10/3/89		
174_6S	174.60	Not used- no repeat survey		10/3/89		
174_6SM	174.60	Not used- no repeat survey		10/3/89		
172_8S	172.80	Not used- no repeat survey		8/29/89		

File Name	River Mile	Used for Analysis of Degradation and Aggradation?	Reach Designation[2]	Date of Survey 1	Date of Survey 2	Date of Survey 3
172_7S	172.70	Not used- no repeat survey		8/30/89		
172_6N	172.60	Not used- no repeat survey		8/31/89		
172_6NM	172.60	Not used- no repeat survey		8/30/89		
172_6S	172.60	Used	Habitat Reach- Main Channel	8/29/89	10/12/98	
172_6SM	172.60	Not used- no repeat survey		8/30/89		
172_4S	172.40	Not used- no repeat survey		8/31/89		
172_1S	172.10	Not used- no repeat survey		8/31/89		
170_3M	170.30	Not used- sole cross section on side channel		9/21/89	10/12/98	
170_3N	170.30	Used	Habitat Reach- Side Channel 2	9/13/89	10/12/98	
170_3S	170.30	Not used- no repeat survey		9/21/89		
168_7N	168.70	Used	Habitat Reach- Side Channel 2	9/1/89	10/12/98	
168_7S	168.70	Not used- no repeat survey		9/13/89		
167_9N	167.90	Not used- no repeat survey		9/16/89		
167_9S	167.90	Not used- no repeat survey		9/14/89		
167_85	167.85	Used	Habitat Reach- Bridge Sites on Main Channel	9/16/89	10/13/98	
166_9	166.90	Not used- no repeat survey		9/14/89		
165_9	165.90	Not used- no repeat survey		8/16/89		
165_85	165.85	Not used- no repeat survey		8/16/89		
165_8	165.80	Not used- no repeat survey		8/16/89		
162_2	162.20	Not used- no repeat survey		8/16/89		
12A-TR3	159.00	Used	Habitat Reach- Main Channel	7/16/85	10/20/00	
12A-TR2	158.70	Used	Habitat Reach- Main Channel/ 2005 Surveys	7/16/85	10/20/00	9/29/05
12A-TR1	158.60	Used	Habitat Reach- Main Channel/ 2005 Surveys	7/16/85	10/20/00	9/29/05
157_2	157.20	Not used- no repeat survey		8/15/89		
157_1	157.10	Used	Habitat Reach- Bridge Sites on Main Channel	8/14/89	10/13/98	

1- Original 1989 survey sites 202_2M and 202_2S were resurveyed together in 1998 and labeled as 202_2M in Appendix D.
2- Each cross section and transect used in the analysis is categorized by reach, as discussed in Section 5.0.



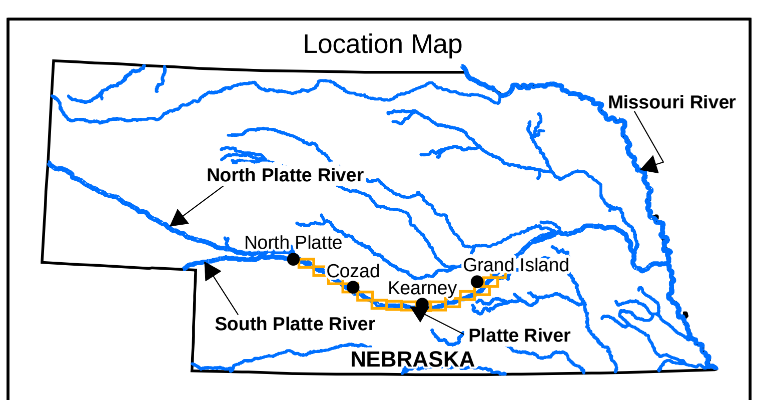


Figure 3.1. Keymap for Cross Section Locations along the Central Platte River

RECLAMATION
Managing Water in the West

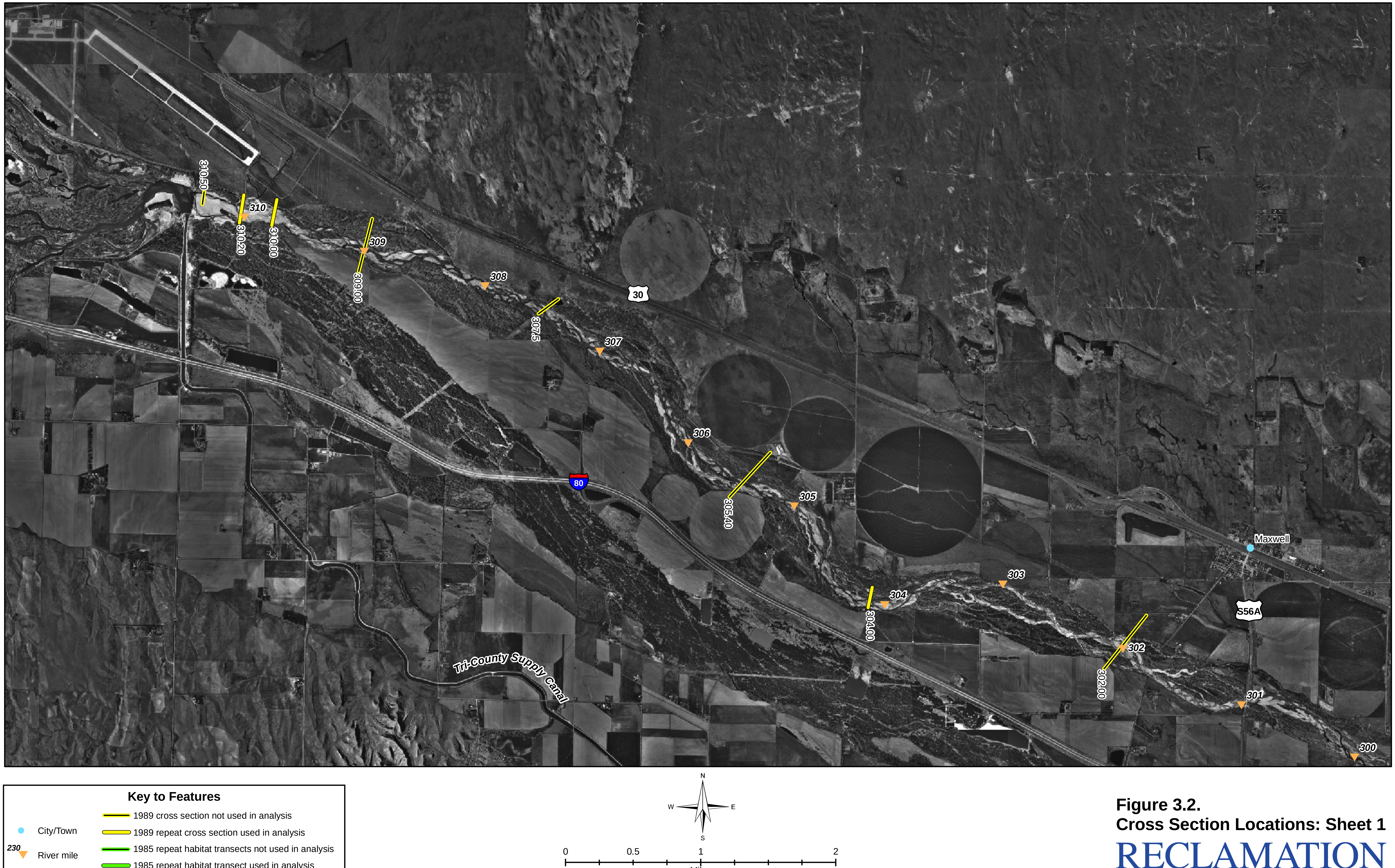


Figure 3.2.
Cross Section Locations: Sheet 1

RECLAMATION
Managing Water in the West

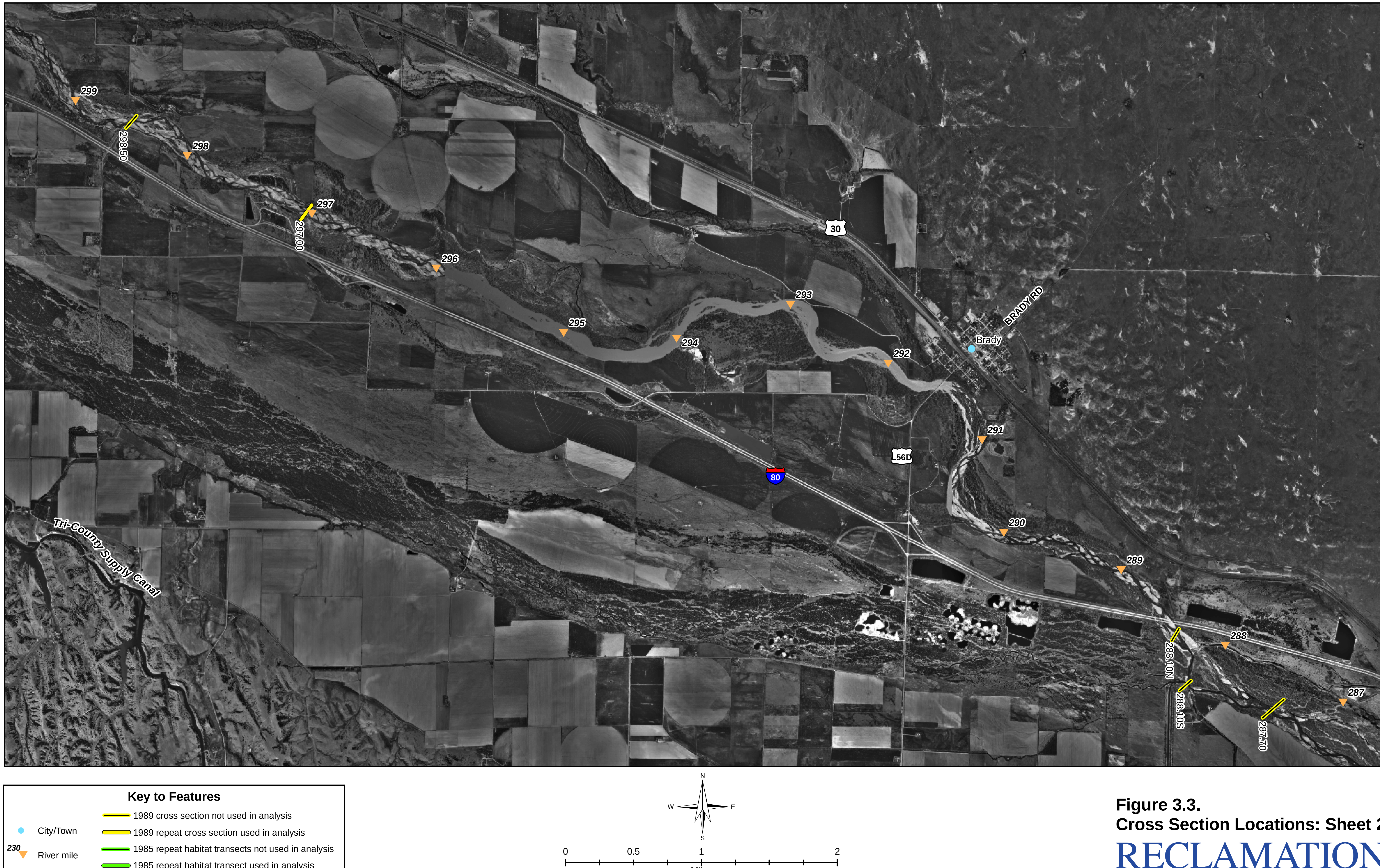
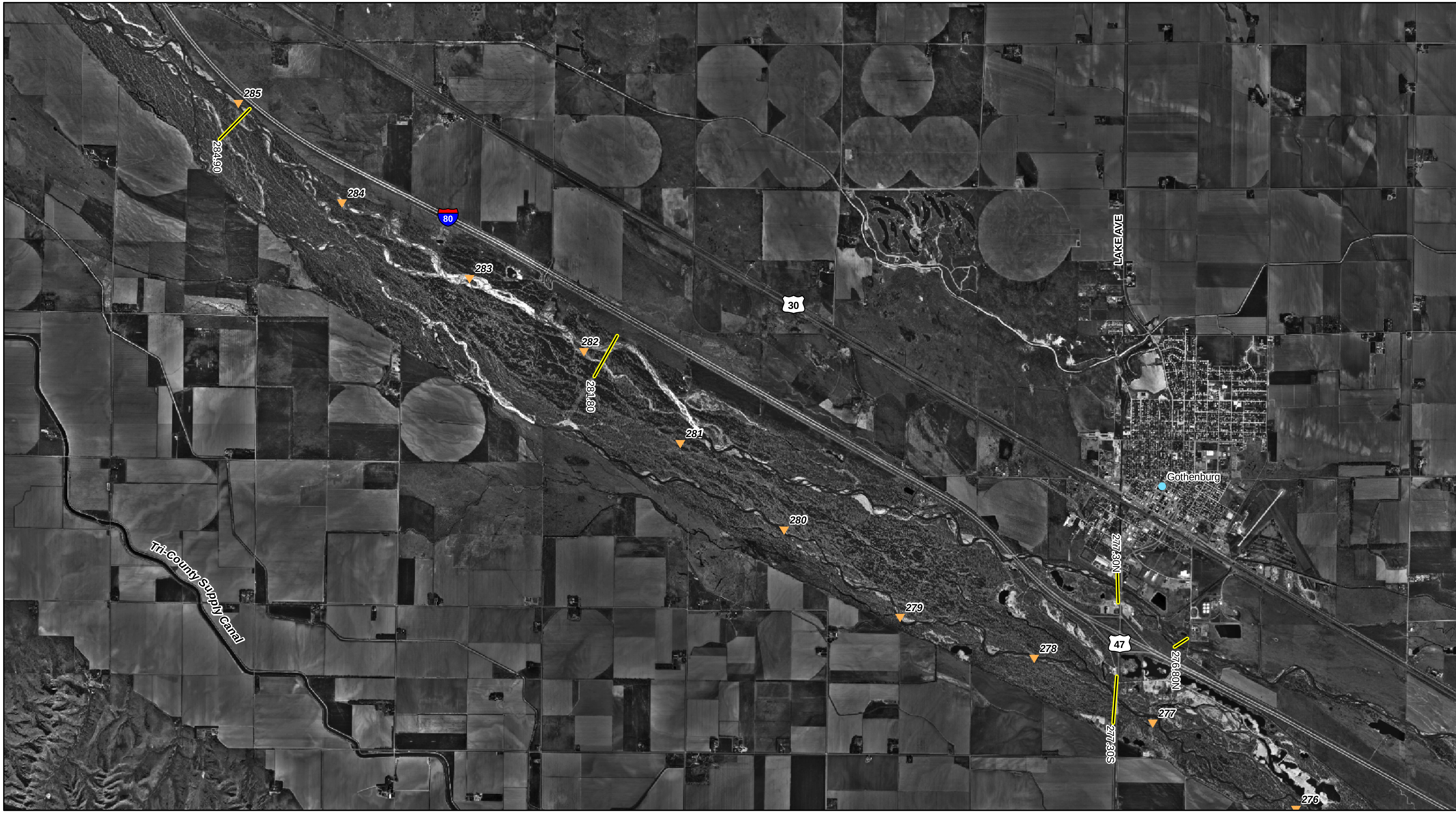


Figure 3.3.
Cross Section Locations: Sheet 2

RECLAMATION
Managing Water in the West



Key to Features

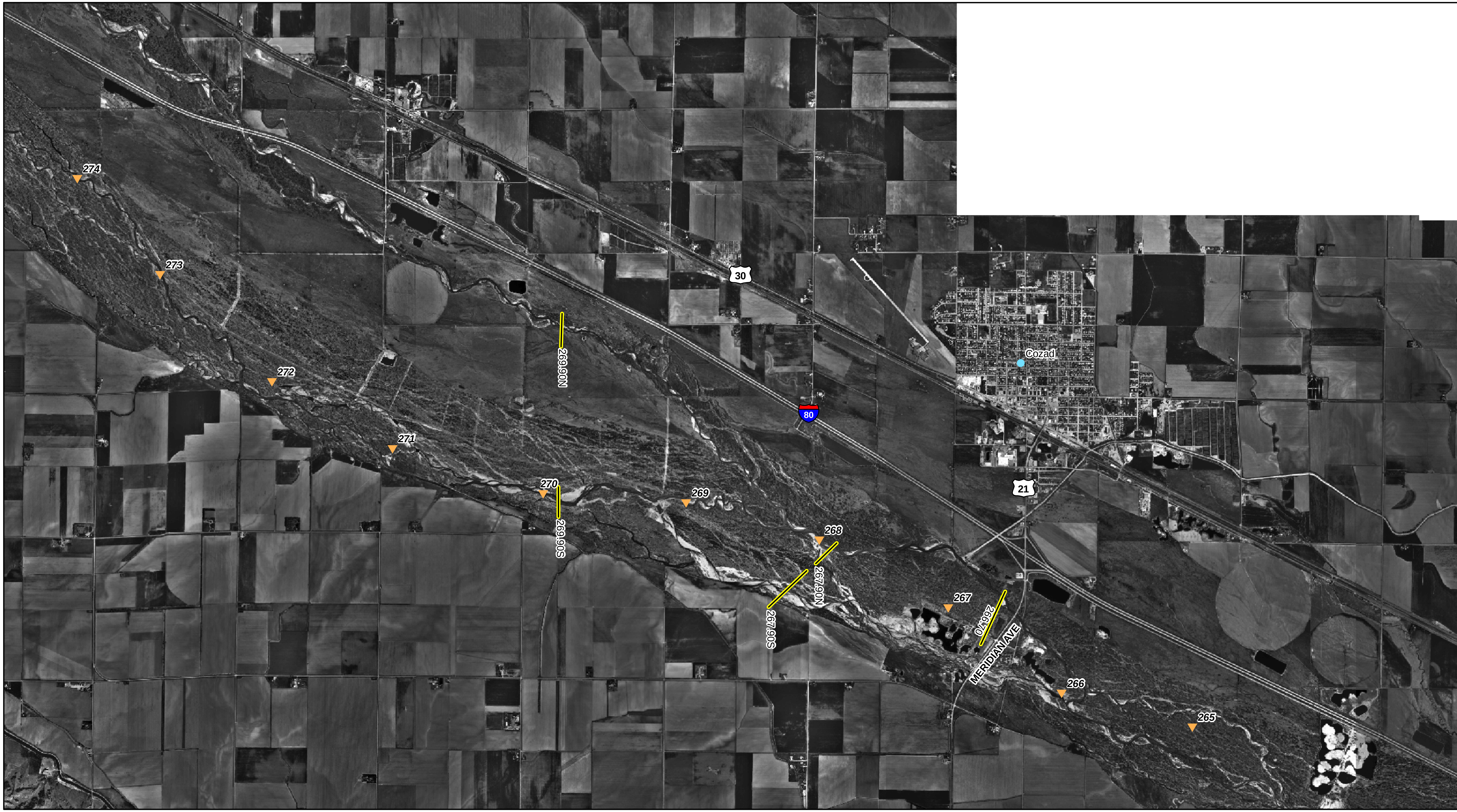
- City/Town
- 230 River mile
- 1989 cross section not used in analysis
- 1989 repeat cross section used in analysis
- 1985 repeat habitat transects not used in analysis
- 1985 repeat habitat transect used in analysis

N
W E
S

0 0.5 1 2
Miles

Figure 3.4.
Cross Section Locations: Sheet 3

RECLAMATION
Managing Water in the West



Key to Features

- City/Town
- River mile (230)
- 1989 cross section not used in analysis
- 1989 repeat cross section used in analysis
- 1985 repeat habitat transects not used in analysis
- 1985 repeat habitat transect used in analysis

N S W E

0 0.5 1 2
Miles

Figure 3.5.
Cross Section Locations: Sheet 4

RECLAMATION
Managing Water in the West

Key to Features

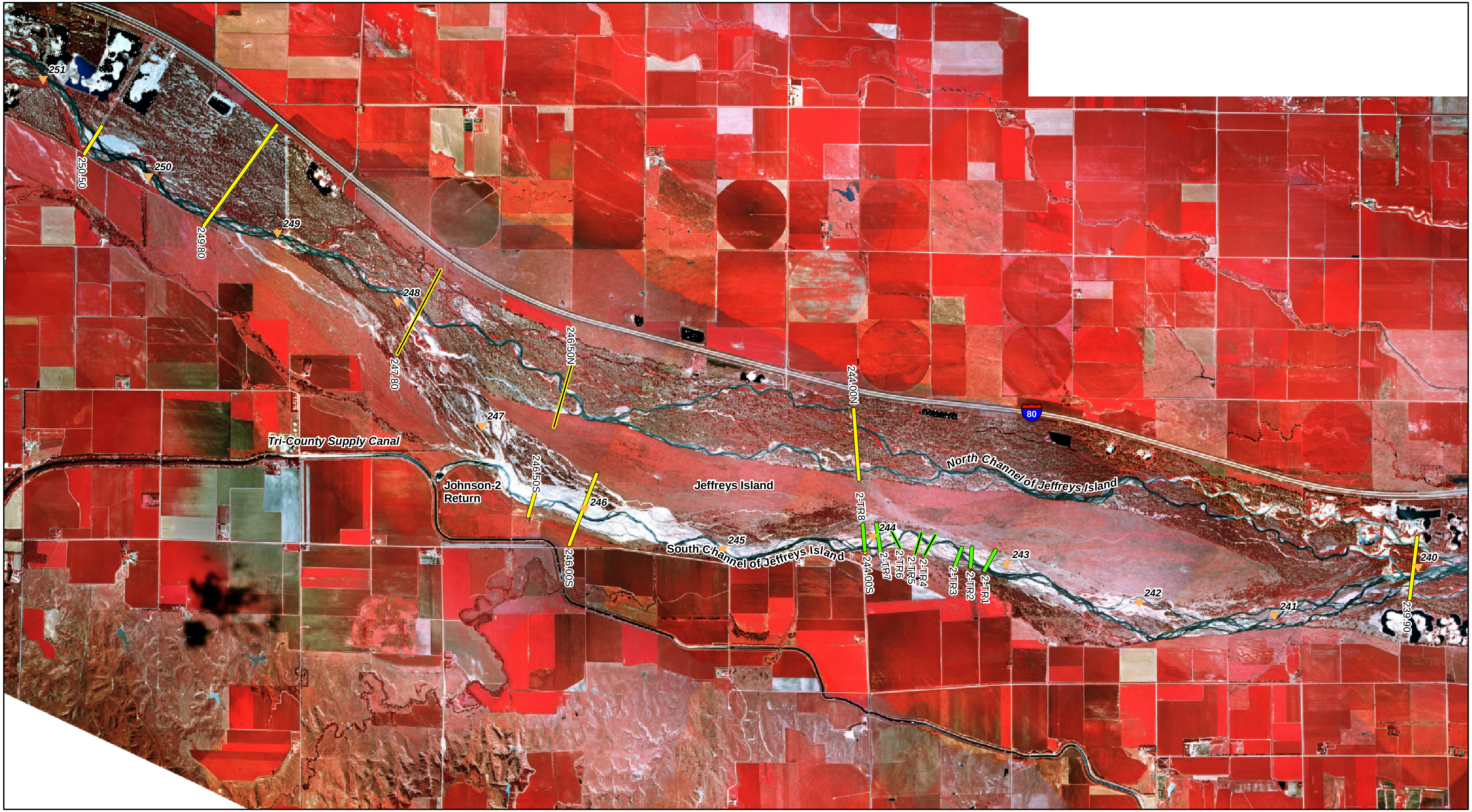
- City/Town
- 230 River mile
- 1989 cross section not used in analysis
- 1989 repeat cross section used in analysis
- 1985 repeat habitat transects not used in analysis
- 1985 repeat habitat transect used in analysis

N W E S

0 0.5 1 2
Miles

Figure 3.6.
Cross Section Locations: Sheet 5

RECLAMATION
Managing Water in the West



Key to Features

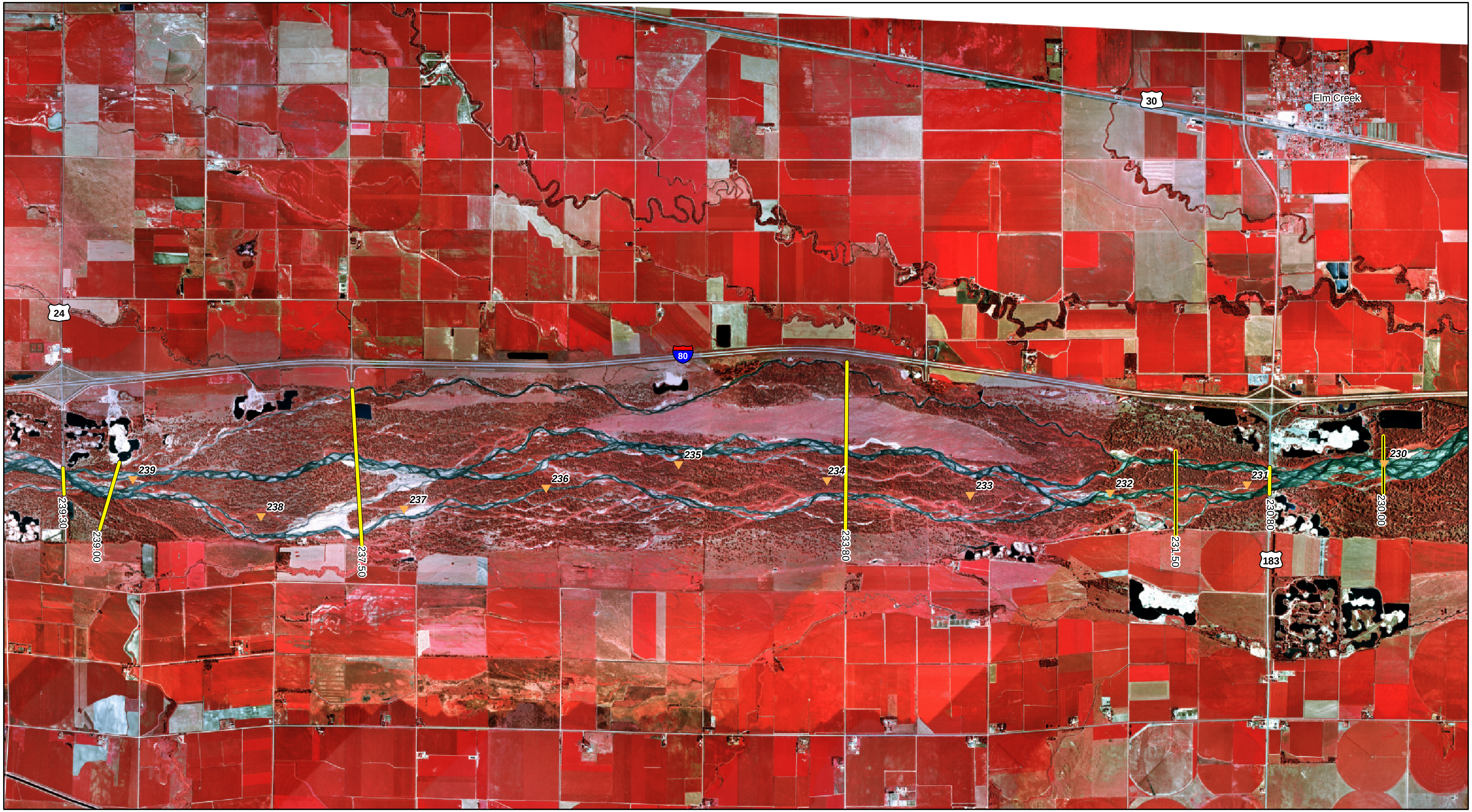
- City/Town
- 230 River mile
- 1989 cross section not used in analysis
- 1989 repeat cross section used in analysis
- 1985 repeat habitat transects not used in analysis
- 1985 repeat habitat transect used in analysis

N
W E
S

0 0.5 1 2
Miles

Figure 3.7.
Cross Section Locations: Sheet 6

RECLAMATION
Managing Water in the West



Key to Features

- City/Town
- 230 River mile
- 1989 cross section not used in analysis
- 1989 repeat cross section used in analysis
- 1985 repeat habitat transects not used in analysis
- 1985 repeat habitat transect used in analysis

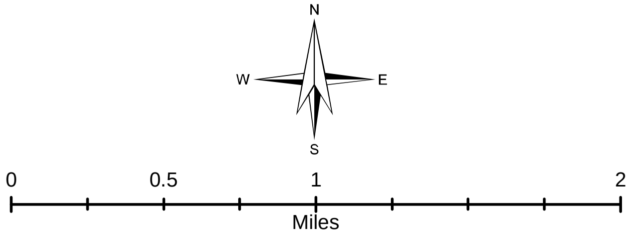
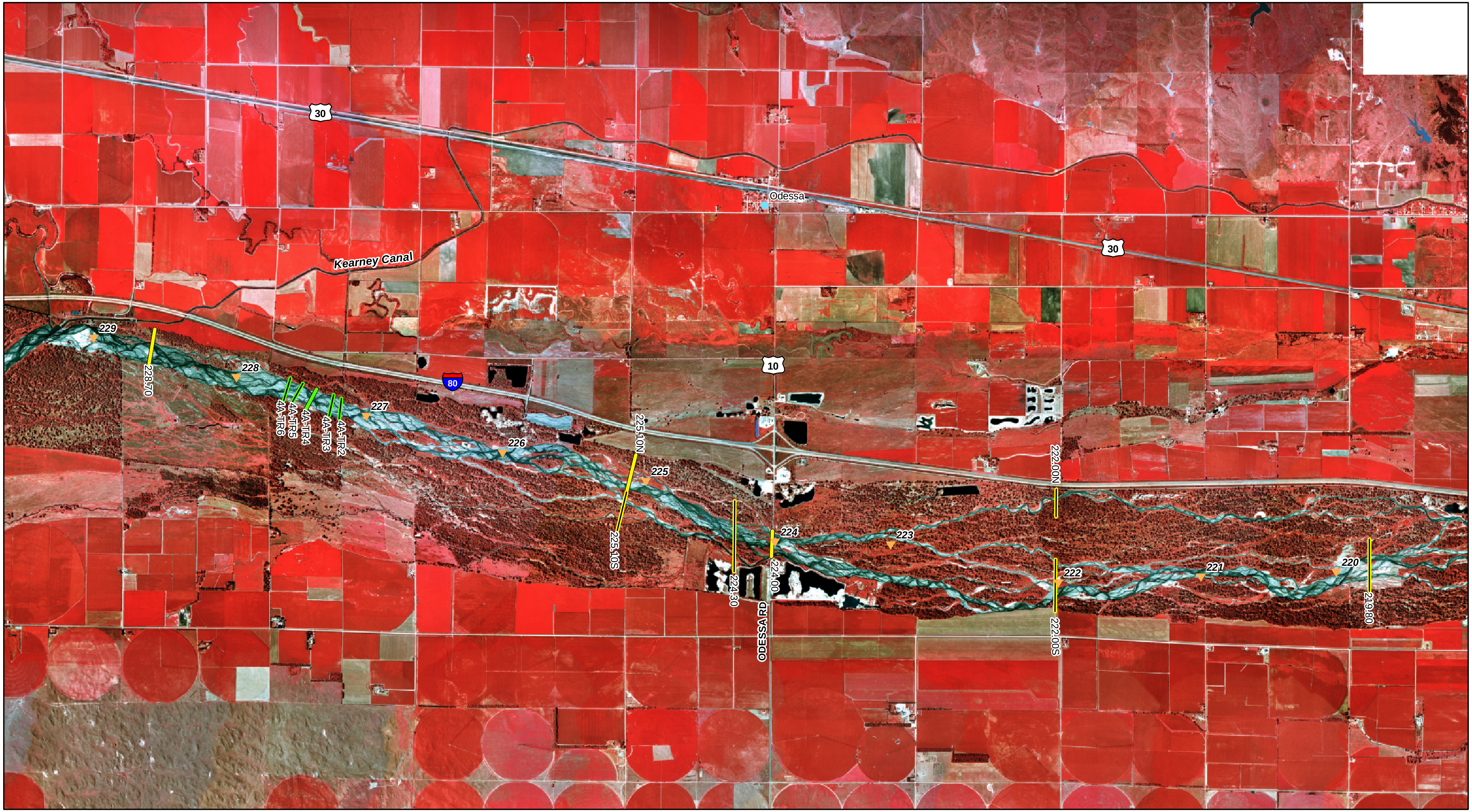


Figure 3.8.
Cross Section Locations: Sheet 7

RECLAMATION
Managing Water in the West



Key to Features

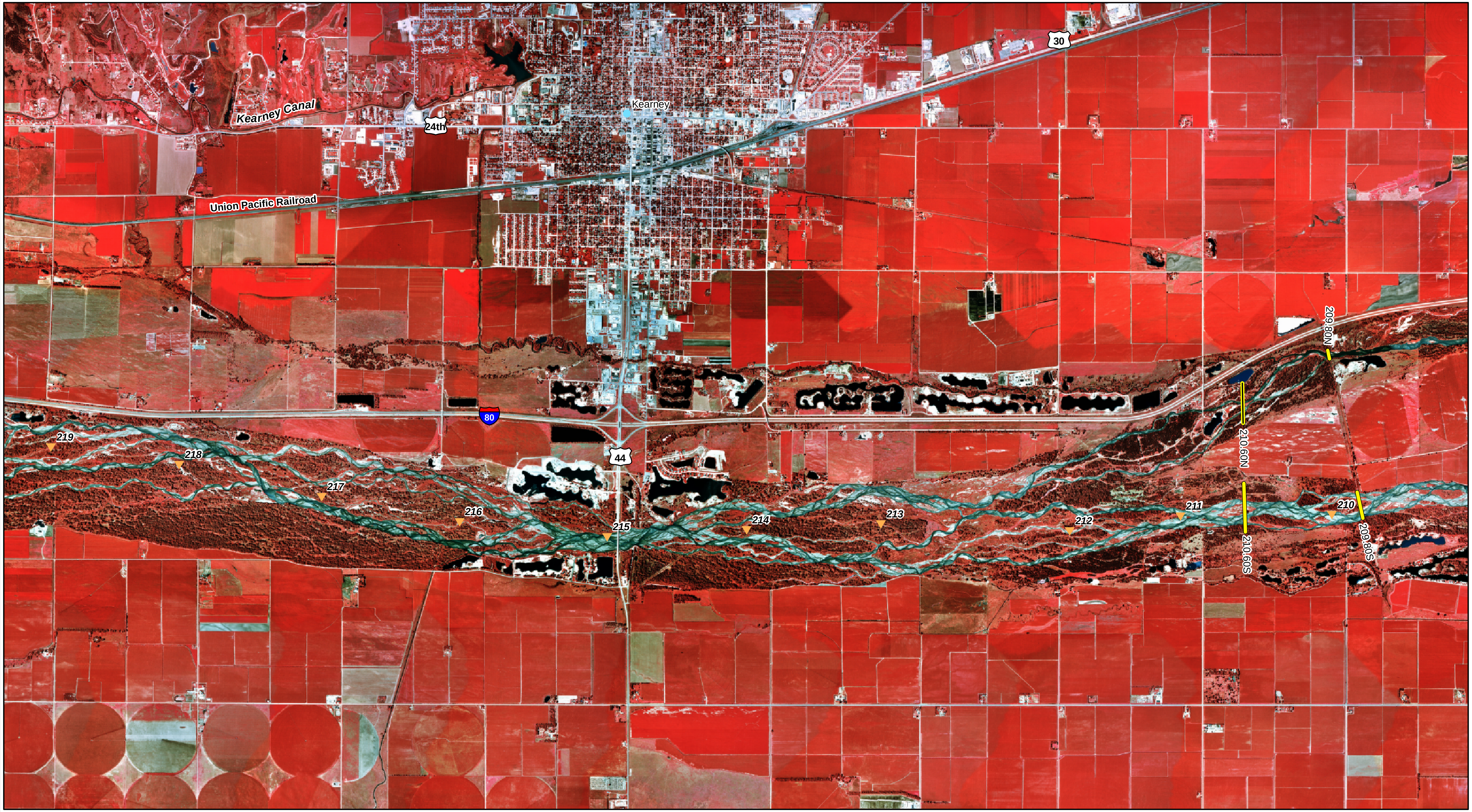
- City/Town
- 230 River mile
- 1989 cross section not used in analysis
- 1989 repeat cross section used in analysis
- 1985 repeat habitat transects not used in analysis
- 1985 repeat habitat transect used in analysis

N W E S

0 0.5 1 2
Miles

Figure 3.9.
Cross Section Locations: Sheet 8

RECLAMATION
Managing Water in the West



Key to Features

- City/Town
- 230 River mile
- 1989 cross section not used in analysis
- 1989 repeat cross section used in analysis
- 1985 repeat habitat transects not used in analysis
- 1985 repeat habitat transect used in analysis

N W E S

0 0.5 1 2
Miles

Figure 3.10.
Cross Section Locations: Sheet 9

RECLAMATION
Managing Water in the West

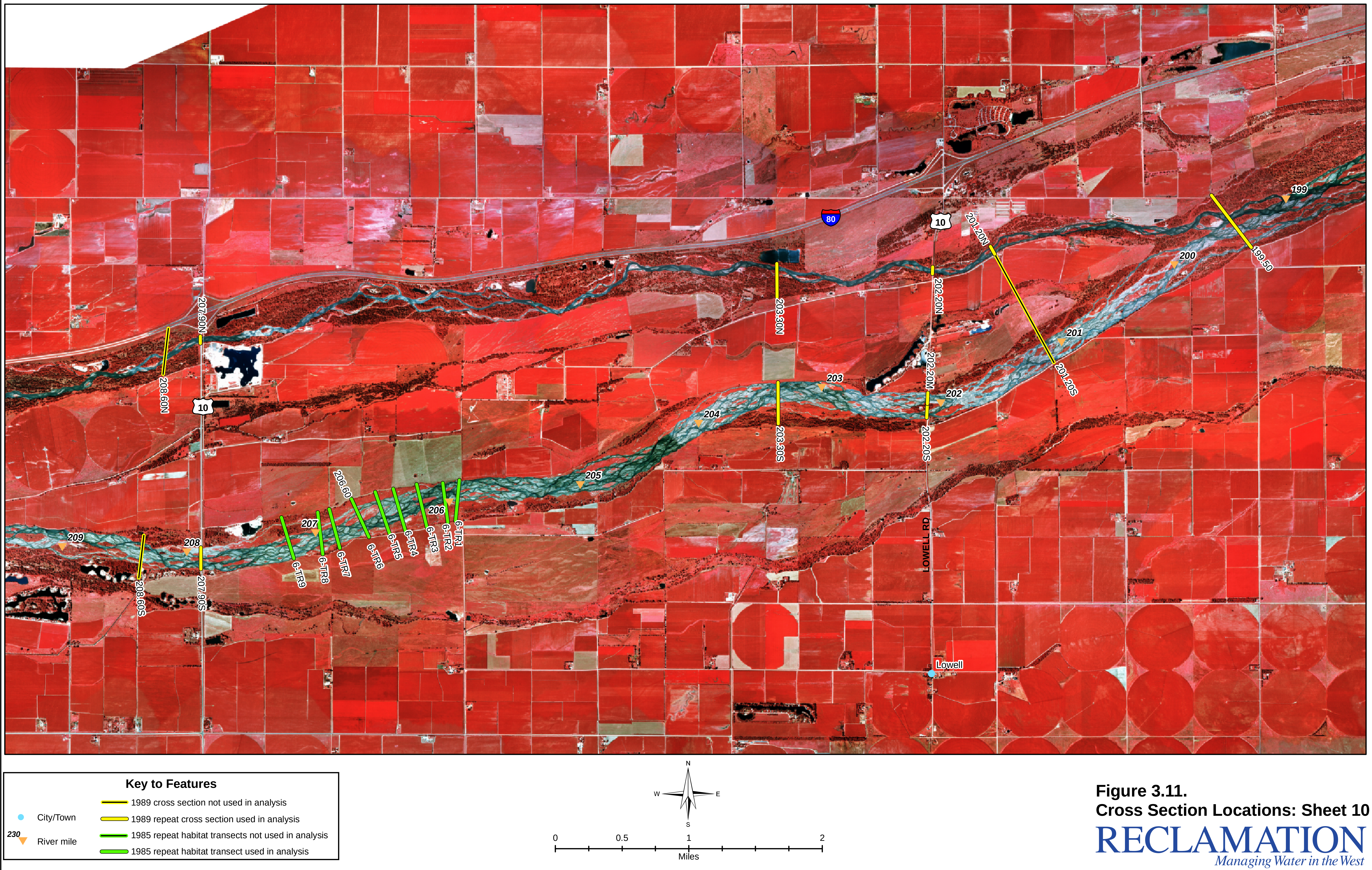


Figure 3.11.
Cross Section Locations: Sheet 10

RECLAMATION
Managing Water in the West

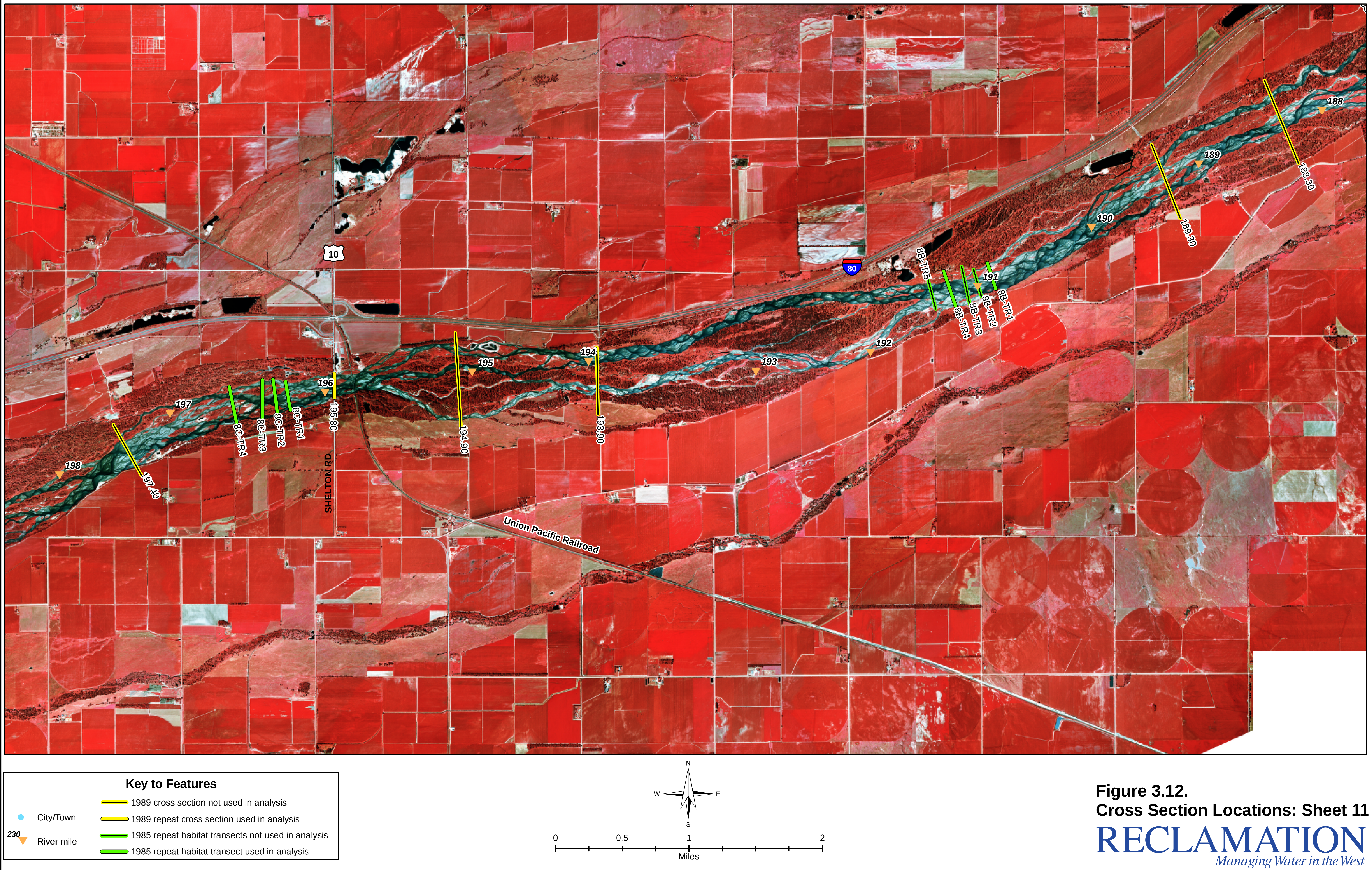
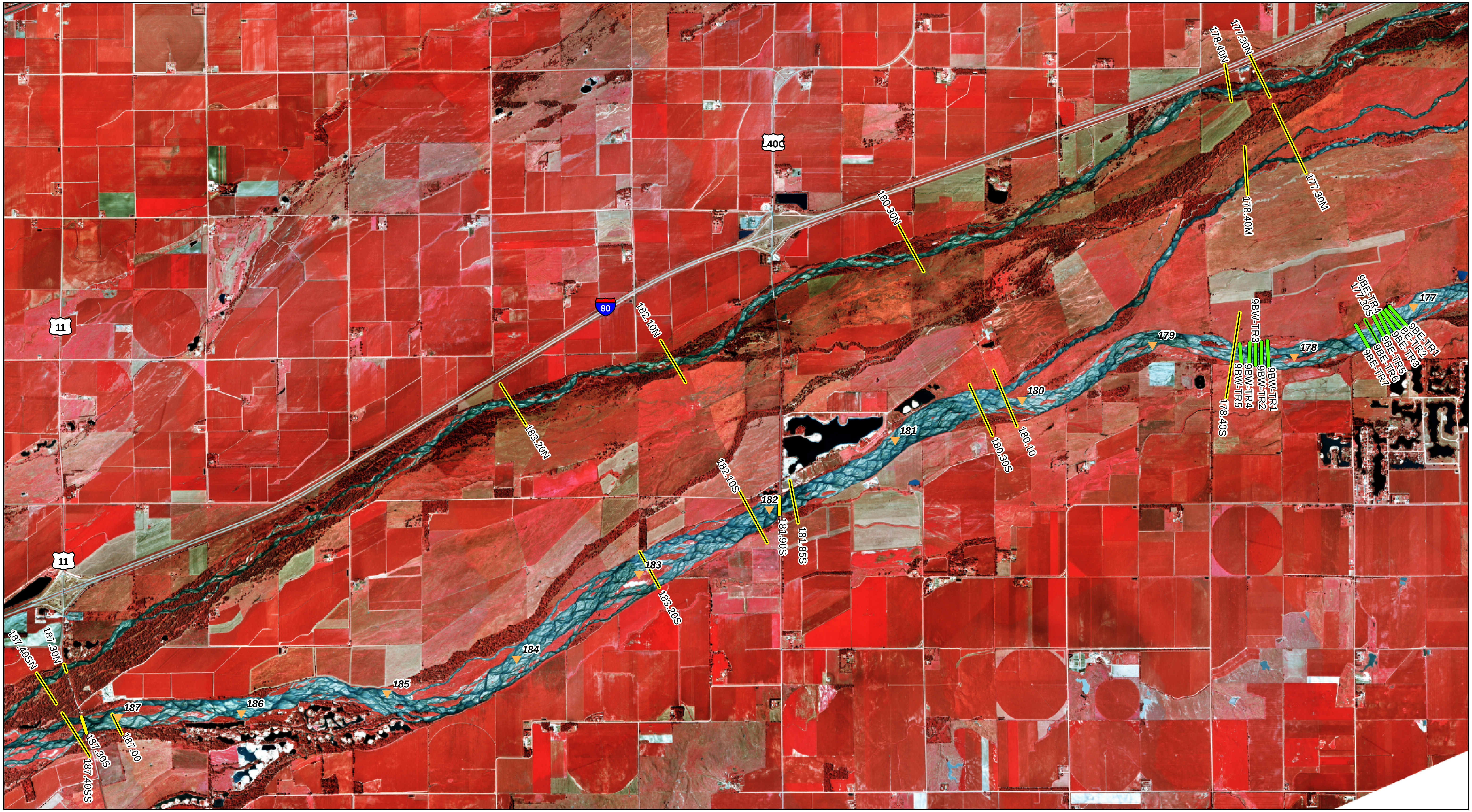


Figure 3.12.
Cross Section Locations: Sheet 11

RECLAMATION
Managing Water in the West



Key to Features

- City/Town
- 230 River mile
- 1989 cross section not used in analysis
- 1989 repeat cross section used in analysis
- 1985 repeat habitat transects not used in analysis
- 1985 repeat habitat transect used in analysis

N W E S

0 0.5 1 2

Miles

Figure 3.13.
Cross Section Locations: Sheet 12

RECLAMATION
Managing Water in the West

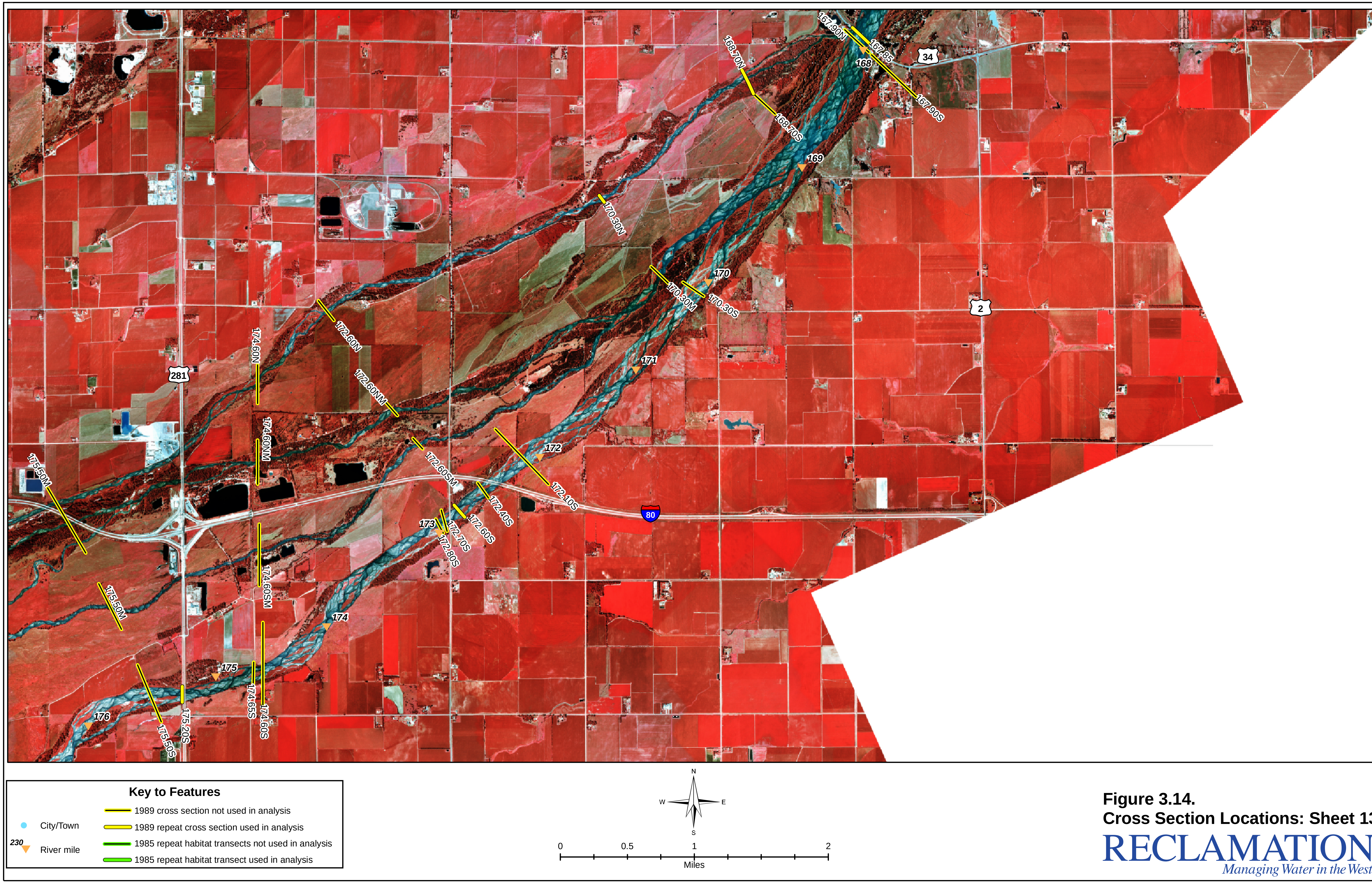


Figure 3.14.
Cross Section Locations: Sheet 13

RECLAMATION
Managing Water in the West

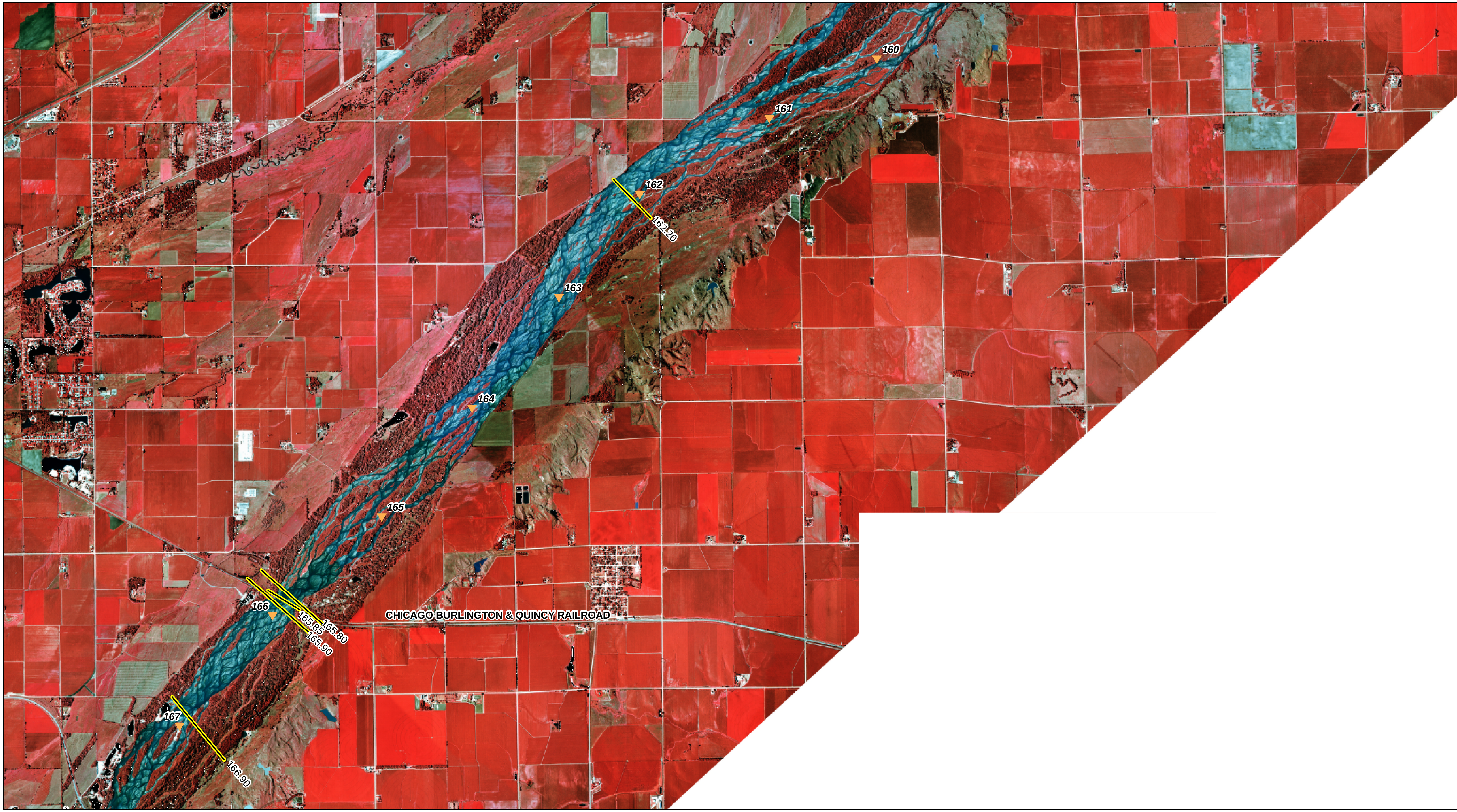


Figure 3.15.
Cross Section Locations: Sheet 14

RECLAMATION
Managing Water in the West

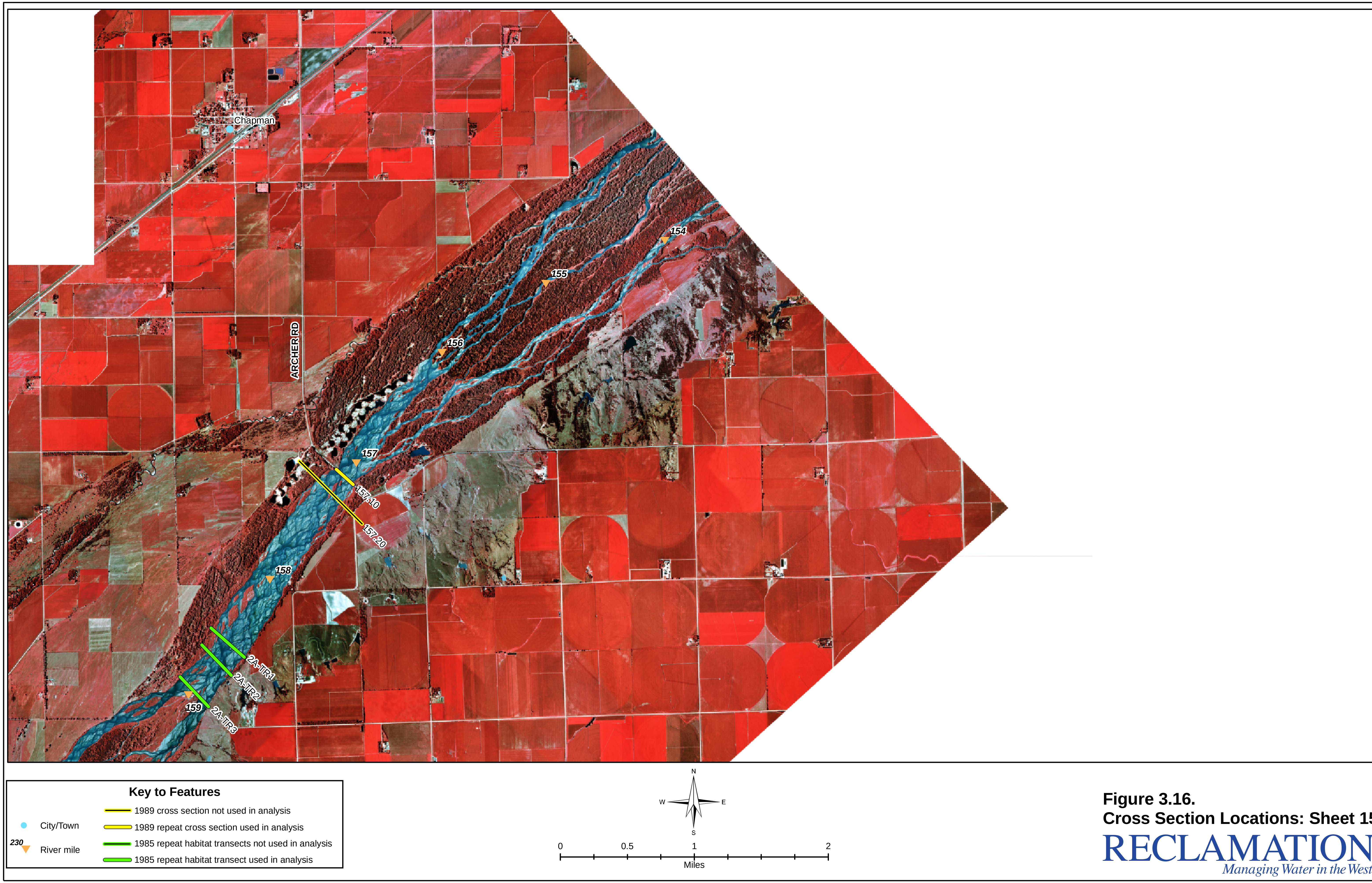


Figure 3.16.
Cross Section Locations: Sheet 15

RECLAMATION
Managing Water in the West

3.1 1983-1988 Habitat Site Surveys by Reclamation

The Reclamation, Nebraska-Kansas Projects Office, Grand Island, Nebraska, surveyed 85 Platte River channel transects between Lexington and Chapman between 1983 and 1988 (USDOI, 1989; Farmer *et al.*, 2000). These 85 habitat transects were nested within 16 local areas of the river, which the Project office referred to as "study sites" (Table 3.2). The placement of nested transects followed the procedures described for "representative reaches" using Physical Habitat Simulation Methodology (PHABSIM) guidelines (Bovee, 1982). Within the individual study sites, the channel length between the most-upstream and most-downstream transects ranged from roughly 700 to 6,900 ft. Due to the anabranched nature of the Platte River channels, not all transects spanned the entire river width; rather, where channels became widely separated by large islands, an additional series of transects were surveyed on the separated channels.

The Project Office used 4-foot metal fence posts ("T-posts") as headpins to designate the end points of transects. These were driven nearly to ground-surface level and marked with a metal tag. Transects and headpins were documented by photographs. Elevations of the headpins were surveyed to a vertical precision of 0.01 foot and tied to the National Geodetic Vertical Datum of 1929 (NGVD29) using rod and transit. Nebraska State Plane coordinates in the North American Datum of 1927 (NAD27) were also established for each headpin.

The 85 habitat transects were repeatedly surveyed two to nine times by the Project Office between 1983 and 1988 (Table 3.3). Horizontal measurements along the transects were generally at intervals of 20 ft or less (i.e., at abrupt changes in elevation), with elevations recorded to nearest 0.1 ft using rod and level. Nearly all of the 85 transects were surveyed in a straight line from one high bank to the opposing high bank. However, in several instances, transects were "dog-legged" on a mid-channel island in order to maintain the survey more nearly perpendicular to divergent channels. Detailed documentation for 1983-1988 habitat site surveys is maintained at Reclamation's Area Office in Mills, WY.

In 1985, the Projects Office also surveyed transects on the Platte River near Cozad, Nebraska, and on the North Platte River near Hershey, Nebraska. The procedures followed those outlined above.

For the purposes of this report, cross-sectional surveys at each of the study sites are referred to as habitat transects. Of the 85 habitat transects originally surveyed by Reclamation, only those transects that were resurveyed between 1998 and 2001 were considered for analysis of aggradation and degradation. Among the habitat transects considered for use, only one month of the 1983-1988 surveys, July 1985, was common to all. Consequently, the July 1985 survey was specified as the initial survey for each habitat transect. This approach presented the greatest amount of consistency among the early surveys and precluded subjectivity in selecting an initial survey date for each transect.

Table 3.2. Information about Reclamation Nebraska-Kansas Project Office channel cross sections surveys, 1983-1988.

Site Name	Site 2	Site 4A	Site 4B	Site 5	Site 6	Site 7	Site 8AN	Site 8AS
Approx. Location (COE RM)	244	227	226	218	206	203	192	192
No. of Cross-sections	8	6	4	4	9	5	4	3
Site Length (ft)	4,777	3,370	2,073	3,135	6,872	2,844	733	784
No. of Site Visits/Surveys	3	2	2	2	5	3	2	2

Site Name	Site 8B	8C	Site 9BW	Site 9BE	Site 10	Site 11	Site 12A	Site 12B
Approx. Location (COE RM)	191	196	178	177	179	181	159	165
No. of Cross-sections	5	4	5	7	8	5	3	5
Site Length (ft)	2,564	2,261	1,025	1,527	1,885	2,031	2,335	2,613
No. of Site Visits/Surveys	3	3	9	6	4	3	4	2

Site Name	N. Platte River near Hershey	Platte River near Cozad						
Approx. Location (COE RM)	325	263						
No. of Cross-sections	6	n/a						
Site Length (ft)	1,071	n/a						
No. of Site Visits/Surveys	2	2						

COE River Mile = Army Corps of Engineers (COE) distance measured upstream from Platte River confluence with Missouri River (COE, 1988a, 1988b)
n/a = information not available

Table 3.3. Identification number and date of channel cross-section surveys performed by Reclamation's Nebraska-Kansas Project Office, 1983-1988, and under TSC contracts, 1998-2001

Study Site	Visit ID #	Date of Survey: Project Office	Date of Survey: TSC Contract
N. Platte River near Hershey	2	9-Apr-85	
	3	1-Aug-85	
Platte River near Cozad	2	9-May-85	
	3	2-Aug-85	
2	1	10-Oct-84	
	2	10-Apr-85	
	3	22-Jul-85	
	4		18-Oct-00
4A	2	27-Mar-85	
	3	8-Jul-85	
	4		26-27 Oct-01
4B	2	27-Mar-85	
	3	9-Jul-85	
5	2	6-May-85	
	3	23-Jul-85	
6	1	3-Oct-84	
	2	3-Apr-85	
	3	17-Jul-85	
	4	9-Jun-86	
	5	May-87	
	6		6-Oct-98
7	1	9-Oct-84	
	2	22-Apr-85	
	3	15-Jul-85	
8an	2	20-Mar-85	
	3	24-Jul-85	
8as	2	20-Mar-85	
	3	30-Jul-85	
8b	2	21-Mar-85	
	3	12-Jul-85	
	4	21-May-86	
	5		1-Jun-00
8c	1	16-Oct-84	
	2	18-Apr-85	
	3	19-Jul-85	
	4		25-26 Oct-01
9be	1	23-Mar-83	
	2	1-Apr-85	
	3	11-Jul-85	
	4	3-Oct-85	
	6	11-Jun-86	
	7	24-Mar-88	
	8		31-May-00

Study Site	Visit ID #	Date of Survey	
		Project Office	TSC Contract
9bw	1	24-Mar-83	
	2	31-Mar-83	
	3	19-Oct-83	
	4	2-Apr-85	
	5	10-Jul-85	
	6	2-Oct-85	
	7	3-Apr-86	
	8	12-Jun-86	
	9	22-Mar-88	
	10		2-Jun-00
10	1	1-Oct-84	
	2	5-Apr-85	
	3	13-Jul-85	
	4	23-Mar-88	
11	1	4-Oct-84	
	2	12-Apr-85	
	3	20-Jul-85	
12a	1	12-Oct-84	
	2	15-Apr-85	
	3	16-Jul-85	
	4	13-Jun-86	
	5		20-Oct-00
12b	2	16-Apr-85	
	3	25-Jul-85	

3.2 1989 Cross-section Surveys by Reclamation

In 1989, Reclamation established and surveyed a network of cross sections across the Platte River from the highway bridge near Chapman, Nebraska (RM 157.1) to immediately downstream from the Tri-County Diversion Dam at North Platte, Nebraska (RM 310.5). This network of cross sections was established for two purposes:

1. Establish a set of baseline cross-section surveys for future monitoring.
2. Provide data for future hydraulic and sediment transport modeling.

Previously collected data from the habitat site surveys (Section 3.1) provided good, detailed information about the channel topography, flow depth, and velocities at the individual study sites. At each habitat study site, transects were closely spaced at a few hundred feet apart. However, these habitat study sites were relatively small, with a river length ranging between 700 and 6,900 ft (Table 3.2). t locations of multiple channels, habitat sites were isolated to a single channel of the Platte River. Therefore, insufficient data were available to link physical river processes between these individual study sites. Data from the 1989 cross sections, together with data from the habitat study site transects, were intended to provide a combined data set that could be used to evaluate the Platte River at both coarse and finer scales.

3.2.1 Cross-Section Locations

The network of cross sections that were established in 1989 included about 90 longitudinal locations along the Platte River, with an average spacing of 1.7 miles per section. River mile designations, based on U.S. Army Corps of Engineers (COE) aerial photographs, (COE, 1988a, 1988b) were used to identify the longitudinal locations.

The geomorphic character of rivers, including the Platte, is not random, and thus, the cross sections were strategically located for modeling and monitoring purposes. Individual cross sections were located to reflect substantial changes in channel width and geomorphic character of the river. Because highway bridges and gravel pits may constrict the river channel, a set of three cross sections was typically used to describe and measure the channel at bridges. One cross section was located either immediately upstream or downstream from the bridge, while the other two cross sections were typically located less than 1 mile upstream and downstream from the bridge cross section. Between bridges, cross sections were typically located about 2 miles apart and at locations to capture considerable changes in channel width or geomorphic character, such as changes in the number of channels. Where possible, cross sections were also located where access was convenient (including landowner permission or public right of way), and where minimal clearing of vegetation was required. When cross sections were in the vicinity of a habitat study site, one of the study sites transects was chosen for the cross section, and the survey line was extended to all other significant channels.

At each longitudinal location, the cross section was intended to transect all significant channels of the Platte River. In general, cross sections were surveyed from the left bank to the right bank, looking downstream. At some locations, the Platte River flows in one main channel, and a cross section was surveyed perpendicular to the channel. At most locations, the Platte River flows through multiple channels. For some of these locations, the cross section was surveyed, along a continuous straight alignment; from the north (left) bank of the northern most channels to the south (right) bank of the southern most channel. For other locations, the island surface was too high and the width of the island terrace was too great (thousands of feet) to be under the influence of modern river processes. In these cases, the cross-section survey line was broken into two, three, or four segments to capture the separate channels of the Platte River. The nomenclature listed below was used to differentiate the separate survey line segments at the same river mile.

- Two cross-section segments were designated as the north and south channels.
- Three cross-section segments were designated as the north, middle, and south channels.
- Four cross-section segments were designated as the north, north middle, south middle, and south channels.

3.2.2 Survey Procedure

The locations of 1989 cross sections were initially plotted on USGS quadrangle maps by Reclamation's Sedimentation and River Hydraulics Group (Tim Randle). Land ownerships for each cross section were then determined by Reclamation's Grand Island Office, who subsequently obtained verbal permission from each landowner to conduct the survey work. Land owners granted permission for nearly all requests, and the survey was able to proceed as planned.

Once landowner permission was granted, the survey work proceeded in five phases from May through November 1989:

1. Setting of cross-section end points (headpins) in the field
2. Clearing of vegetation along each survey line
3. Surveying of each channel cross section
4. Level surveying of cross-section headpin elevations
5. River bed-material sampling

During the first phase, a Reclamation crew, consisting of Duane Woodward and Tim Randle, set at least one headpin in the field for each cross-section line segment. The other headpin was also set during this phase when no clearing of vegetation was required, which typically occurred at bridges. When vegetation clearing was required, the alignment of the survey line was marked by tying survey tape to the vegetation. The other cross-section end point was later set after vegetation clearing. For the convenience of the survey, the final location of the

cross sections only varied slightly (a few feet to a mile) from the original plotted locations.
The cross-section headpins consisted of 4-foot long steel T-posts with a 3-inch by 3-inch steel plate welded to the end of the post. The river mile was stamped into the steel plate, and the steel post was pounded into the ground so that the steel plate was flush with the ground surface. At some locations, such as bridges, the soil was so well compacted that the 4-foot long steel T-post could not be driven flush with the ground, and in some cases, the steel plate broke off as the post was being driven into the ground. T-posts that extended above ground at bridge locations were later removed, most likely by highway maintenance crews.

Several redundant methods were used to document the field locations of the cross-section headpins:

- Reference points
- Field sketches
- Photographs
- Plots on the aerial photographs
- Plots on the USGS quadrangle maps

Metal tags were then nailed into nearby trees or wooden fence posts as reference points both upstream and downstream from the cross-section headpins. The upstream metal tag was stamped "US" while the downstream metal tag was stamped "DS." At bridges, the metal tags were nailed into the wooden guardrail posts. A cloth tape was used to measure the distances from the cross-section headpins to each of the reference points (metal tags).

A sketch was also made in the field to document the locations of the cross-section headpin, reference points, and other features such as trees, fence lines, and posts.

Photographs were taken to provide visual documentation of the cross-section headpin locations (Appendix D). In addition, the cross-section headpins were plotted on the aerial photographs and the USGS quadrangle maps. Unfortunately, the USGS quadrangle maps with the end-point locations have since been lost.

During the second phase, a three-person crew (led by Craig Schwieger) cleared vegetation along the survey line using chain saws and pruning tools. A survey transit was used during the clearing operation to ensure that a clear line-of-sight was provided for the subsequent cross-section survey. The crew set the second cross-section end point after each line was cleared.

The channel cross sections were surveyed during the third phase by Reclamation crews that were led by Ron Ferrari, Tim Randle, and Joe Lyons. Survey crews initially consisted of three people. Once experience was gained near the end of the field season, the crew was reduced to only two people. Each crew alternated on ten-day survey trips from May through November 1989.

A total station survey instrument and electronic data recorder were used to conduct the surveys. The total station was set up over one cross-section headpin, while the other headpin was used as the back sight. The zero azimuth was set along the survey line. The elevation of the headpin, under the survey instrument, was initially assumed to have an elevation of 100 ft and a starting horizontal location of 0+00.

Points were surveyed along the cross section at breaks in slope and not more than 20 ft from the last point. The measurements at each point included the slope distance from the total station in addition to horizontal and vertical angles. From these measurements, the electronic data recorder computed and stored the station along the survey line, the offset from the line, and the point elevation. A description was also entered and recorded for each point to document if the point was the channel bottom below the river water surface, the water surface elevation, edge of water, toe of bank, top of bank, cross-section monument (headpin), reference point, etc.

During the fourth phase, a Reclamation survey crew from Ord, Nebraska, used level instruments to measure the elevation of at least one cross-section headpin to NGVD29. Budget was not available to establish the horizontal Nebraska State Plane coordinates.

During the fifth phase in November 1989, a Reclamation crew (Tim Randle and Wayne Graham) collected bed material samples from various points along representative cross sections between North Platte and Chapman, Nebraska. These samples were collected for comparison with previous sediment samples obtained by the Army Corps of Engineers and the USGS (Murphy *et al*., 2004) and for numerically modeling sediment transport. A hand-held bed material sampler was used where the river channel could be waded. At bridge sites, a standard bed material sampler was lowered. In dry channels, bed-material samples were collected using a shovel. All samples were analyzed by Reclamation Interregional Soil and Water Laboratory for particle grain size analysis. Results of the grain-size analyses are presented in electronic format in Appendix F to document all data collected by Reclamation in 1989.

3.3 1998, 2000 & 2001 Habitat Site Surveys by DJ&A, P.C.[1]

Due to funding limitations, repeat measurements of the habitat transects between 1998 and 2001 were limited to eight study sites. Selected sites were on the primary (i.e., widest) channels, distributed through the length of the study area, and located within river reaches with the highest use by sandhill cranes, an possible indicator species of whooping cranes. Sites that were not selected for

[1] In 2000, Druyvestein, Johnson & Anderson Consulting Engineers and Land Surveyors became DJ&A, P.C. Consulting Engineers and Land Surveyors.

repeat measurements were either located in relatively narrow side channels or in heavily anabranched and forested river reaches, and have received far less sandhill crane use.

In October 1998, Reclamation's Technical Service Center (TSC) in Denver contracted with Druyvestein, Johnson & Anderson Consulting Engineers and Land Surveyors (DJ&A, P.C.), based in Missoula, Montana, to repeat surveys of the nine habitat transects previously established by the Nebraska-Kansas Project Office at study site 6 (DJ&A, 1998; Sutton, 1998). DJ&A, P.C. was also contracted by the TSC to repeat the surveys for a total of the 38 habitat transects at study sites 9BE, 9BW, and 8B in May and June of 2000; sites 2 and 12a in October 2000; and sites 4A and 8C in October 2001 (Sutton, 2002a,b,c) (Table 3.3).

The TSC attempted to locate original transect headpins installed in the 1983-1988 surveys using the original surveyed Nebraska State Plane coordinates in NAD27 and a Global Position System (GPS) instrument. At least one of the original headpins was found at 42 of 46 transects. Access to one transect (study site 4A, transect 1) was denied by the landowner. In cases where no headpin was found, DJ&A, P.C. re-set positions based on descriptions from field survey notes and horizontal coordinates of original surveys. If headpins could not be found, they were replaced as close as practical to the former surveyed coordinates with 6-foot steel posts driven to near ground level. Headpin locations were photographed. The TSC obtained GPS positions in Nebraska State Plane coordinates in the North American Datum (NAD 83) and elevations in the North American Vertical Datum (NAVD 88) for transect headpins. DJ&A, P.C. recorded ground surface and channel bed elevations along transects at intervals of about 10 ft or less, and at elevations to the nearest 0.01 ft using total station and standard survey techniques. In general, the surveying accuracy on ground shots of sandy riverbeds is limited to 0.1 ft.

3.4 1998 & 2002 Cross-section Surveys by DJ&A, P.C.

DJ&A, P.C. was contracted by Reclamation in 1998 and again in 2002 to survey multiple cross sections, and one habitat site (Section 3.3). In October and November of 1998, DJ&A, P.C. conducted field surveys along the Platte River to develop 42 repeat hydrographic river cross sections and transects between North Platte and Grand Island, Nebraska (DJ&A, 1998). Using field notes from surveys performed in 1984 and 1989, DJ&A, P.C. attempted to locate headpins on each bank of the 42 sites. At 31 sites, at least one of the original headpins was recovered. In cases where no headpin was found, DJ&A, P.C. re-set positions based on descriptions from field survey notes and horizontal coordinates from previous surveys, where available. In March of 2002, DJ&A, P.C. performed additional field surveys at 30 sites between Lexington and Gibbon using the same procedures as followed in 1998 to locate or re-set previously established headpins

(DJ&A, P.C., 2002). At 20 of these sites, at least one of the original headpins was recovered.

Nebraska State Plane Coordinates were established for each of the headpins through the use of National Geodetic Survey (NGS) High Accuracy Reference Network (HARN) stations and first-order stations within the project vicinity. GPS equipment was used to incorporate NGS horizontal stations and NGS first- and second-order vertical stations into the project control network.

Cross-sectional surveys were performed across the line between the recovered or re-set headpins at each site using a total station that contained an on-board data collector. Horizontal coordinates were referenced to NAD83, and vertical coordinates were referenced to NAVD88.

3.5 2005 Habitat Site Surveys by Eisenbraun and Associates, Inc.

Eisenbraun and Associates, Inc. were contracted by Reclamation in 2005 to resurvey several habitat transects (Eisenbraun and Associates, Inc., 2005). The purpose of this survey was to measure the elevation of sand bars after a recent high flow event on the Platte River. Six habitat sites were selected for repeat surveys. Two transects were surveyed at each selected site, totaling 12 transects.

Nebraska State Plane coordinates in NAD83 and elevations in NAVD88 were previously established during surveys conducted between 1998 and 2002 for the headpins at each of the selected sites. Twenty-one out of 24 previously established headpins were found. The locations of two headpins along the right bank of Habitat Site 6 appeared to have been graded, and the headpins were likely destroyed. Two newly established headpins on the right bank of Habitat Site 6 were placed as closely as possible to the previous locations. The location of a single headpin along the right bank of site 8B was underwater at the time of the survey, due to an apparent bank failure. A new headpin was established above the current high bank. All headpins were tied into the control network using kinematic GPS procedures (a minimum of 3-minute observations).

Due to sufficient satellite coverage, the use of a total station was not necessary for any portion of the surveys. Kinematic GPS survey methods were used on all headpins. Real time kinematic methodologies were used for the cross-sectional surveys between the headpins for each selected location.

4.0 Vertical Transformations of Data

4.1 Vertical Adjustments to 1985 and 1989 Repeat Surveys

Data collected during the 1985 and 1989 surveys were referenced to NGVD29, and all surveys performed between 1998 and 2005 were referenced to the NAVD88. In order to compare the 1985 and 1989 surveys with surveys performed between 1998 and 2005, a vertical adjustment was conducted. At each repeat survey site, a single vertical adjustment was applied to all data points in the 1985 transect or 1989 cross section based on the difference in elevation of the control points between the original survey and the more recent survey. In several instances, neither control point was recovered, but overlaying the cross sections and comparing common channel features that remained the same between the surveys suggested that the repeat survey was located at the same site as the original survey. For cross sections with no located headpins, these channel features (e.g. top of bank, vegetated island) were also used as indicators of the vertical adjustment. In some cases, the vertical adjustment of the nearest upstream or downstream cross section was applied. Vertical adjustment values varied up to a maximum of 1.55 ft (Figure 4.1).

An alternative method to determine the appropriate vertical adjustment is to use a datum transformation model, like VERTCON 2.0 (Milbert, 1999), that corrects for differences between NGVD29 and NAVD88 due to the removal of distortions in the level data and to physical differences in the height systems (Mulcare, 1999). However, this type of program cannot provide the vertical control accuracy of geodetic leveling and does not account for any local errors associated with the earlier 1985 or 1989 surveys. Consequently, the use of actual measured differences in the elevations of the headpins was selected to establish the vertical transformations at each survey location.

4.2 Vertical Adjustments to the 1989 Non-repeat Surveys

While the primary purpose of this report is to evaluate trends in sediment transport along the Central Platte River, a secondary objective is to present all cross sections surveyed by Reclamation in 1989 (Section 3.2). Many of these cross sections were not selected for repeat surveys and did not have established Nebraska State Plane horizontal control. When initially surveyed, the starting headpin of the cross section was assigned a horizontal value of 0+00. A subsequent ground survey established vertical control tied to NGVD29 but not the horizontal control. As a result of the originally established control, a vertical adjustment between NGVD29 and NAVD88 could not be determined using

VERTCON 2.0 with high accuracy due to the lack of horizontal coordinates of the control points. Although horizontal coordinates were unknown for the non-repeat survey sites, the approximate river mile of each survey site was established. Thus, a more suitable approach to calculate a vertical adjustment at each of these sites was through the use of a regression equation, in which the vertical adjustment was a function of river mile.

To develop this equation, it was first necessary to evaluate the anticipated trend (linear, power, polynomial, etc.) of the vertical adjustment with increasing river mile. For the repeat cross sections where horizontal control had been established, the datum transformation model VERTCON 2.0 was used to calculate the vertical adjustment. An examination of various trend lines through these data points indicated that a polynomial regression equation provided the best fit (Figure 4.1). Consequently, a second order polynomial regression equation based on the measured vertical adjustments of the repeat cross sections was developed and applied to those sites that were not selected for repeat surveys. Two outlier vertical adjustment points were removed from the development of the regression equation.

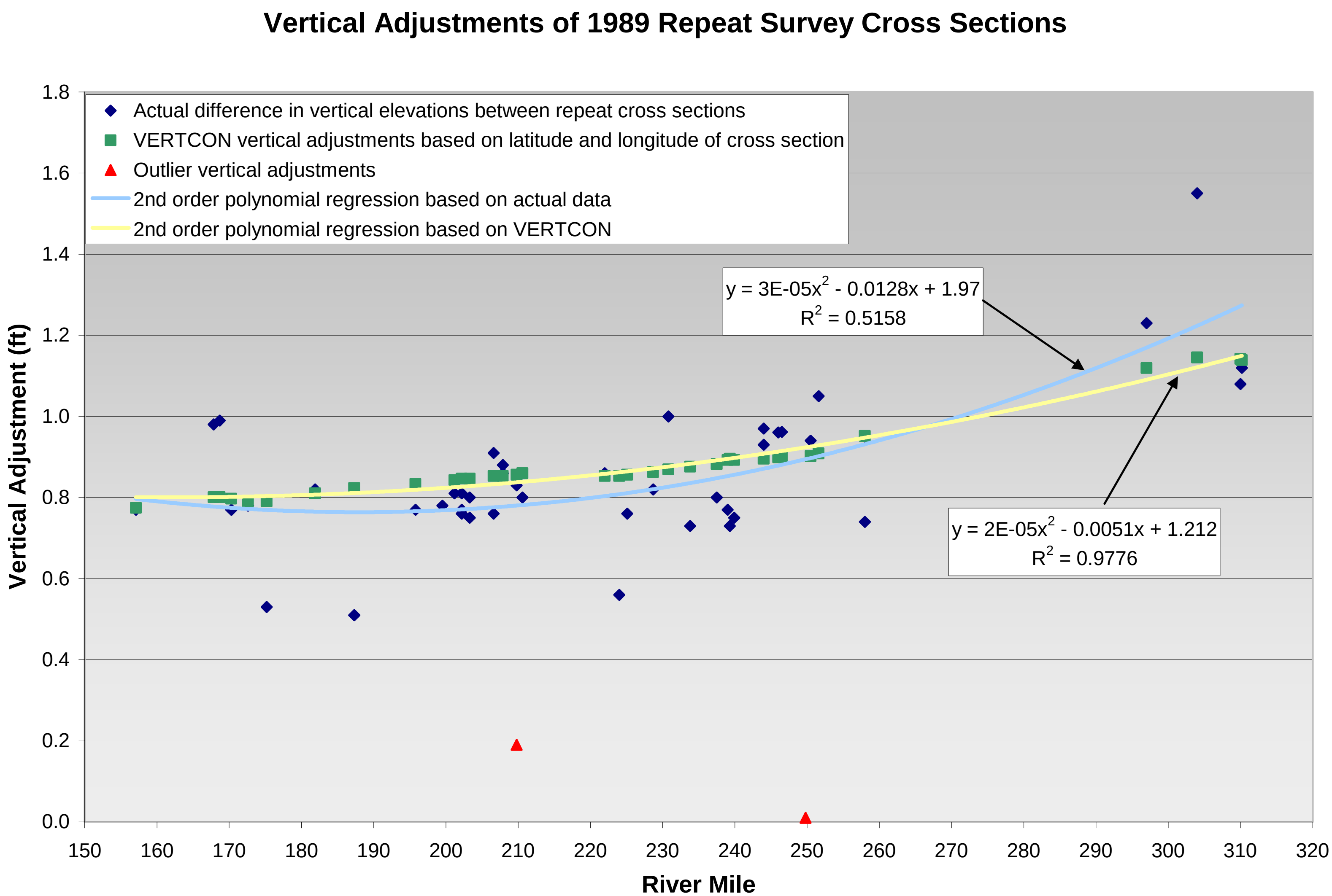


Figure 4.1. Data and regression equations used in the determination of vertical adjustments for all1989 surveys that were not selected for repeat measurements.

5.0 Development of Plots of Repeat Cross Sections and Habitat Transects

Following the determination of the vertical adjustments of all cross sections and transects, plots were developed to compare surveys from 1985 and 1989 with the repeat surveys. The plots are presented in Appendix A.

Repeat survey sites were not considered for analysis of aggradation and degradation if the repeat cross section or transect appeared to be at a skewed angle or at a different location than the original site (e.g. Figure 5.1). At several locations, overlaying repeat surveys indicated bank erosion. At sites where aerial photography verified the bank erosion, the surveys were retained for analysis of aggradation and degradation. The ground photo in Figure 5.2 illustrates a site where bank erosion was apparent.

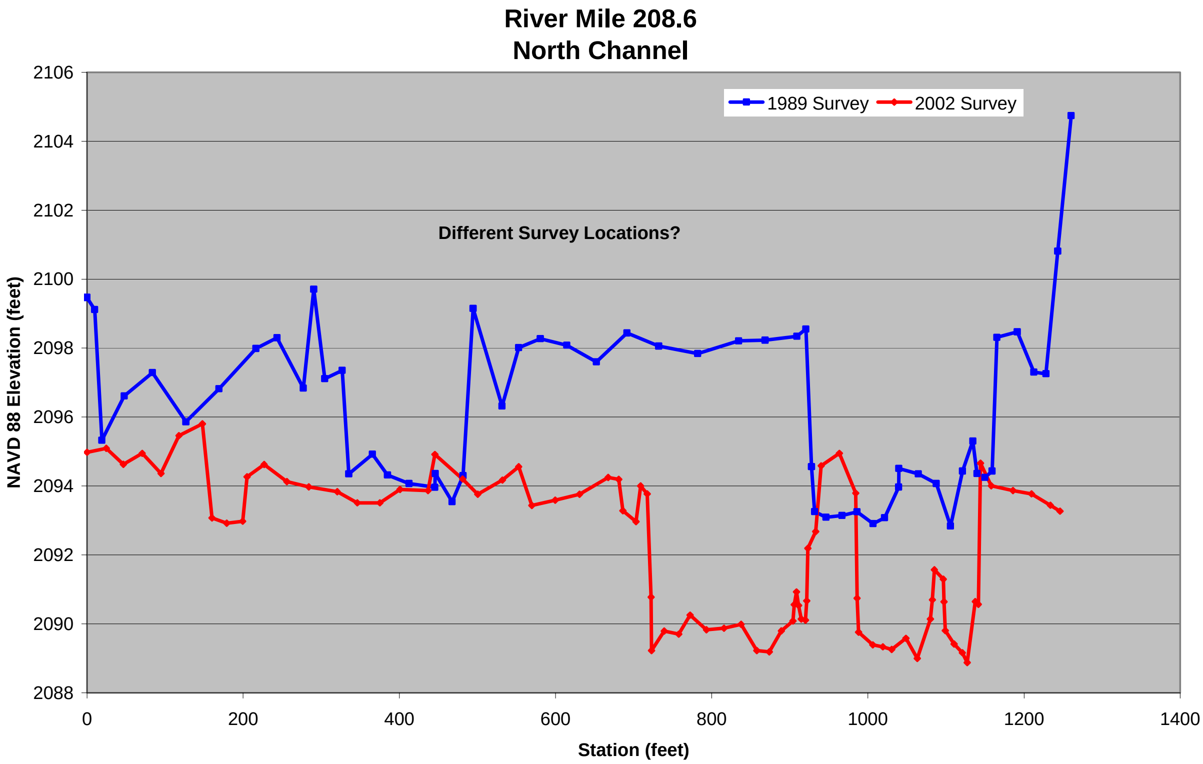


Figure 5.1. Example of a repeat cross section that was not considered for analysis due to either a skewed angle or possible different location than the original survey.

Figure 5.2. Photograph demonstrating occurrences of bank erosion.

Minor adjustments were made to the 1989 surveys to remove survey points that did not indicate the ground surface, including reference features such as fences and water surface elevations. Removal of these points from the cross section is noted in the plot. All surveys were plotted from left bank to right bank, looking downstream. Original survey data for all 1989 surveys (including non-repeats) and for all other surveys included in this report are provided in electronic format in Appendices D and E.

Repeat survey sites were located along the Central Platte River between North Platte and Chapman, Nebraska and were categorized into the following reaches (Table 3.1):

1. Downstream of North Platte - This reach includes repeat cross sections from RM 310.2 to 297.0. This segment does not contain any bridge segments or habitat transects and is located along the main channel.
2. Near Lexington - This classification applies to repeat cross sections that lie between RM 258.0 and 244.0. The reach follows the main channel until the division of flow at Jeffreys Island. At this point, the reach follows the North Channel to RM 244.0. Two bridge cross sections at RM 258.0 and 251.6 are included.
3. Habitat Reach - The habitat reach begins along the south channel of Jeffreys Island, just downstream of the Johnson-2 irrigation return, at RM 246.5 and ends near Chapman, Nebraska, at RM 157.10. Due to the

abundance of data from multiple sources and the presence of island reaches where the river branched into side channels, further categorization of the reach was necessary. Each category is exclusive.

a. *Main Channel* - The main channel is comprised of repeat cross sections originally surveyed in 1989 or repeat habitat transects originally surveyed in July 1985, and follows the path of the majority of flow.
b. *Bridge Sites on Main Channel* - All repeat cross sections located at bridges within the main channel of the habitat reach are included this category. This category does not include bridges on side channel 1 or side channel 2.
c. *2005 Surveys* - This category includes transects at several habitat sites that were surveyed in September and October 2005 (Eisenbraun and Associates, Inc., 2005).
d. *Side Channel 1* - Just downstream of Kearney, at approximate RM 211.5, flow is divided into a north and a south channel, with the south channel carrying the majority of flows. Side channel 1 is comprised of all repeat cross sections along the north channel, including 3 bridge segments at RMs 209.8, 207.9, and 202.2. Flows merge back together at approximate RM 199.5.
e. *Side Channel 2* - This side channel follows a north channel just upstream of Grand Island and only contains two repeat cross sections, 168.7 and 170.3.

6.0 Calculations of Aggradation and Degradation

Temporal changes in cross-sectional areas were computed and recorded for each repeat cross section and transect (Tables 6.1 through 6.7). An annual average change in cross-sectional area was calculated for each site based on the total change in the cross-sectional area divided by the number of years between the surveys. Positive annual changes in cross-sectional area greater than 10 square-feet (ft^2) in main reaches, or greater than 5 ft^2 in side channels, are labeled aggradation. Negative annual changes in cross-sectional area greater than 10 ft^2 in main reaches, or greater than 5 ft^2 in side channels, are labeled degradation. Annual changes of plus or minus 10 ft^2 or less in main reaches, or 5 ft^2 or less in side channels, are assumed to be relatively stable channel. A value of 5 ft^2 was used to differentiate between labels for side channels because they generally have smaller widths than main reaches and therefore may not demonstrate as great a value in the annual change in cross-sectional area as main reaches.

The values of 10 ft^2 and 5 ft^2 used to distinguish a segment as aggradational, degradational, or stable represent an average change over the last two decades (Section 8.1.4). However, the cross-sectional area of a river in dynamic equilibrium may actually fluctuate much greater than 10 ft^2 within a single year and maintain stability. Over the long-term, the average annual change in cross-sectional area of a river in dynamic equilibrium is not expected to aggrade or degrade considerably.

While the focus of the investigation is the main channel of the habitat reach, calculations of aggradation and degradation were completed for all reaches as designated in Section 5.0. The subsequent sections demonstrate the results of these computations.

6.1 Downstream of North Platte

Table 6.1. Calculated changes in cross-sectional areas for the reach Downstream of North Platte. Stable = + or – 10 ft^2/yr or less.

File Name	River Mile	Date of Survey 1	Date of Survey 2	# of Years Between Surveys	Change in Cross-sectional Area (ft^2)	Annual Average Change in Cross-sectional Area (ft^2/year)	Controlling Geomorphic Process
310_2	310.20	10/26/89	10/9/98	8.96	1,075	120	Aggradation
310_0	310.00	10/26/89	10/9/98	8.96	1,083	121	Aggradation
304_0	304.00	10/25/89	10/9/98	8.96	-94	-10	Stable
297_0	297.00	10/25/89	10/9/98	8.96	661	74	Aggradation

6.2 Near Lexington

Table 6.2. Calculated changes in cross-sectional areas for the reach Near Lexington. Stable = + or - 10 ft^2/yr or less.

File Name	River Mile	Date of Survey 1	Date of Survey 2	# of Years Between Surveys	Change in Cross-sectional Area (ft^2)	Annual Average Change in Cross-sectional Area (ft^2/year)	Controlling Geomorphic Process
258_0N	258.00	10/15/89	10/10/98	8.99	-77	-9	Stable
251_6	251.60	10/12/89	10/10/98	9.00	926	103	Aggradation
250_5	250.50	10/14/89	10/10/98	8.99	13	1	Stable
250_5	250.50	10/14/89	3/13/02	12.42	228	18	Aggradation
249_8	249.80	10/15/89	3/24/02	12.45	58	5	Stable
244_0N	244.00	10/19/89	3/23/02	12.43	-1,997	-161	Degradation

6.3 Habitat Reach

6.3.1 Main Channel

Table 6.3. Calculated changes in cross-sectional areas for the main channel of the Habitat Reach. Stable = + or – 10 ft^2/yr or less.

File Name	River Mile	Date of Survey 1	Date of Survey 2	# of Years Between Surveys	Change in Cross-sectional Area (ft^2)	Annual Average Change in Cross-sectional Area (ft^2/year)	Controlling Geomorphic Process
246_5S	246.50	10/22/89	3/24/02	12.43	-2,254	-181	Degradation
246_0S	246.00	10/18/89	3/24/02	12.44	-1,607	-129	Degradation
244_0S	244.00	10/23/89	3/23/02	12.42	-953	-77	Degradation
2-TR8	244.00	7/22/85	10/18/00	15.25	-1,299	-85	Degradation
2-TR7	243.90	7/22/85	10/18/00	15.25	-1,032	-68	Degradation
2-TR3	243.30	7/22/85	10/18/00	15.25	-1,240	-81	Degradation
2-TR2	243.25	7/22/85	10/18/00	15.25	-1,321	-87	Degradation
2-TR1	243.10	7/22/85	10/18/00	15.25	-1,007	-66	Degradation
239_9	240.10	10/14/89	3/23/02	12.45	-847	-68	Degradation
239_0	239.00	10/13/89	3/22/02	12.45	-892	-72	Degradation
237_5	237.50	10/22/89	11/18/98	9.08	814	90	Aggradation
237_5	237.50	10/22/89	3/21/02	12.42	-249	-20	Degradation
233_8	233.80	10/21/89	11/18/98	9.08	-46	-5	Stable
233_8	233.80	10/21/89	3/20/02	12.42	-131	-11	Degradation
228_7	228.70	10/5/89	3/19/02	12.46	-687	-55	Degradation
4A-TR4	227.40	7/8/85	10/26/01	16.31	-567	-35	Degradation
225_1N	225.10	10/4/89	3/18/02	12.46	-107	-9	Stable
210_6S	210.60	9/28/89	3/16/02	12.47	131	10	Stable
6-TR9	207.20	7/17/85	10/7/98	13.23	-270	-20	Degradation
6-TR8	207.00	7/17/85	10/7/98	13.23	-295	-22	Degradation
6-TR7	206.80	7/17/85	10/7/98	13.23	-197	-15	Degradation

File Name	River Mile	Date of Survey 1	Date of Survey 2	# of Years Between Surveys	Change in Cross-sectional Area (ft^2)	Annual Average Change in Cross-sectional Area (ft^2/year)	Controlling Geomorphic Process
206_6S	206.60	9/27/89	3/15/02	12.47	352	28	Aggradation
6-TR6	206.60	7/17/85	10/6/98	13.23	86	7	Stable
6-TR5	206.50	7/17/85	10/6/98	13.23	-206	-16	Degradation
6-TR4	206.40	7/17/85	10/6/98	13.23	-371	-28	Degradation
6-TR3	206.20	7/17/85	10/6/98	13.23	-374	-28	Degradation
6-TR2	206.00	7/17/85	10/6/98	13.23	-171	-13	Degradation
6-TR1	205.90	7/17/85	10/6/98	13.23	-584	-44	Degradation
203_3S	203.30	9/29/89	3/14/02	12.46	-353	-28	Degradation
199_5	199.50	9/30/89	3/14/02	12.46	1,164	93	Aggradation
8C-TR4	196.60	7/19/85	10/25/01	16.28	-99	-6	Stable
8C-TR3	196.50	7/19/85	10/25/01	16.28	-248	-15	Degradation
8C-TR2	196.40	7/19/85	10/25/01	16.28	-11	-1	Stable
8C-TR1	196.30	7/19/85	10/25/01	16.28	-203	-12	Degradation
8B-TR4	191.20	7/12/85	6/1/00	14.90	-75	-5	Stable
8B-TR1	190.90	7/12/85	6/1/00	14.90	38	3	Stable
9BW-TR5	178.38	7/10/85	6/2/00	14.91	125	8	Stable
9BW-TR4	178.32	7/10/85	6/2/00	14.91	13	1	Stable
9BW-TR3	178.27	7/10/85	6/2/00	14.91	-1	0	Stable
9BW-TR2	178.23	7/10/85	6/2/00	14.91	69	5	Stable
9BW-TR1	178.18	7/10/85	6/2/00	14.91	264	18	Aggradation
9BE-TR7	177.40	7/11/85	5/31/01	15.90	-8	-1	Stable
9BE-TR5	177.30	7/11/85	5/31/01	15.90	-165	-10	Stable
9BE-TR4	177.25	7/11/85	5/31/01	15.90	215	14	Aggradation
9BE-TR3	177.20	7/11/85	5/31/01	15.90	8	0	Stable
9BE-TR2	177.15	7/11/85	5/31/01	15.90	164	10	Stable
9BE-TR1	177.10	7/11/85	5/31/01	15.90	3	0	Stable
172_6S	172.60	8/29/89	10/12/98	9.13	-93	-10	Stable
12A-TR3	159.00	7/16/85	10/20/00	15.27	178	12	Aggradation
12A-TR2	158.70	7/16/85	10/20/00	15.27	-344	-23	Degradation
12A-TR1	158.55	7/16/85	10/20/00	15.27	248	16	Aggradation

Additional analyses were performed to examine the sensitivity of the results to changes to the vertical adjustments for the main channel of the Habitat Reach. Analyses were performed on the vertical adjustments to calculate potential limits of aggradation and degradation for determining the sensitivity of the average annual change in cross-sectional area to the vertical adjustment. To represent a maximum and minimum degradation value at each cross section and transect in the main channel of the Habitat Reach, the vertical adjustment was modified by adding and subtracting ten percent of its original value, resulting in two new cross-sectional areas (Figure 6.1). Values of plus or minus ten percent of the original vertical adjustment were selected to represent the most expected range of error in the vertical transformation. Small changes in the vertical adjustment resulted in substantial differences in the average annual change in cross-sectional area. Although these modifications to the vertical adjustments altered the average annual change in the cross-sectional area at each site, they did not confuse general trends in degradation or aggradation from upstream to downstream.

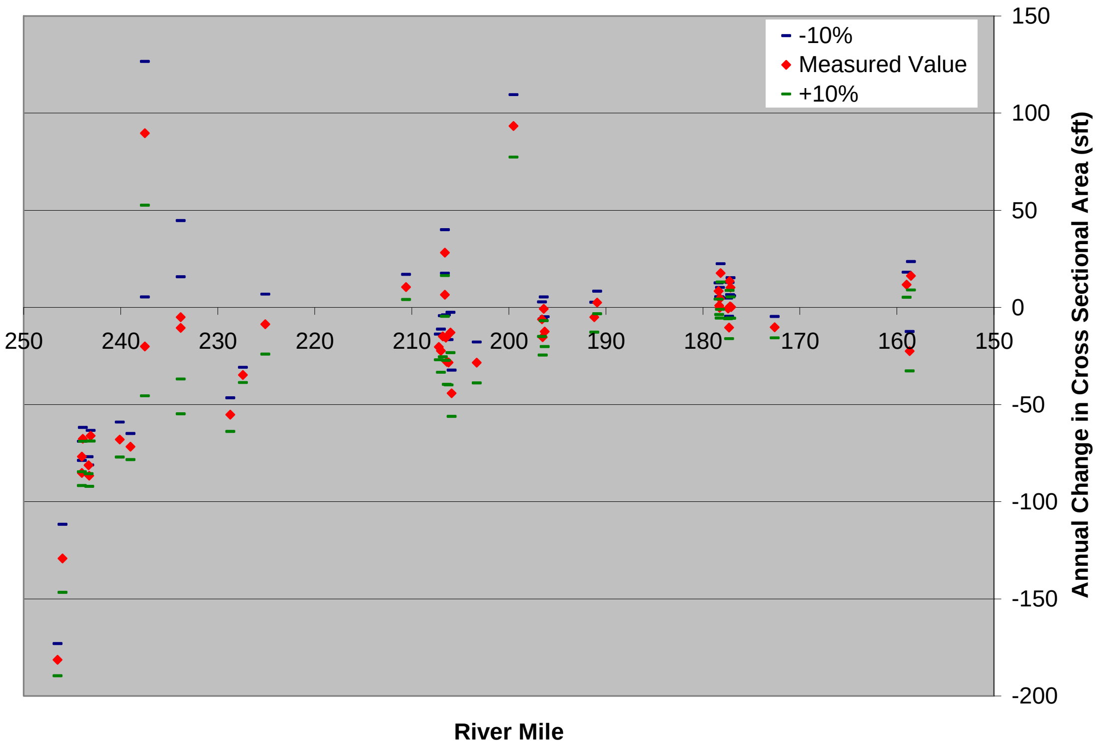


Figure 6.1. Average annual change in cross-sectional area on main channel. Red points indicate change in cross-sectional area calculated using measured vertical transformations. Green and blue bars are calculated changes in cross-sectional area following a 10% increase and decrease in the value of the vertical transformation, respectively.

6.3.2 Bridge Sites on Main Channel

Table 6.4. Calculated changes in cross-sectional areas for bridge sites on the main channel of the habitat reach. Stable = + or – 10 ft^2/yr or less.

File Name	River Mile	Date of Survey 1	Date of Survey 2	# of Years Between Surveys	Change in Cross-sectional Area (ft^2)	Annual Average Change in Cross-sectional Area (ft^2/year)	Controlling Geomorphic Process
239_3	239.30	10/13/89	10/8/98	8.99	-15	-2	Stable
239_3	239.30	10/13/89	3/22/02	12.45	-319	-26	Degradation
230_8	230.80	10/5/89	10/8/98	9.01	-309	-34	Degradation
230_8	230.80	10/5/89	3/19/02	12.46	-362	-29	Degradation
224_0	224.00	10/4/89	10/8/98	9.02	295	33	Aggradation
209_8S	209.80	9/27/89	10/11/98	9.04	200	22	Aggradation
207_9S	207.90	9/27/89	10/7/98	9.03	170	19	Aggradation
202_2M 202_2S	202.20	9/29/89	10/11/98	9.04	-301	-33	Degradation
195_8	195.80	9/22/89	10/11/98	9.06	554	61	Aggradation
187_3S	187.30	9/15/89	10/12/98	9.08	74	8	Stable
181_9S	181.90	9/17/89	10/12/98	9.07	-943	-104	Degradation
175_2S	175.20	9/1/89	10/13/98	9.12	190	21	Aggradation
167_85	167.85	9/16/89	10/13/98	9.08	183	20	Aggradation
157_1	157.10	8/14/89	10/13/98	9.17	-235	-26	Degradation

6.3.3 2005 Surveys

Table 6.5. Calculated changes in cross-sectional areas for 2005 Surveys of the habitat reach. Stable = + or – 10 ft^2/yr or less.

File Name	River Mile	Date of Survey 1	Date of Survey 2	# of Years Between Surveys	Change in Cross-sectional Area (ft^2)	Annual Average Change in Cross-sectional Area (ft^2/year)	Controlling Geomorphic Process
4A-TR3	227.40	10/26/01	9/28/05	3.93	89	23	Aggradation
4A-TR2	227.25	10/26/01	9/28/05	3.93	111	28	Aggradation
6-TR4	206.40	10/6/98	9/27/05	6.98	279	40	Aggradation
6-TR3	206.20	10/6/98	9/27/05	6.98	411	59	Aggradation
8B-TR3	191.10	6/1/00	9/27/05	5.33	110	21	Aggradation
8B-TR2	191.00	6/1/00	9/27/05	5.33	-47	-9	Stable
9BW-TR4	178.32	6/2/00	9/26/05	5.32	70	13	Aggradation
9BW-TR2	178.23	6/2/00	9/26/05	5.32	48	9	Stable
9BE-TR7	177.40	5/31/00	9/23/05	5.32	-9	-2	Stable
9BE-TR2	177.15	5/31/00	9/23/05	5.32	58	11	Aggradation
12A-TR2	158.70	10/20/00	9/29/05	4.95	362	73	Aggradation
12A-TR1	158.55	10/20/00	9/29/05	4.95	158	32	Aggradation

6.3.4 Side Channel 1

Table 6.6. Calculated changes in cross-sectional areas for side channel 1 of the habitat reach. Stable = + or – 10 ft^2/yr or less.

File Name	River Mile	Date of Survey 1	Date of Survey 2	# of Years Between Surveys	Change in Cross-sectional Area (ft^2)	Annual Average Change in Cross-sectional Area (ft^2/year)	Controlling Geomorphic Process
209_8N	209.80	9/27/89	11/18/98	9.15	115	13	Aggradation
207_9N	207.90	9/27/89	10/7/98	9.03	53	6	Aggradation
206_6N	206.60	9/27/89	3/15/02	12.47	96	8	Aggradation
203_3N	203.30	9/30/89	3/14/02	12.46	-192	-15	Degradation
202_2N	202.20	9/29/89	10/10/98	9.04	-62	-7	Degradation
201_2N	201.20	9/30/89	10/11/98	9.04	84	9	Aggradation

6.3.5 Side Channel 2

Table 6.7. Calculated changes in cross-sectional areas for side channel 2 of the habitat reach. Stable = + or – 10 ft^2/yr or less.

File Name	River Mile	Date of Survey 1	Date of Survey 2	# of Years Between Surveys	Change in Cross-sectional Area (ft^2)	Annual Average Change in Cross-sectional Area (ft^2/year)	Controlling Geomorphic Process
170_3N	170.30	9/13/89	10/12/98	9.08	50	5	Stable
168_7N	168.70	9/1/89	10/12/98	9.12	370	41	Aggradation

7.0 Trends of Aggradation and Degradation

Changes in average annual cross-sectional area presented in Section 6.0 were used to note trends in sediment transport. The data were examined by the reach categories presented in Section 5.0. Generally aggrading, degrading and stable reaches were identified based on the field data. Following identification of the trend for each reach, an interpretation of the geomorphic processes reflected by the data was developed. A summary of the trends of aggradation and degradation is presented in Table 7.1. The general trend indicates the overall pattern identified in the river segment, while the localized trend indicates patterns identified in the segment that differed from the general trend and were limited to one or two cross sections. For example, most cross sections within the Near Lexington reach demonstrate a general trend of stability. However, the last segment of the reach shows degradation, which is presumably caused by localized conditions.

Table 7.1. Summary of trends of aggradation and degradation along the Central Platte River

Reach	Sub-Reach	River Mile	General Trend	Localized Trend
Downstream of North Platte		310 to 297	Aggradation	Stable
Near Lexington		258 to 244	Stable	Degradation & Aggradation
Habitat Reach	**Main Channel**	**247 to 225**	**Degradation**	
		225 to 211	***No Data***	
		211 to 195	**Aggradation & Degradation**	Stable
		195 to 157	**Stable**	
	Bridge Sites on Main Channel	239 to 157	*Consistent with main channel data*	
	2005 Survey	227 to 158	Aggradation	Stable
	Side Channel 1	210 to 201	Aggradation	Degradation
	Side Channel 2	170 to 169	Aggradation/Stable	

The principal objective of this study was to evaluate long-term geomorphic trends. However, short-term analyses may result in different conclusions. Previous analyses comparing habitat transects surveyed between 1983 and 1988 were completed by Carlson (2006) and Simons and Associates, Inc. (2000). Carlson examined changes in cross-sectional areas and mean bed elevations for each habitat site, while Simons and Associates, Inc. investigated changes in mean bed elevations. Both studies identified little change in the respective metrics when averaged across each habitat site. Based on individual transects, however, the differences in the cross-sectional area and mean bed elevation between the repeat measurements were substantial. Numerous factors contribute to the differences in the individual transects measured between the 1983 and 1988 surveys, but these factors can not be distinguished without further investigation of the short-term analyses. The long-term approach, as presented in this study, is intended to represent continuing patterns of aggradation and degradation observed over the last two decades and does not reflect short-term fluctuations in each cross section and transect.

7.1 Downstream of North Platte

Trend: This reach is predominantly aggrading with 3 of 4 cross-section sites showing positive changes in cross-sectional area (Table 6.1).

Interpretation: This trend is at least partially due to the presence of the Central Diversion at the upstream end of the North Platte Reach. The Tri-County Supply Canal diverts approximately half the mean annual flow from the river at this location. Backwater and eddies created by the diversion causes general deposition of sediment upstream of the diversion dam. Boyd (1995) reported that a hydraulic dredge is used to transfer approximately 100,000 tons of sand annually to immediately downstream of the diversion dam. However, aerial photos indicate that not all the transferred sediment deposits have been conveyed downstream and that deposition of the remaining sediment occurs immediately downstream of the structure. This suggests a sufficient or possibly excess supply of sediment into the reach downstream of North Platte under the current flow regime. Repeat cross-section data demonstrate that an excess of sediment is depositing at locations downstream of the diversion (Table 6.1).

7.2 Near Lexington

Trend: The Near Lexington reach is primarily stable with the exception of one aggrading segment at RM 251.6 and one pronounced degrading segment at RM 244.

Interpretation: Trends between RM 297 and 258 are unknown due to gaps in available data. However, in the Near Lexington reach, between RM 258 and 244, no shortage of sediment is apparent. The data indicate that this river reach is generally stable with the sediment transport in equilibrium with the existing flow regime. Local conditions at RM 251.8 demonstrate the only notable aggradation in the reach (Table 6.2).

In marked contrast, considerable degradation is noted at RM 244, located in the downstream end of the Near Lexington reach. One hypothesis for this extreme difference is that this section reflects a head cut advancing upstream from the confluence downstream of Jeffreys Island, caused by the Johnson-2 Return and the Jeffreys Diversion Dike upstream of the Return. Degradation of approximately 2 ft near Overton may be driving upstream erosion in the north channel of Jeffreys Island, causing the channel bed in the Near Lexington reach to become a future source of sediment for the downstream habitat area. Additional cross-section surveys and studies are needed to support or refute this hypothesis.

7.3 Habitat Reach

Data from the main channel of the Habitat Reach are presented in Figure 7.1 to demonstrate trends in the annual average change in cross-sectional area. Trends and interpretations for the Habitat Reach rely primarily on the main channel data (Table 6.3.1). However, data from the bridge sites and 2005 surveys were also considered, especially in areas where main channel data were limited (Figure 7.2). Limitations and benefits of data from bridge sites on main channel and 2005 surveys are described in individual sections. Side channels 1 and 2 are also presented separately since these channels are expected to have different localized trends than the main channel.

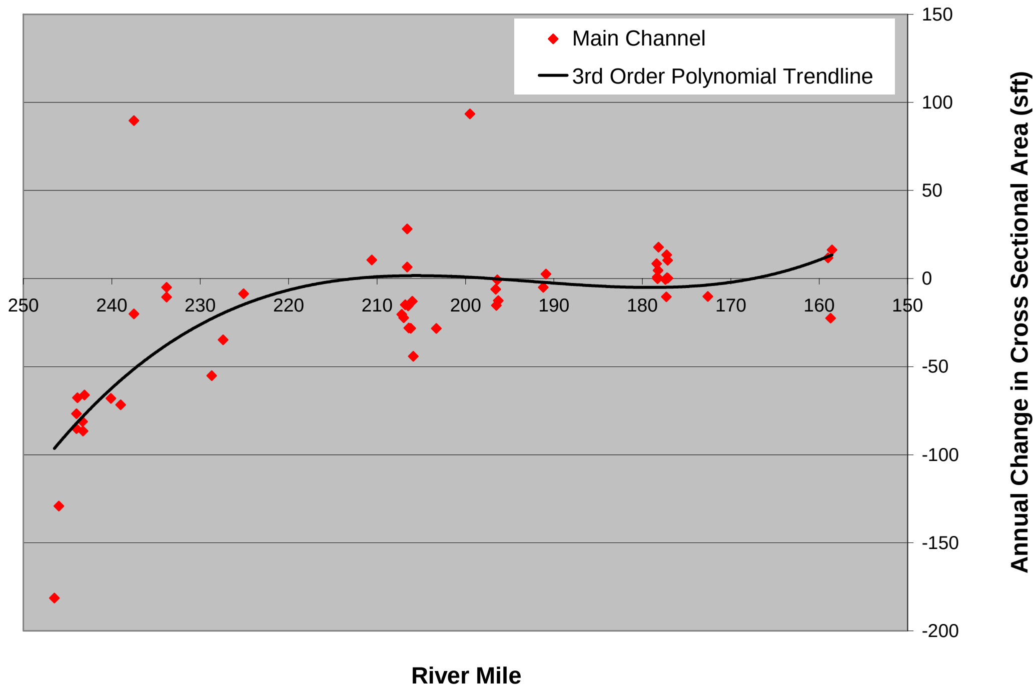


Figure 7.1. Average annual change in cross-sectional area of points along the main channel of the Habitat Reach. A 3rd order polynomial trendline was fit to the data.

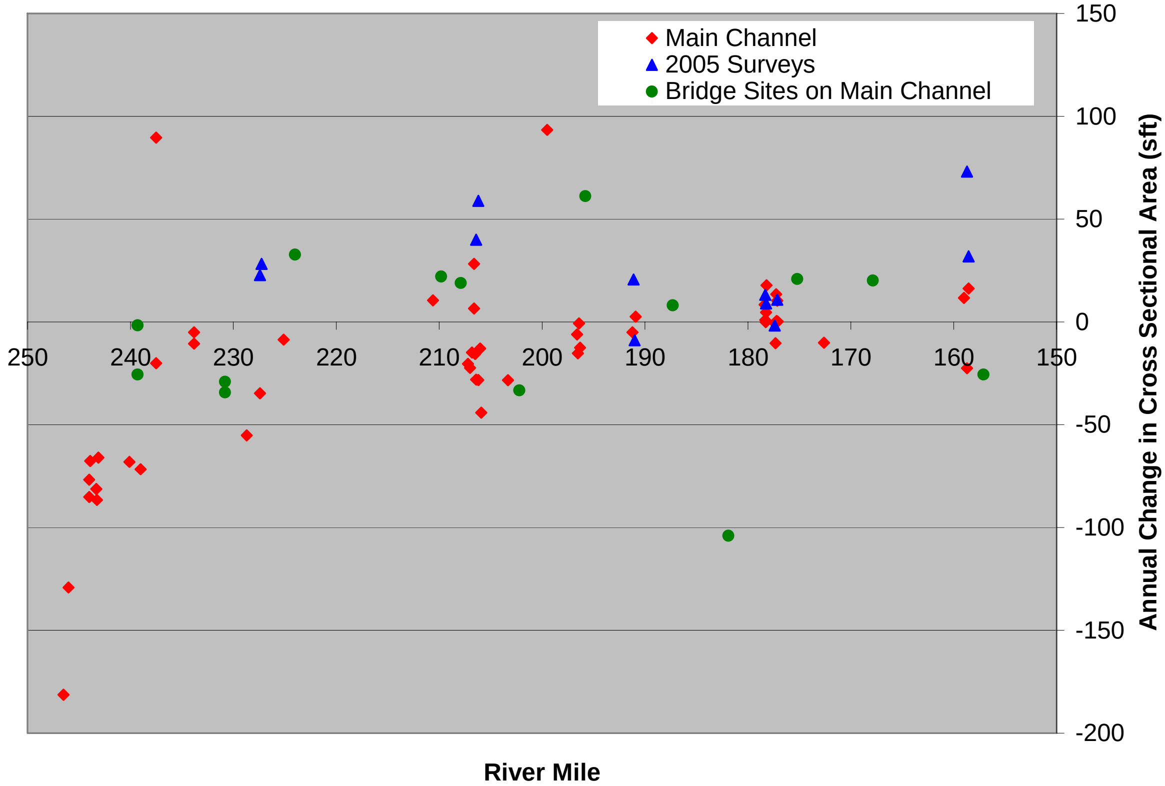


Figure 7.2. Average annual change in cross-sectional area for the main channel, bridge sites on main channel, and 2005 surveys.

7.3.1 Main Channel

The main channel of the Habitat Reach encompasses approximately 90 RMs. Descriptions of noted trends and their interpretations are presented by river segments that were partitioned according to identified trends.

River Mile 247 to River Mile 225

Trend: From RM 247 to 225, there is clear trend of degradation. The most pronounced degradation occurs at the upstream end, and degradation diminishes with downstream distance from RM 247. At RM 225.1, the difference in the average annual change in cross-sectional area is less than 10 ft^2, therefore, was assigned a stable designation. The one notable irregularity in this pattern is substantial aggradation at RM 237.5, as measured from the 1998 surveys results. In contrast, results of the 2002 repeat survey at RM 237.5 indicate that degradation occurred between 1989 and 2002.

Interpretation: Clear water discharge from the Johnson-2 Return at RM 247 is very erosive as it enters the south channel of Jeffreys Island. The sediment imbalance is eventually offset. Bed degradation diminishes as sediment is eroded from the bed and banks of the river and contributed from the north channel of Jeffreys Island and from a few small tributaries, such as Plum Creek.

The cross section at 237.5 is located at Cottonwood Ranch, where some mechanical restoration efforts have occurred in recent years. Measured aggradation may be partially due to an inability to distinguish between area changes resulting from mechanical alterations of the cross section and area changes resulting from natural flow and sediment processes.

River Mile 225 to River Mile 211

Trend: No survey data are available from RM 225 to 211. Thus, no trends could be identified.

Interpretation: This is a high priority area for future surveys.

River Mile 211 to River Mile 195

Trend: The reach from RM 211 to 195 is the most variable segment within the Habitat Reach with measured locations of degradation, stability and aggradation. Main channel data primarily show degradation with some stable and aggrading points, while data from bridge sites on main channel, 2005 surveys, side channel 1, and side channel 2 predominantly demonstrate aggrading points (Sections 7.3.2-7.3.5).

Interpretation: The distance from RM 211 to 195 is influenced by more than one dominant process. Further investigation of localized conditions, such as topography and manmade structures including local flow returns, is needed to sort out trends in sediment transport in this area. At this time, a section of degrading river (RM 206 to 202) appears to be bordered by two sections of aggrading river.

River Mile 195 to River Mile 158

Trend: Between RM 195 and 158, the river is stable with only an occasional instance of aggradation or degradation.

Interpretation: By RM 195 and throughout this section of river, survey data indicate a balance in sediment transport with the existing channel topography. Available data do not reflect any pronounced localized conditions. However, the availability and locations of the data points also need to be considered. Within this segment, survey data are primarily from habitat transects with gaps of approximately 5 miles in which no repeat surveys occurred. Transect sites were also selected at wider locations of the river for habitat studies and may be contributing a bias to the data (Section 8.0). In addition to the Near Lexington reach and the Habitat Reach between RM 225 and 211, this is a third area that is assigned priority for additional cross-section surveys.

7.3.2 Bridge Sites on Main Channel

Trend: Twelve of the fourteen data points in this category lie within a band of plus or minus 35 ft^2 of annual change in cross-sectional area (Figure 7.2). In the degrading segment, from RM 247 to 225, four out of five cross sections indicate degradation. In the variable segment, from RM 211 to 195, three out of four cross sections indicate aggradation. In the stable segment, from RM 195 to 158, two cross sections suggest aggradation; two cross sections suggest degradation, and one cross section suggests stability (Table 6.4).

Interpretation: Relatively stable locations along the river are normally selected for bridge sites. Once the bridge is constructed, the river banks and occasionally the bed may be restricted to protect bridge footings and abutments. These localized conditions may account for the restricted range of annual change in cross-sectional area computed at bridge sites. However, the trends appear consistent with the main channel data between RM 247 to 225, and between RM 195 and 158. Two out of three cross sections also demonstrate consistency with main channel data between RM 211 and 207, possibly indicating a localized trend of aggradation. In the downstream reach between RM 195 and 158, the bridge sites provide additional information between habitat transect sites.

7.3.3 2005 Surveys

Trend: All of the 2005 survey sites are stable or aggrading. Data from three of the habitat sites are consistent with previously measured repeat surveys, and the remaining three habitat sites show more aggradation (Table 6.5).

Interpretation: In most cases, 2005 survey data were compared with survey data from 2000 or 2001. Results from this comparison therefore represent average conditions for the 5-ear period between 2000 and 2005. Only two transects at Habitat Site 6 were compared with surveys performed in 1998. In contrast, analyses of all other surveys indicate average conditions from the period 1985/1989 to 1998/2002. The years 2001 to 2005 were particularly dry years for the Central Platte River, which theoretically can lead to aggradation. The 2005 survey data indicate that more aggradation occurred at a minimum of half the sites surveyed, than previously measured in earlier surveys.

The first high flow event since 2001 occurred previous to the survey in 2005. This localized storm event produced the highest flows downstream of Kearney. The area of highest flows coincides with the three habitat sites (8B, 9BW, and 9BE) with measurements consistent to previous surveys. High flows may have flushed excessive aggradation from these three sites, but does not appear to have impacted the furthest downstream site (12) at RM 158.

7.3.4 Side Channel 1

Trend: From RM 210 to 201, this side channel is aggrading with the exception of RMs 202 and 203, where degradation is occurring (Table 6.3.3).

Interpretation: RMs 210 to 201 coincide with the variable reach on the main channel, where both degradation and aggradation are found. Side channel 1 primarily shows aggradation with some degradation at RMs 202 and 203, which is assumed to result from localized conditions. This pattern is similar to that of the main channel.

7.3.5 Side Channel 2

Trend: At RM 170.3, the side channel is stable, and at RM 168.7, the channel is aggrading (Table 6.3.4).

Interpretation: Side channel 2 shows consistency with trends on the main channel, where the river between RM 195 and 158 is stable or aggrading.

8.0 Limitations of Study Findings and Future Directions

8.1 Study Limitations

8.1.1 Habitat Sites

All habitat sites that were selected for repeat surveys in 1998, 2000, 2001, and 2005 are presented in this report. However, these habitat sites were originally selected for repeat surveys because they were located within wide reaches of river and had the highest use by sandhill cranes. The presented habitat sites therefore represented the best habitat for the intended studies. Data from habitat sites may subsequently be biased towards more stable or aggrading conditions since degrading rivers tend to have smaller width to depth ratios and narrower widths. This concern is most relevant to the downstream reach between RM 195 and 158, where most repeat surveys originate from 4 transect sites.

8.1.2 Gaps in Repeat Cross Sections

A second limitation of this study includes the longitudinal gaps between repeat surveys at some locations. The largest gap occurs in the main channel of the Habitat Reach, from RM 225 to 211. Smaller gaps occur in the main channel downstream of RM 190. An additional critical area in need of more repeat surveys is the region upstream and downstream of RM 244 in the Near Lexington reach.

8.1.3 Bridge Data

Because of the shortage of main channel repeat cross sections between RM 195 and 158, bridge data were used in identifying and interpreting trends of aggradation and degradation. However, bridge data may be influenced by local conditions resulting from structural maintenance. For example, there is a limitation to the river widening (degradation) that can occur under a bridge.

Banks may have protection, such as riprap, crib walls or deflectors, to prevent erosion of the bridge abutments (e.g. Figure 8.1).

Figure 8.1. Example of bridge protection on the Central Platte River, Nebraska

8.1.4 Labels of Degradation, Aggradation, and Stable

Each cross section was assigned a label of degradation, aggradation, or stable based on the calculated average annual change in cross-sectional area. A river reach in dynamic equilibrium will still have varied sediment transport at the same location from year to year. Therefore, a stable condition was defined as having an average annual change in cross-sectional area within a band of +/- 10 ft^2 for main reaches and +/- 5 ft^2 for side channels. Labels of degradation, aggradation, and stable river represent broad estimates only.

Also to be considered, values used in the designation of degradation, aggradation, or stable do not reflect (1) variations in channel widths, (2) variations between cross sections, which usually include floodplains, and transects, which often exclude floodplains, and (3) variation in survey methods (e.g. number of survey points collected per section). These factors may contribute to varying degrees in accuracy for computed changes in the average annual cross-sectional area, which in turn could impact selection of a degradation, aggradation, or stable label. Values for changes in cross-sectional area are included in tables in Section 6.0 to help access the confidence in the labels.

8.1.5 River Bed Profile

Interpretation of trends in sediment transport is also limited by the lack of a detailed river bed profile for the longitudinal length of the study reach. Bed profiles showing the elevation of the river thalweg often help identify the local conditions that affect sediment transport. A bed profile based on a single data point every 100 to 500 ft could be collected through a field survey or developed from bathymetric Lidar data. A field GPS survey provides more accurate bed profile data than a bathymetric Lidar survey. However, a Lidar survey typically covers additional topography that could be used to develop more cross-sections throughout the study reach.

8.2 Recommendations for Future Research

Further data collection, including more repeat cross-sectional surveys at locations identified in the Section 8.1.2 and a longitudinal bed profile of the river, are recommended to increase understanding of sediment transport and geomorphic processes in the Central Platte River.

Numerical modeling of sediment transport through the Central Platte River was used for the development of the Platte River Recovery Implementation Program EIS (USDOI, 2006). Continuation of modeling sediment transport with at least a one-dimensional model is recommended to complement the information gained from the repeat cross sections presented in this report.

Sediment augmentation has been proposed as a method of reducing channel degradation and promoting braided channel conditions along the Central Platte River (USDOI, 2006). Current estimates of sediment inputs from tributaries are approximations and require additional studies to improve these estimated values. To more accurately estimate sediment transport, additional studies should be implemented to examine current tributary inputs of sediment and to determine a feasible means of increasing this supply. Increasing sediment supply from upstream tributaries may help to decrease degradation in the main channel reach between RM 247 and 225, and decrease the volume of sediment augmentation.

Investigation of the potential head cut process in the north channel of Jeffreys Island and its migration upstream towards Lexington is recommended. If actually occurring, this process may be a significant current and future source of sediment to the downstream habitat reach. Accurately accounting for this supply may aid calculations of the volume of sediment augmentation required to balance aggradation and degradation. A head cut through the north channel of Jeffreys Island could also have impacts on upstream habitat, depending on the depth of incision in the riverbed.

Another suggested avenue of research, that considers means of offsetting the degradation noted between RM 247 and 225, is the promotion of a head cut from the south channel of Jeffreys Island. A fraction of the incision in the south channel could be released upstream through a controlled head cut process if Platte River flows were redirected through the south channel of Jeffreys Island. This could be accomplished by replacing the Jeffreys Dike, located at the upstream end of the south channel, with a grade control structure, and placing a dike across the north channel. Impacts to upstream habitat would be an important element of this investigation.

An additional method to reduce the existing sediment imbalance in the main channel between RM 247 and 225 is to increase flows in the river between North Platte and Lexington. An increase in flows would increase the conveyance of sediment from upstream, near the city of North Platte, through the system. Currently, half of the flows passing through North Platte, Nebraska are diverted downstream by the Tri-County Supply Canal. These flows are used for irrigation and power generation before re-entering the Central Platte River as clear water flows at the Johnson-2 Return. Results of this major diversion include aggradation downstream of North Platte and degradation downstream of RM 247, at the clear water release. A portion of flows diverted to the Tri-County Supply Canal may be directed down the Platte River to counter the sediment imbalance. Further exploration of this possibility is recommended.

Development of a master plan is recommended to outline how sediment transport in the Central Platte River can be balanced under present and future conditions for the improvement of habitat. The plan could incorporate a combination of the actions presented above, and could consider adapting methods over time. A documented plan to achieve and maintain a balance in sediment transport through the Central Platte River would facilitate the development of feasible long range goals.

9.0 References

Boyd, K.M. (1995). Sand removal at a diversion dam. In *Proceedings of the International Conference on Hydropower, Water Power ’95, American Society of Civil Engineers, Reston, Virginia*, pp. 1951-1955.

Carlson, D., D. Holz, D. Woodward, and J. Ziewitz (1990). Whooping crane roosting habitat simulation model for the Platte River in Nebraska. Report to the Biology Workgroup, Platte River Management Joint Study. U.S. Fish and Wildlife Service, Grand Island, Nebraska, 22 pp+app.

Carlson, D.E. (2006). Investigations of channel morphology changes affecting Platte River habitats. Draft Report. U.S. Fish and Wildlife Service, Platte River EIS Office, Denver, Colorado.

Chen, A.H., D.L. Rus, and C.P. Stanton (1999). Trends in channel gradation in Nebraska streams, 1913-1995. Water-Resources Investigations Report 99-4103. U.S. Department of Interior, U.S. Geological Survey, Lincoln, Nebraska, 36 pp.

Colorado, Nebraska, Wyoming, and the U. S. Department of the Interior (1997). Cooperative Agreement for Platte River Research and Other Efforts Relating to Endangered Species Habitats along the Central Platte River, Nebraska. Platte River Endangered Species Partnership, Cheyenne, Wyoming, 14 pp.

Colorado Water Conservation Board (2002). South Platte /Republican River Basin Facts. March 2002. Available online at: http://cwcb.state.co.us/Fact_Sheets/Basin_Planning_pdf.htm

Currier, P.J. (1997). Woody vegetation expansion and continuing declines in open channel habitat on the Platte River in Nebraska. In *Proceedings of the Seventh North American Crane Workshop, January 10-13, 1996, Biloxi, MS,* edited by R.P. Urbanek, and D.W. Stahlecker, 141-152. Grand Island, Nebraska: North American Crane Working Group.

Druyvestein, Johnson & Anderson Consulting Engineers and Land Surveyors (DJ&A) (1998). USBR Platte River, Nebraska Study Project. Prepared for the Bureau of Reclamation, Denver, Colorado. Contract No. 1425-98-CA-60-00090, Work Order 0006. Missoula, Montana.

DJ&A, P.C. Professional Engineers and Land Surveyors (2002). Bureau of Reclamation Platte River Channel Studies, Nebraska. Prepared for the Bureau of Reclamation, Denver, Colorado. URS Contract No. 1425-97-CA-81-20003, Delivery Order 271, Modification No. 002. Missoula, Montana.

Eisenbraun and Associates, Inc. (2005). Platte River Channel Studies. Prepared for the Bureau of Reclamation, Denver, Colorado. Task Order No. 05A8601041, Contract No. 03CA601041. Yankton, South Dakota.

Eschner, T.R., R.F. Hadley, and K.C. Crowley (1983). Hydrologic and morphologic changes in channels of the Platte River basin in Colorado, Wyoming, and Nebraska: A historical perspective. U.S. Geological Survey Professional Paper 1277-A, 39 pp.

Farmer, A.H., Cade, B.S., Terrell, J.W., Henriksen, J.H., Schneider, D.M., and T.S. Fancher (2000). Evaluation of a suitability model and associated procedures utilized for assessment of Whooping Crane (Grus americana) habitat in the Platte River, Nebraska. Final report to U.S. Fish and Wildlife Service, Region 6. Contract #1448-60181-99-N292. Midcontinent Ecological Science Center, Fort Collins, Colorado, 198 pp.

Friesen, B., J. Von Loh, J. Schrott, J. Butler, D. Crawford, and M. Pucherelli (2000). Central Platte River, 1998 land cover/use mapping project, Nebraska. Technical Memorandum No. 8260-00-08. Bureau of Reclamation, U.S. Fish and Wildlife Service, Denver, Colorado.

Johnson, W.C. (1997). Equilibrium response of riparian vegetation to flow regulation in the Platte River, Nebraska. *Regulated Rivers: Research & Management*, 13, 403-415.

Leopold, L.B. and M.G. Wolman (1957). River channel patterns: braided, meandering and straight. U.S. Geological Survey, Professional Paper No. 282-B, Reston, Virginia, 85 pp.

Milbert, D.G. (1999). National Geodetic Survey (NGS) height conversion methodology. National Geodetic Survey, National Ocean and Atmospheric Administration. Available online at: http://www.ngs.noaa.gov/TOOLS/Vertcon/vert_method.html.

Mulcare, D.M. (2004). NGS toolkit, part 9: The National Geodetic Survey VERTCON tool. *Professional Surveyor*, 24(3).

Murphy, P.J., T.J. Randle, L.M. Fotherby, J.A. Daraio. (2004). The Platte River Channel: History and Restoration. U.S. Department of the Interior, Bureau of Reclamation, Denver, Colorado, 167 pp.

National Research Council (2005). Endangered and Threatened Species of the Platte River. Washington, DC: The National Academic Press.

Nebraska Department of Natural Resources (2000). Accessed April 2004. Digital orthophoto quarter quadrangles-1999. DOQQ index for the State of Nebraska. Work-share agreement with the U.S. Geological Survey, Lincoln, Nebraska. Available online at: http://www.dnr.state.ne.us/databank/coq.html

Platte River Management Joint Study Hydrology Workgroup (1989). Evaluating management alternatives: sediment, flow, and channel geometry considerations. Hydrology Workgroup Final Report, Summary of Findings. U.S. Department of Interior, Bureau of Reclamation, Great Plains Region, 84 pp.

Randle, T.J., and M.A. Samad (2003). Platte River flow and sediment transport between North Platte and Grand Island, Nebraska (1895-1999). U.S. Department of the Interior, Bureau of Reclamation, Denver, Colorado.

Sidle, J.G., E.D. Miller, and P.J. Currier (1989). Changing habitats in the Platte River valley of Nebraska. *Prairie Naturalist*, 21: 91-104.

Simons & Associates, Inc. (2000). Physical History of the Platte River in Nebraska: Focusing upon Flow, Sediment Transport, Geomorphology, and Vegetation. Fort Collins, Colorado, 100 pp.

Sutton, R.J. (1998). IFG4 data hydraulic simulation for Platte River habitat surveys at study sites 6. Unpublished data. U.S. Department of the Interior, Bureau of Reclamation, Denver, Colorado.

Sutton, R.J. (2002a). Platte River Habitat Surveys at Study Sites 4A and 8C. Prepared for U.S Fish and Wildlife Service. U.S. Department of the Interior, Bureau of Reclamation, Denver, Colorado.

Sutton, R.J. (2002b). Platte River Habitat Surveys at Study Sites 2 and 12A. Prepared for U.S Fish and Wildlife Service. U.S. Department of the Interior, Bureau of Reclamation, Denver, Colorado.

Sutton, R.S. (2002c). Platte River Habitat Surveys at Study Sites 9BE, 9BW, and 8B. Prepared for U.S Fish and Wildlife Service. U.S. Department of the Interior, Bureau of Reclamation, Denver, Colorado.

U.S. Army Corps of Engineers (COE) (1988a) Aerial photography for Platte River system in Lincoln County, Nebraska: South Platte River - river mile 22 to 1, North Platte River - river mile 11 to 1, Platte River - river mile 310 to 281. Omaha District.

U.S. Army Corps of Engineers (COE) (1988b) Aerial photography for Platte River: Grand Island, Nebraska to Missouri River, river mile 166 to the mouth. Omaha District.

U.S. Department of the Interior (USDOI) (1989). Prairie Bend Unit, P-S MBP, Nebraska. Regional Directors Planning report/ Draft Environmental Statement. Hydrology Appendix Volume 1 of 3. Bureau of Reclamation.

U.S. Department of the Interior (USDOI) (2003). Platte River Recovery Implementation Program Draft Environmental Impact Statement. Bureau of Reclamation and U.S. Fish and Wildlife Service, Platte River EIS Office, Denver, Colorado.

U.S. Department of the Interior (USDOI) (2006). Platte River Recovery Implementation Program Final Environmental Impact Statement. Bureau of Reclamation and U.S. Fish and Wildlife Service, Platte River EIS Office, Denver, Colorado.

U.S. Fish and Wildlife Service (FWS) (1938). Platte River 1938 Black & White Aerial Photography. Prepared for the Agricultural Stabilization and Conservation Service (ASCS).U.S. Fish and Wildlife Field Office in Grand Island, Nebraska (GIFO).

U.S. Fish and Wildlife Service (FWS) (1997). Biological opinion on the Federal Energy Regulatory Commission's preferred alternative for the Kingsley Dam project (Project No. 1417) and North Platte/Keystone Dam project (Project No. 1835). Letter from U.S. Fish and Wildlife Service to the Federal Energy Regulatory Commission dated July 25, 1997, 164 pp. + app.

U.S. Geological Survey (USGS) (2005). Accessed March 2006. USGS real-time water data for Nebraska, USGS streamflow gage # 06768000, Platte River near Overton, Nebraska. Available online at: http://waterdata.usgs.gov/ne/nwis/uv?site_no=06768000

Williams, G. (1978). The case of the shrinking channels- the North Platte and Platte Rivers in Nebraska. U.S. Geological Survey Circular 781, 48 pp.

Appendix Contents

Page

APPENDIX A: PLOTS OF REPEAT CROSS SECTIONS 68

A.1 DOWNSTREAM OF NORTH PLATTE 69
A.2 NEAR LEXINGTON 73
A.3 HABITAT REACH 78
A.3.1 Main Channel 78
A.3.2 Bridges Sites on Main Channel 127
A.3.3 2005 Surveys 139
A.3.4 Side Channel 1 151
A.3.5 Side Channel 2 157

APPENDIX B: CONTROL POINTS SUMMARY TABLE 159

APPENDIX C: FLOW ON DATE OF SURVEY TABLE 169

APPENDIX D: ELECTRONIC FORM OF 1989 USBR SURVEY DATA AND PHOTOGRAPHS 178

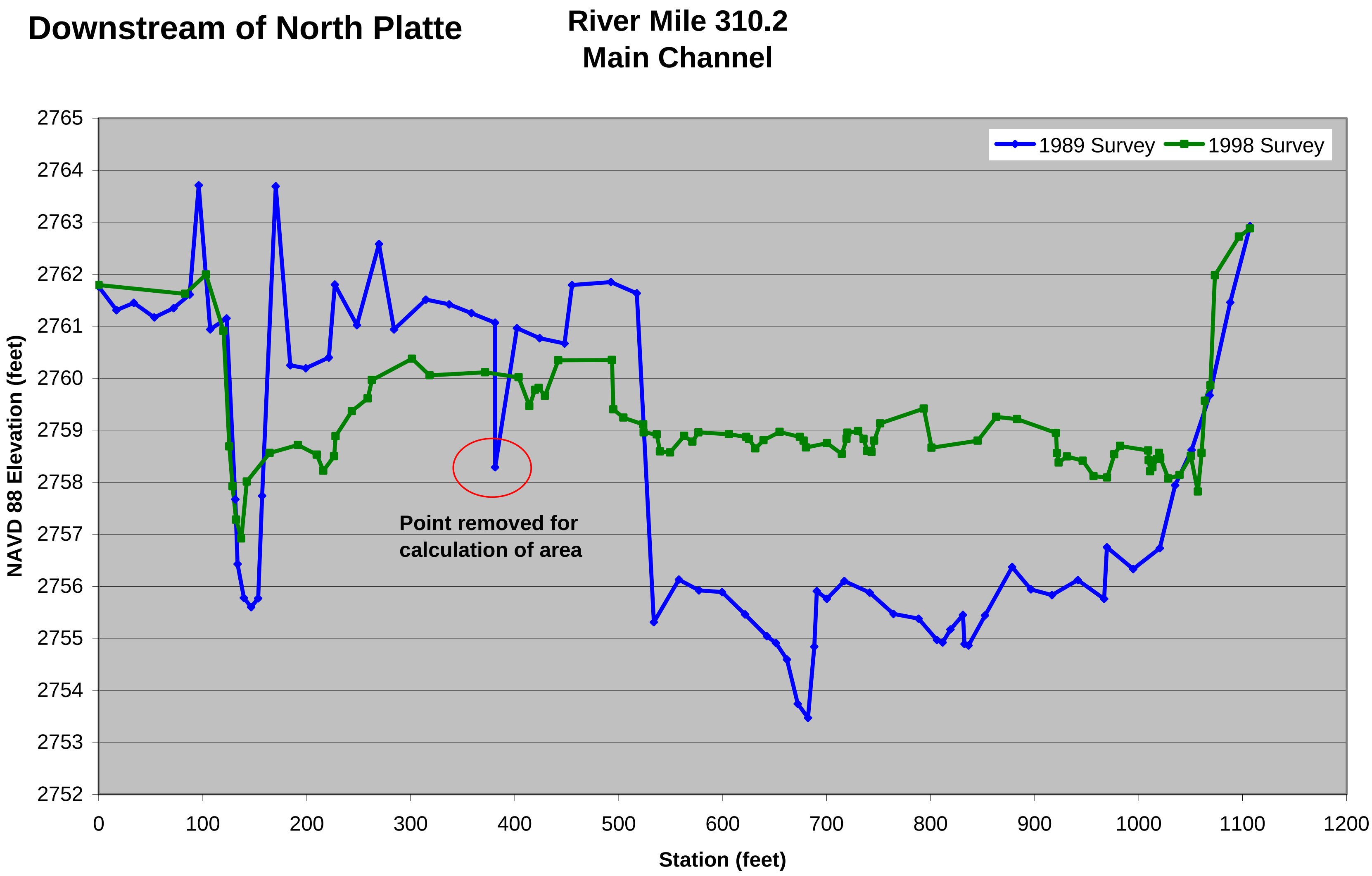
APPENDIX E: ELECTRONIC FORM OF ALL OTHER SURVEY DATA USED 179

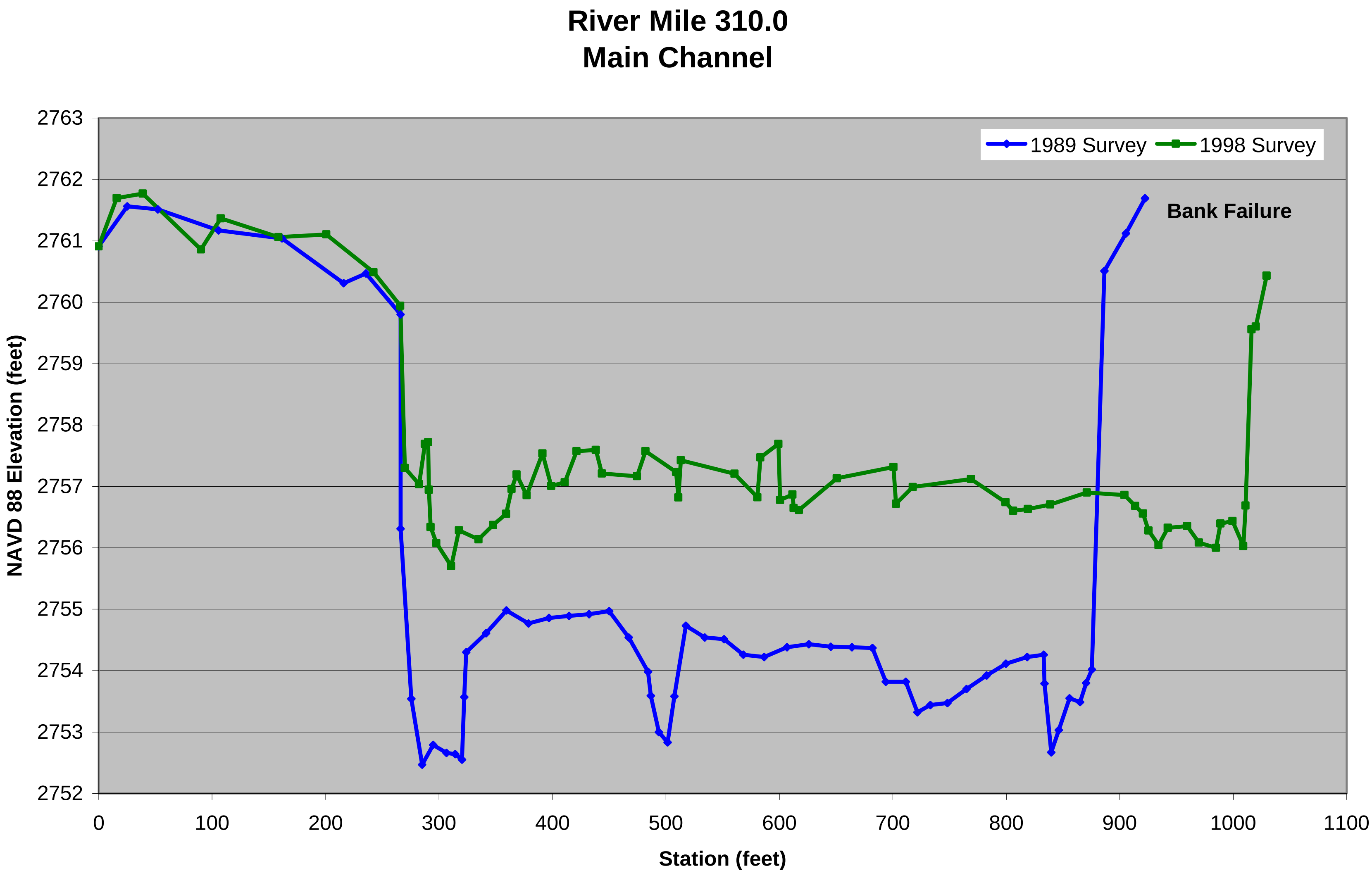
APPENDIX F: ELECTRONIC FORM OF 1989 USBR SEDIMENT SAMPLE DATA 180

APPENDIX A: PLOTS OF REPEAT CROSS SECTIONS

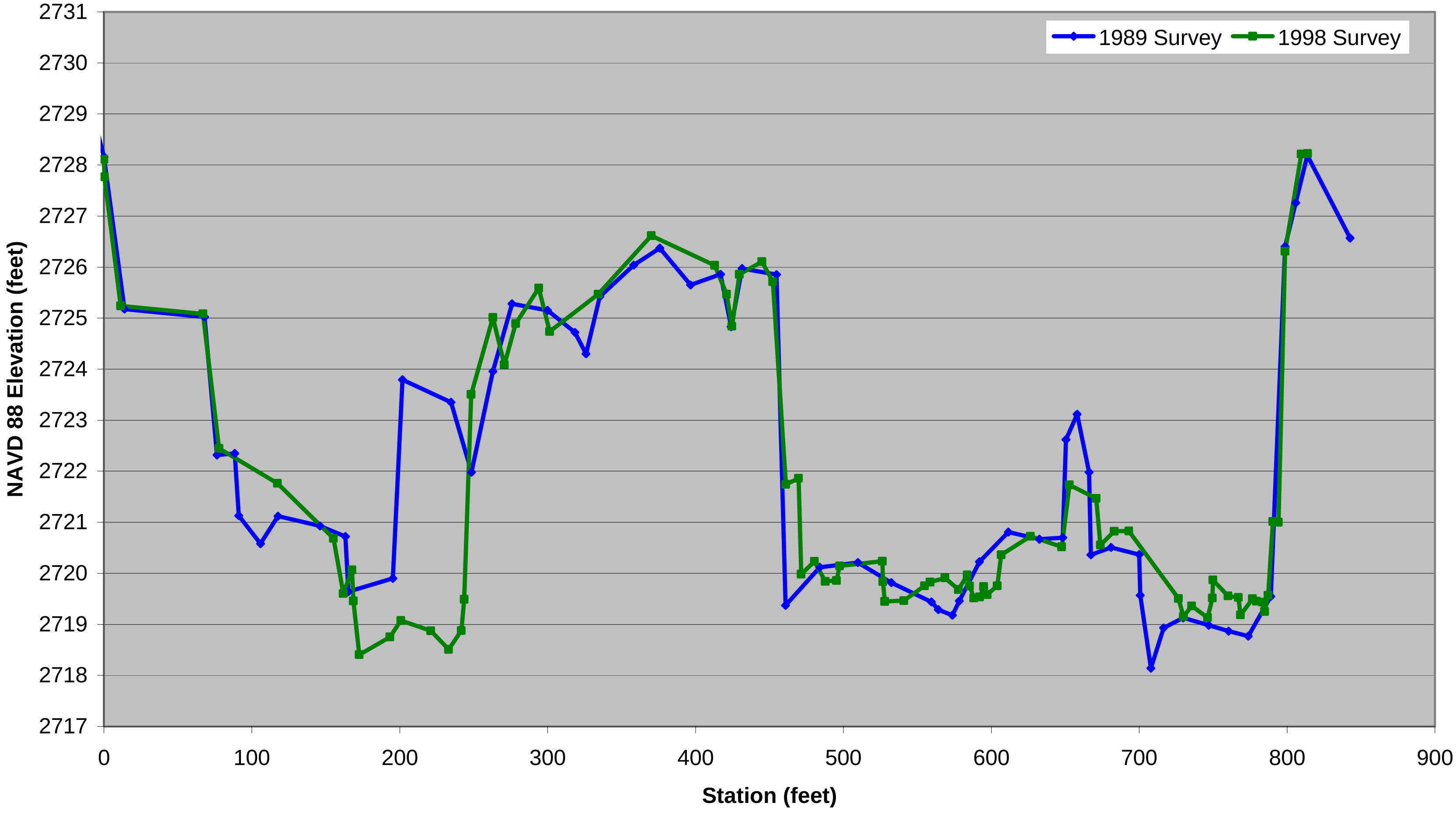
The following cross-section plots have all been adjusted to reflect elevations tied to NAVD88. All cross sections and transects are plotted from left to right bank looking downstream. Removal of reference points is indicated on individual plots.

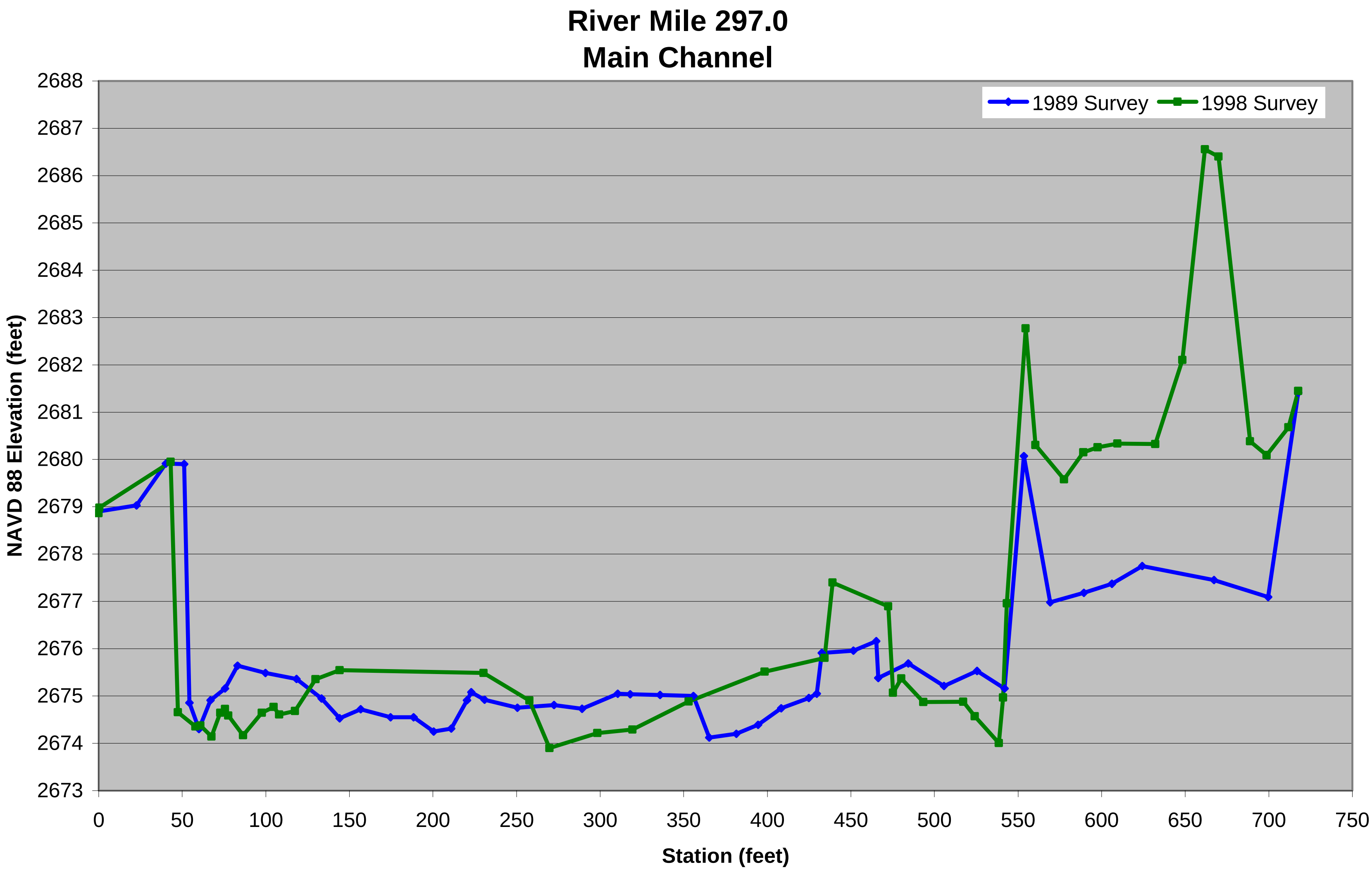
A.1 Downstream of North Platte



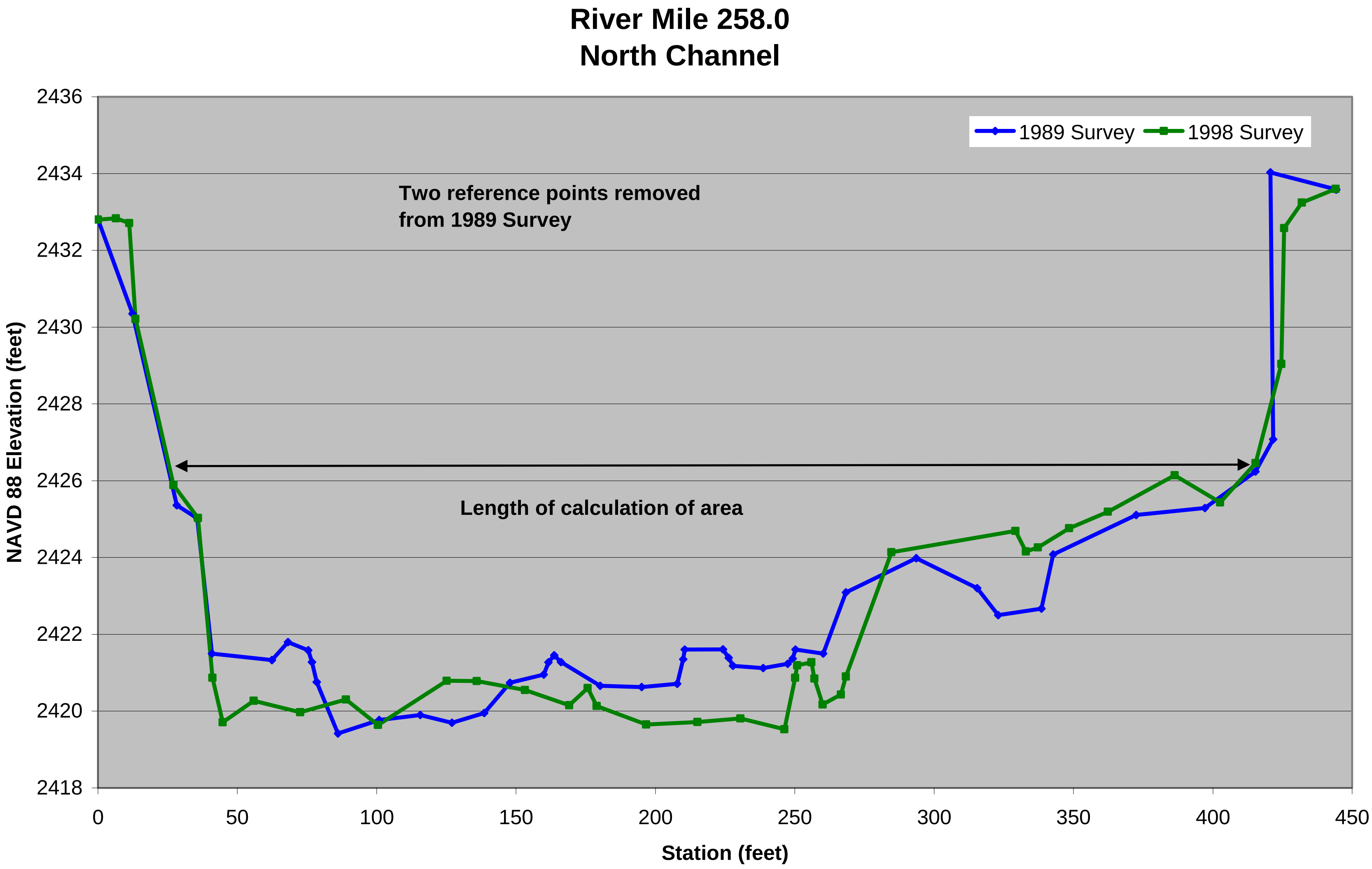

River Mile 310.0
Main Channel
1989 Survey
1998 Survey
Bank Failure
NAVD 88 Elevation (feet)
Station (feet)
2763
2762
2761
2760
2759
2758
2757
2756
2755
2754
2753
2752
0
100
200
300
400
500
600
700
800
900
1000
1100

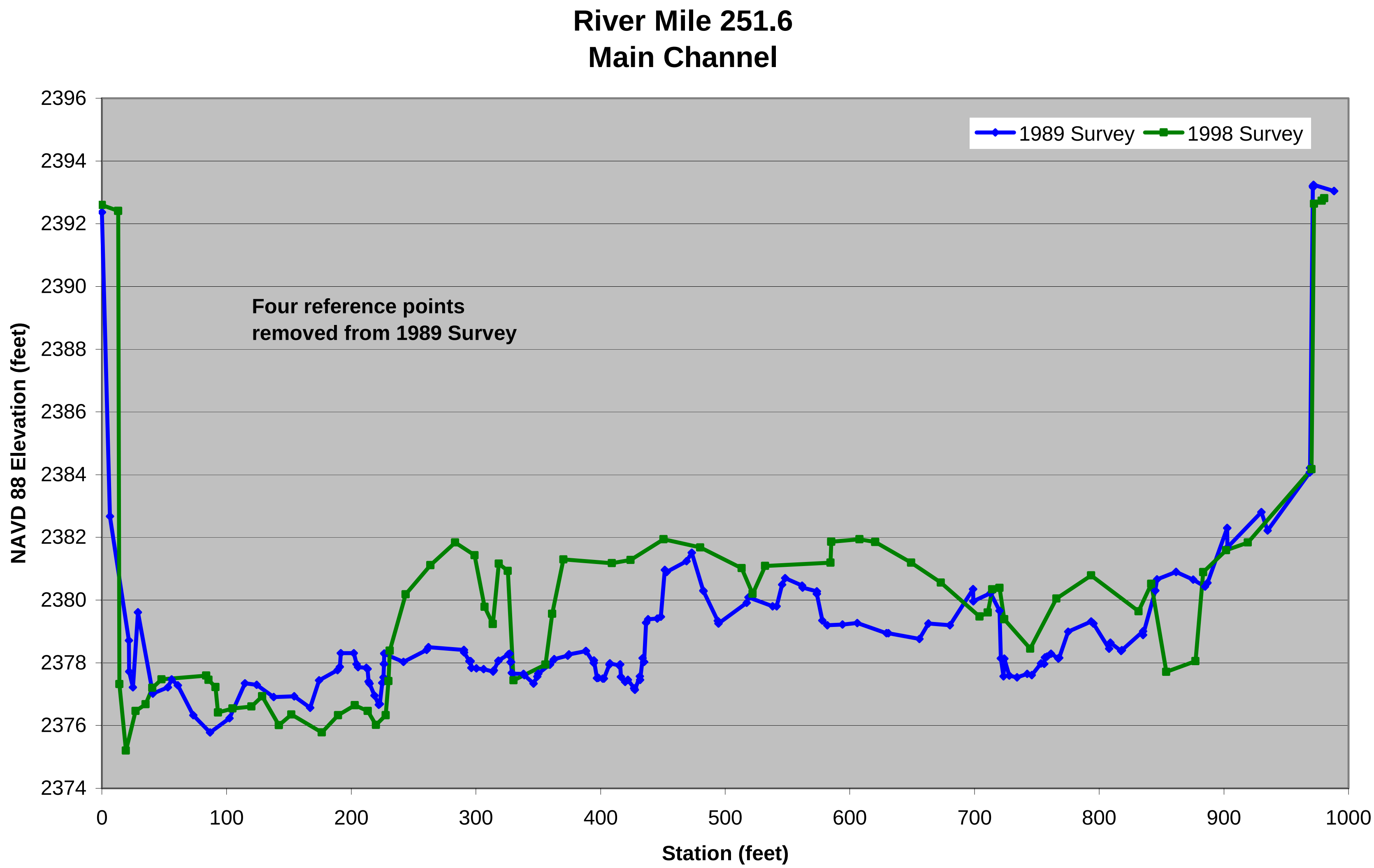
River Mile 304.0
Main Channel



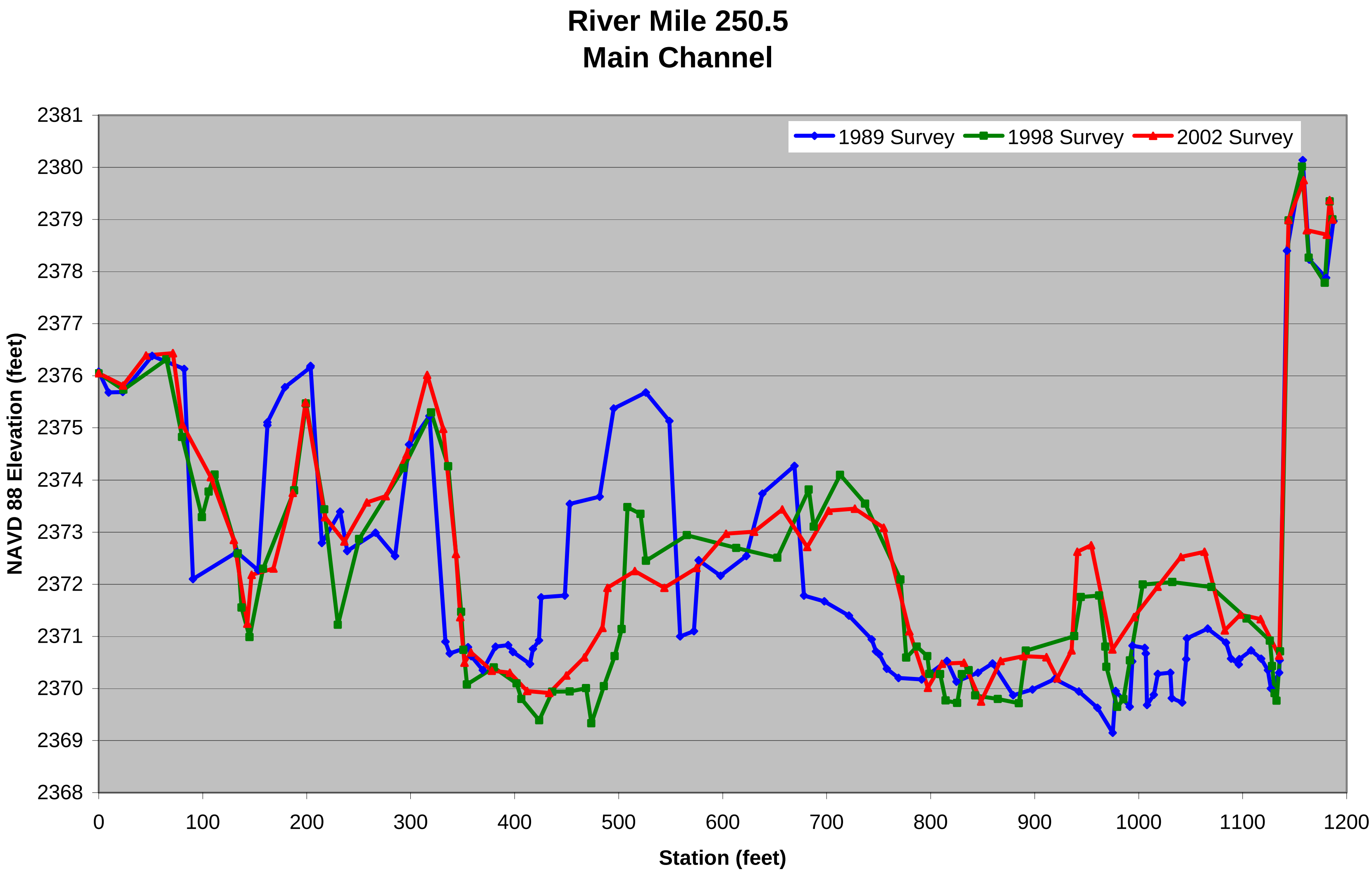

River Mile 297.0
Main Channel
1989 Survey
1998 Survey
NAVD 88 Elevation (feet)
Station (feet)
2688
2687
2686
2685
2684
2683
2682
2681
2680
2679
2678
2677
2676
2675
2674
2673
0
50
100
150
200
250
300
350
400
450
500
550
600
650
700
750

A.2 Near Lexington



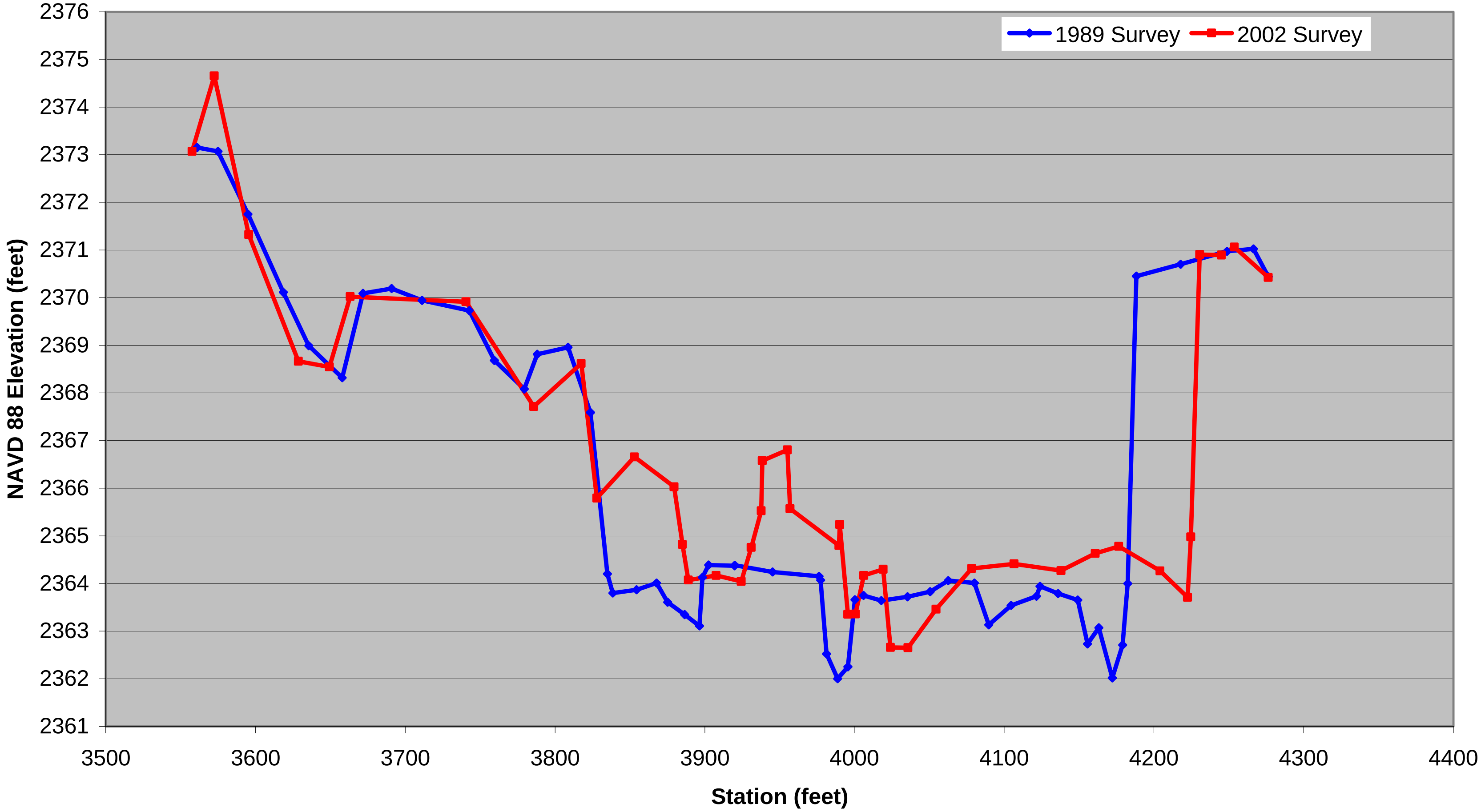


River Mile 251.6
Main Channel
1989 Survey
1998 Survey
Four reference points
removed from 1989 Survey
NAVD 88 Elevation (feet)
Station (feet)
2396
2394
2392
2390
2388
2386
2384
2382
2380
2378
2376
2374
0
100
200
300
400
500
600
700
800
900
1000

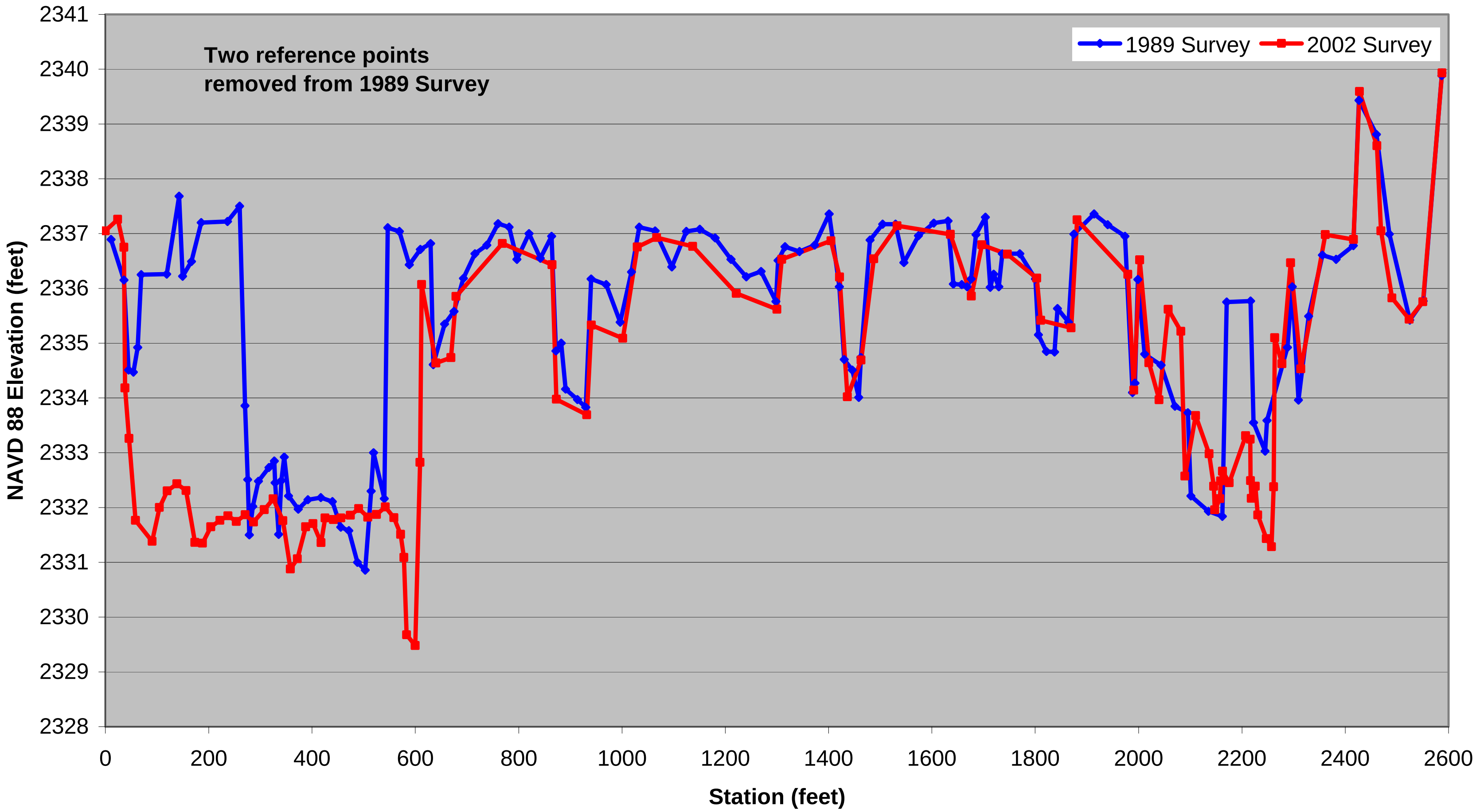


River Mile 250.5
Main Channel
1989 Survey
1998 Survey
2002 Survey
NAVD 88 Elevation (feet)
2381
2380
2379
2378
2377
2376
2375
2374
2373
2372
2371
2370
2369
2368
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
Station (feet)

River Mile 249.8
North Channel



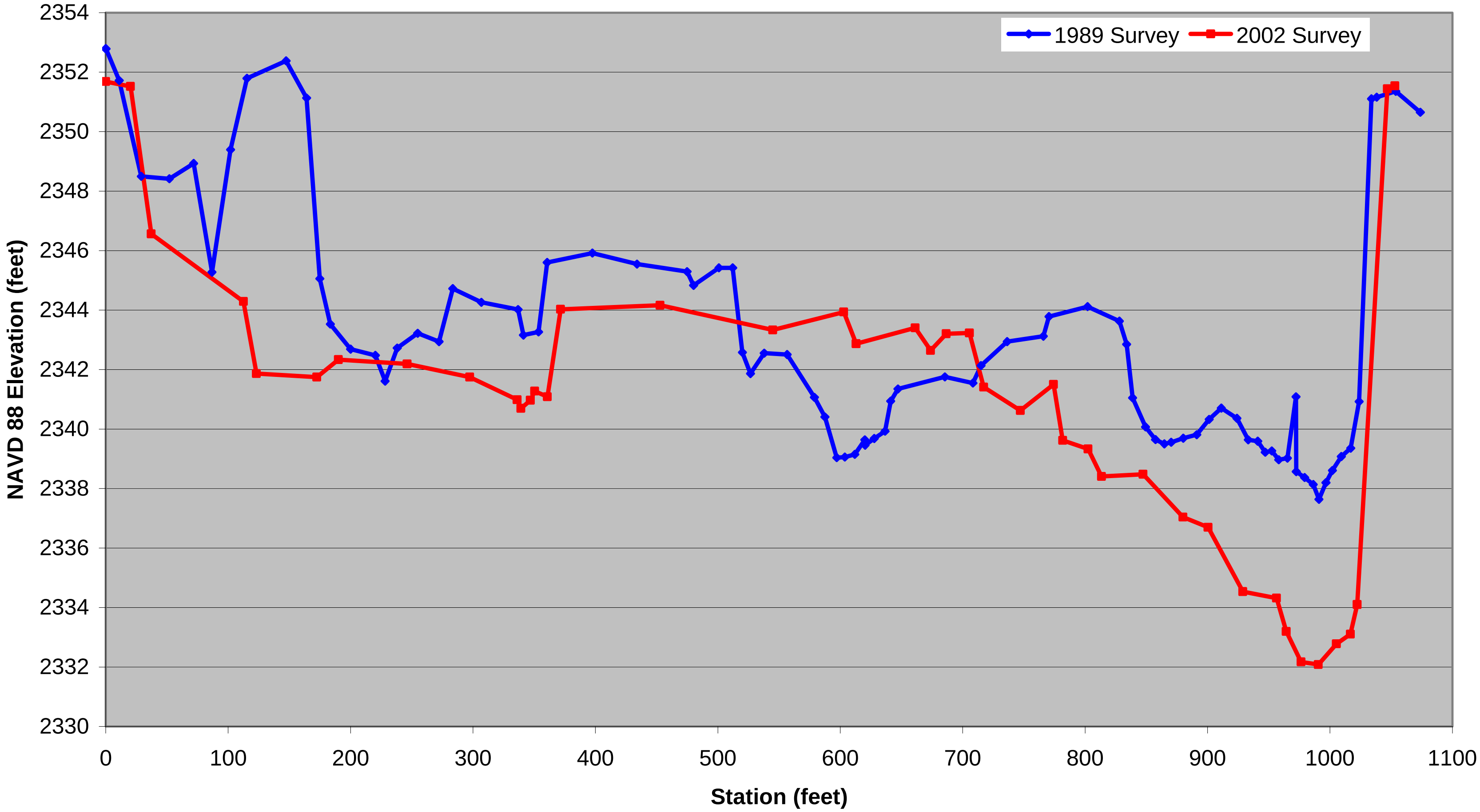
River Mile 244.0
North Channel

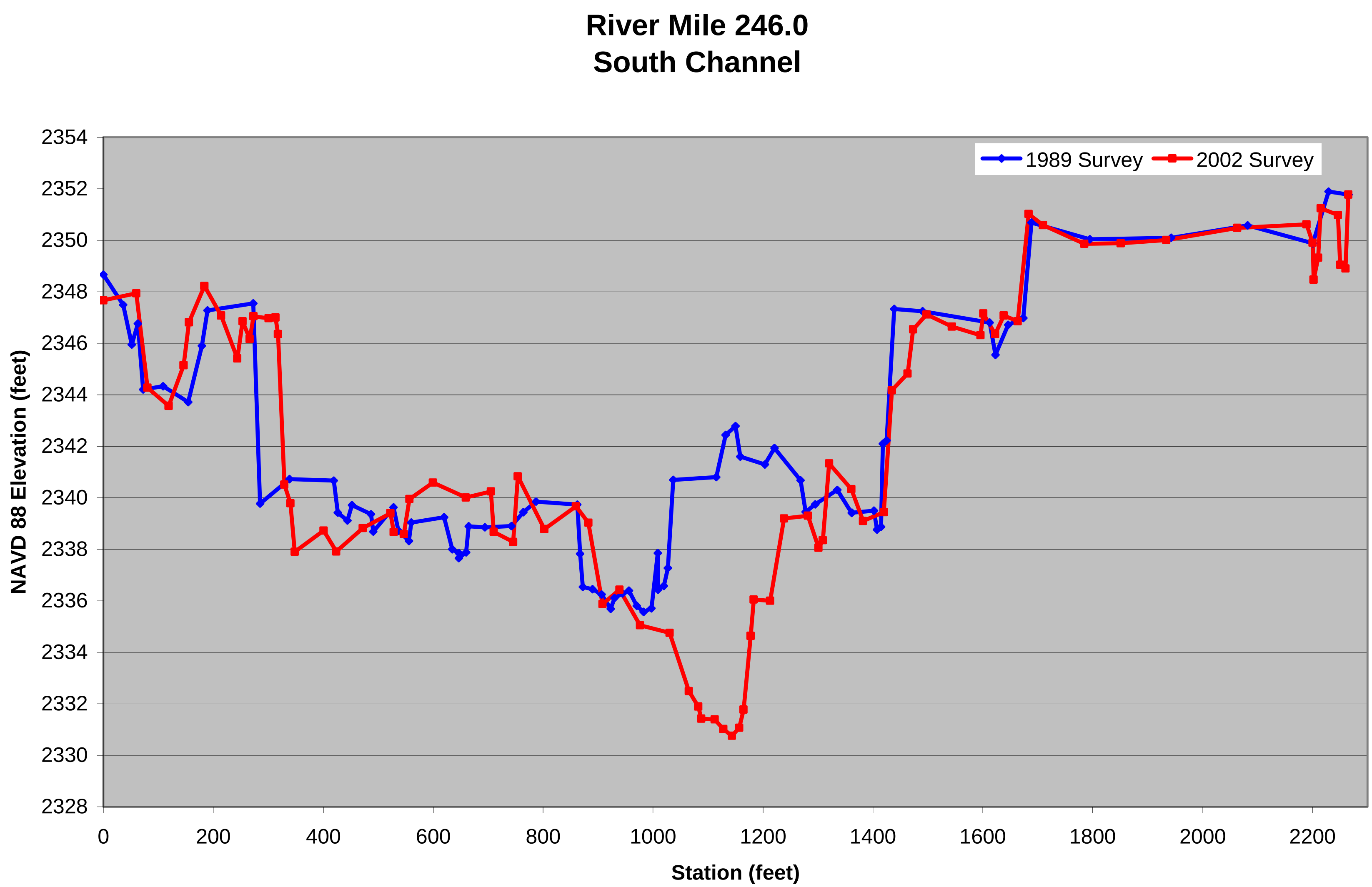


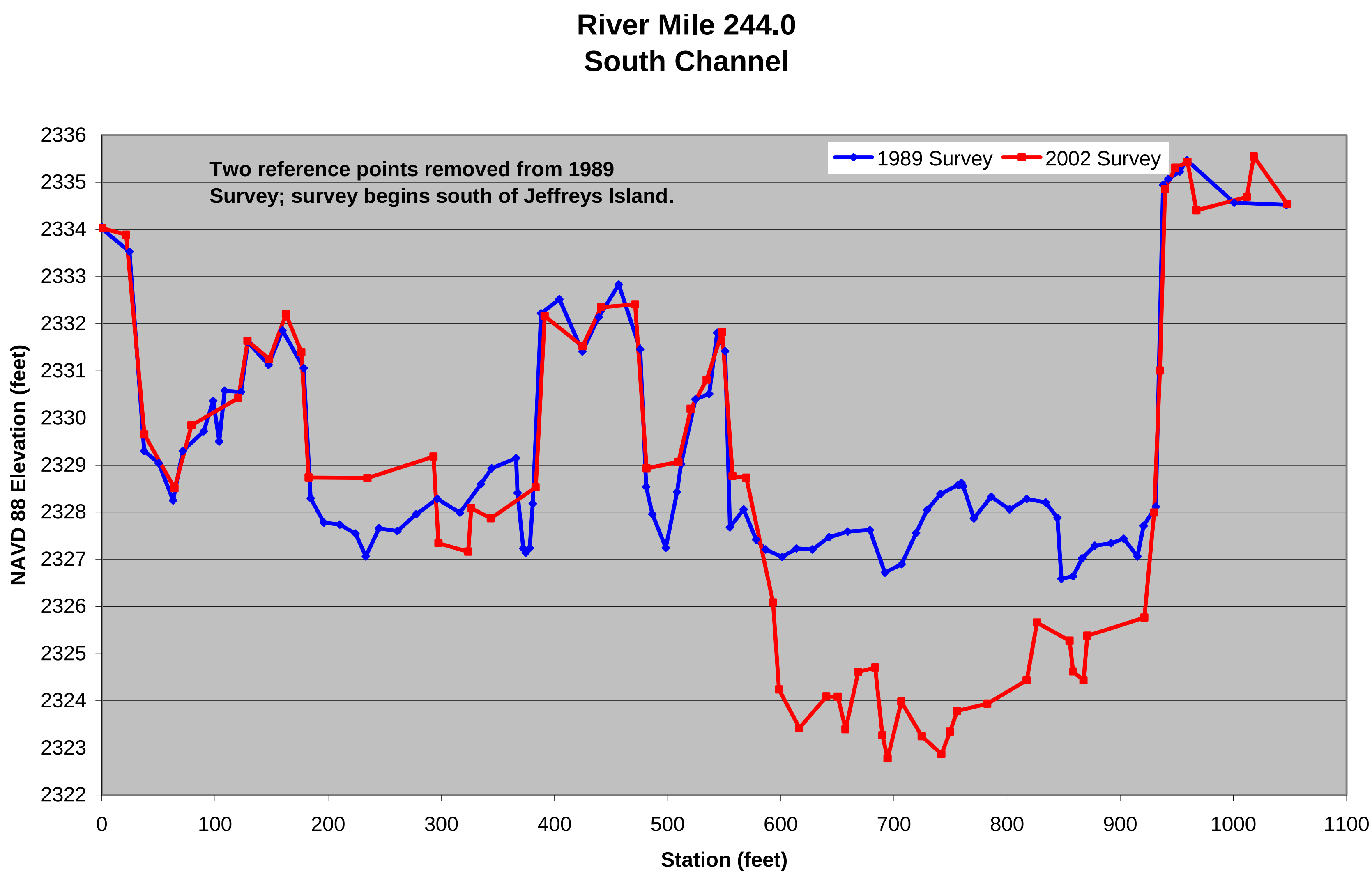
A.3 Habitat Reach

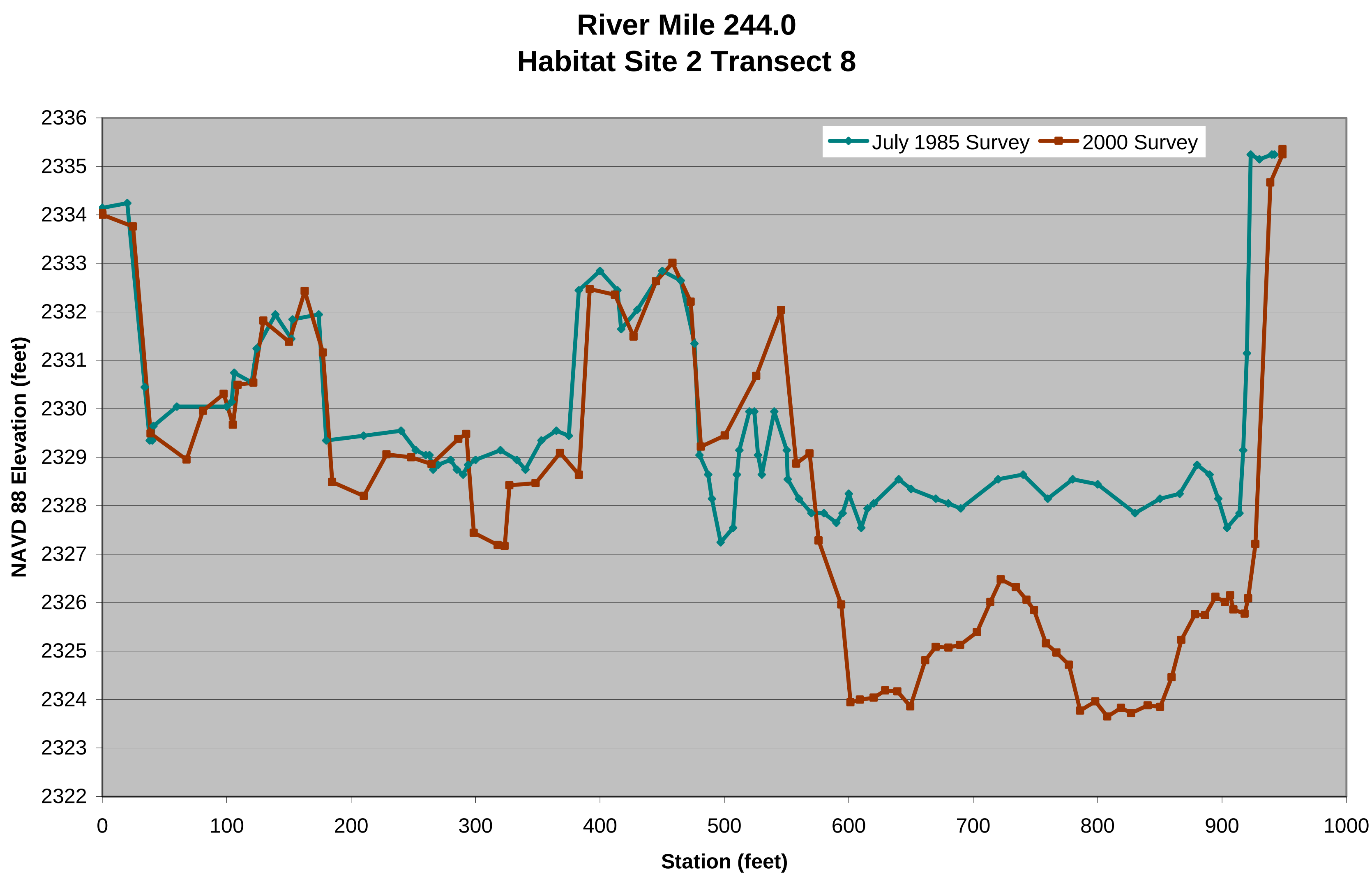
A.3.1 Main Channel

River Mile 246.5
South Channel

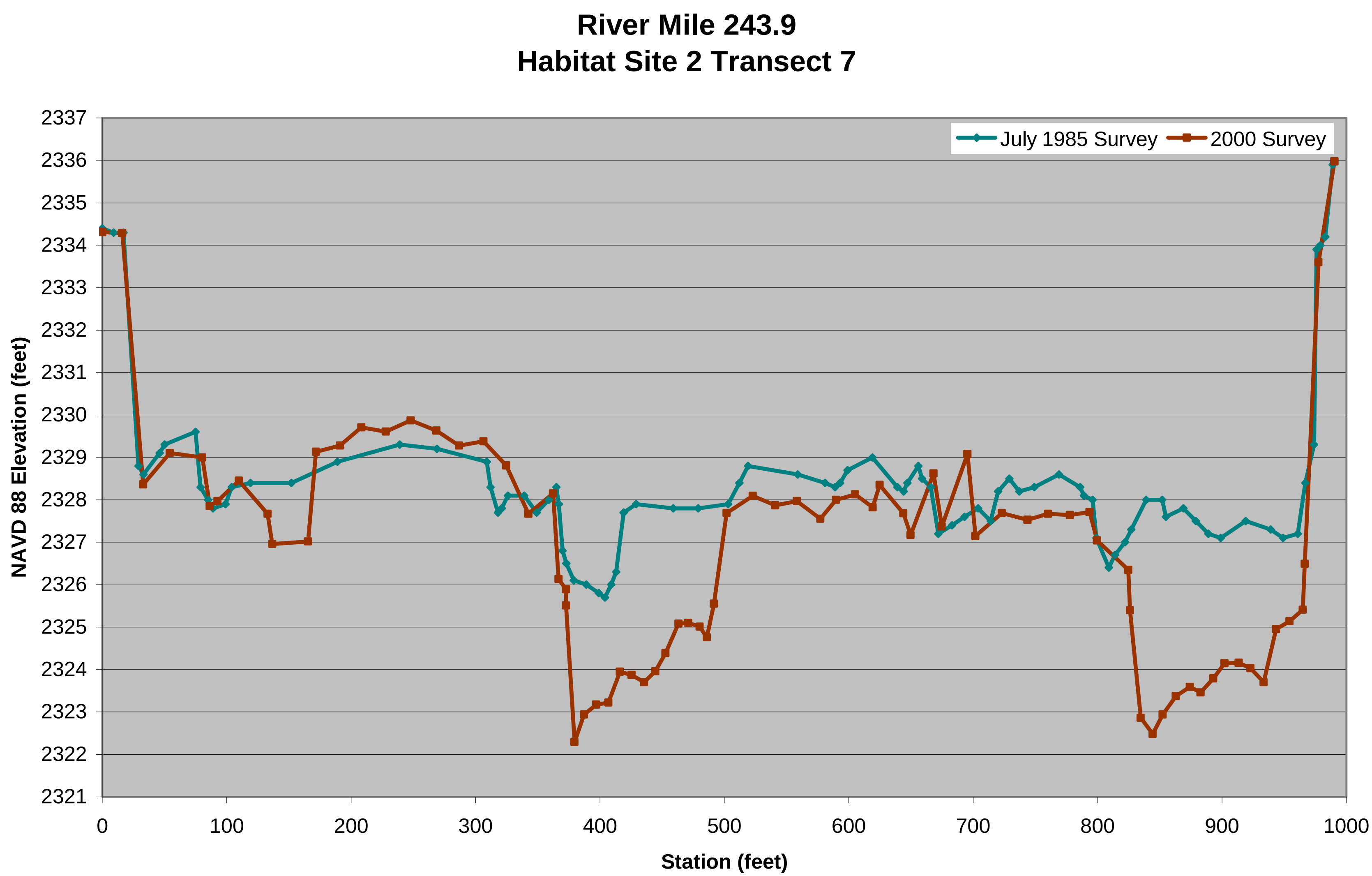


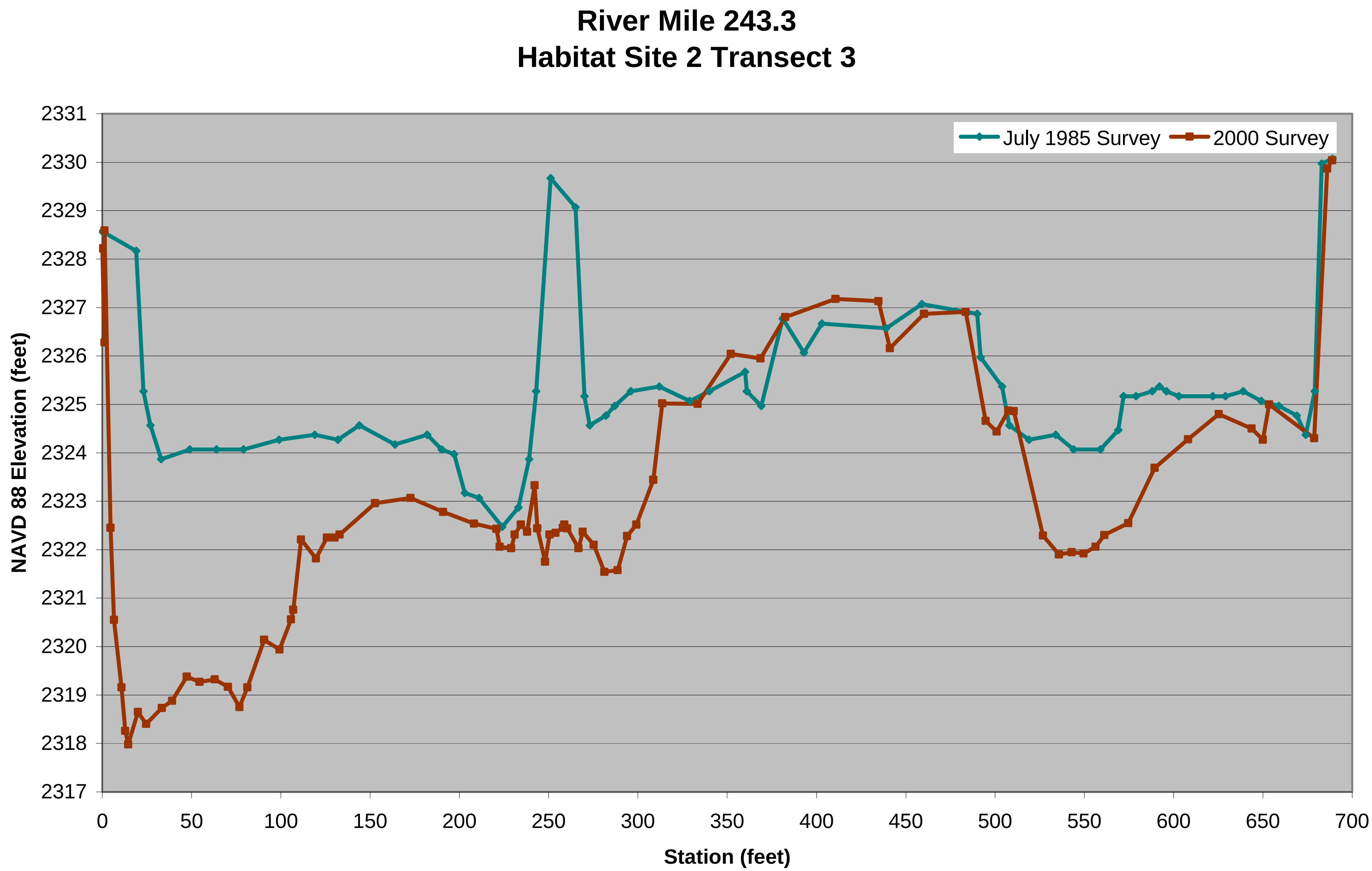

River Mile 246.0
South Channel
1989 Survey
2002 Survey
NAVD 88 Elevation (feet)
Station (feet)
2354
2352
2350
2348
2346
2344
2342
2340
2338
2336
2334
2332
2330
2328
0
200
400
600
800
1000
1200
1400
1600
1800
2000
2200

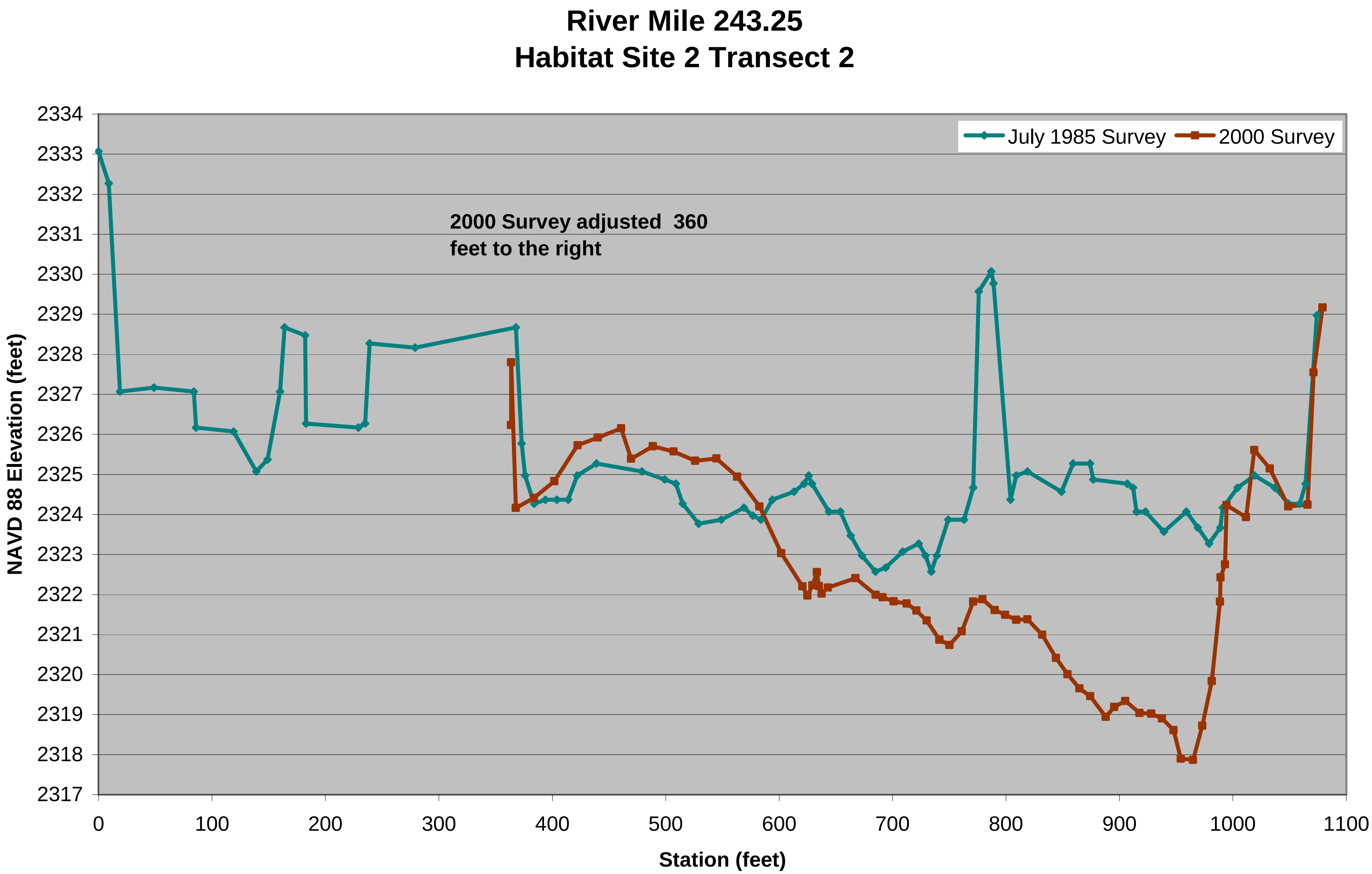

River Mile 244.0
South Channel
Two reference points removed from 1989
Survey; survey begins south of Jeffreys Island.
1989 Survey
2002 Survey
NAVD 88 Elevation (feet)
2336
2335
2334
2333
2332
2331
2330
2329
2328
2327
2326
2325
2324
2323
2322
Station (feet)
0
100
200
300
400
500
600
700
800
900
1000
1100

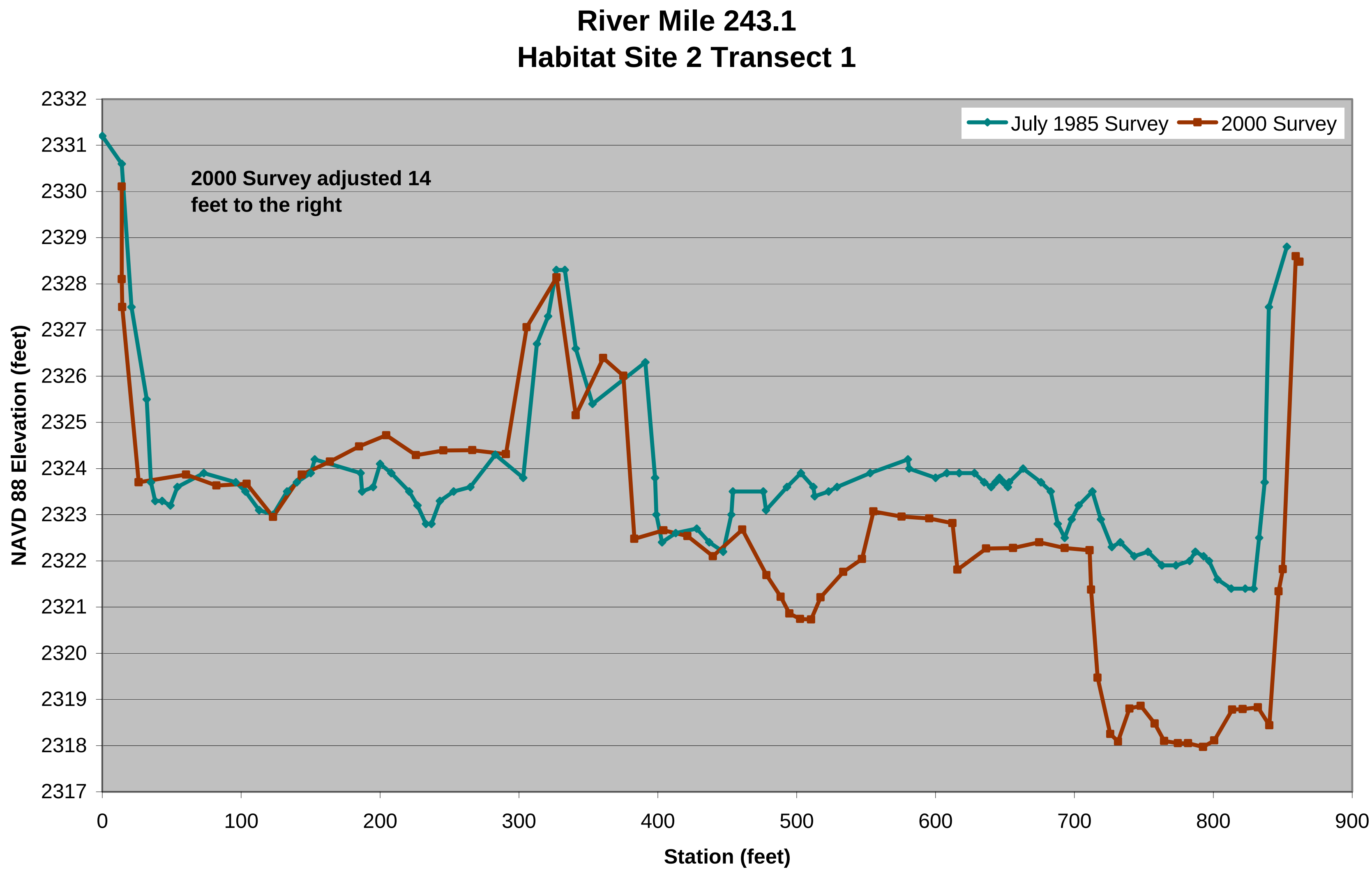


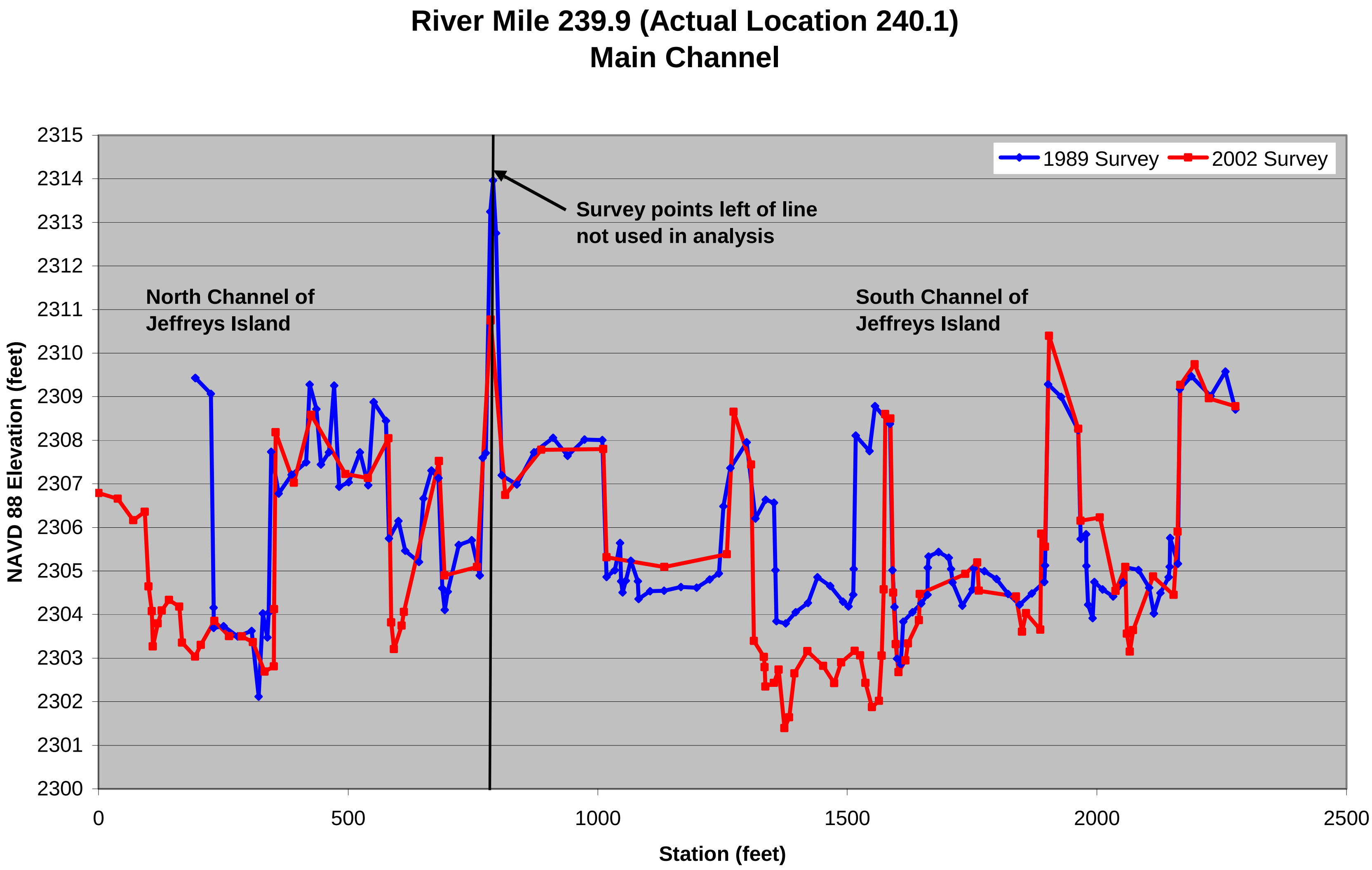
River Mile 244.0
Habitat Site 2 Transect 8
July 1985 Survey
2000 Survey
NAVD 88 Elevation (feet)
2336
2335
2334
2333
2332
2331
2330
2329
2328
2327
2326
2325
2324
2323
2322
0
100
200
300
400
500
600
700
800
900
1000
Station (feet)

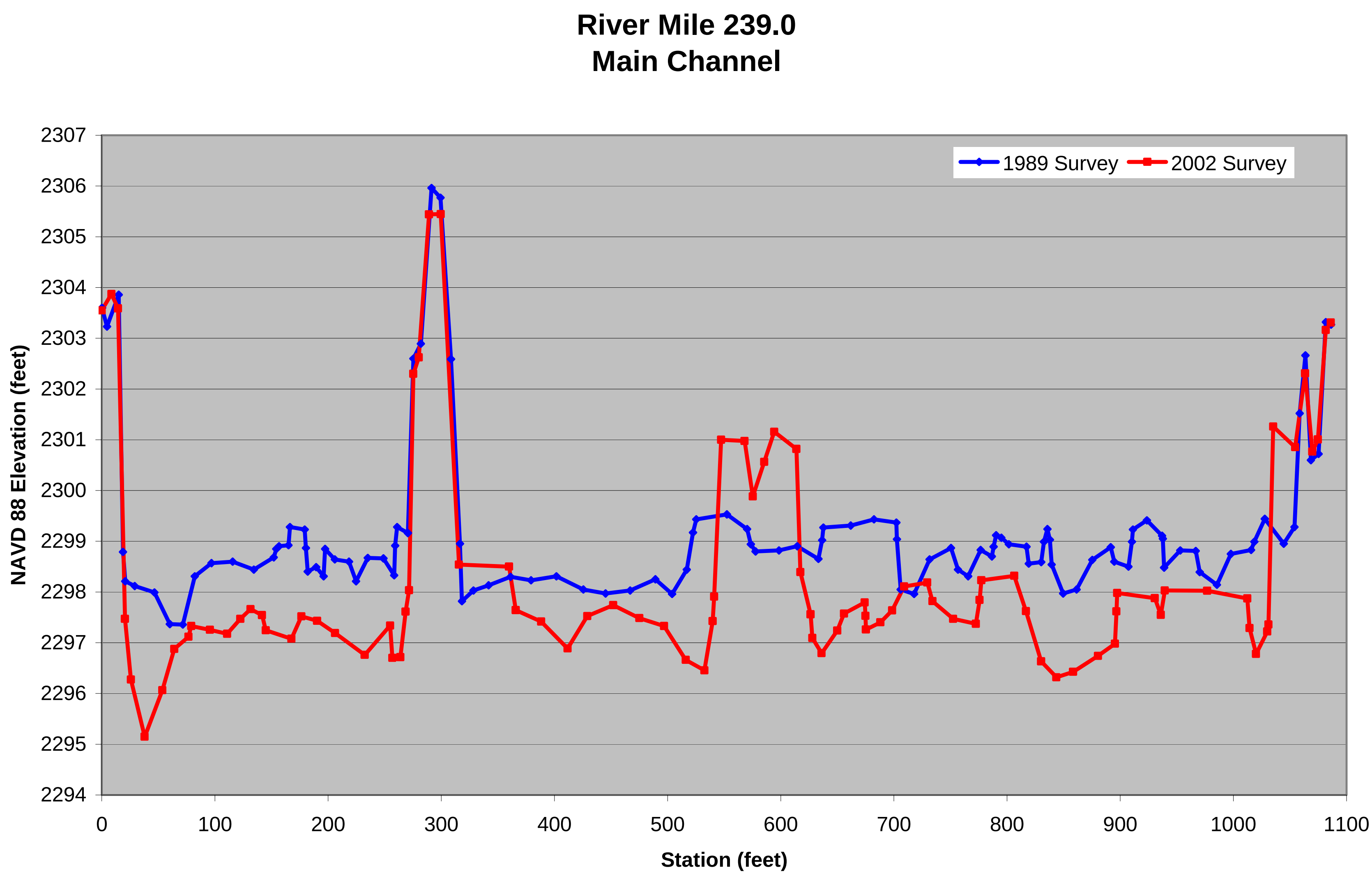

River Mile 243.9
Habitat Site 2 Transect 7
July 1985 Survey
2000 Survey
NAVD 88 Elevation (feet)
2337
2336
2335
2334
2333
2332
2331
2330
2329
2328
2327
2326
2325
2324
2323
2322
2321
0
100
200
300
400
500
600
700
800
900
1000
Station (feet)


River Mile 243.3
Habitat Site 2 Transect 3
July 1985 Survey
2000 Survey
NAVD 88 Elevation (feet)
2331
2330
2329
2328
2327
2326
2325
2324
2323
2322
2321
2320
2319
2318
2317
0
50
100
150
200
250
300
350
400
450
500
550
600
650
700
Station (feet)


River Mile 243.25
Habitat Site 2 Transect 2
July 1985 Survey
2000 Survey
2000 Survey adjusted 360
feet to the right
NAVD 88 Elevation (feet)
Station (feet)
2334
2333
2332
2331
2330
2329
2328
2327
2326
2325
2324
2323
2322
2321
2320
2319
2318
2317
0
100
200
300
400
500
600
700
800
900
1000
1100

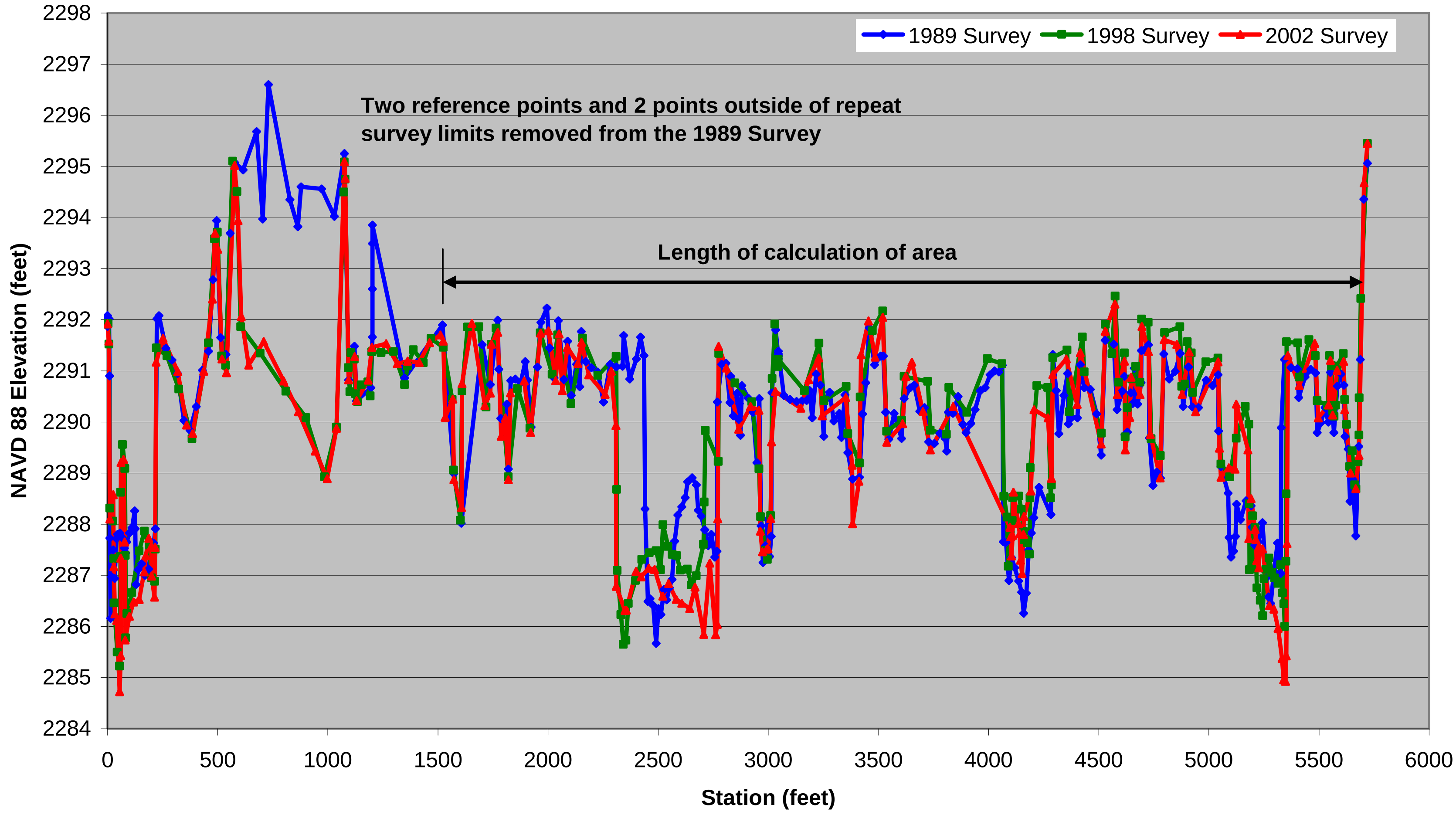

River Mile 243.1
Habitat Site 2 Transect 1
July 1985 Survey
2000 Survey
2000 Survey adjusted 14 feet to the right
NAVD 88 Elevation (feet)
2332
2331
2330
2329
2328
2327
2326
2325
2324
2323
2322
2321
2320
2319
2318
2317
0
100
200
300
400
500
600
700
800
900
Station (feet)

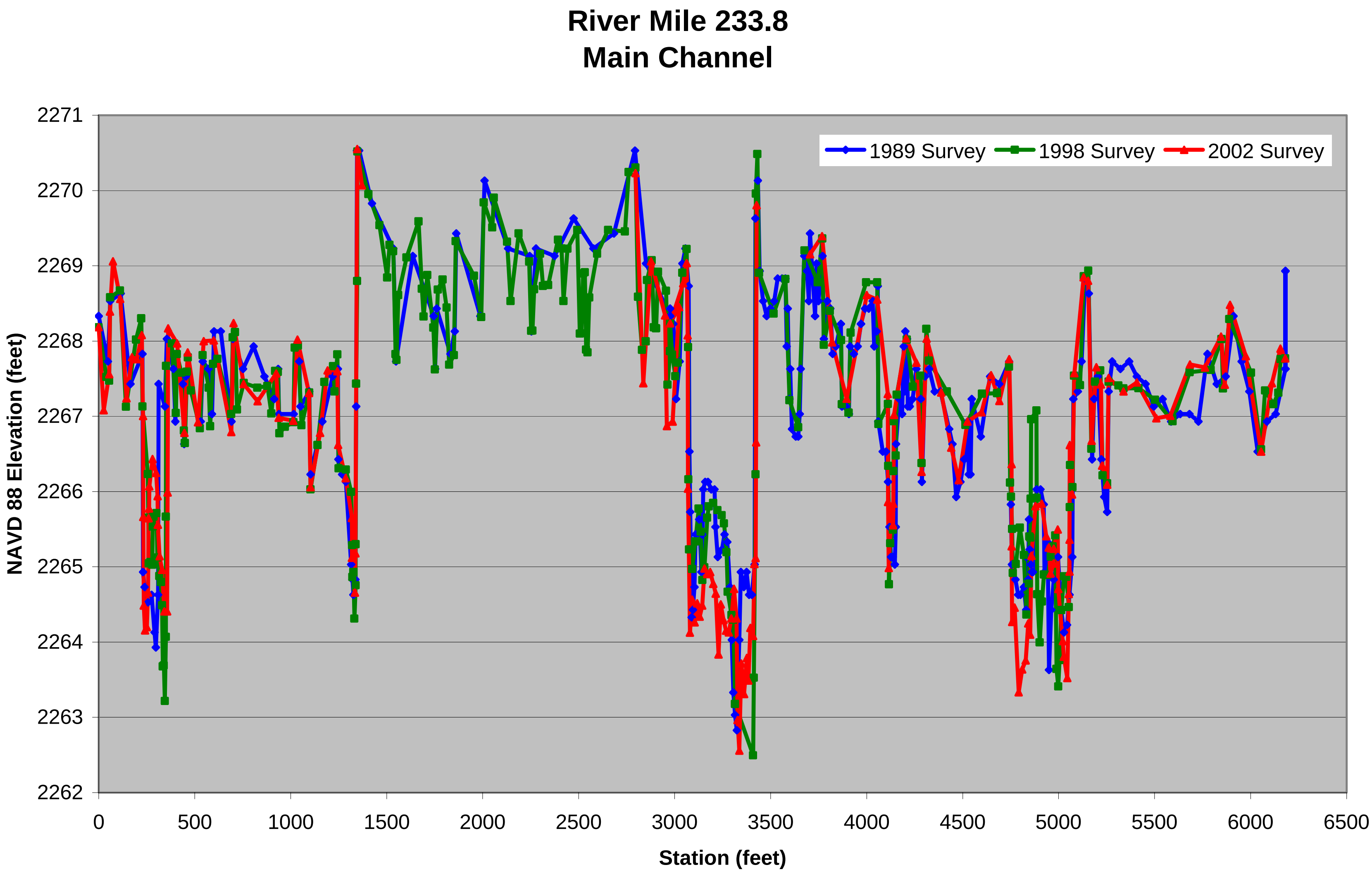

River Mile 239.9 (Actual Location 240.1)
Main Channel
NAVD 88 Elevation (feet)
Station (feet)
1989 Survey
2002 Survey
Survey points left of line
not used in analysis
North Channel of
Jeffreys Island
South Channel of
Jeffreys Island
2300
2301
2302
2303
2304
2305
2306
2307
2308
2309
2310
2311
2312
2313
2314
2315
0
500
1000
1500
2000
2500

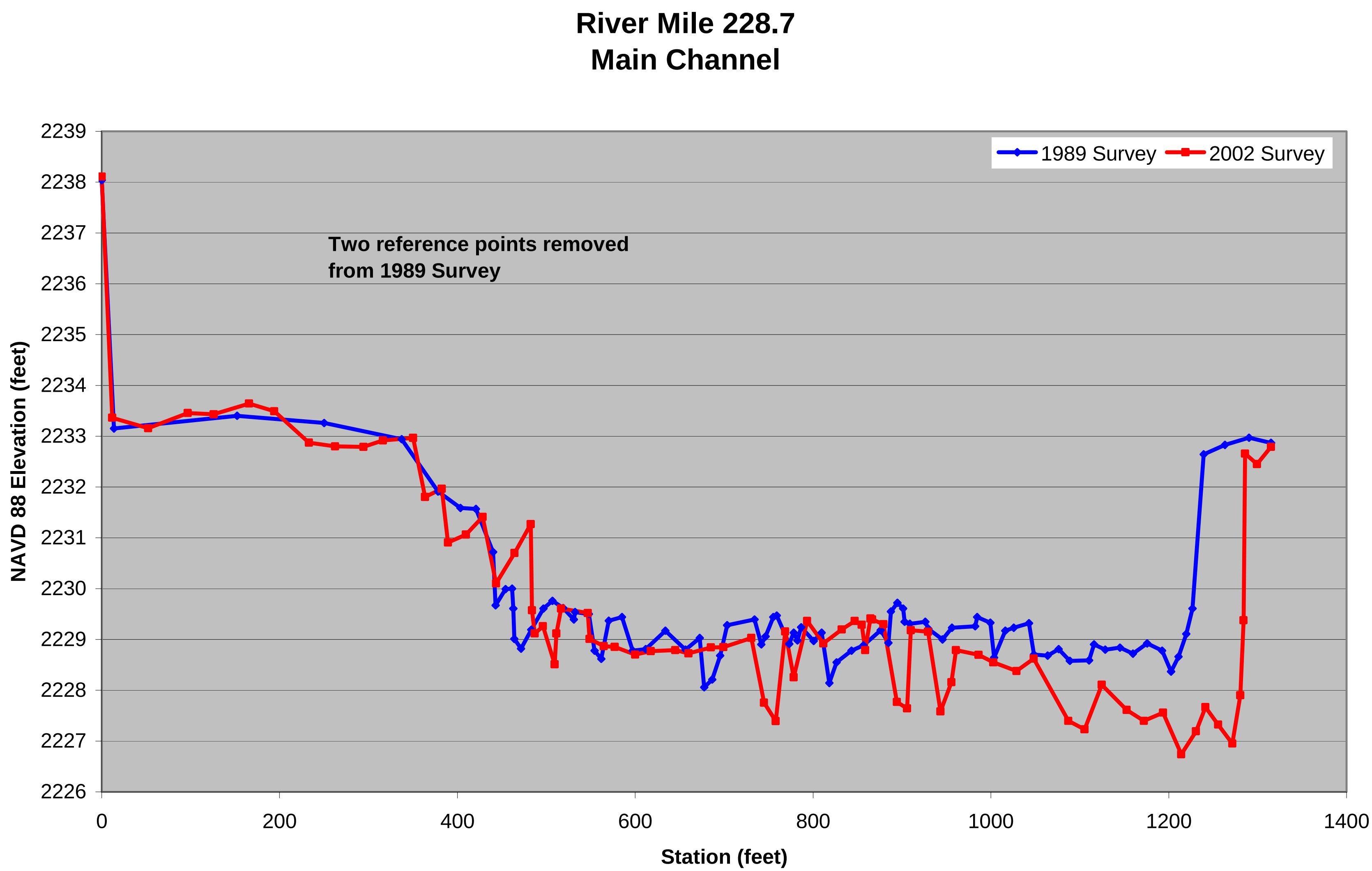


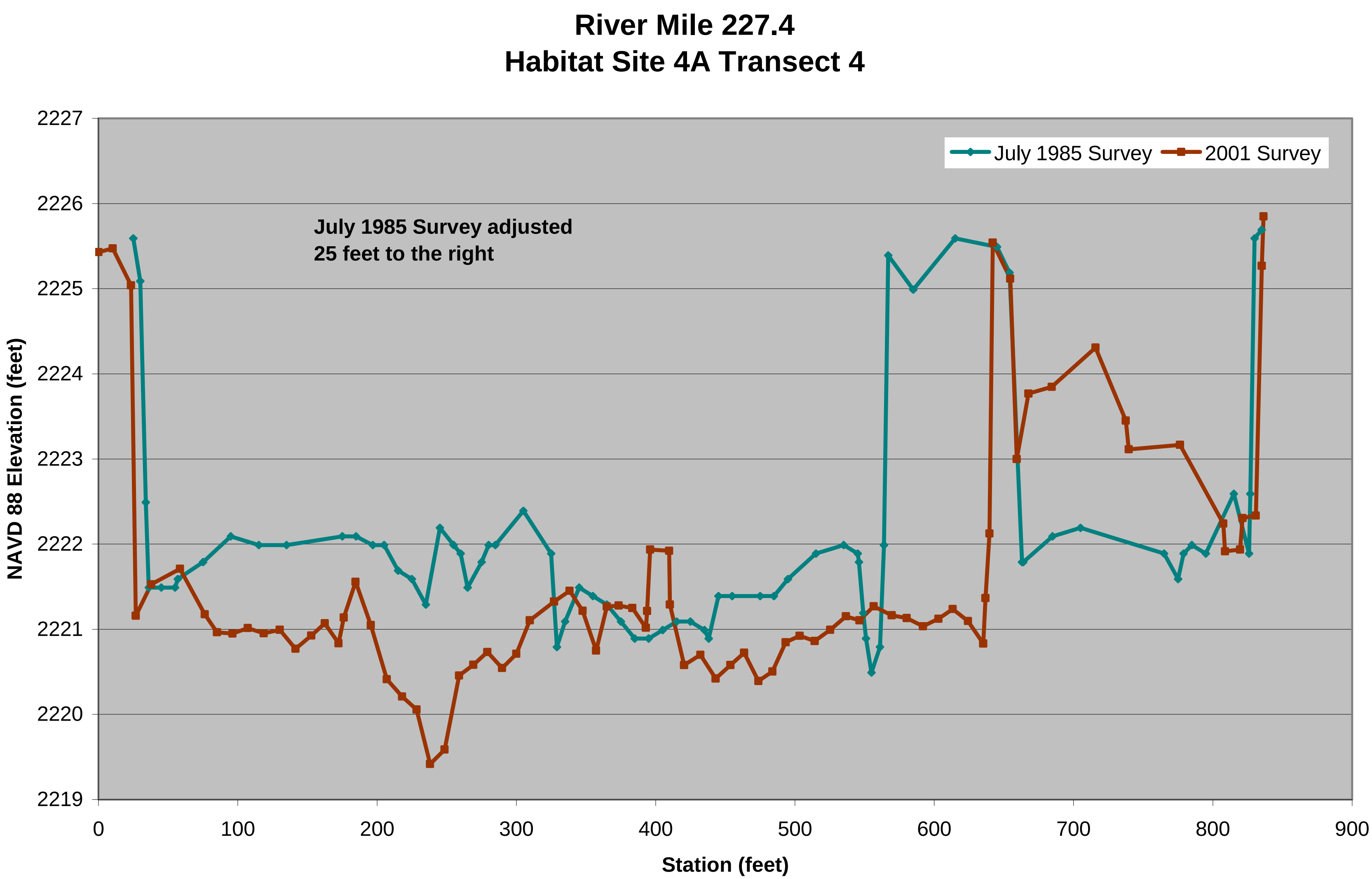
River Mile 239.0
Main Channel
1989 Survey
2002 Survey
NAVD 88 Elevation (feet)
2307
2306
2305
2304
2303
2302
2301
2300
2299
2298
2297
2296
2295
2294
Station (feet)
0
100
200
300
400
500
600
700
800
900
1000
1100

River Mile 237.5
Main Channel

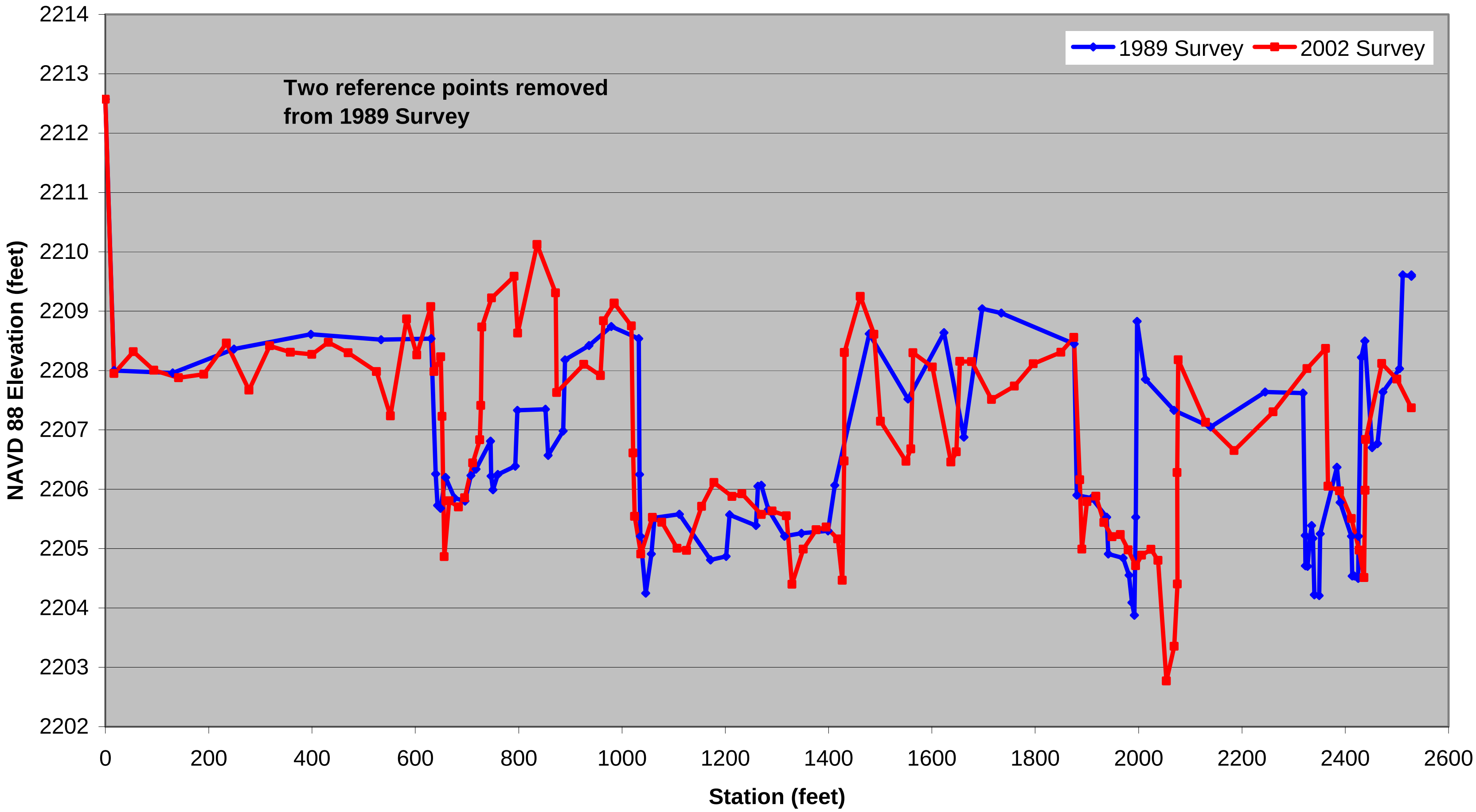


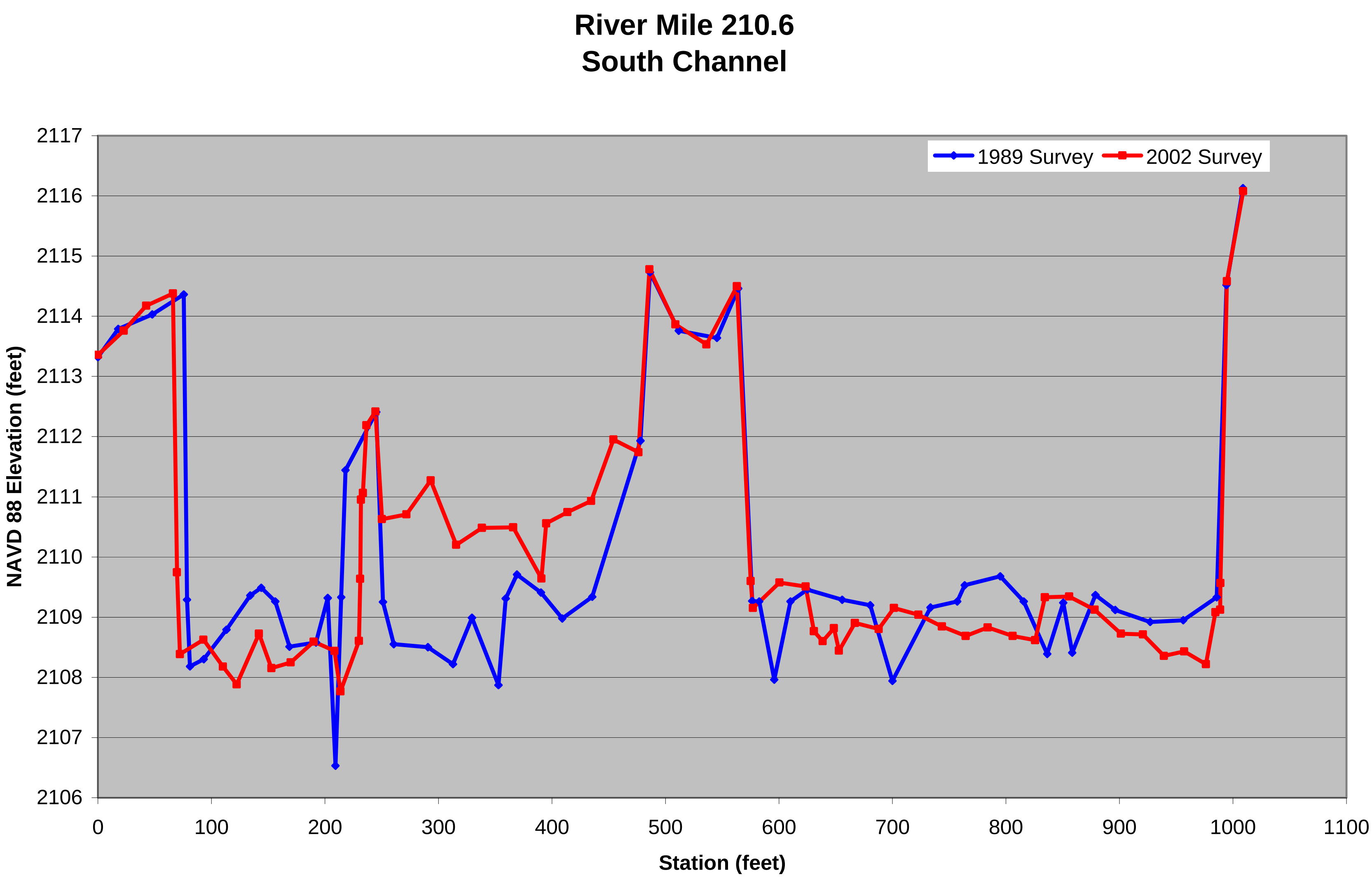

River Mile 233.8
Main Channel
NAVD 88 Elevation (feet)
Station (feet)
1989 Survey
1998 Survey
2002 Survey
2271
2270
2269
2268
2267
2266
2265
2264
2263
2262
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
6500

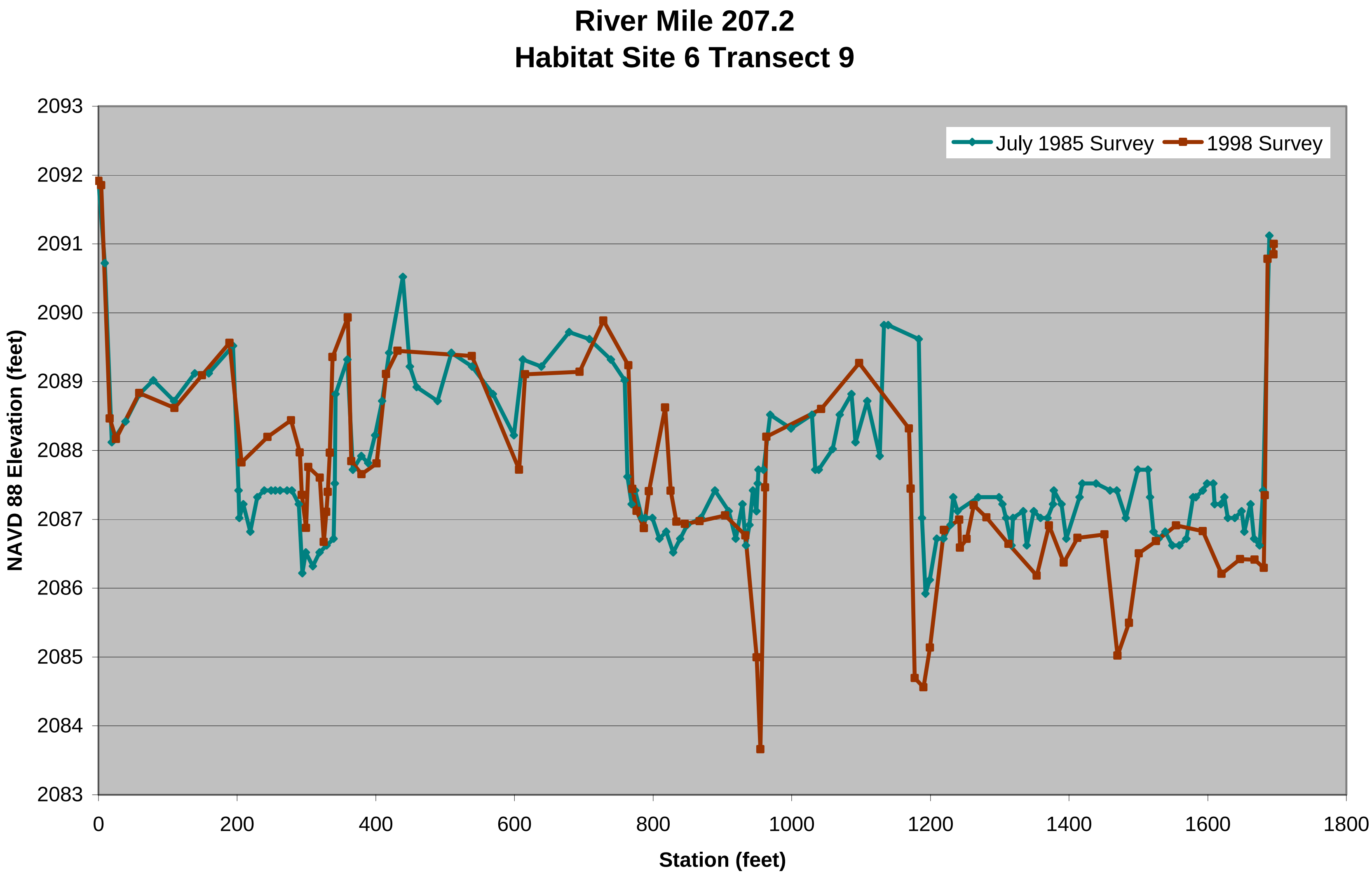

River Mile 228.7
Main Channel
1989 Survey
2002 Survey
Two reference points removed
from 1989 Survey
NAVD 88 Elevation (feet)
Station (feet)
2226
2227
2228
2229
2230
2231
2232
2233
2234
2235
2236
2237
2238
2239
0
200
400
600
800
1000
1200
1400


River Mile 227.4
Habitat Site 4A Transect 4
July 1985 Survey
2001 Survey
July 1985 Survey adjusted 25 feet to the right
NAVD 88 Elevation (feet)
2227
2226
2225
2224
2223
2222
2221
2220
2219
0
100
200
300
400
500
600
700
800
900
Station (feet)

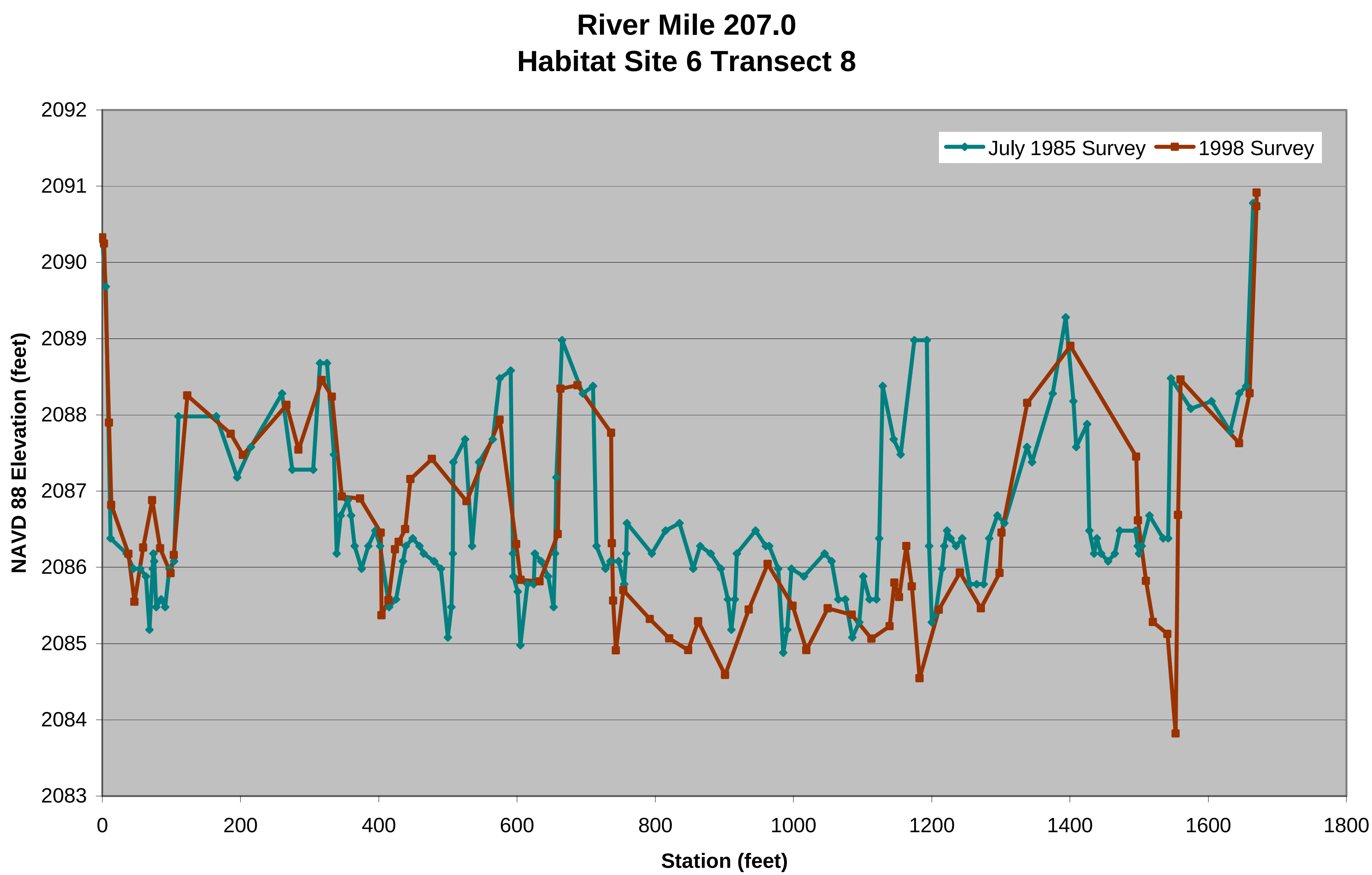
River Mile 225.1
North Channel




River Mile 210.6
South Channel
NAVD 88 Elevation (feet)
2117
2116
2115
2114
2113
2112
2111
2110
2109
2108
2107
2106
0
100
200
300
400
500
600
700
800
900
1000
1100
Station (feet)
1989 Survey
2002 Survey

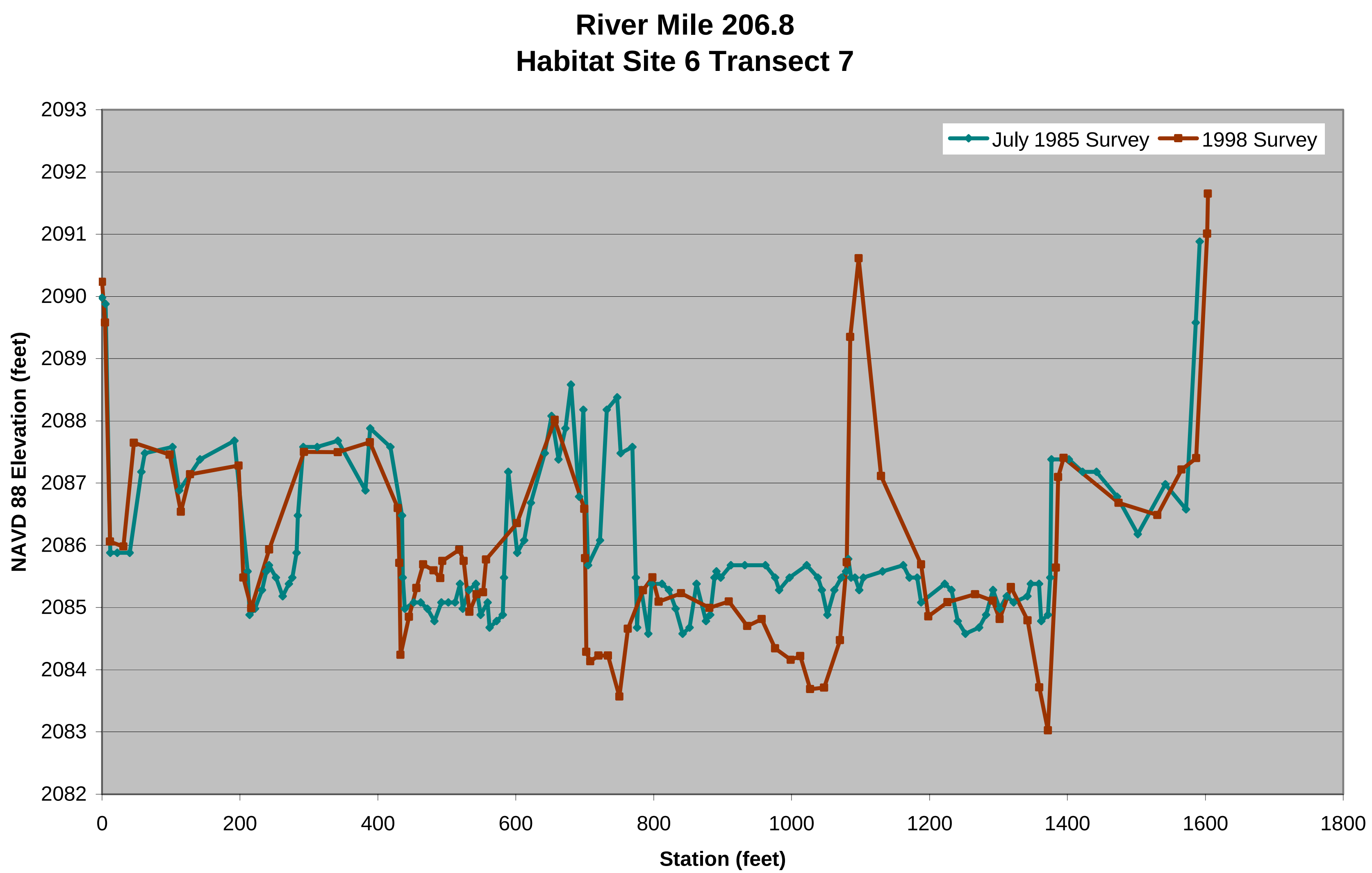

River Mile 207.2
Habitat Site 6 Transect 9
NAVD 88 Elevation (feet)
2093
2092
2091
2090
2089
2088
2087
2086
2085
2084
2083
Station (feet)
0
200
400
600
800
1000
1200
1400
1600
1800
July 1985 Survey
1998 Survey

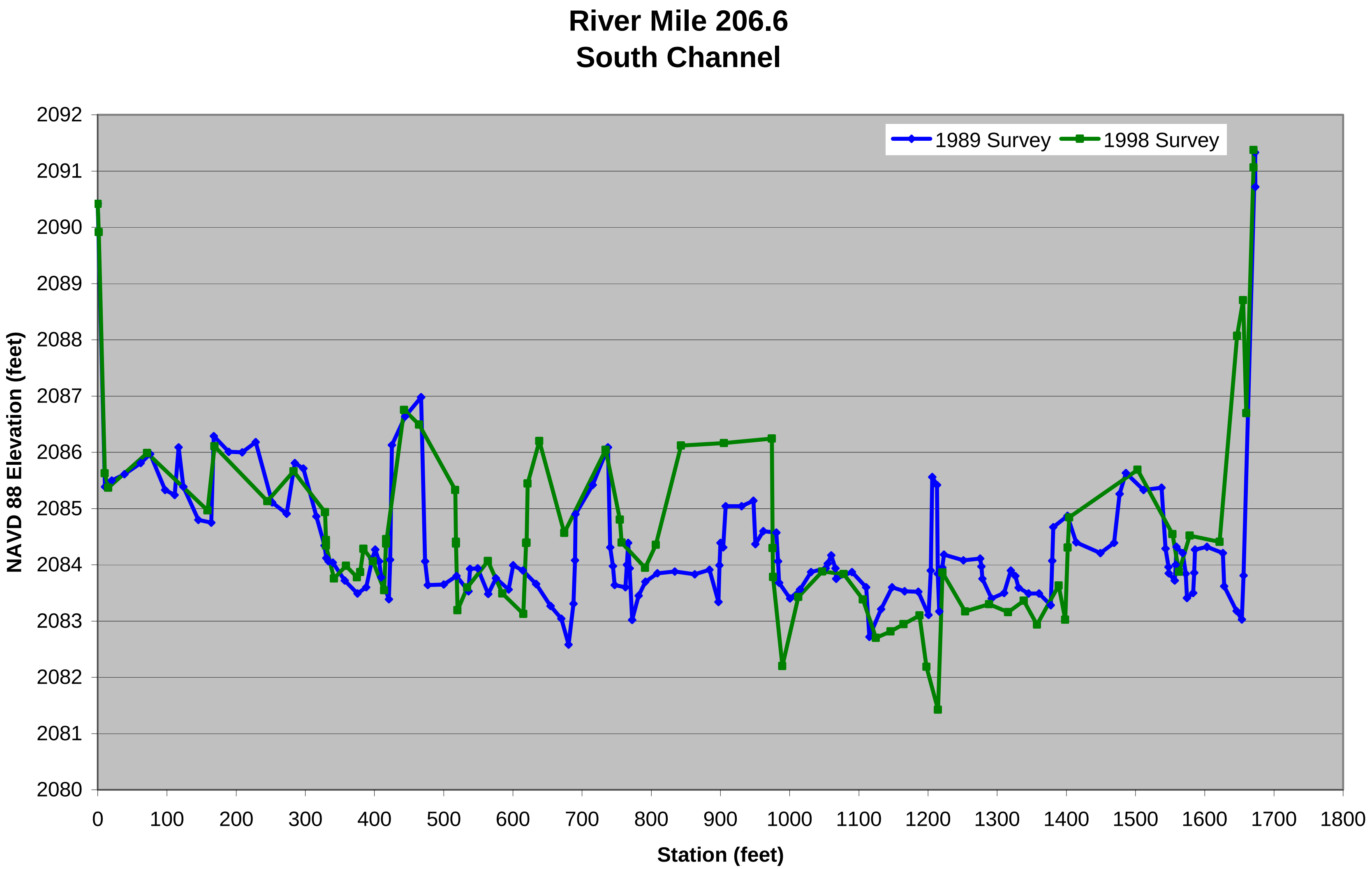
95



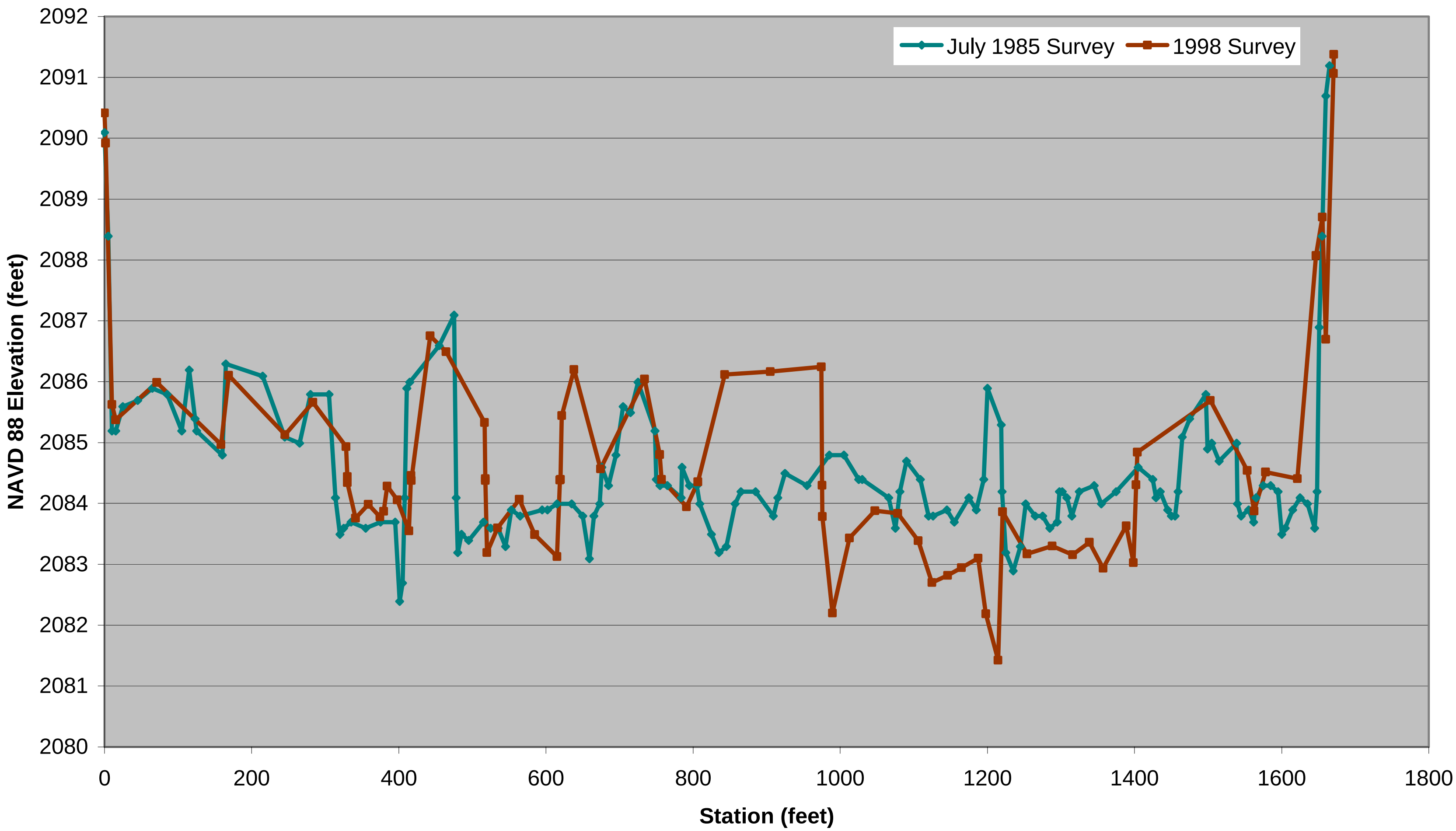
River Mile 207.0
Habitat Site 6 Transect 8
July 1985 Survey
1998 Survey
NAVD 88 Elevation (feet)
2092
2091
2090
2089
2088
2087
2086
2085
2084
2083
0
200
400
600
800
1000
1200
1400
1600
1800
Station (feet)

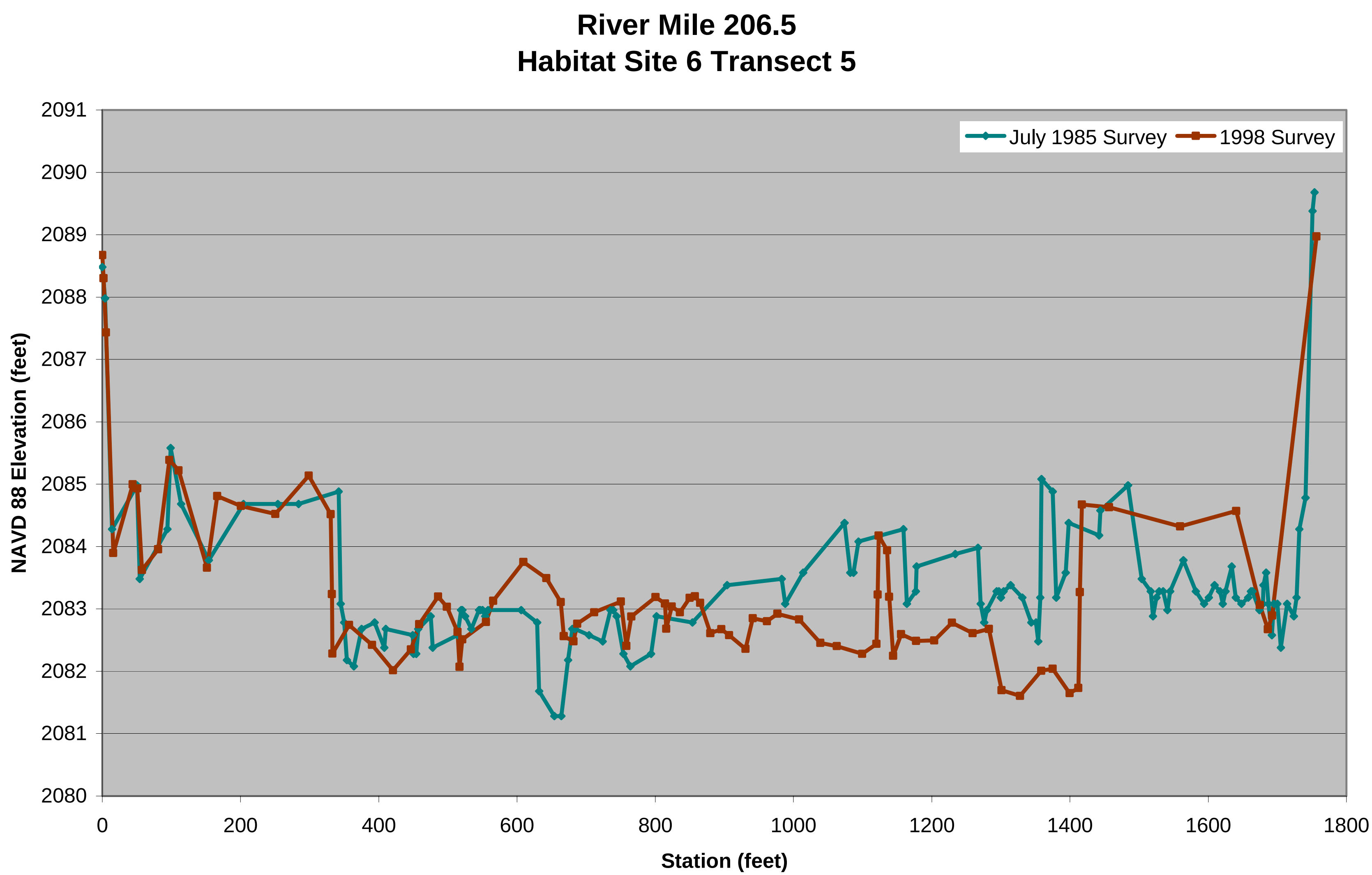
96


River Mile 206.8
Habitat Site 6 Transect 7
NAVD 88 Elevation (feet)
2082
2083
2084
2085
2086
2087
2088
2089
2090
2091
2092
2093
Station (feet)
0
200
400
600
800
1000
1200
1400
1600
1800
July 1985 Survey
1998 Survey

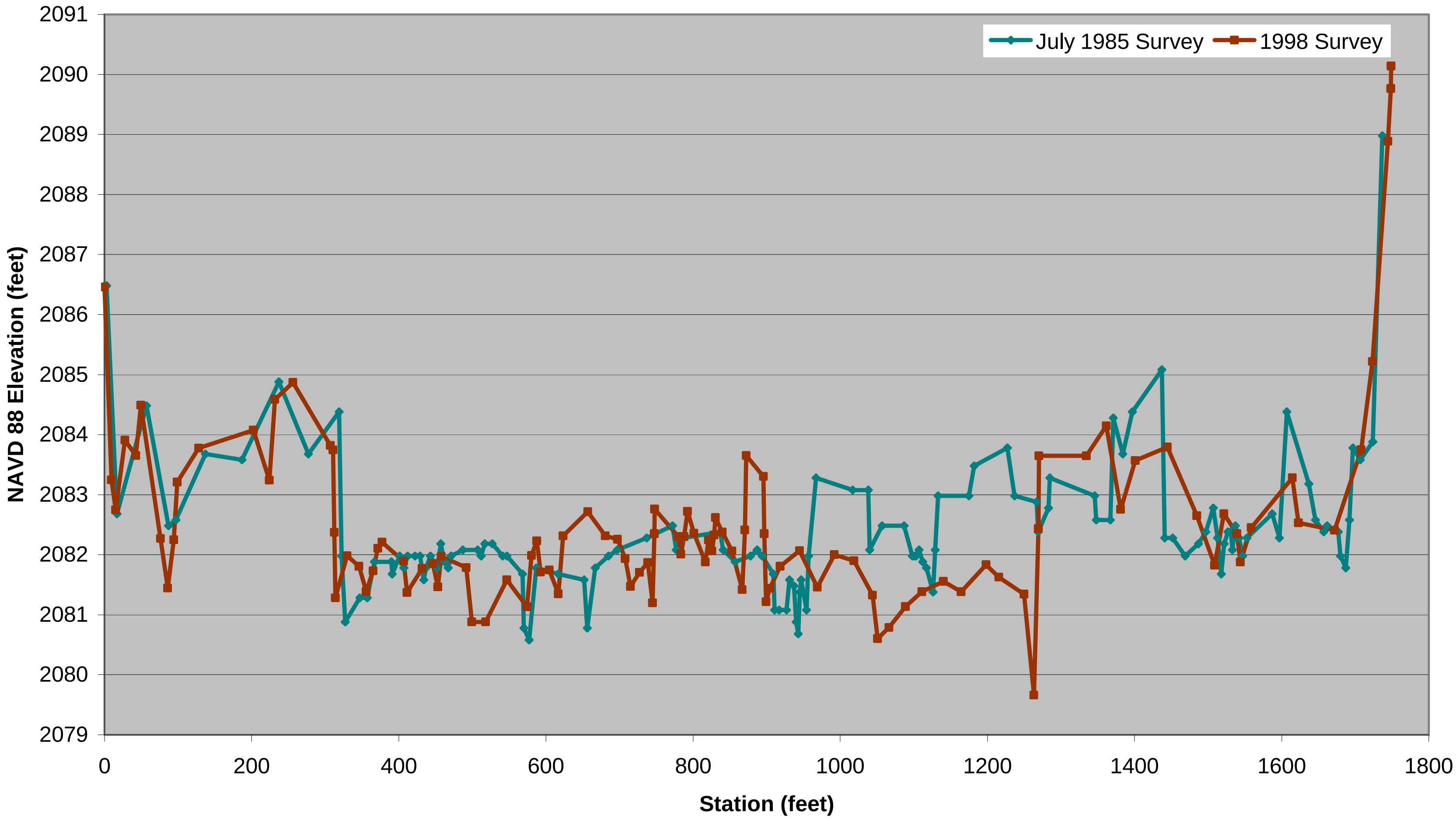

River Mile 206.6
South Channel
NAVD 88 Elevation (feet)
Station (feet)
1989 Survey
1998 Survey
2080
2081
2082
2083
2084
2085
2086
2087
2088
2089
2090
2091
2092
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
1600
1700
1800

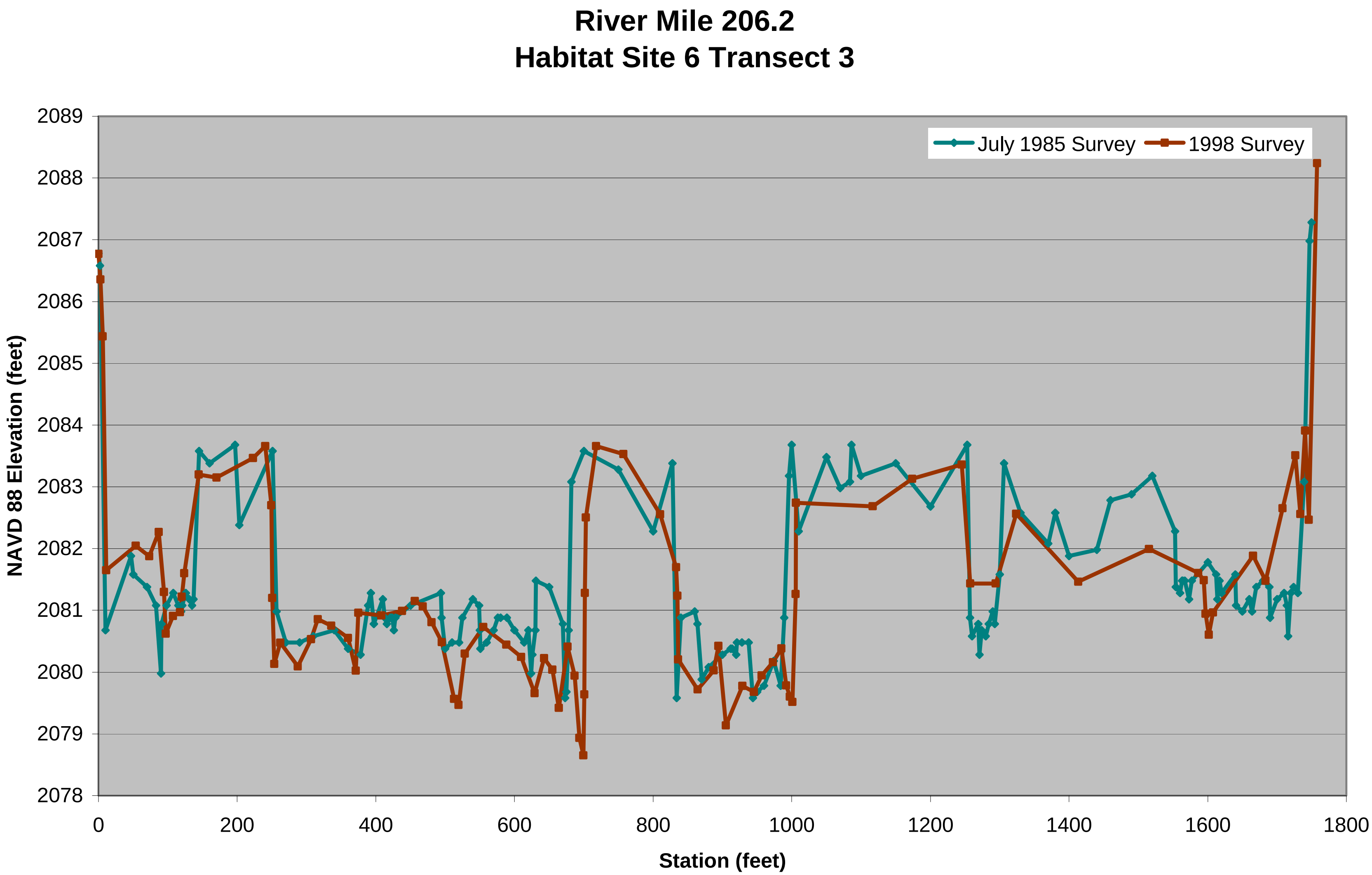
River Mile 206.6
Habitat Site 6 Transect 6

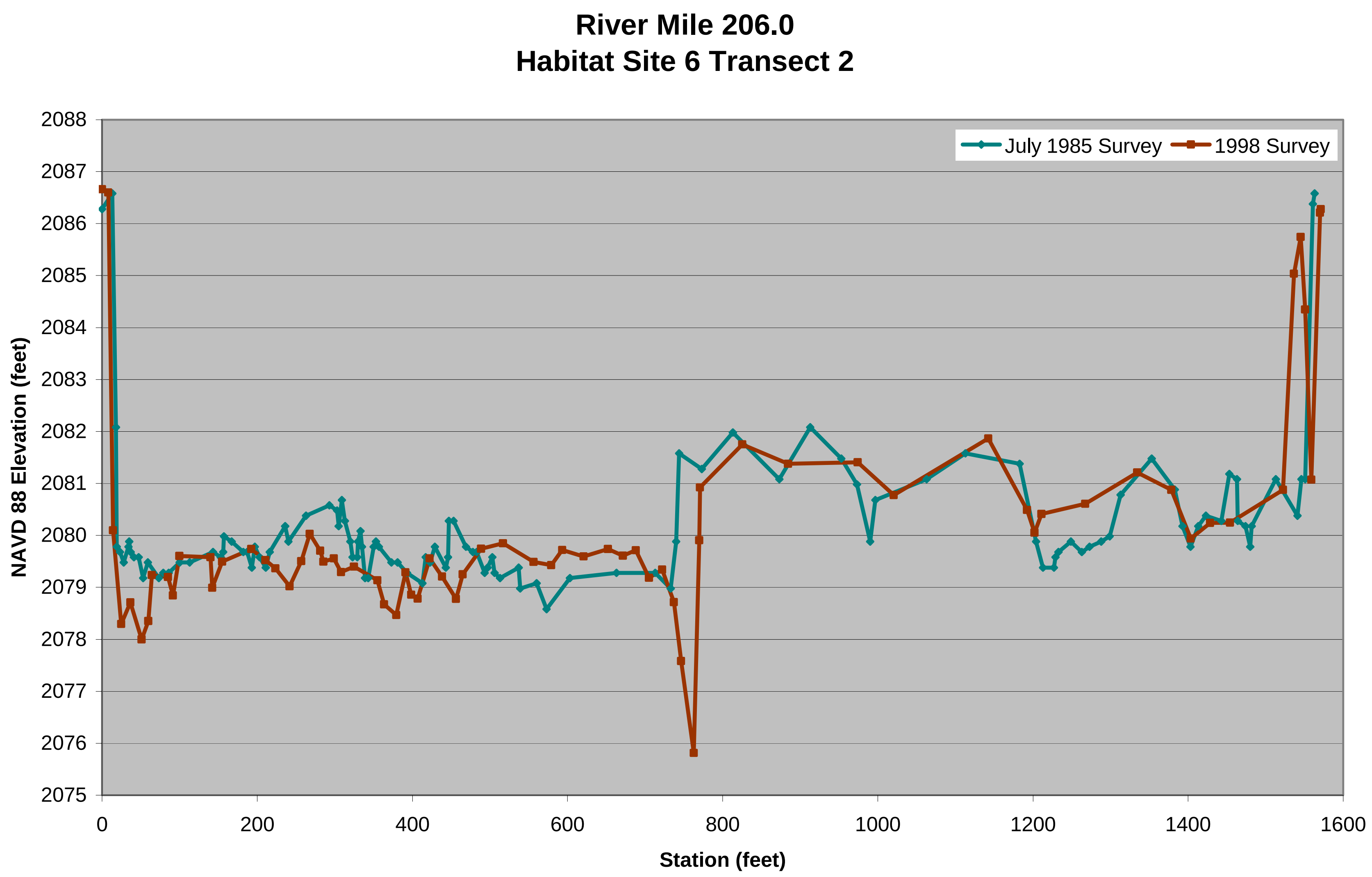



River Mile 206.5
Habitat Site 6 Transect 5
NAVD 88 Elevation (feet)
2080
2081
2082
2083
2084
2085
2086
2087
2088
2089
2090
2091
Station (feet)
0
200
400
600
800
1000
1200
1400
1600
1800
July 1985 Survey
1998 Survey

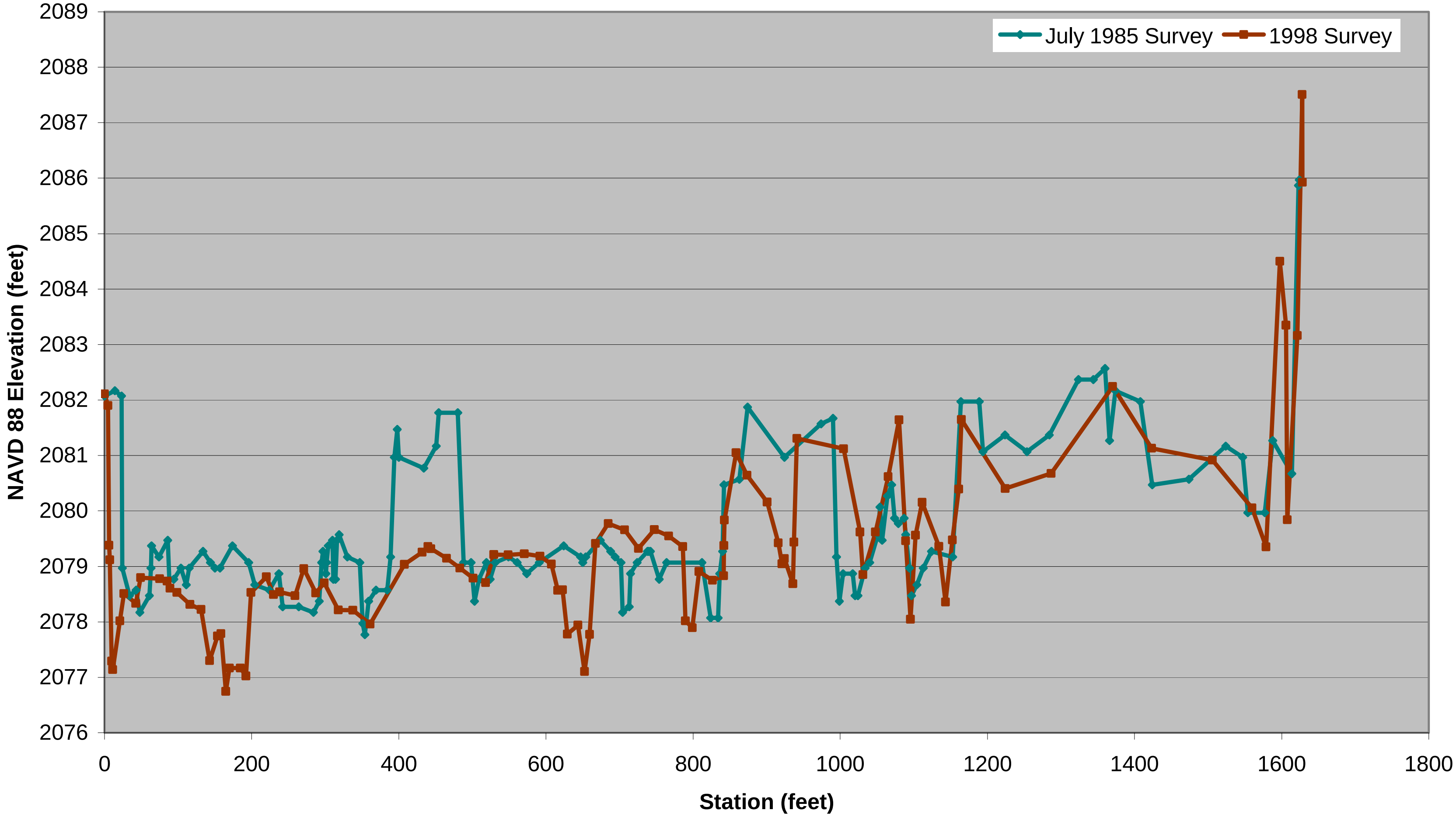
River Mile 206.4
Habitat Site 6 Transect 4

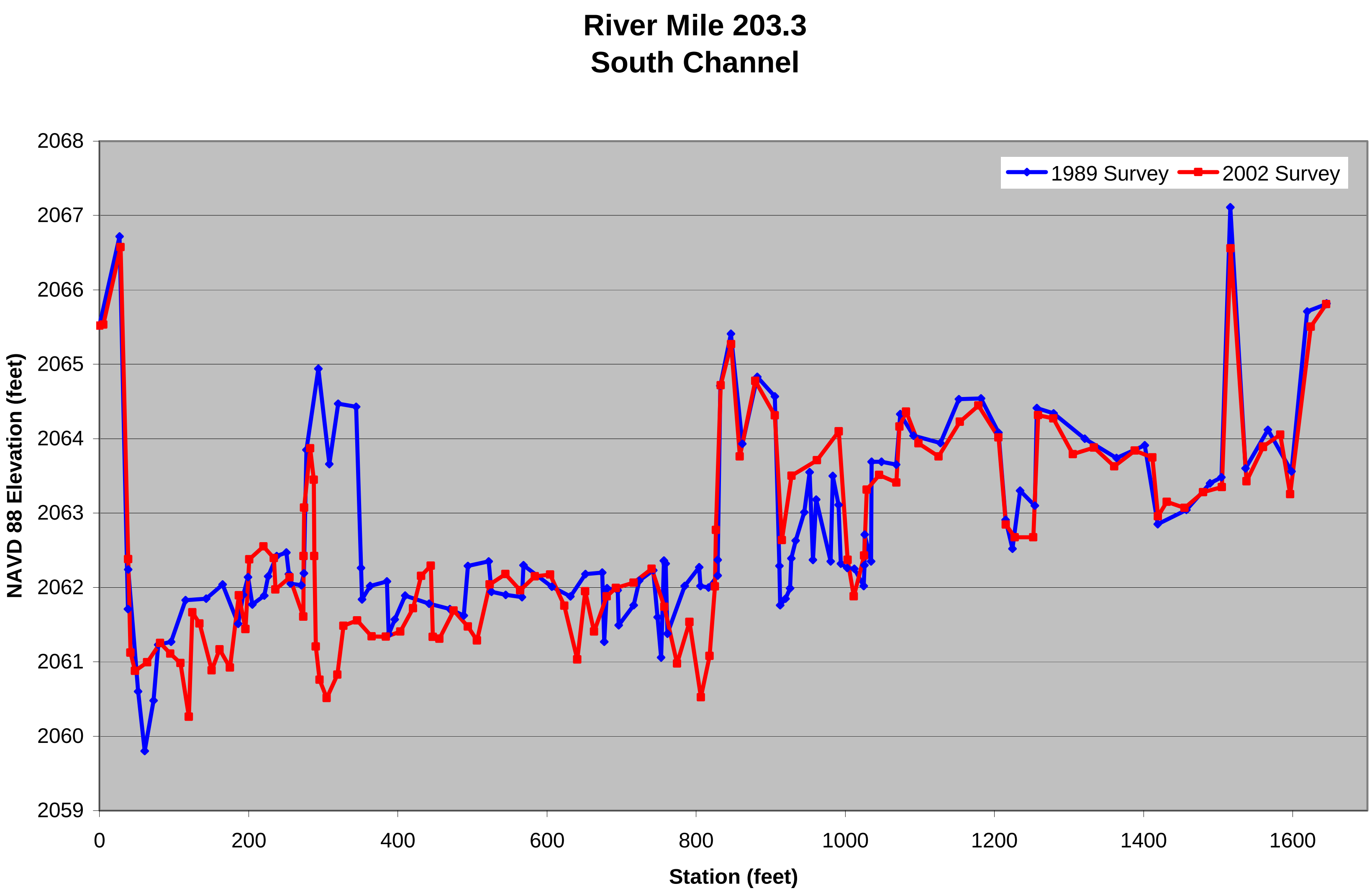


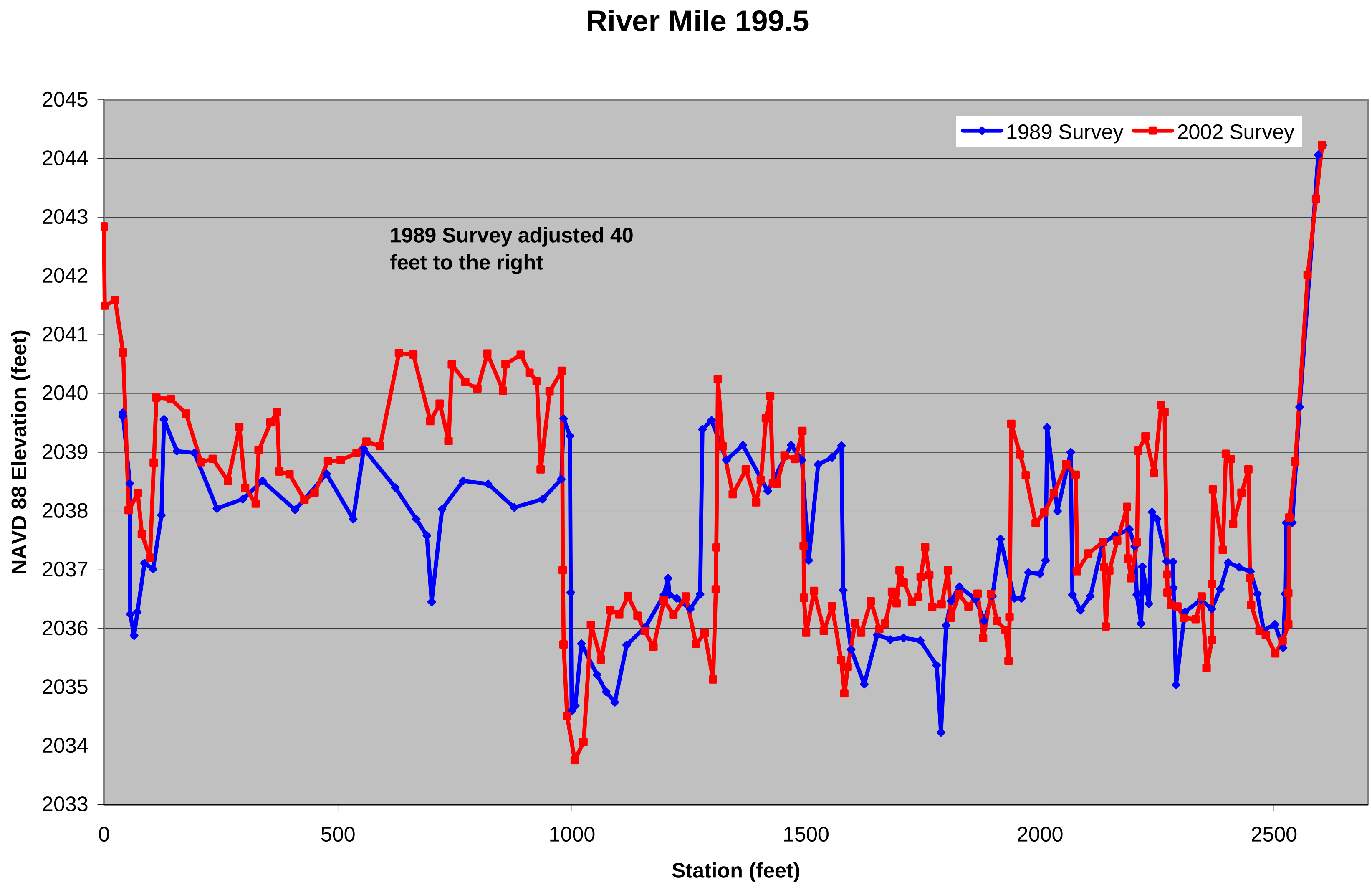

River Mile 206.2
Habitat Site 6 Transect 3
July 1985 Survey
1998 Survey
NAVD 88 Elevation (feet)
2089
2088
2087
2086
2085
2084
2083
2082
2081
2080
2079
2078
0
200
400
600
800
1000
1200
1400
1600
1800
Station (feet)

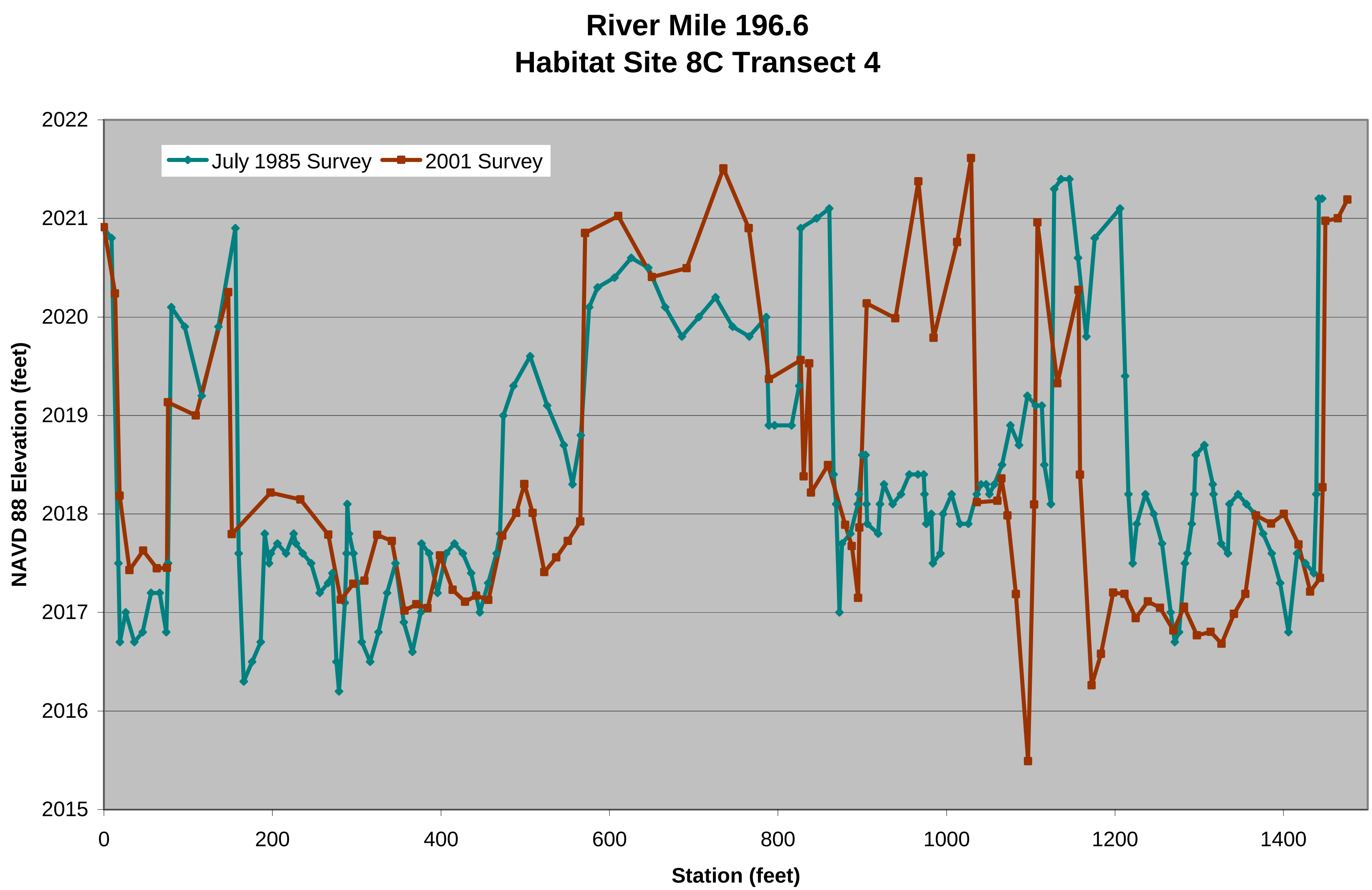

River Mile 206.0
Habitat Site 6 Transect 2
NAVD 88 Elevation (feet)
2088
2087
2086
2085
2084
2083
2082
2081
2080
2079
2078
2077
2076
2075
0
200
400
600
800
1000
1200
1400
1600
Station (feet)
July 1985 Survey
1998 Survey

River Mile 205.9
Habitat Site 6 Transect 1



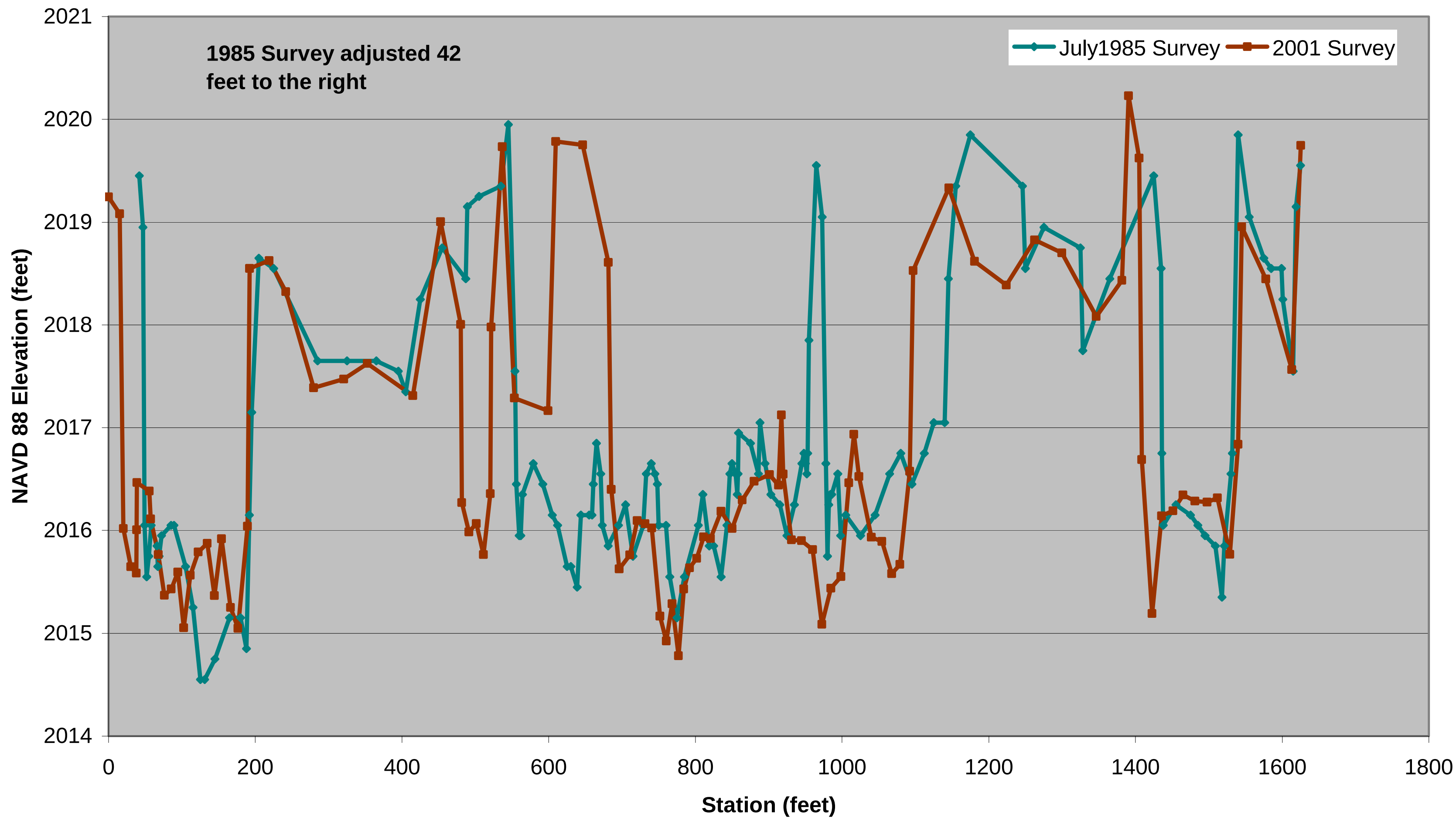

River Mile 203.3
South Channel
1989 Survey
2002 Survey
NAVD 88 Elevation (feet)
2068
2067
2066
2065
2064
2063
2062
2061
2060
2059
0
200
400
600
800
1000
1200
1400
1600
Station (feet)

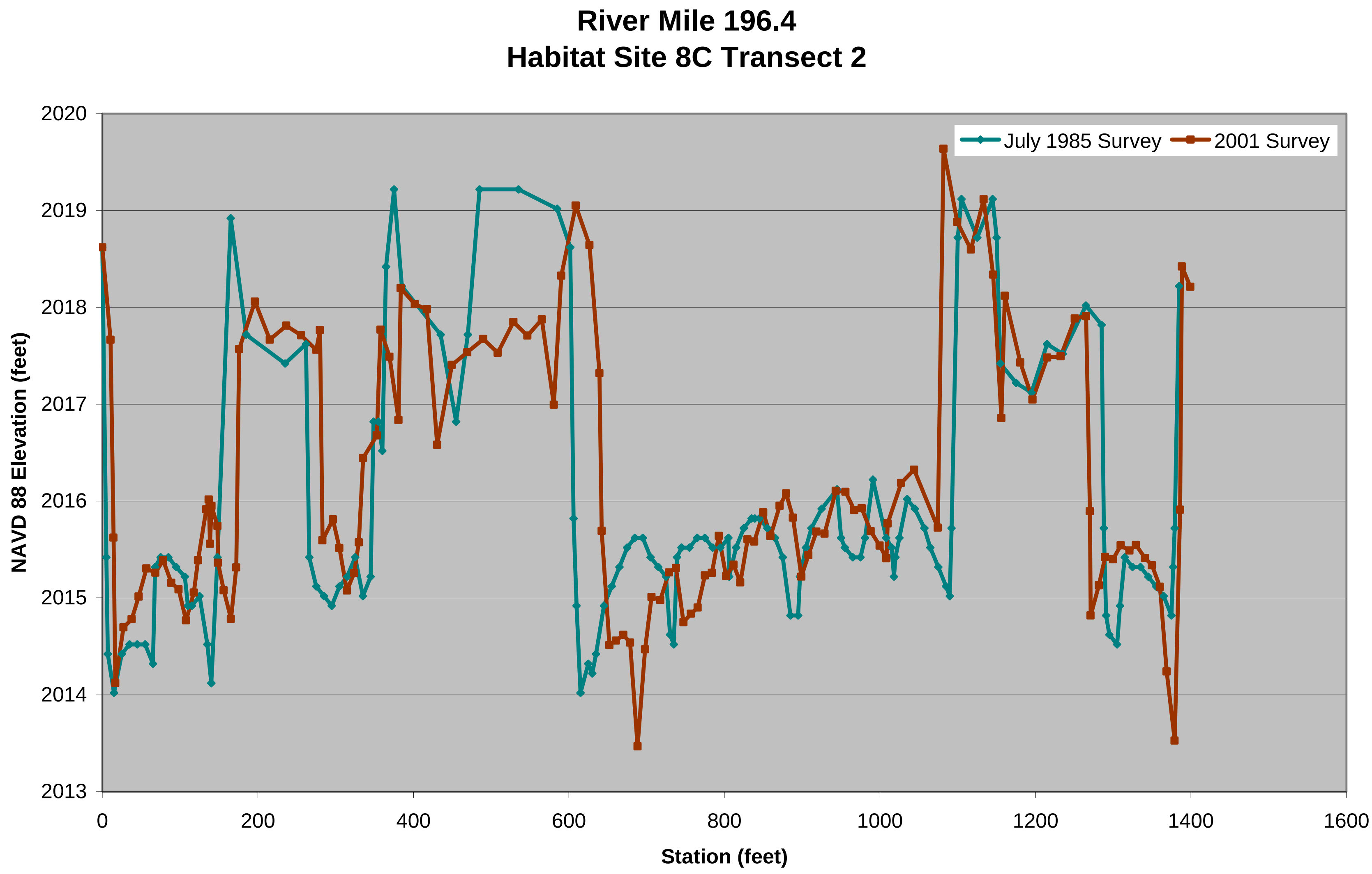

River Mile 199.5
1989 Survey
2002 Survey
1989 Survey adjusted 40 feet to the right
NAVD 88 Elevation (feet)
Station (feet)
2045
2044
2043
2042
2041
2040
2039
2038
2037
2036
2035
2034
2033
0
500
1000
1500
2000
2500



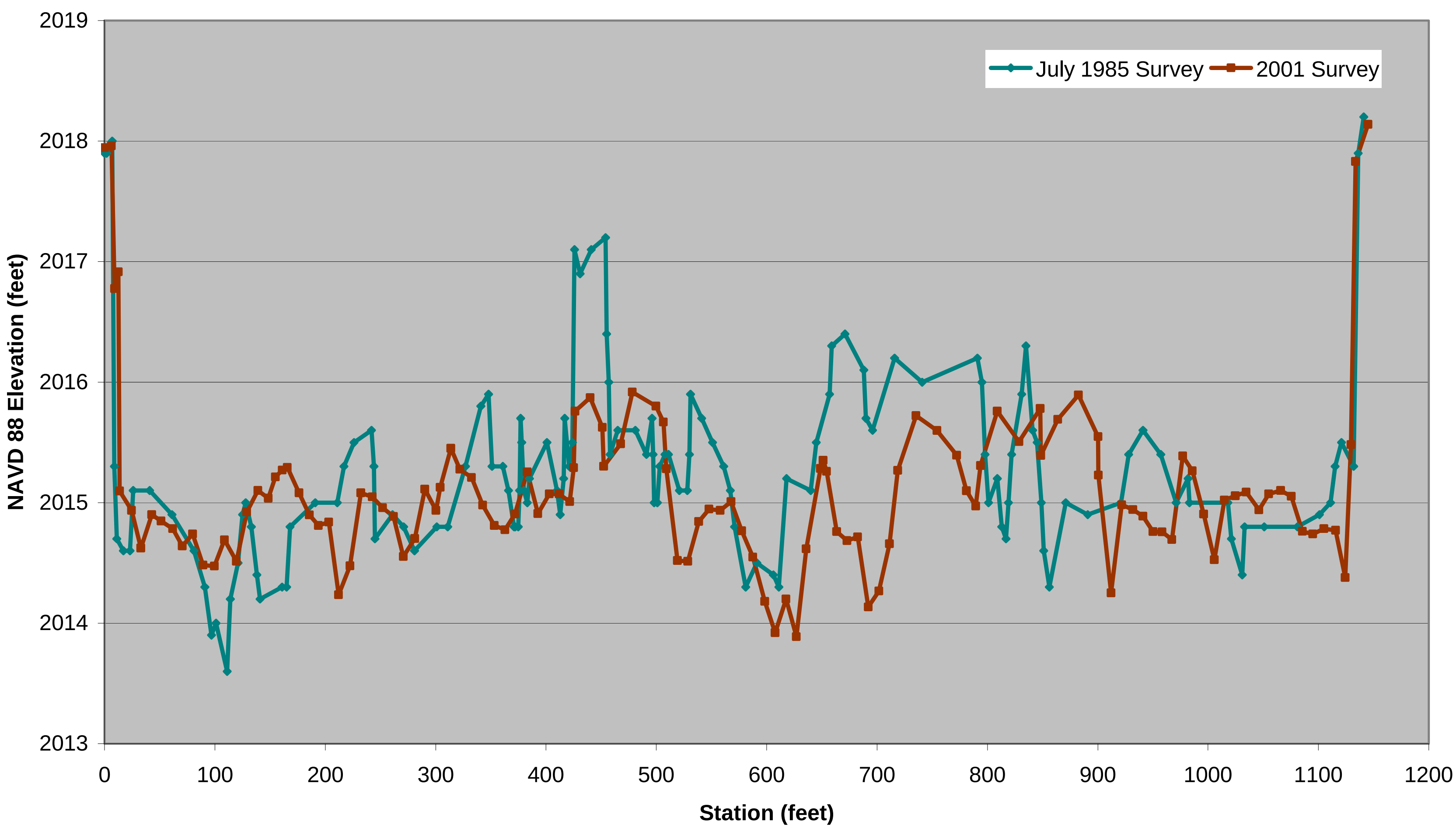
River Mile 196.6
Habitat Site 8C Transect 4
July 1985 Survey
2001 Survey
NAVD 88 Elevation (feet)
2022
2021
2020
2019
2018
2017
2016
2015
Station (feet)
0
200
400
600
800
1000
1200
1400

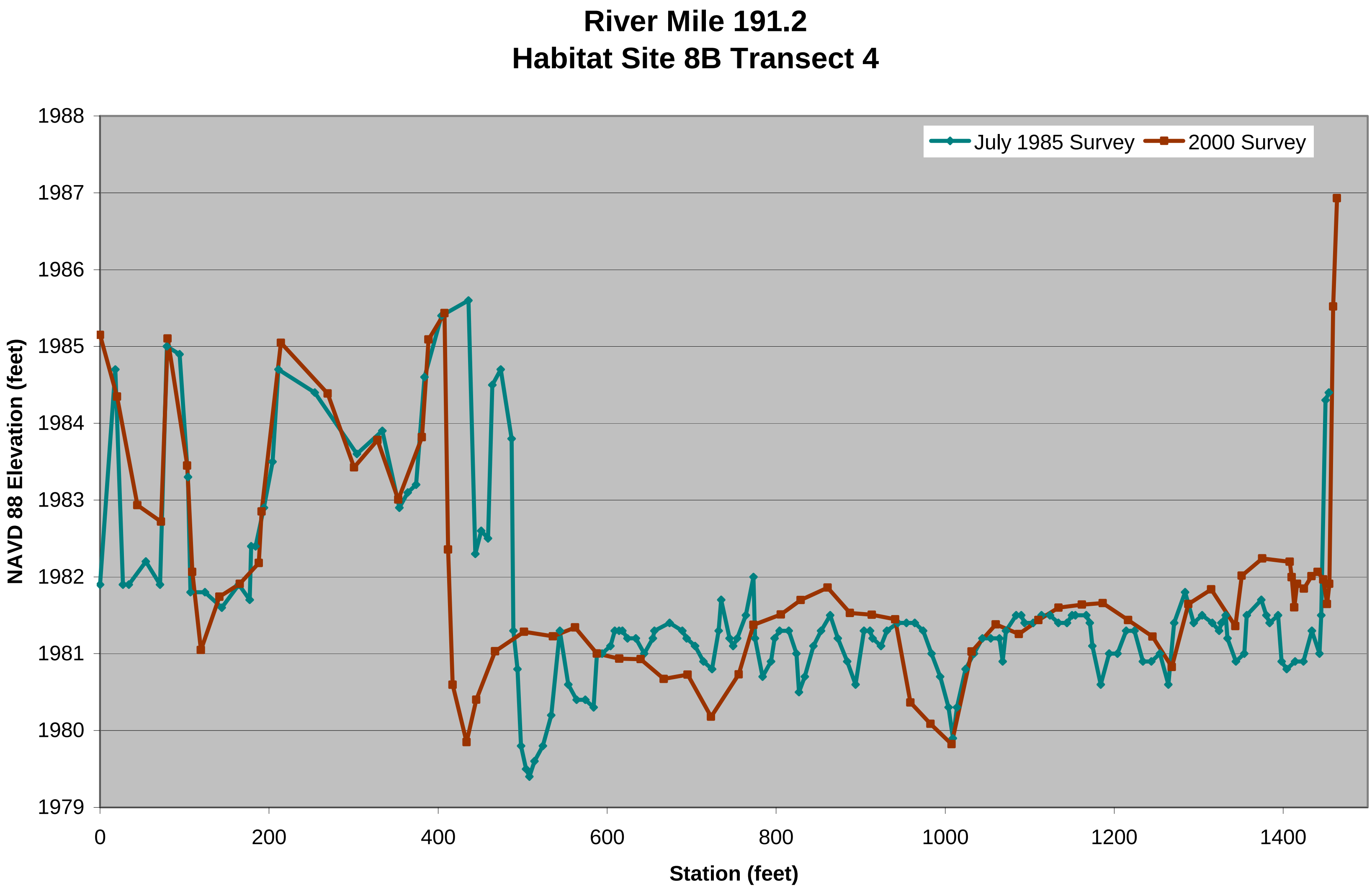
River Mile 196.5
Habitat Site 8C Transect 3



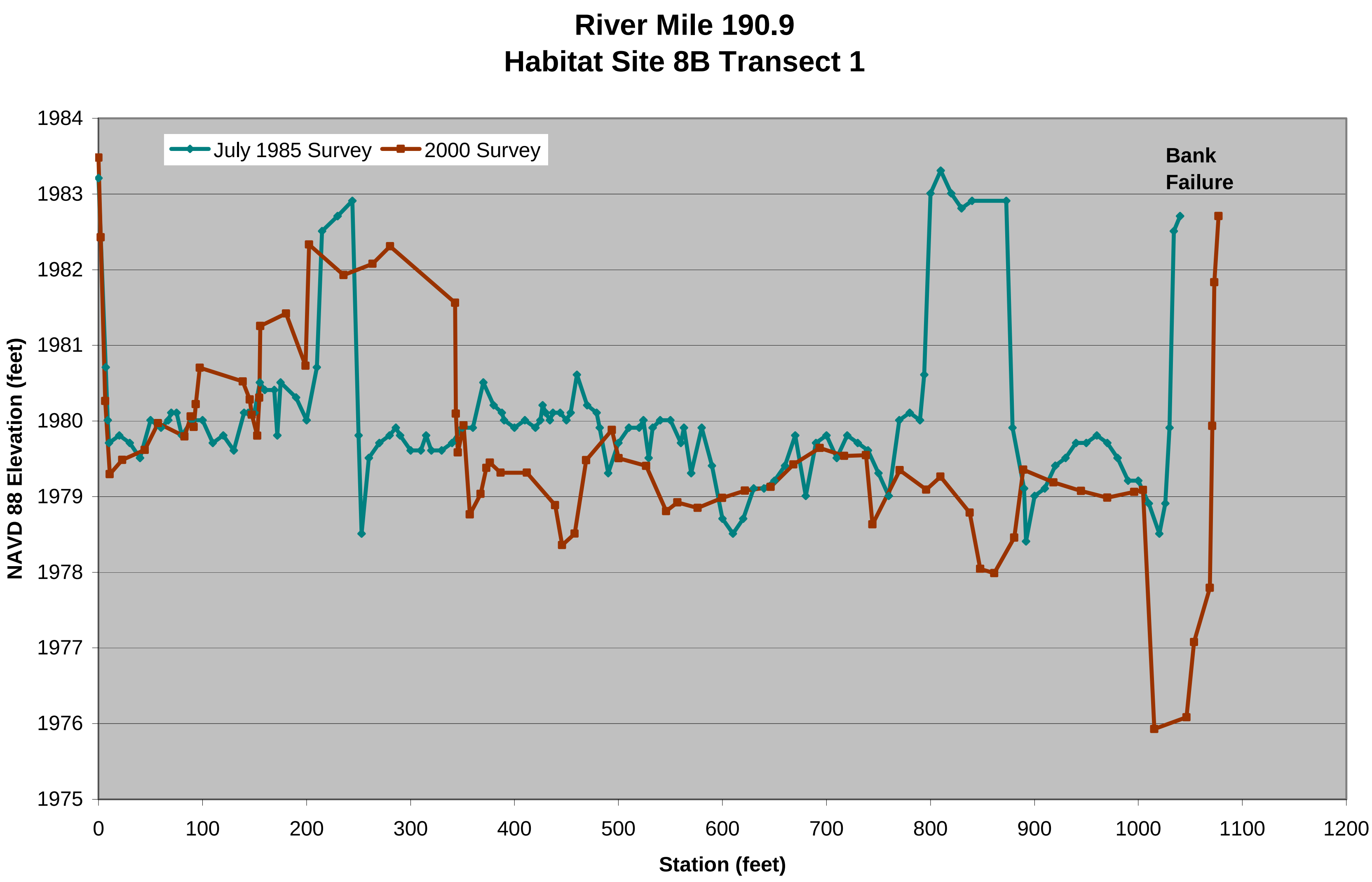

River Mile 196.4
Habitat Site 8C Transect 2
July 1985 Survey
2001 Survey
NAVD 88 Elevation (feet)
2020
2019
2018
2017
2016
2015
2014
2013
0
200
400
600
800
1000
1200
1400
1600
Station (feet)

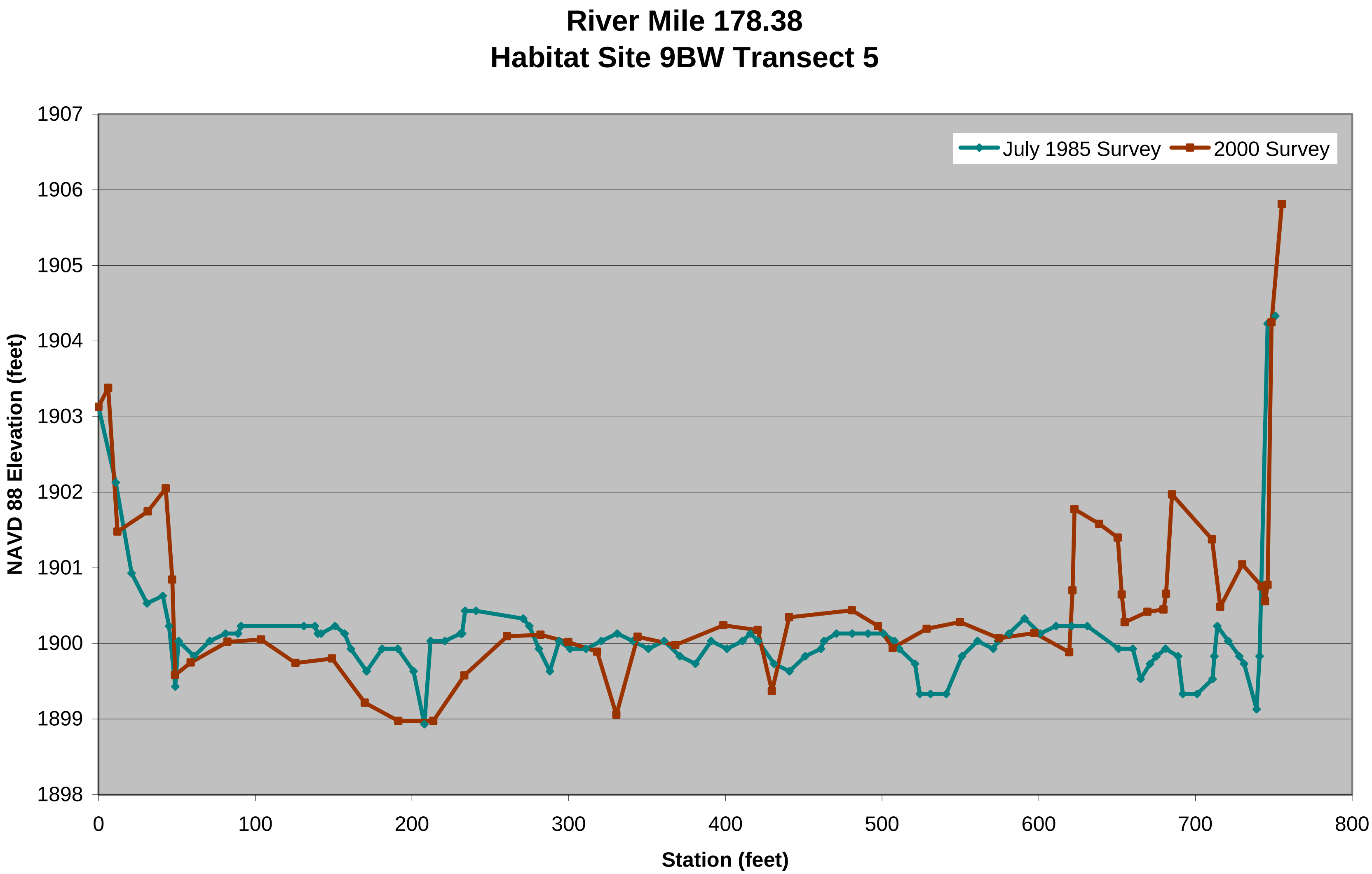
River Mile 196.3
Habitat Site 8C Transect 1

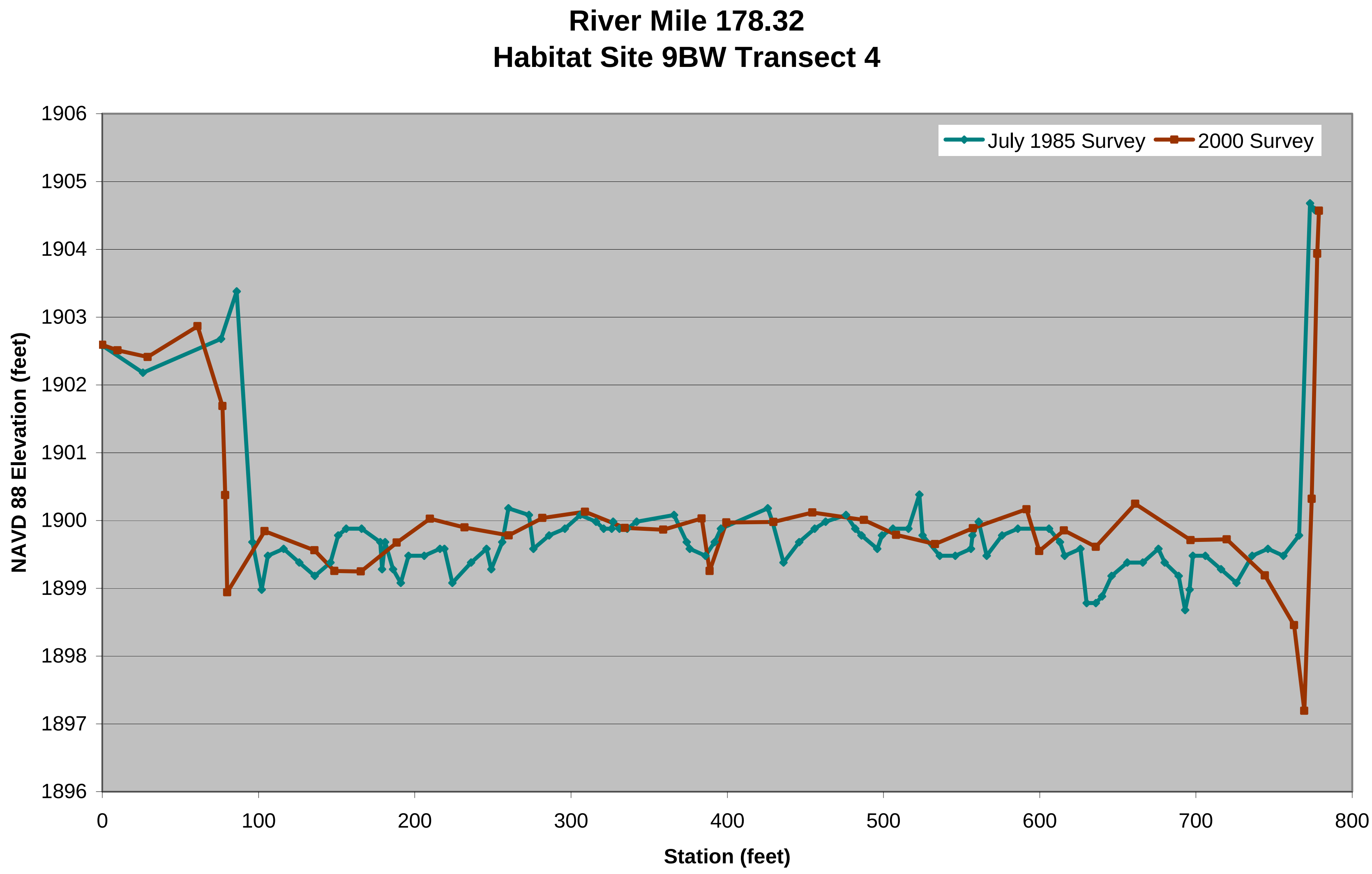


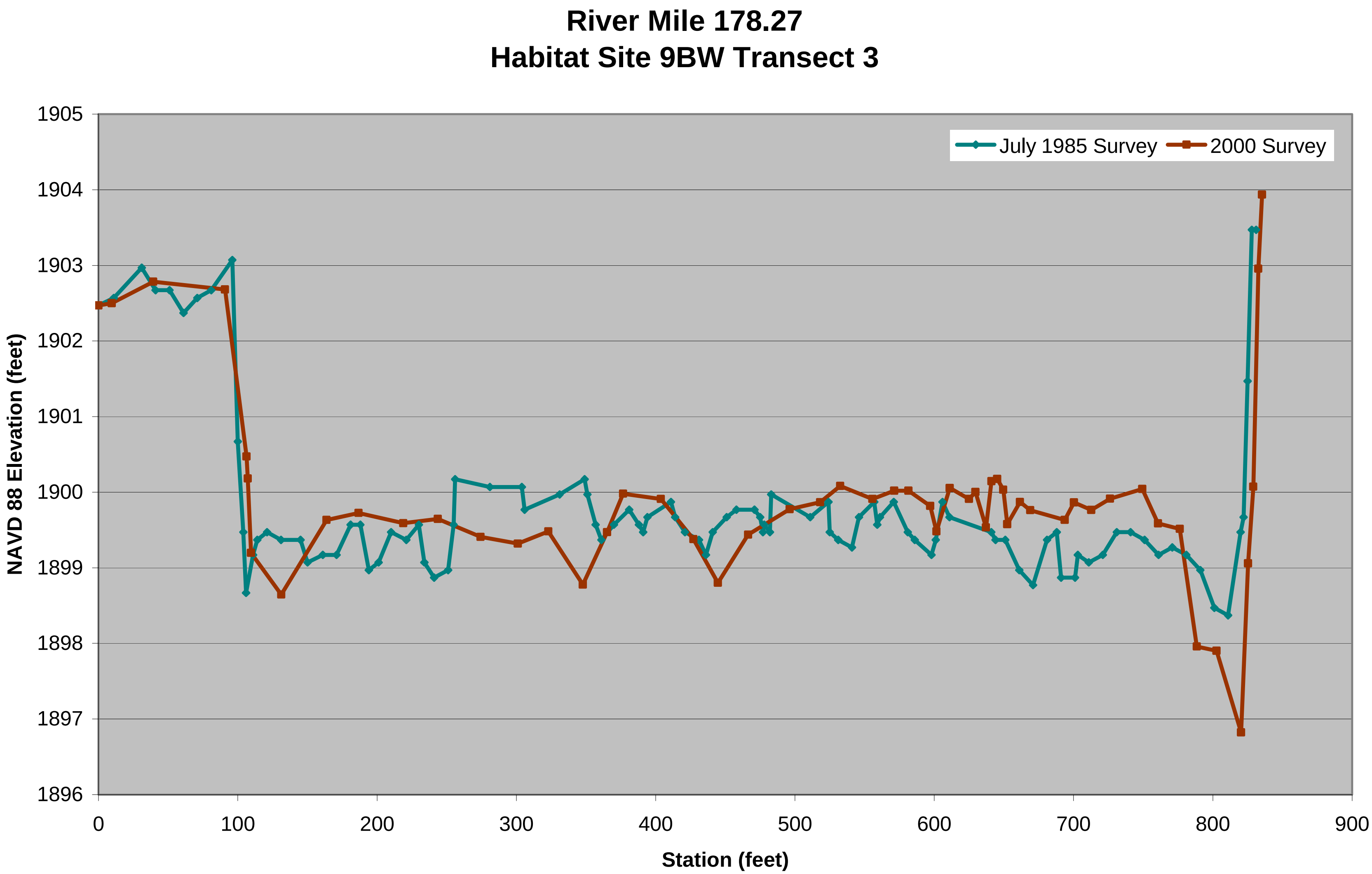


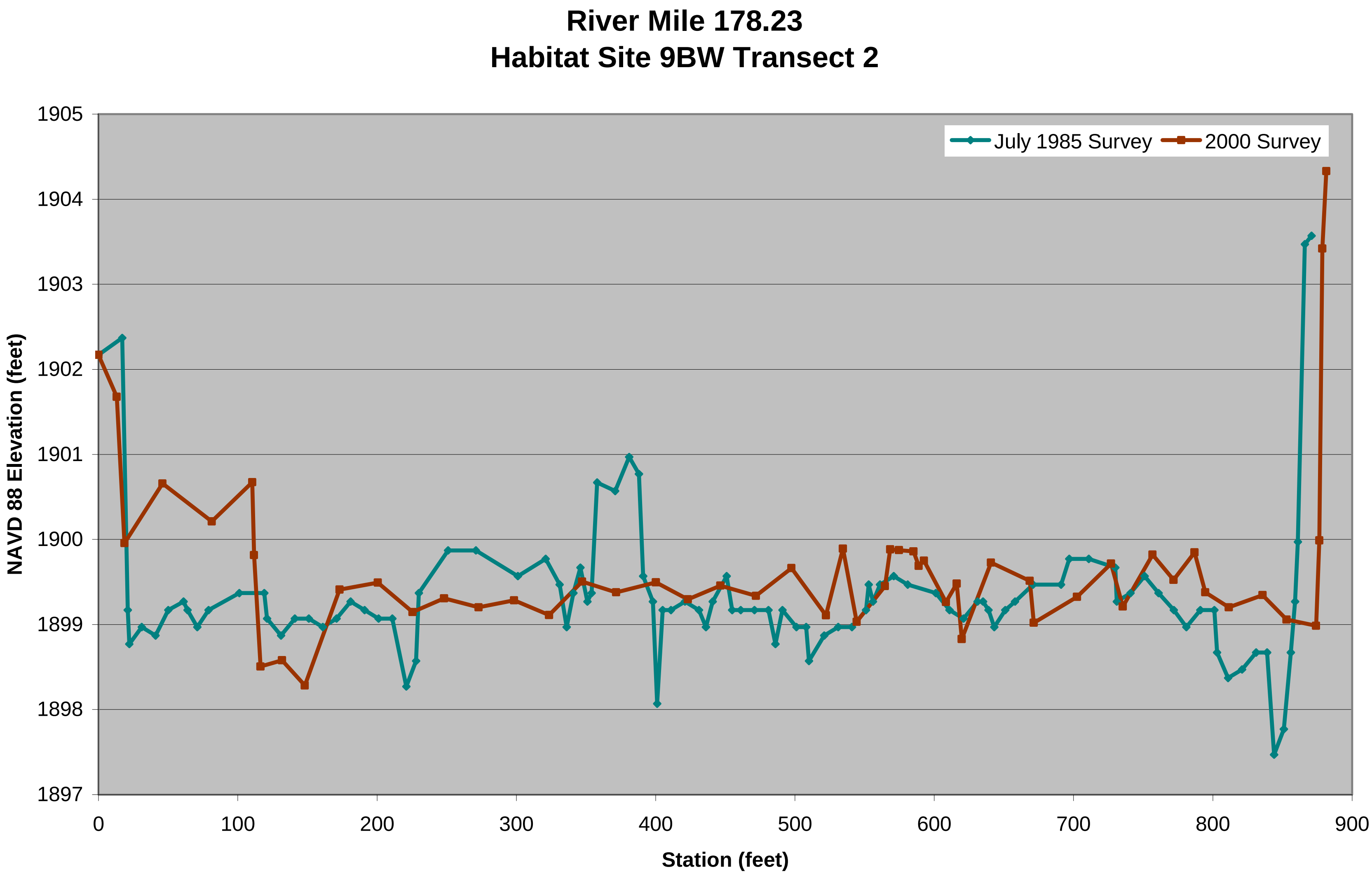
River Mile 191.2
Habitat Site 8B Transect 4
July 1985 Survey
2000 Survey
NAVD 88 Elevation (feet)
Station (feet)
1988
1987
1986
1985
1984
1983
1982
1981
1980
1979
0
200
400
600
800
1000
1200
1400

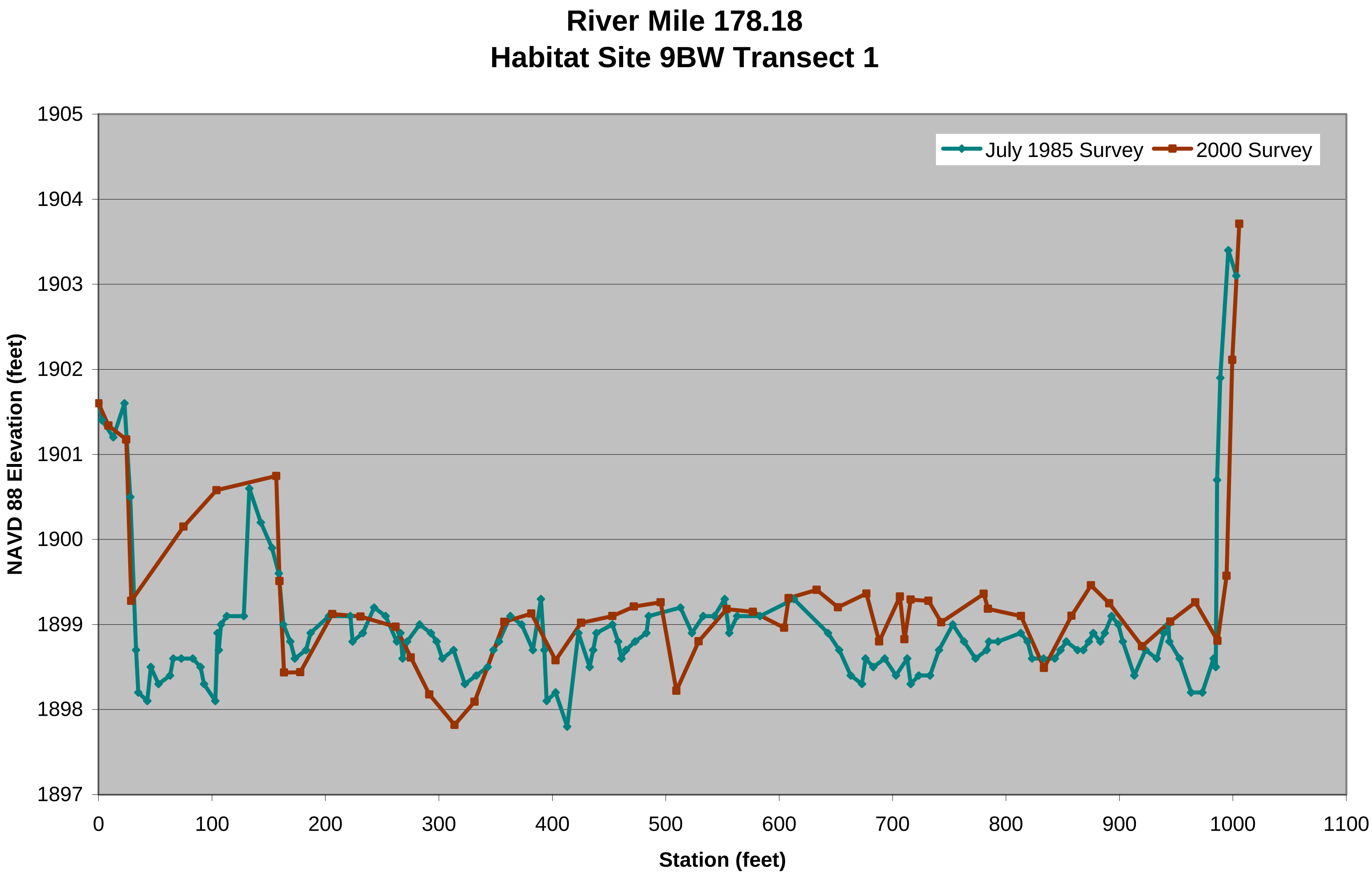

River Mile 190.9
Habitat Site 8B Transect 1
July 1985 Survey
2000 Survey
Bank
Failure
NAVD 88 Elevation (feet)
Station (feet)
1984
1983
1982
1981
1980
1979
1978
1977
1976
1975
0
100
200
300
400
500
600
700
800
900
1000
1100
1200

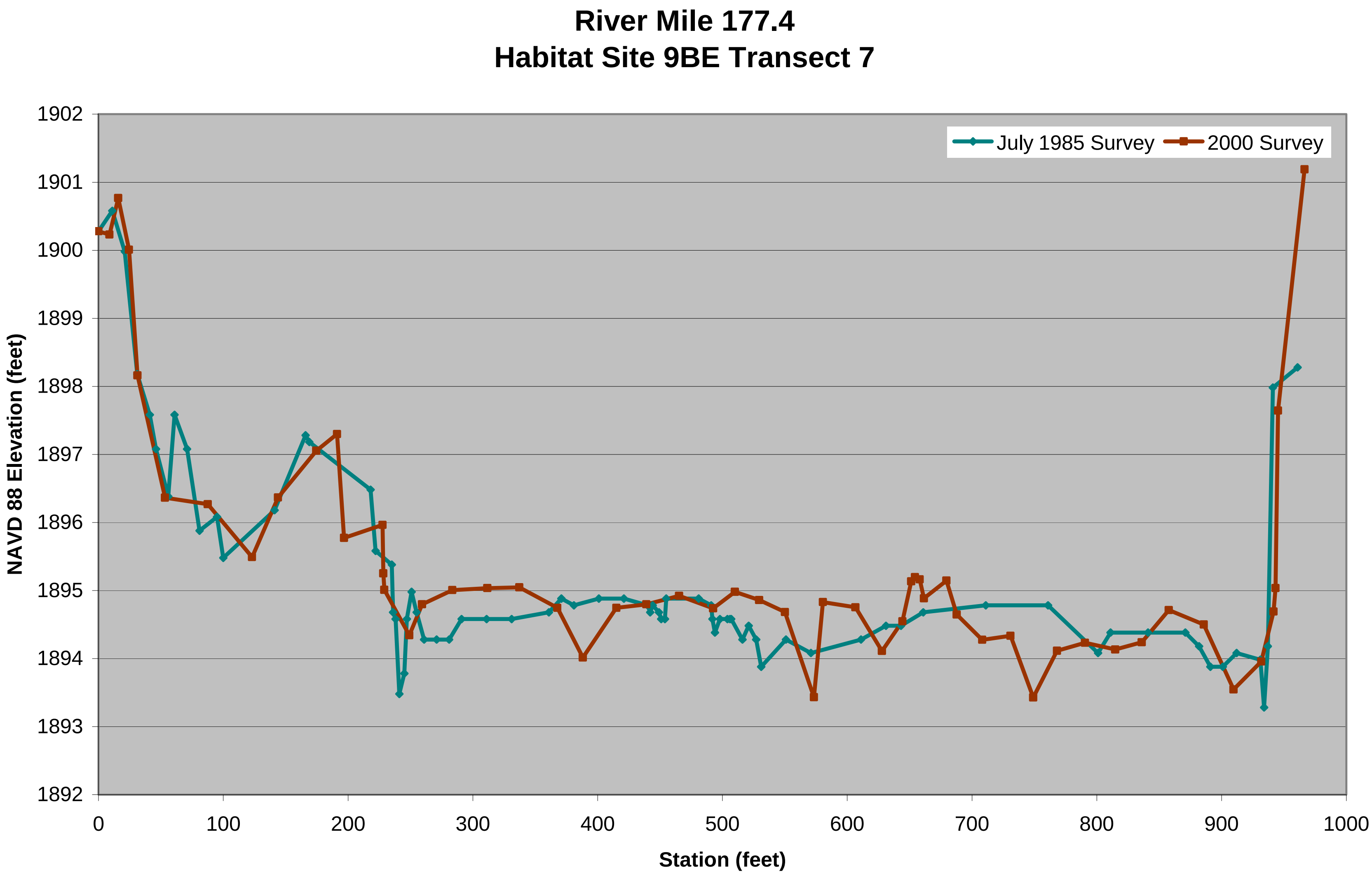

River Mile 178.38
Habitat Site 9BW Transect 5
July 1985 Survey
2000 Survey
NAVD 88 Elevation (feet)
Station (feet)
1898
1899
1900
1901
1902
1903
1904
1905
1906
1907
0
100
200
300
400
500
600
700
800

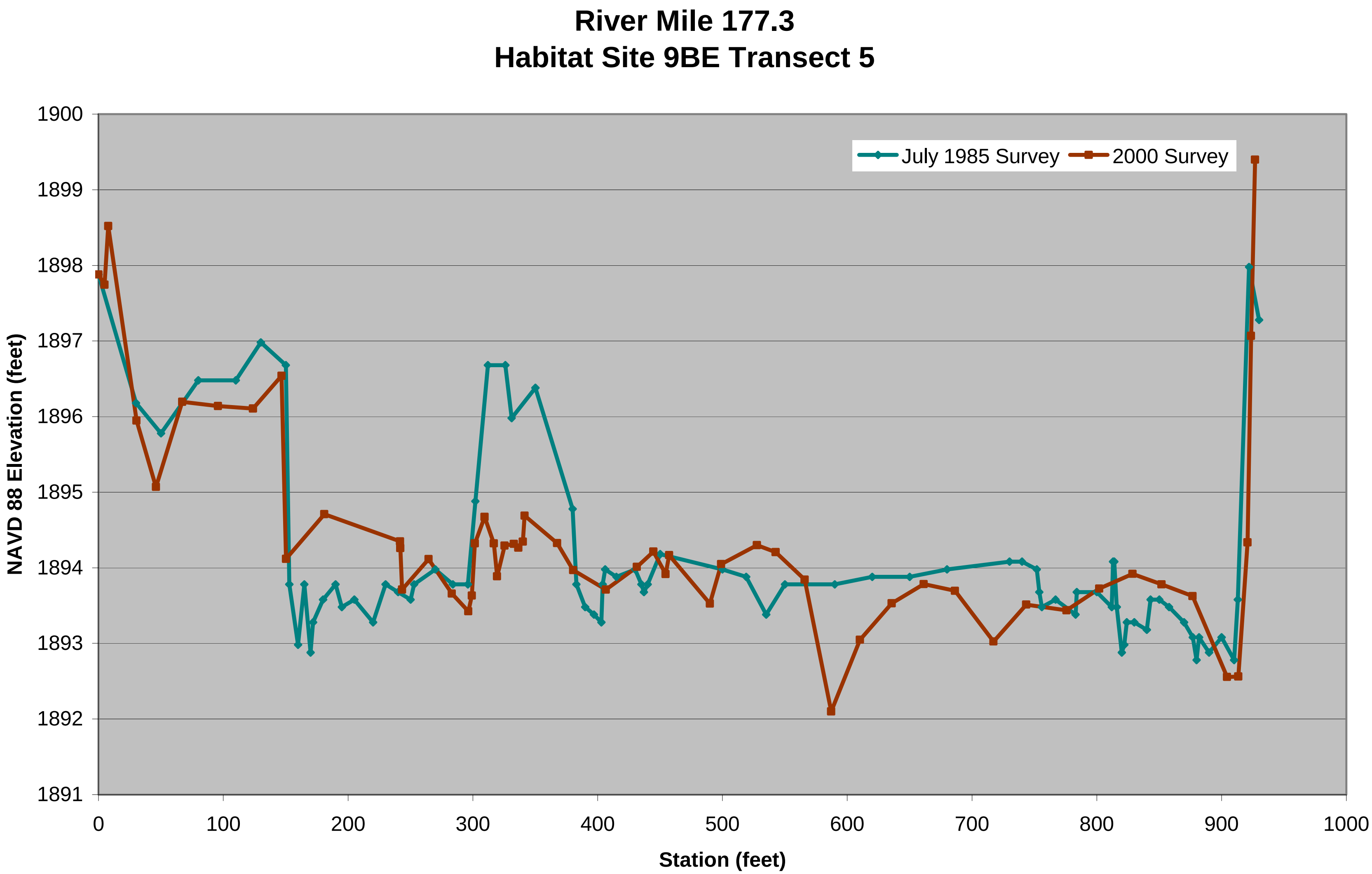

River Mile 178.32
Habitat Site 9BW Transect 4
July 1985 Survey
2000 Survey
NAVD 88 Elevation (feet)
1906
1905
1904
1903
1902
1901
1900
1899
1898
1897
1896
0
100
200
300
400
500
600
700
800
Station (feet)


River Mile 178.27
Habitat Site 9BW Transect 3
July 1985 Survey
2000 Survey
NAVD 88 Elevation (feet)
Station (feet)
1905
1904
1903
1902
1901
1900
1899
1898
1897
1896
0
100
200
300
400
500
600
700
800
900

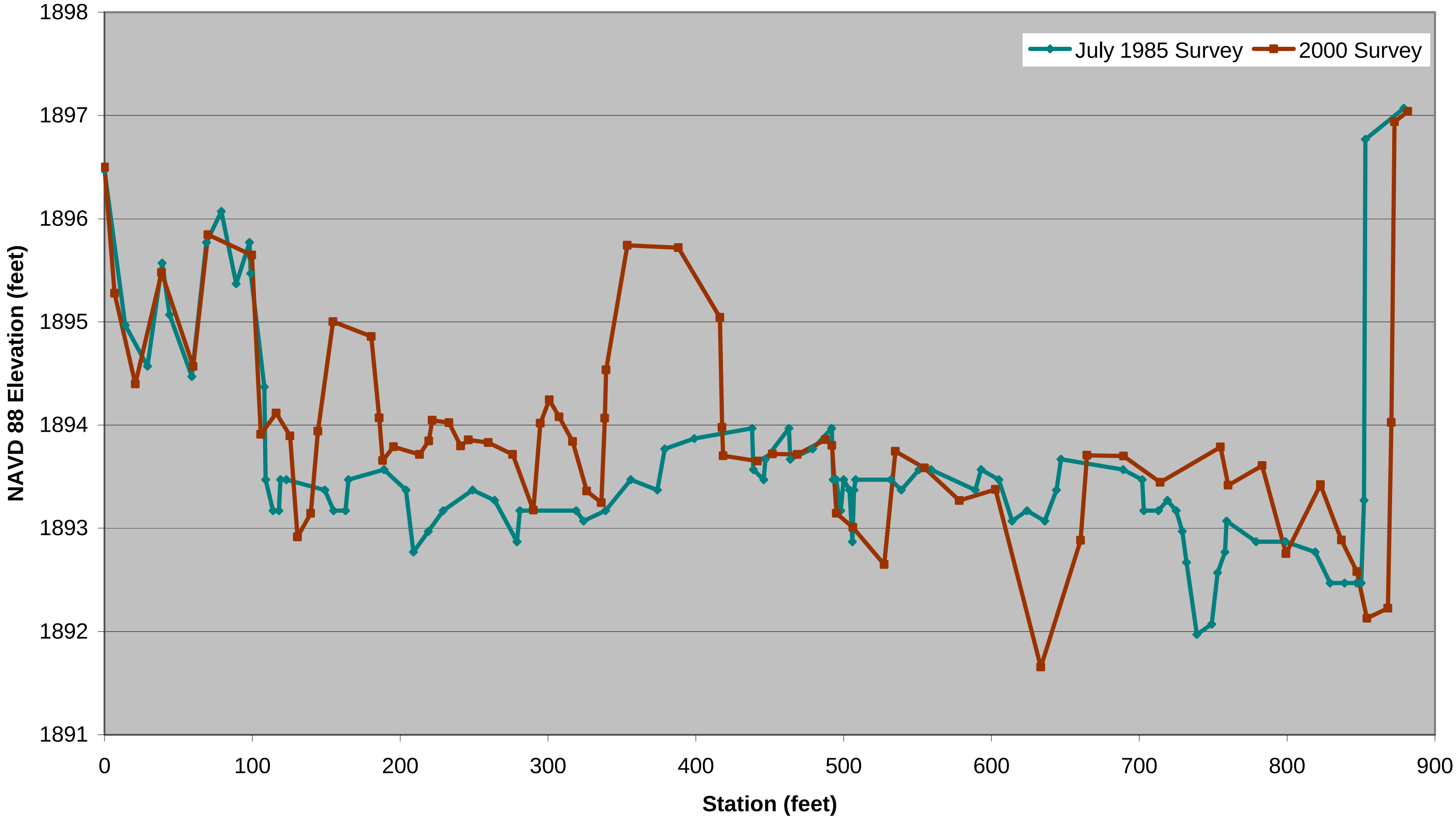

River Mile 178.23
Habitat Site 9BW Transect 2
July 1985 Survey
2000 Survey
NAVD 88 Elevation (feet)
1905
1904
1903
1902
1901
1900
1899
1898
1897
0
100
200
300
400
500
600
700
800
900
Station (feet)

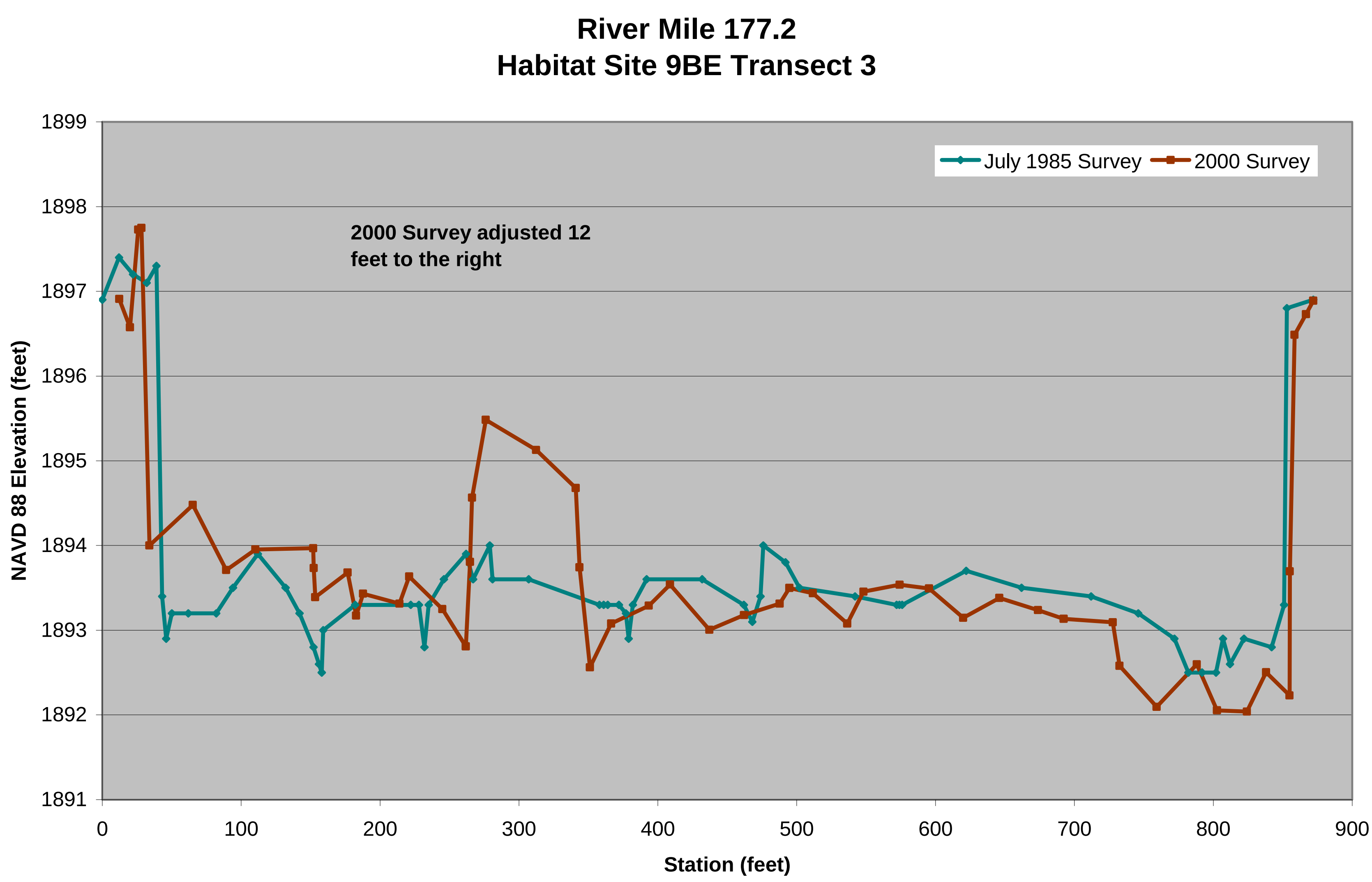

River Mile 178.18
Habitat Site 9BW Transect 1
July 1985 Survey
2000 Survey
NAVD 88 Elevation (feet)
Station (feet)
1905
1904
1903
1902
1901
1900
1899
1898
1897
0
100
200
300
400
500
600
700
800
900
1000
1100


River Mile 177.4
Habitat Site 9BE Transect 7
NAVD 88 Elevation (feet)
Station (feet)
July 1985 Survey
2000 Survey
1902
1901
1900
1899
1898
1897
1896
1895
1894
1893
1892
0
100
200
300
400
500
600
700
800
900
1000

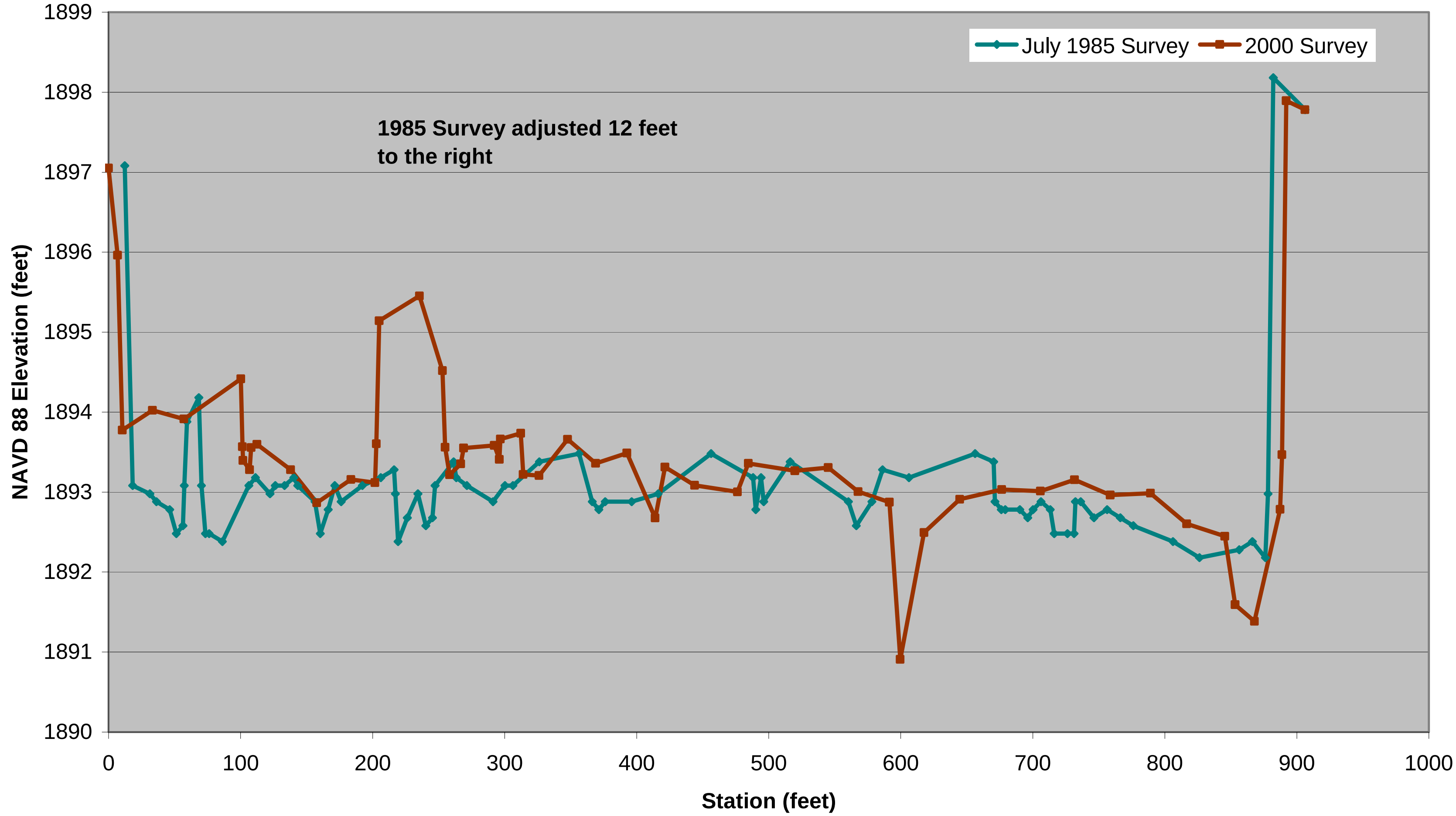

River Mile 177.3
Habitat Site 9BE Transect 5
NAVD 88 Elevation (feet)
1900
1899
1898
1897
1896
1895
1894
1893
1892
1891
0
100
200
300
400
500
600
700
800
900
1000
Station (feet)
July 1985 Survey
2000 Survey

River Mile 177.25
Habitat Site 9BE Transect 4

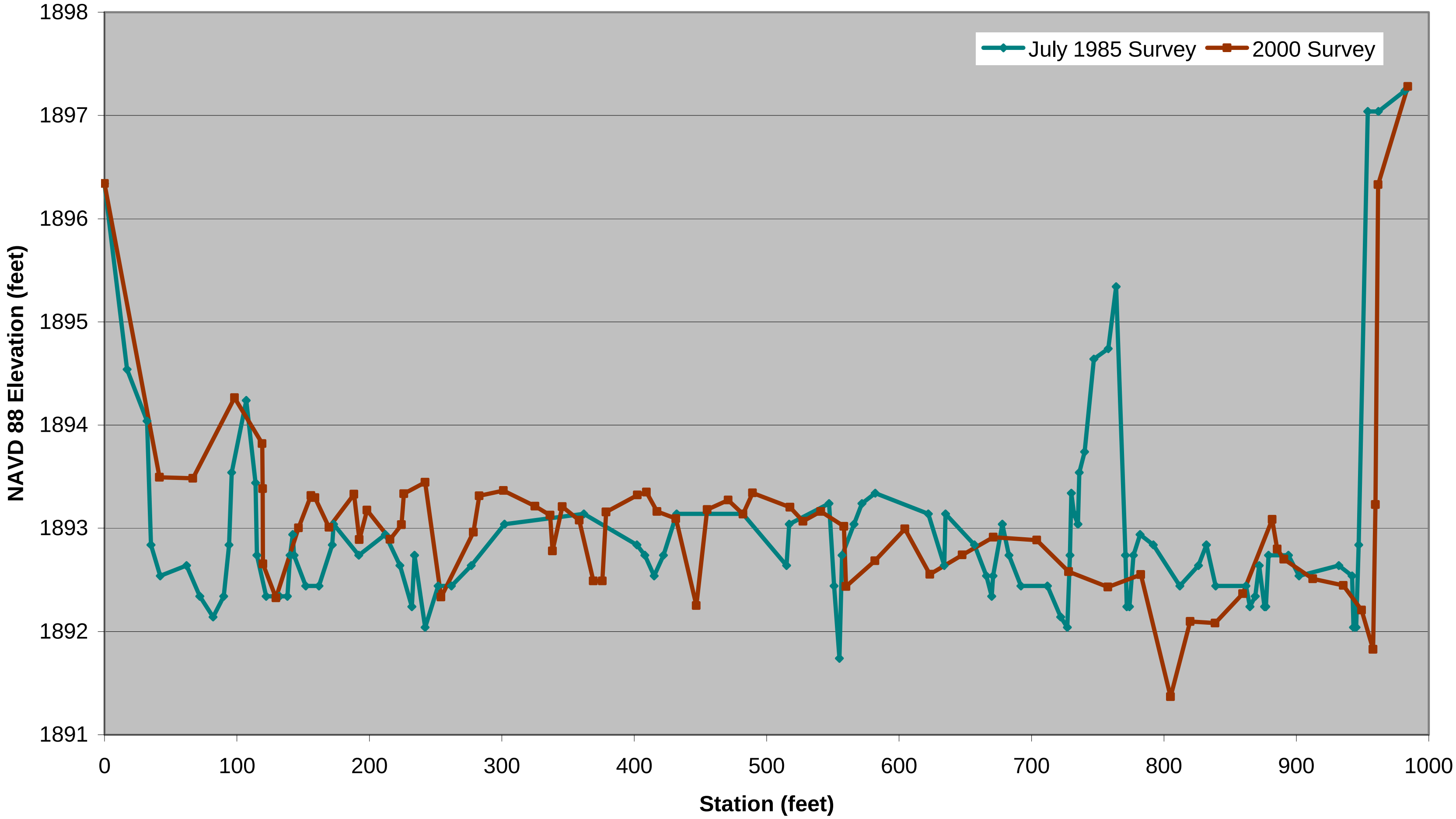


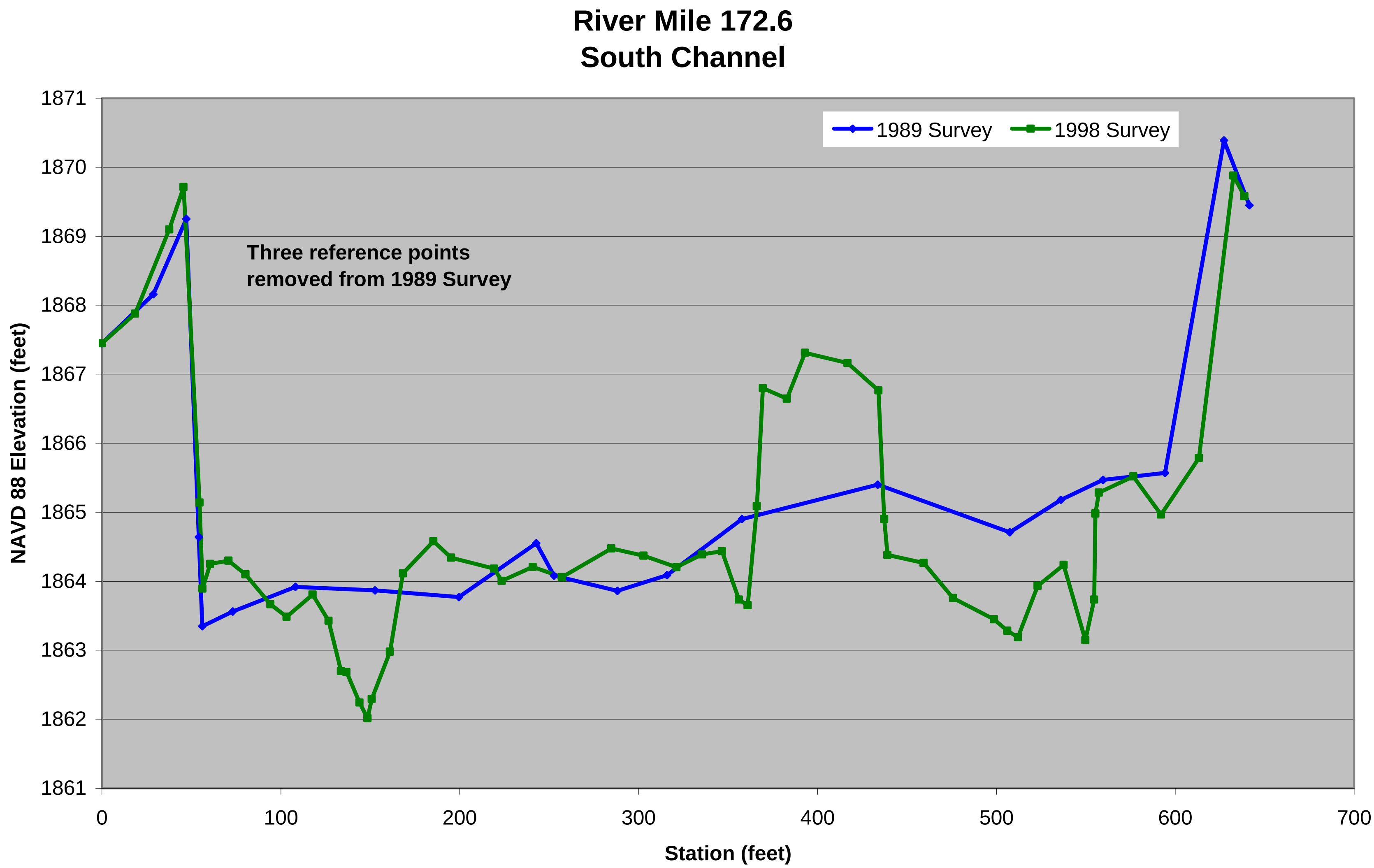

River Mile 177.2
Habitat Site 9BE Transect 3
July 1985 Survey
2000 Survey
2000 Survey adjusted 12 feet to the right
NAVD 88 Elevation (feet)
Station (feet)
1891
1892
1893
1894
1895
1896
1897
1898
1899
0
100
200
300
400
500
600
700
800
900

River Mile 177.15
Habitat Site 9BE Transect 2

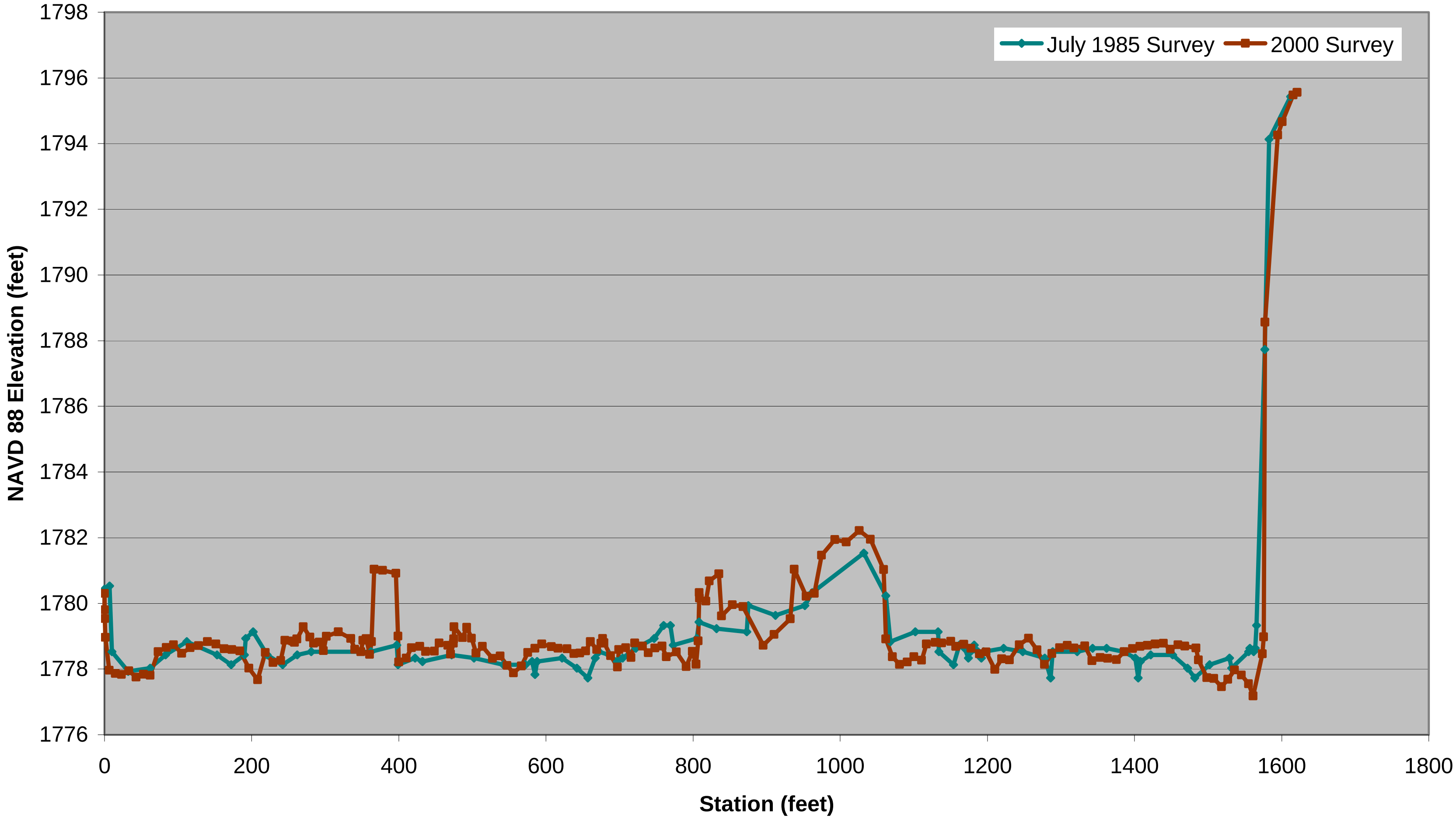


River Mile 177.1
Habitat Site 9BE Transect 1

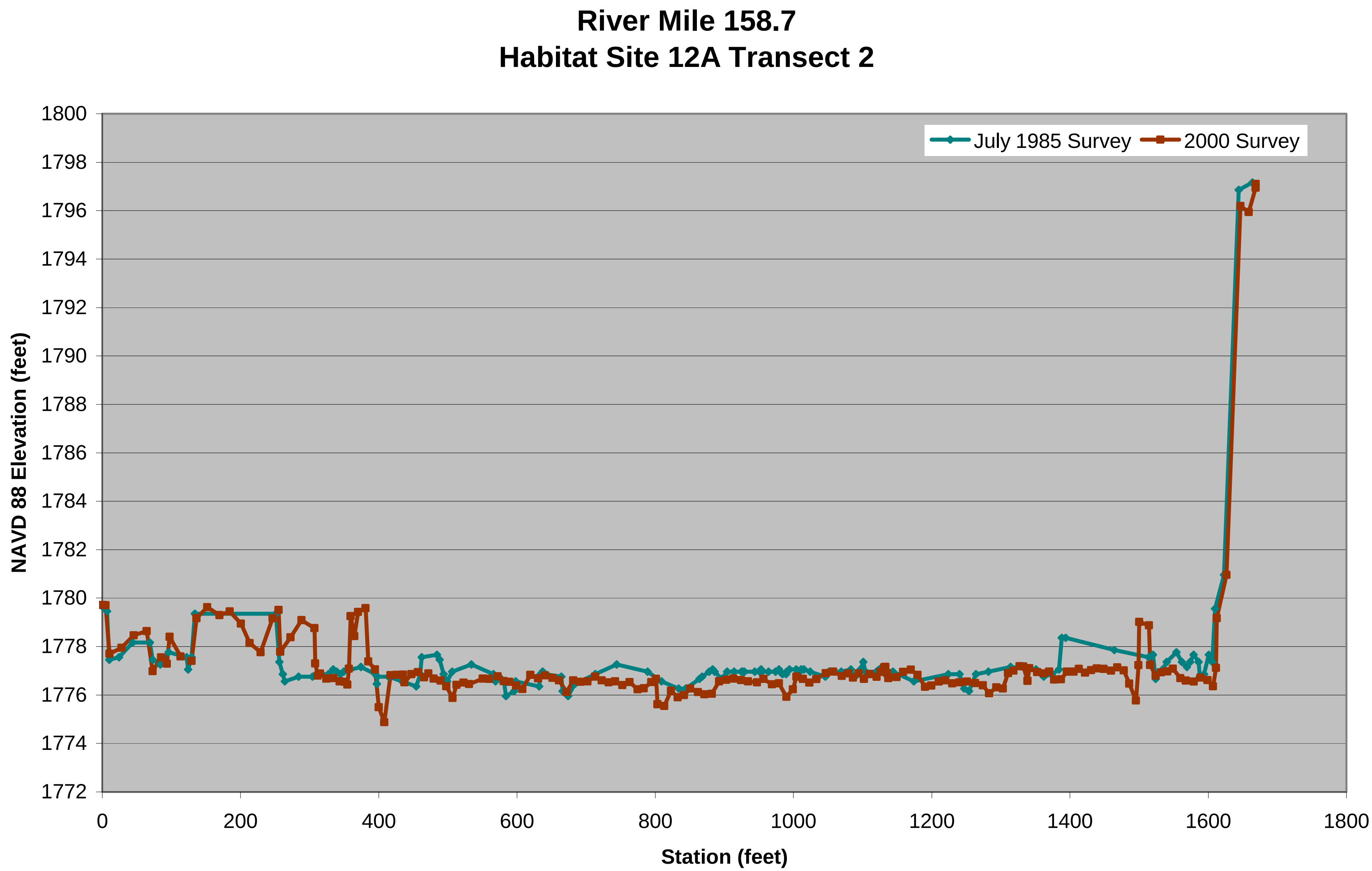


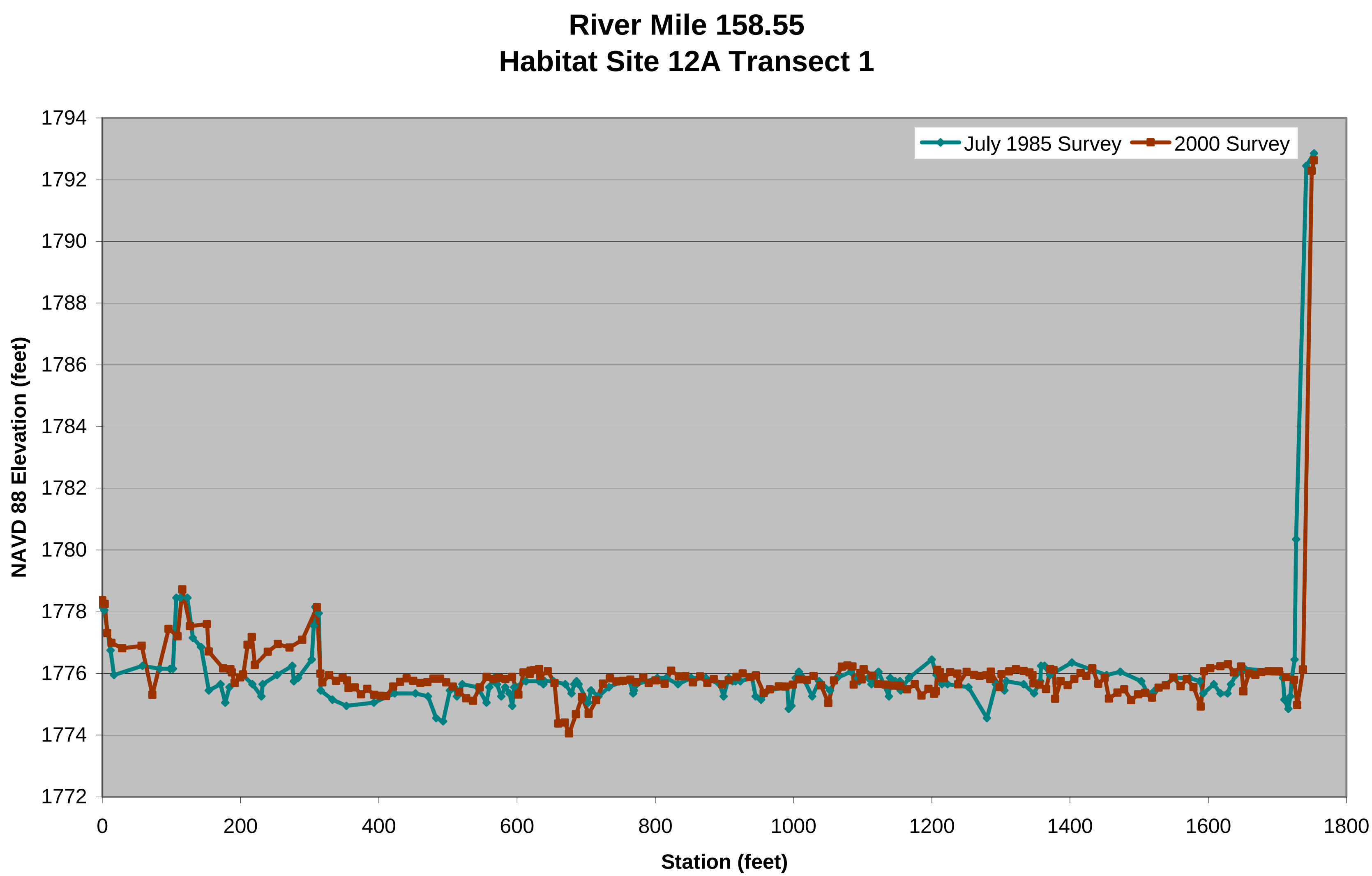

River Mile 172.6
South Channel
1989 Survey
1998 Survey
Three reference points
removed from 1989 Survey
NAVD 88 Elevation (feet)
Station (feet)
1871
1870
1869
1868
1867
1866
1865
1864
1863
1862
1861
0
100
200
300
400
500
600
700

River Mile 159.0
Habitat Site 12A Transect 3



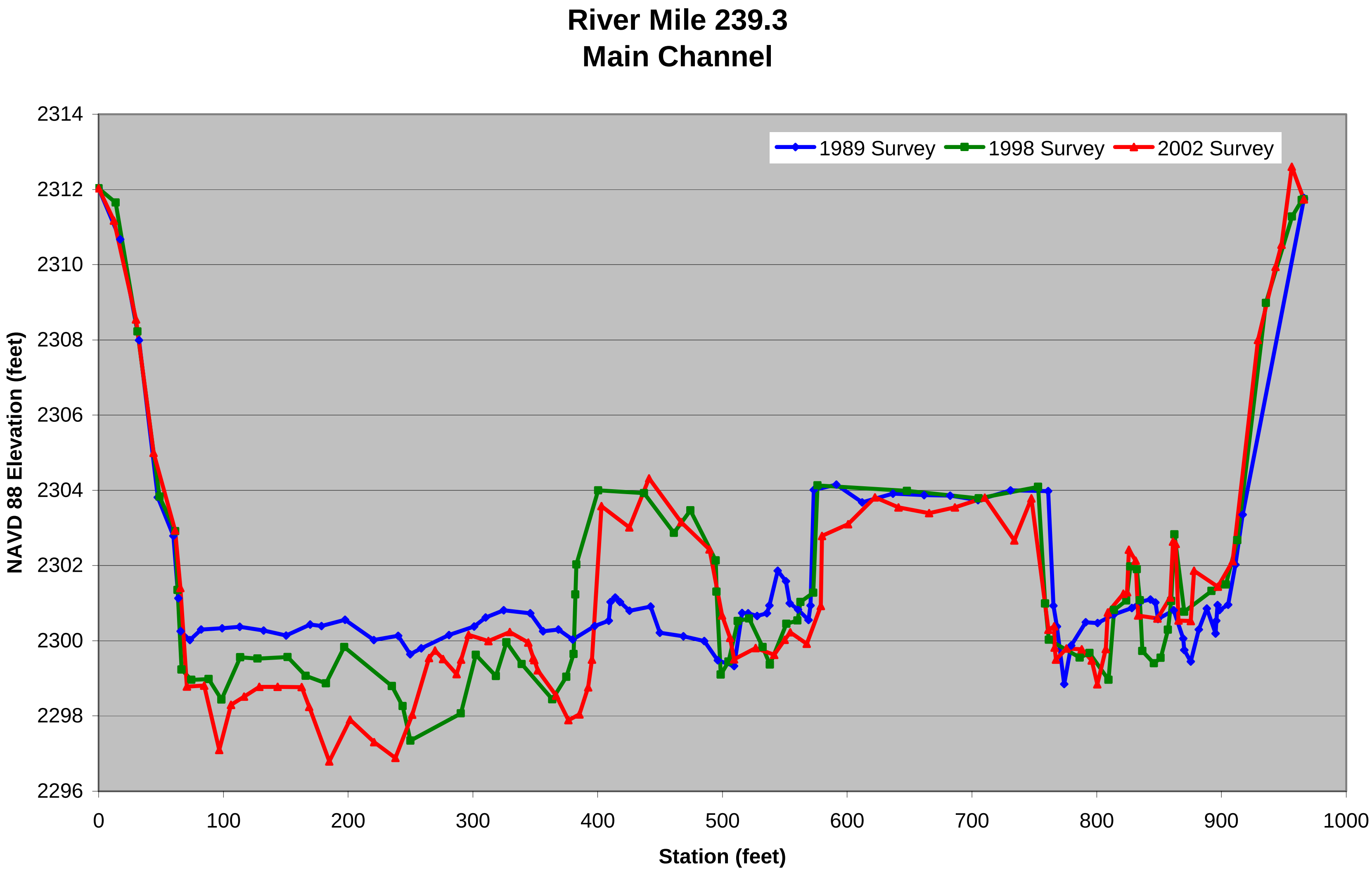
125

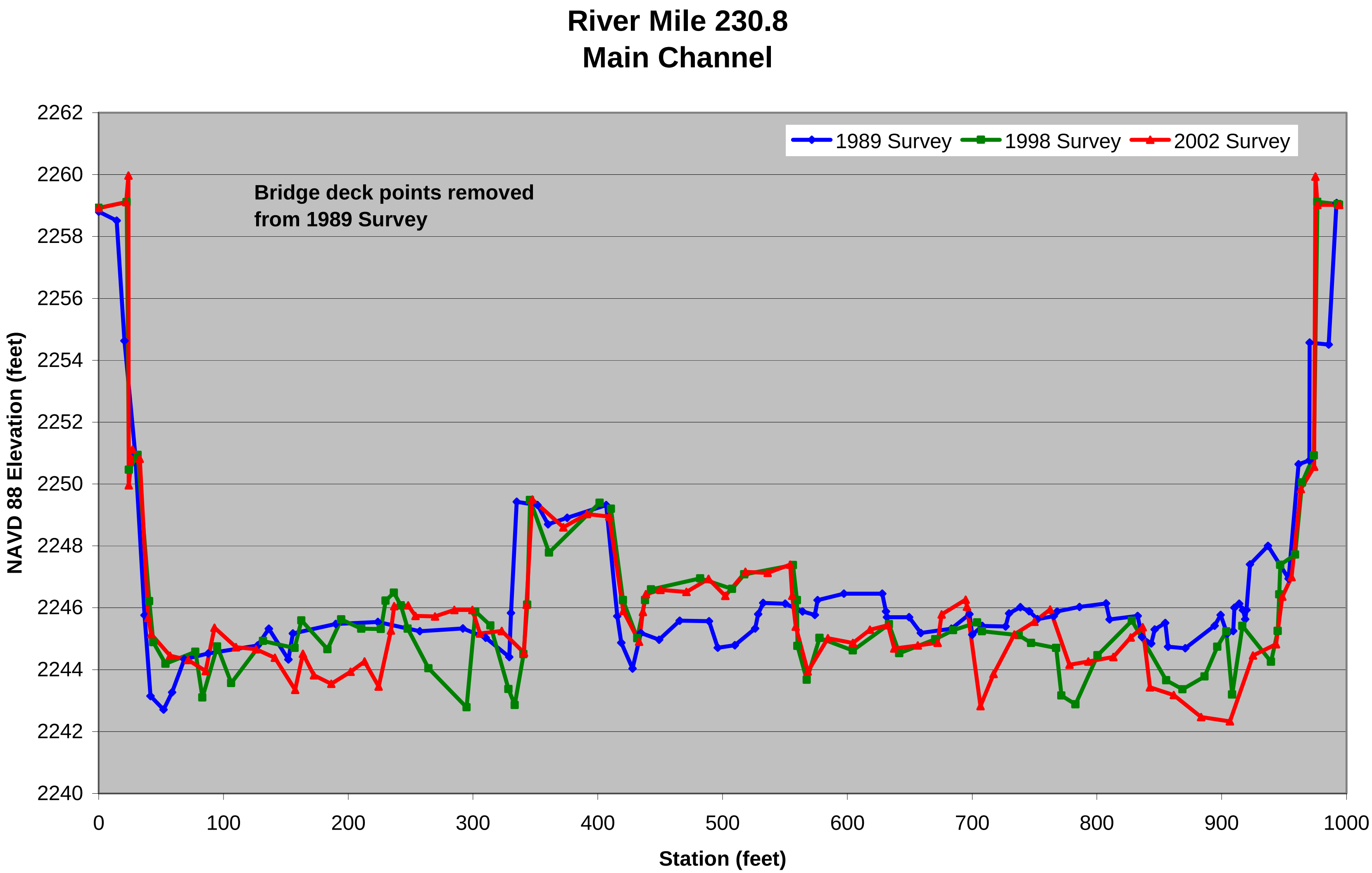

River Mile 158.7
Habitat Site 12A Transect 2
July 1985 Survey
2000 Survey
NAVD 88 Elevation (feet)
Station (feet)
1800
1798
1796
1794
1792
1790
1788
1786
1784
1782
1780
1778
1776
1774
1772
0
200
400
600
800
1000
1200
1400
1600
1800

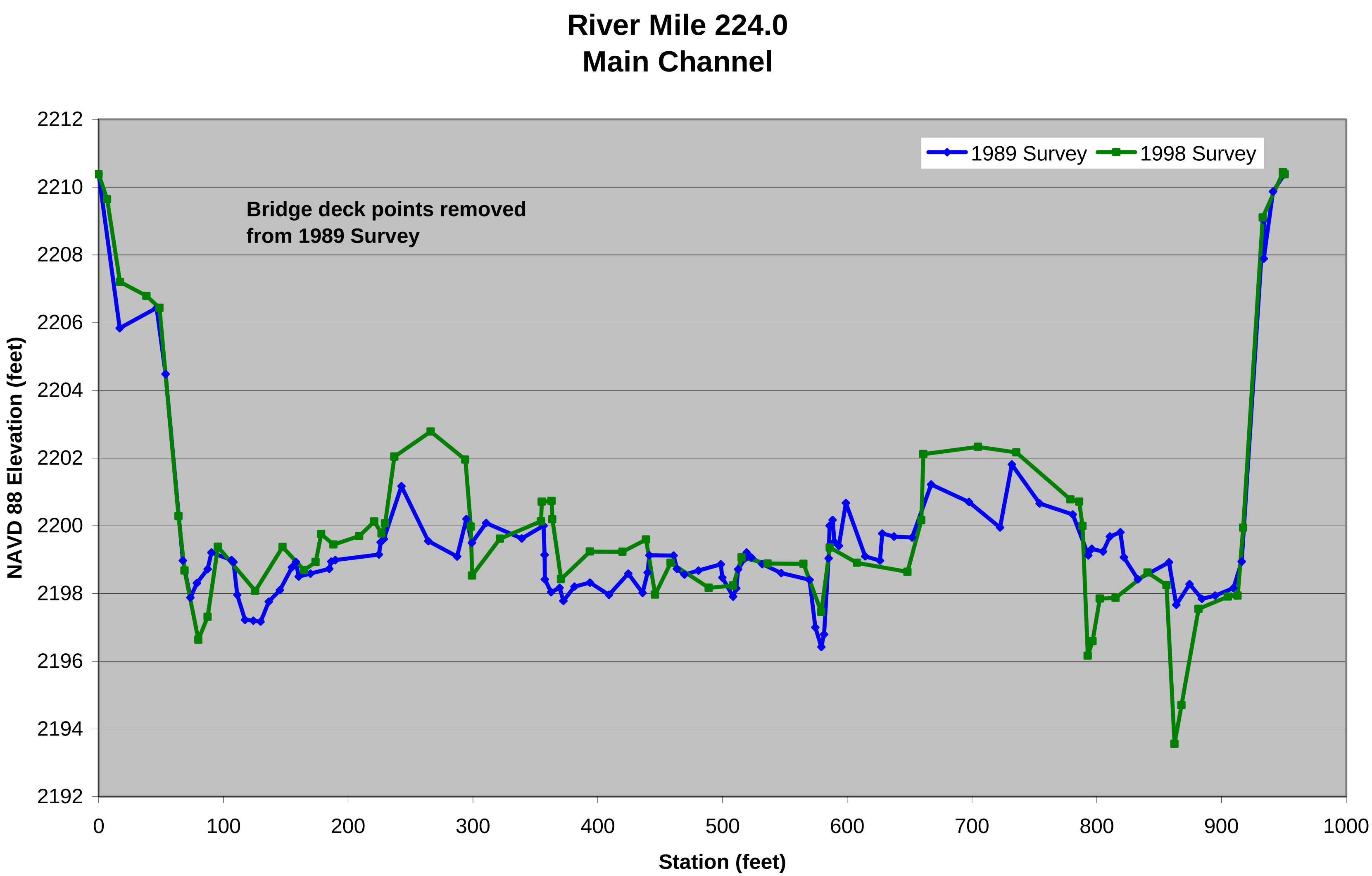


River Mile 158.55
Habitat Site 12A Transect 1
NAVD 88 Elevation (feet)
Station (feet)
July 1985 Survey
2000 Survey
1794
1792
1790
1788
1786
1784
1782
1780
1778
1776
1774
1772
0
200
400
600
800
1000
1200
1400
1600
1800

A.3.2 Bridges Sites on Main Channel

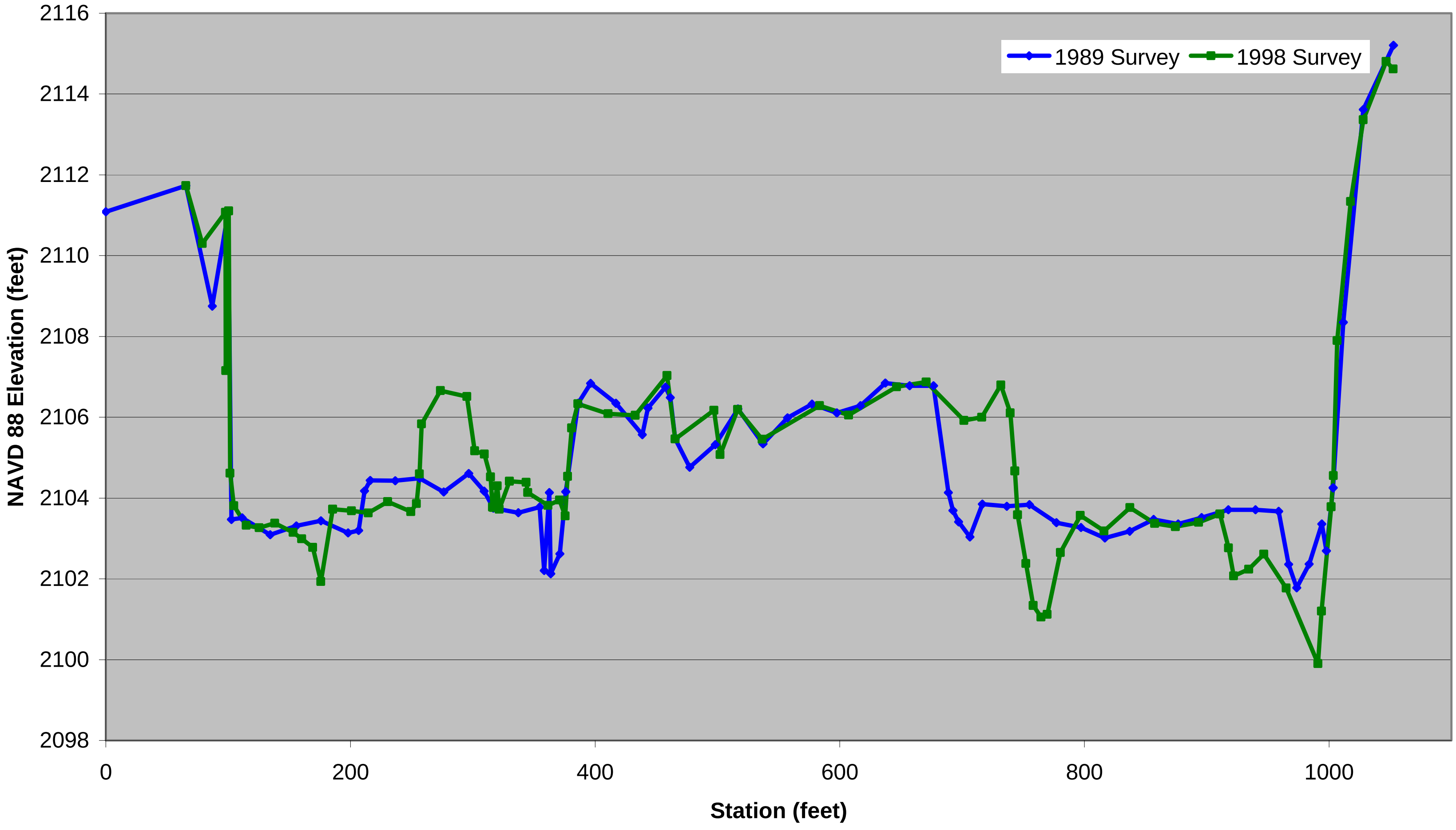


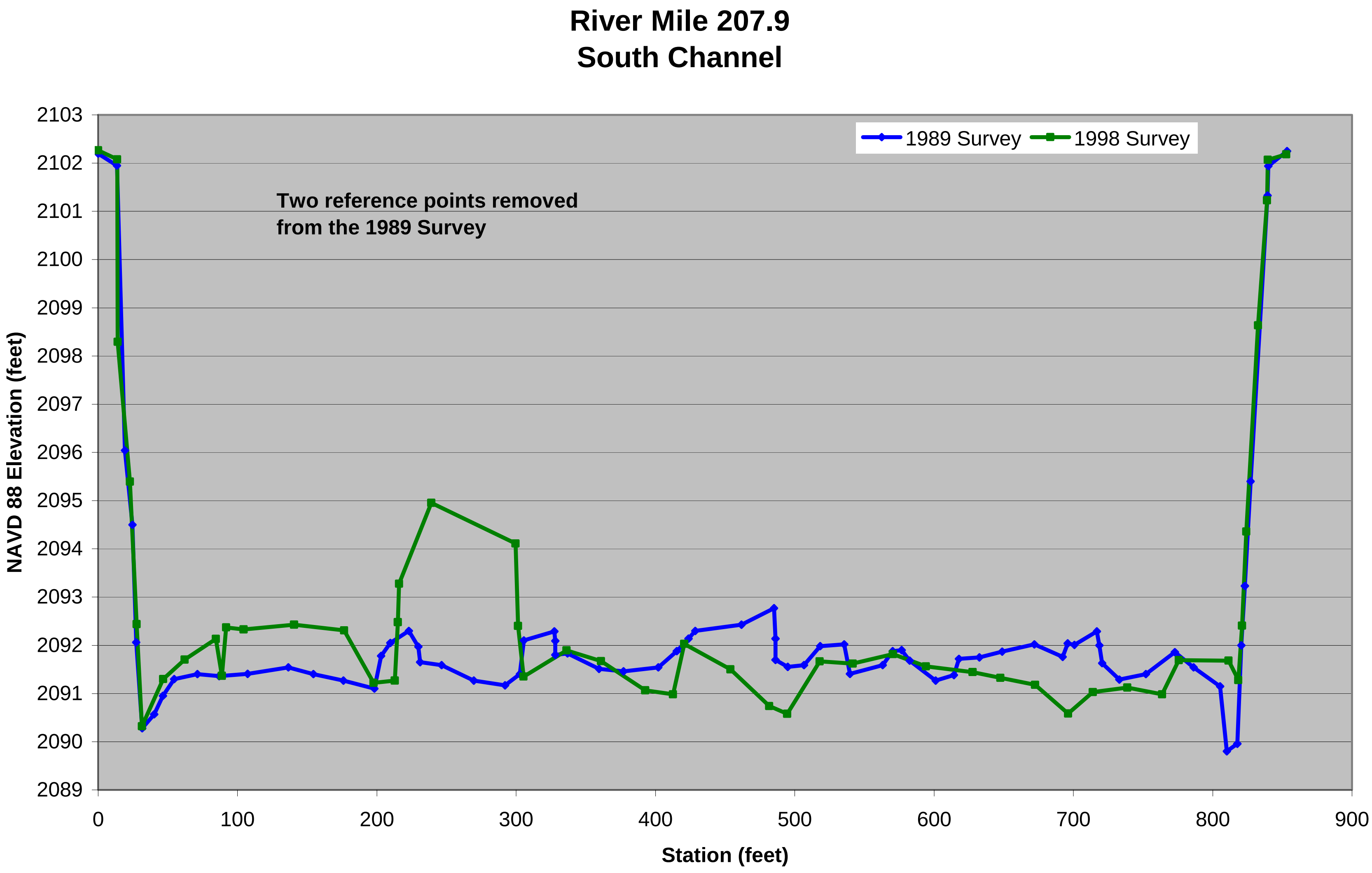

River Mile 230.8
Main Channel
Bridge deck points removed from 1989 Survey
1989 Survey
1998 Survey
2002 Survey
NAVD 88 Elevation (feet)
Station (feet)
2262
2260
2258
2256
2254
2252
2250
2248
2246
2244
2242
2240
0
100
200
300
400
500
600
700
800
900
1000

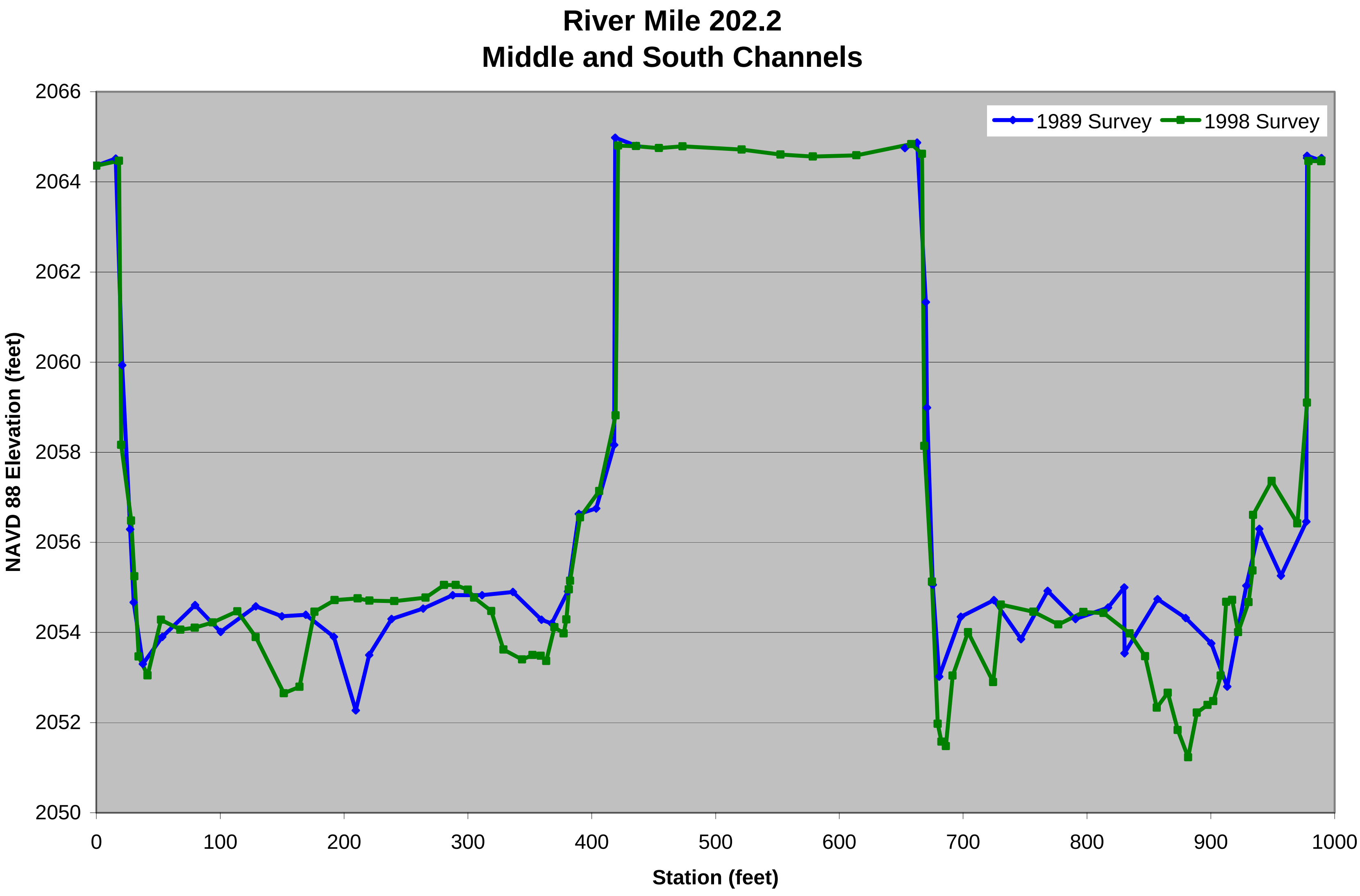


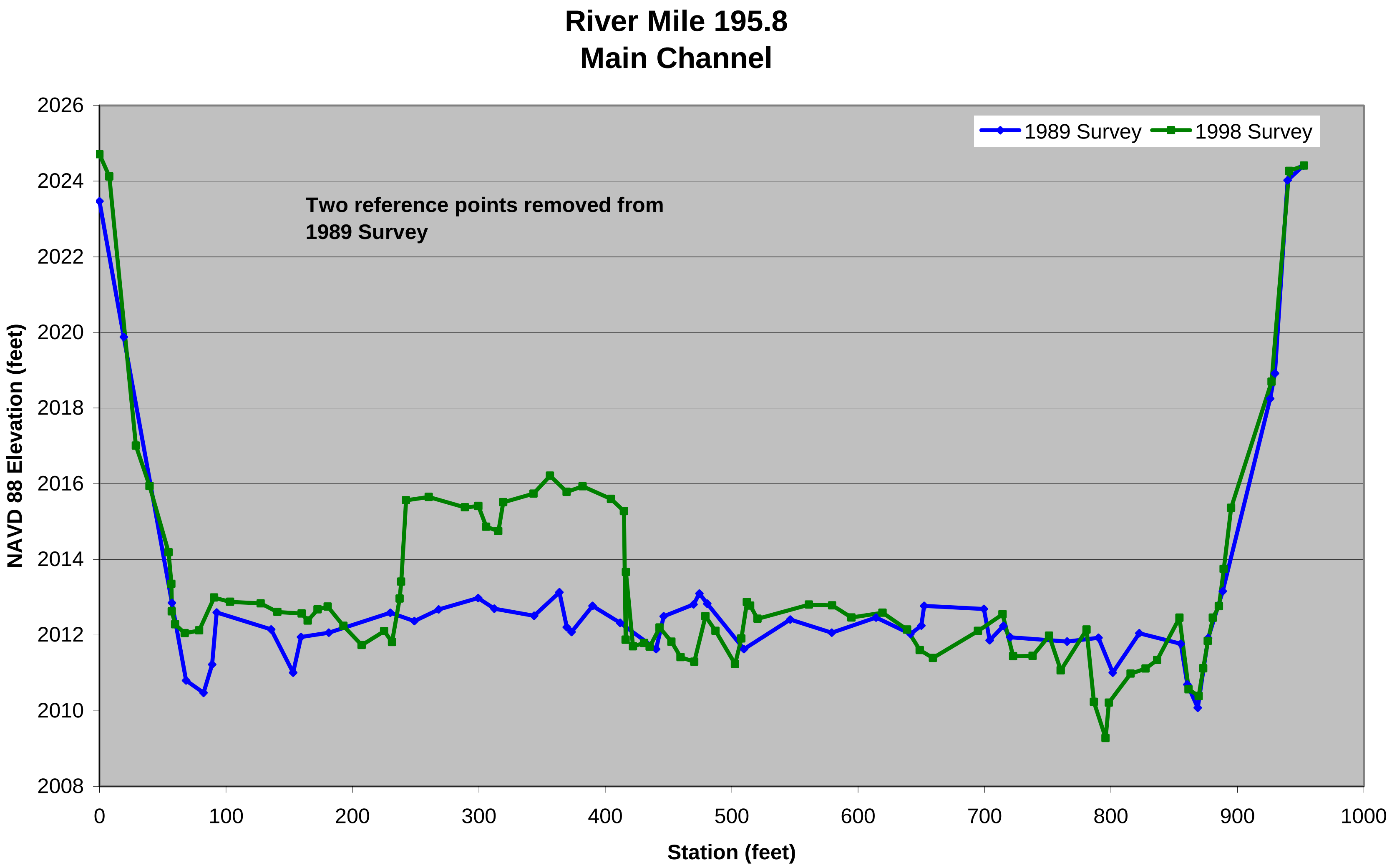
River Mile 224.0
Main Channel
NAVD 88 Elevation (feet)
Station (feet)
1989 Survey
1998 Survey
Bridge deck points removed
from 1989 Survey
2212
2210
2208
2206
2204
2202
2200
2198
2196
2194
2192
0
100
200
300
400
500
600
700
800
900
1000

River Mile 209.8
South Channel

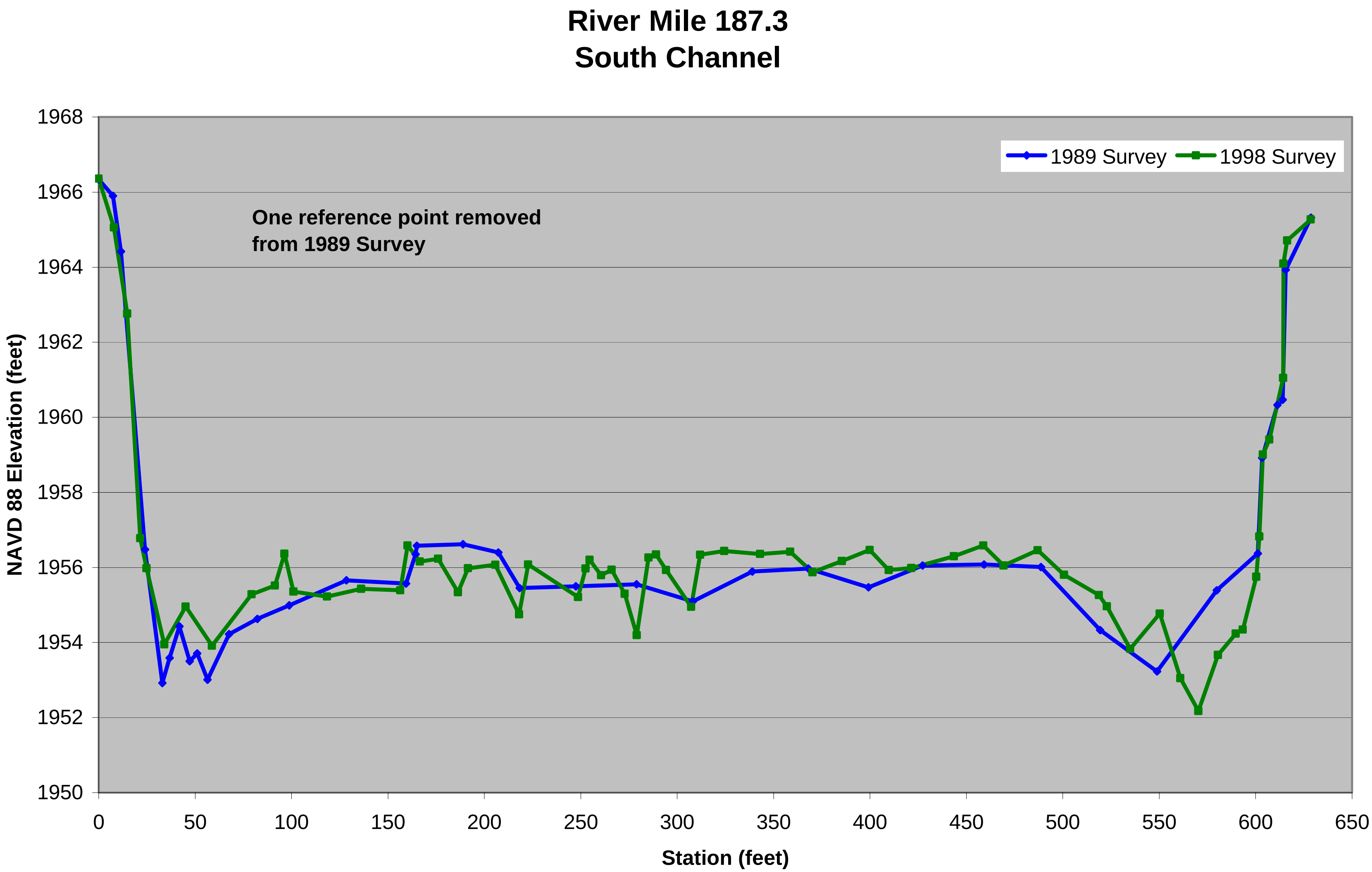


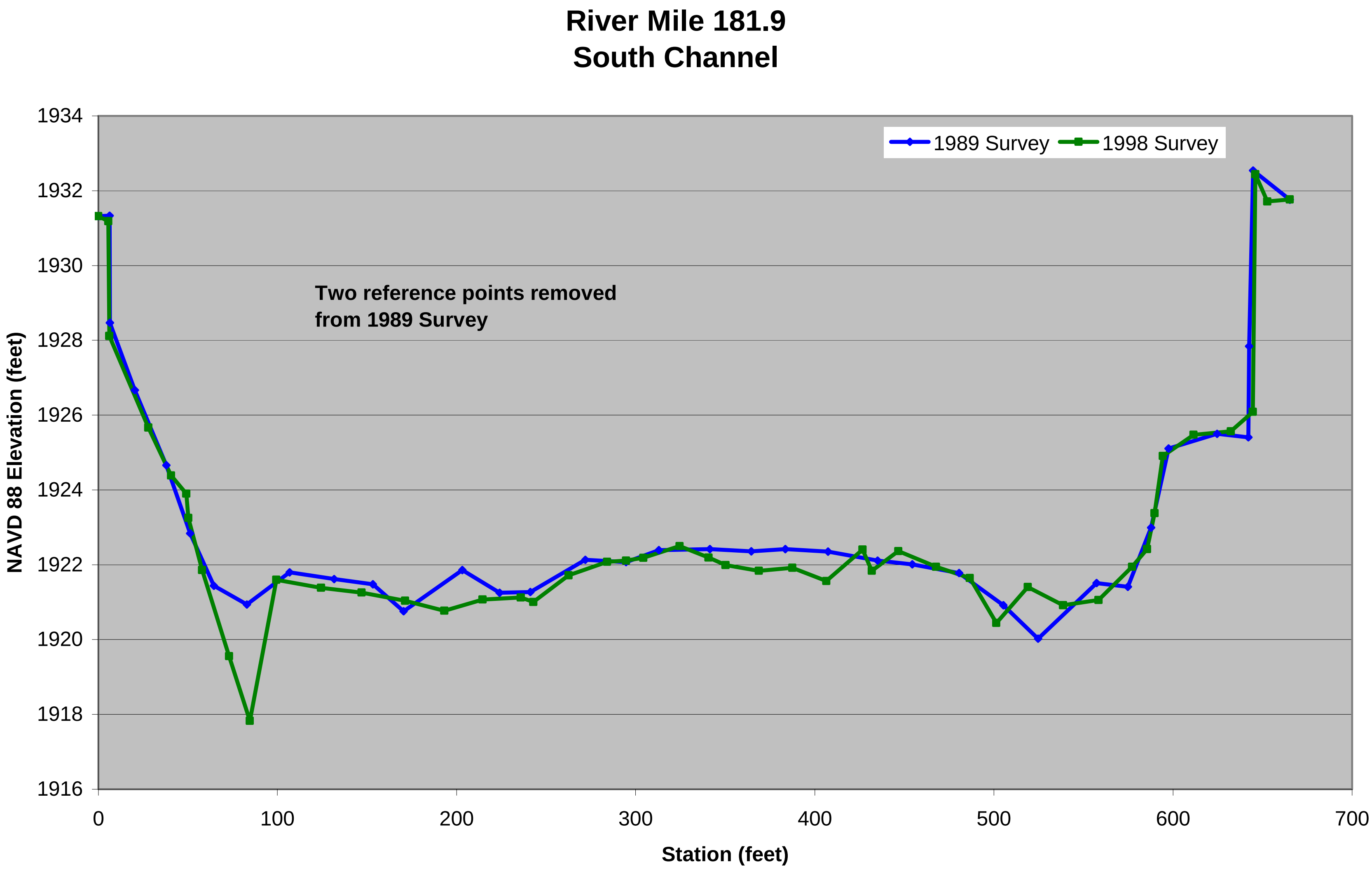

River Mile 207.9
South Channel
1989 Survey
1998 Survey
Two reference points removed
from the 1989 Survey
NAVD 88 Elevation (feet)
Station (feet)
2103
2102
2101
2100
2099
2098
2097
2096
2095
2094
2093
2092
2091
2090
2089
0
100
200
300
400
500
600
700
800
900


River Mile 202.2
Middle and South Channels
1989 Survey
1998 Survey
NAVD 88 Elevation (feet)
2066
2064
2062
2060
2058
2056
2054
2052
2050
Station (feet)
0
100
200
300
400
500
600
700
800
900
1000

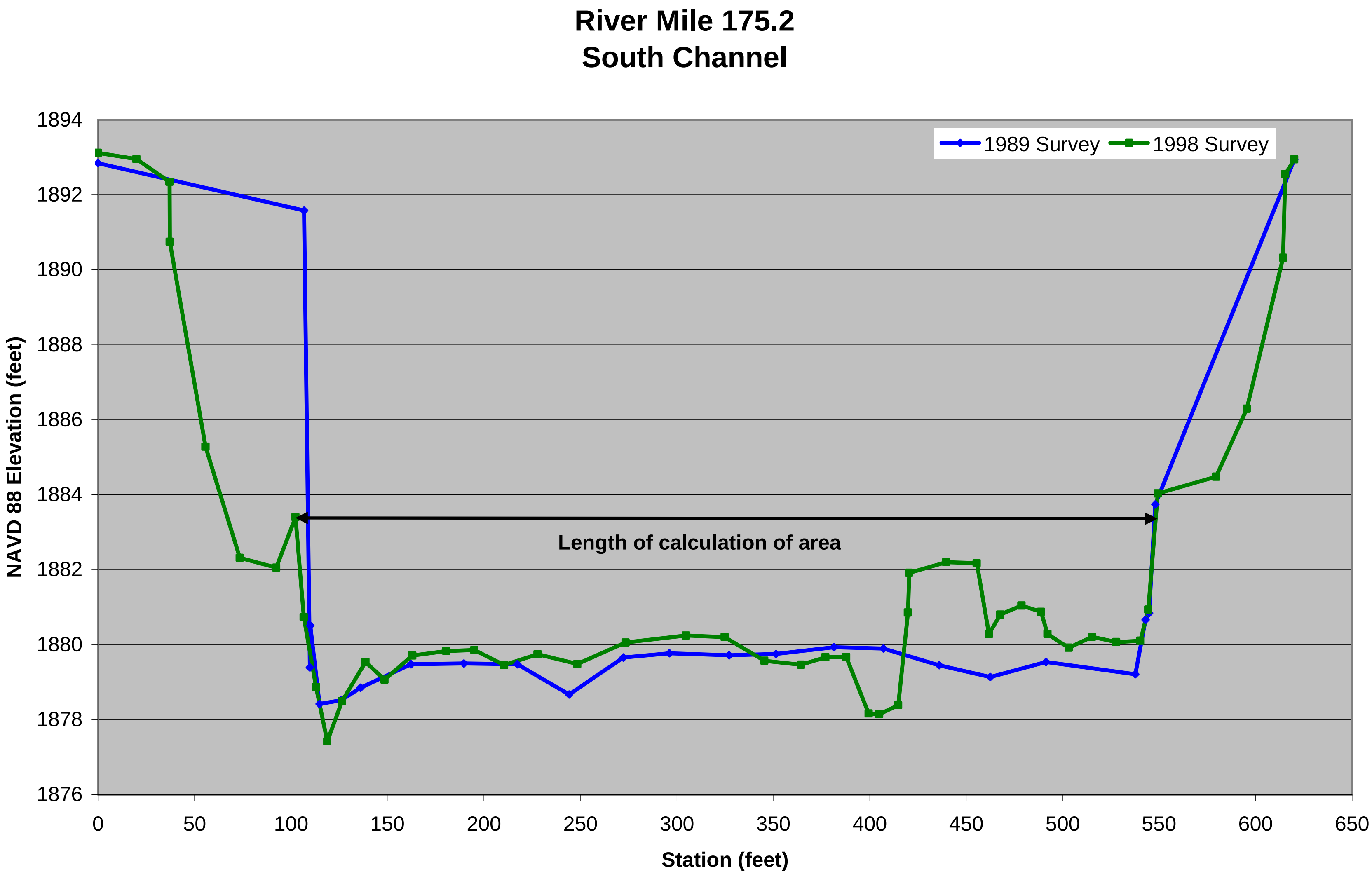


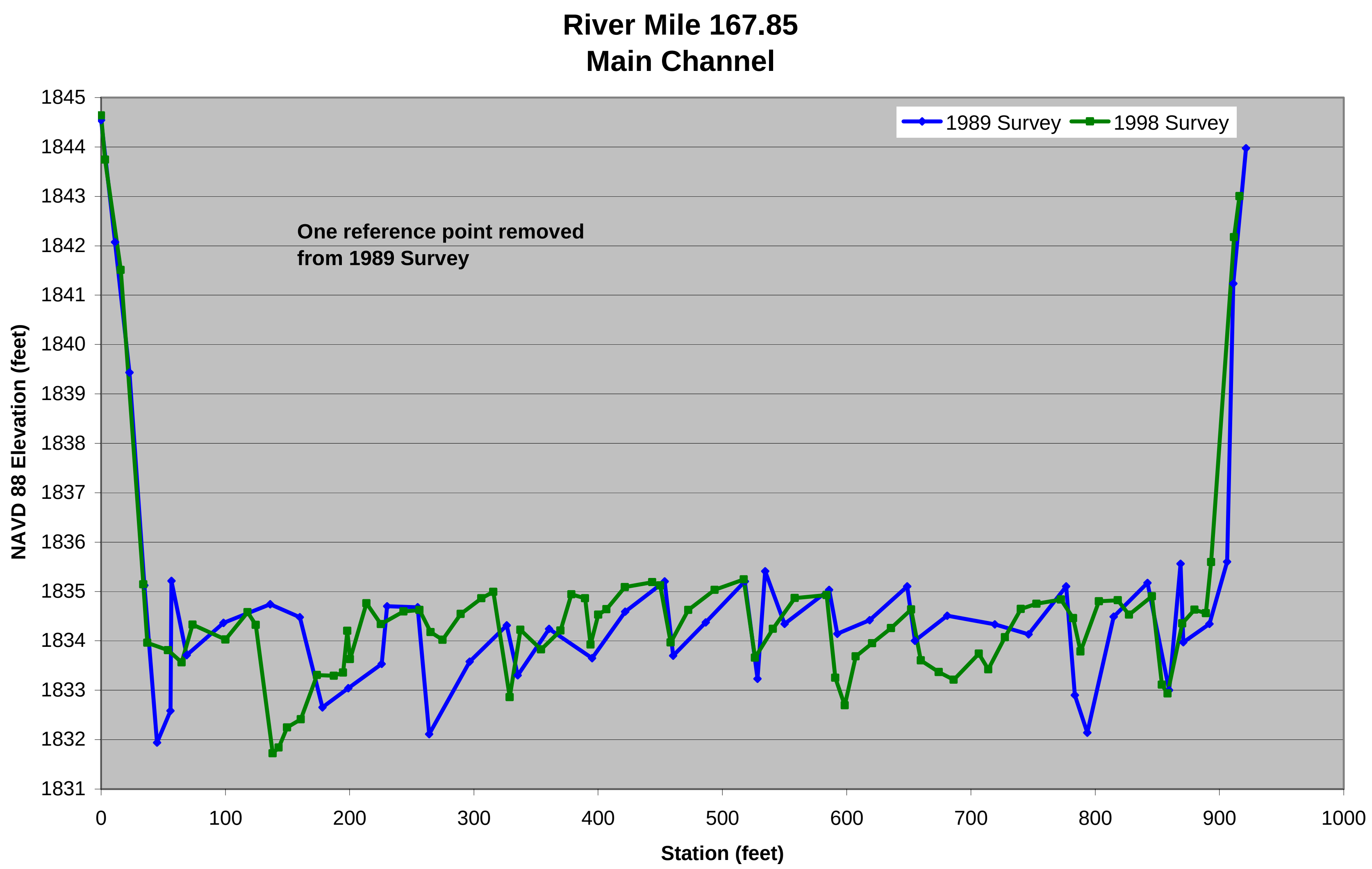
River Mile 195.8
Main Channel
1989 Survey
1998 Survey
Two reference points removed from
1989 Survey
NAVD 88 Elevation (feet)
Station (feet)
2026
2024
2022
2020
2018
2016
2014
2012
2010
2008
0
100
200
300
400
500
600
700
800
900
1000


River Mile 187.3
South Channel
1989 Survey
1998 Survey
One reference point removed
from 1989 Survey
NAVD 88 Elevation (feet)
1968
1966
1964
1962
1960
1958
1956
1954
1952
1950
0
50
100
150
200
250
300
350
400
450
500
550
600
650
Station (feet)

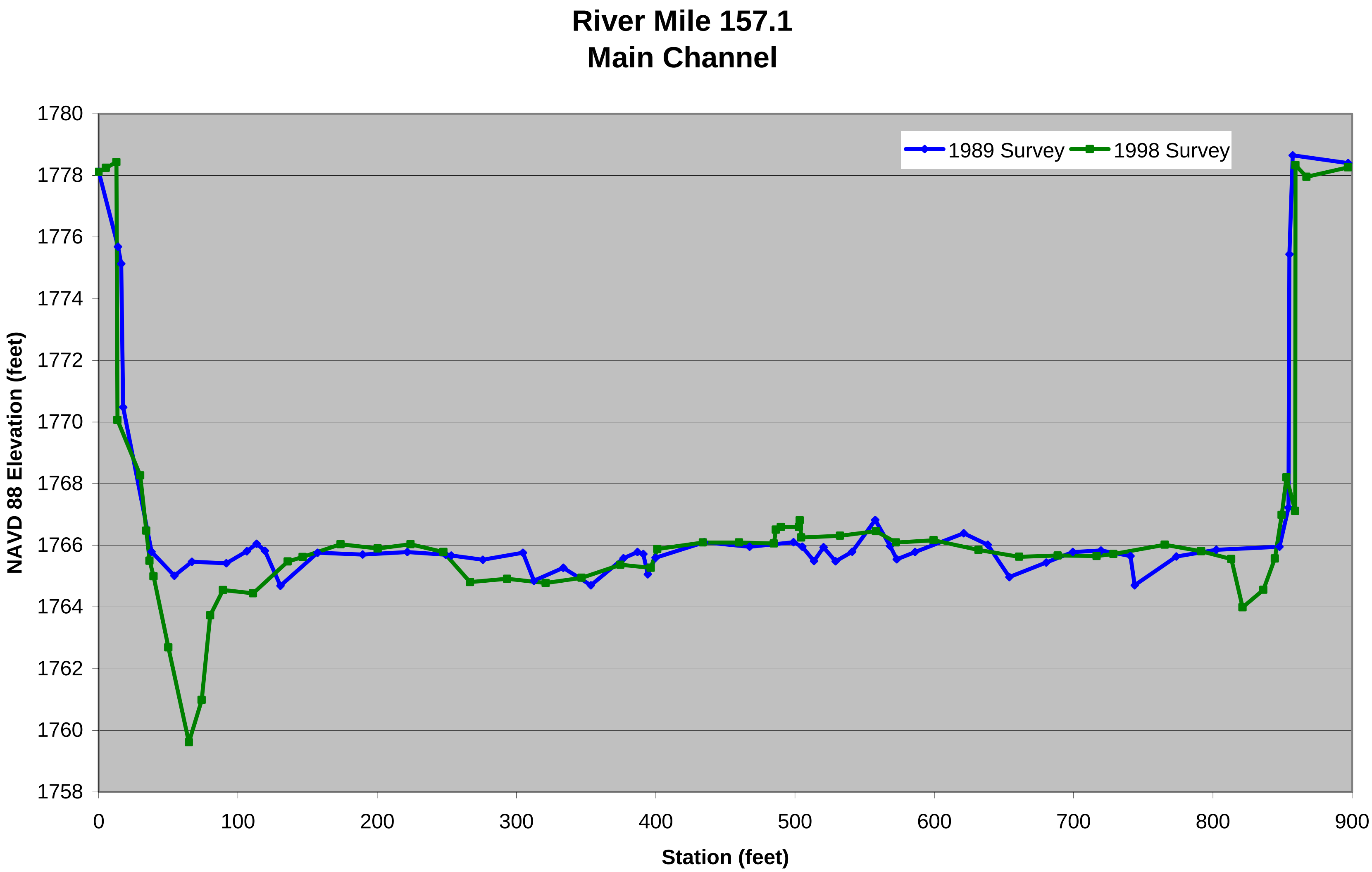


River Mile 181.9
South Channel
1989 Survey
1998 Survey
Two reference points removed
from 1989 Survey
NAVD 88 Elevation (feet)
Station (feet)
1934
1932
1930
1928
1926
1924
1922
1920
1918
1916
0
100
200
300
400
500
600
700


River Mile 175.2
South Channel
1989 Survey
1998 Survey
Length of calculation of area
NAVD 88 Elevation (feet)
Station (feet)
1876
1878
1880
1882
1884
1886
1888
1890
1892
1894
0
50
100
150
200
250
300
350
400
450
500
550
600
650

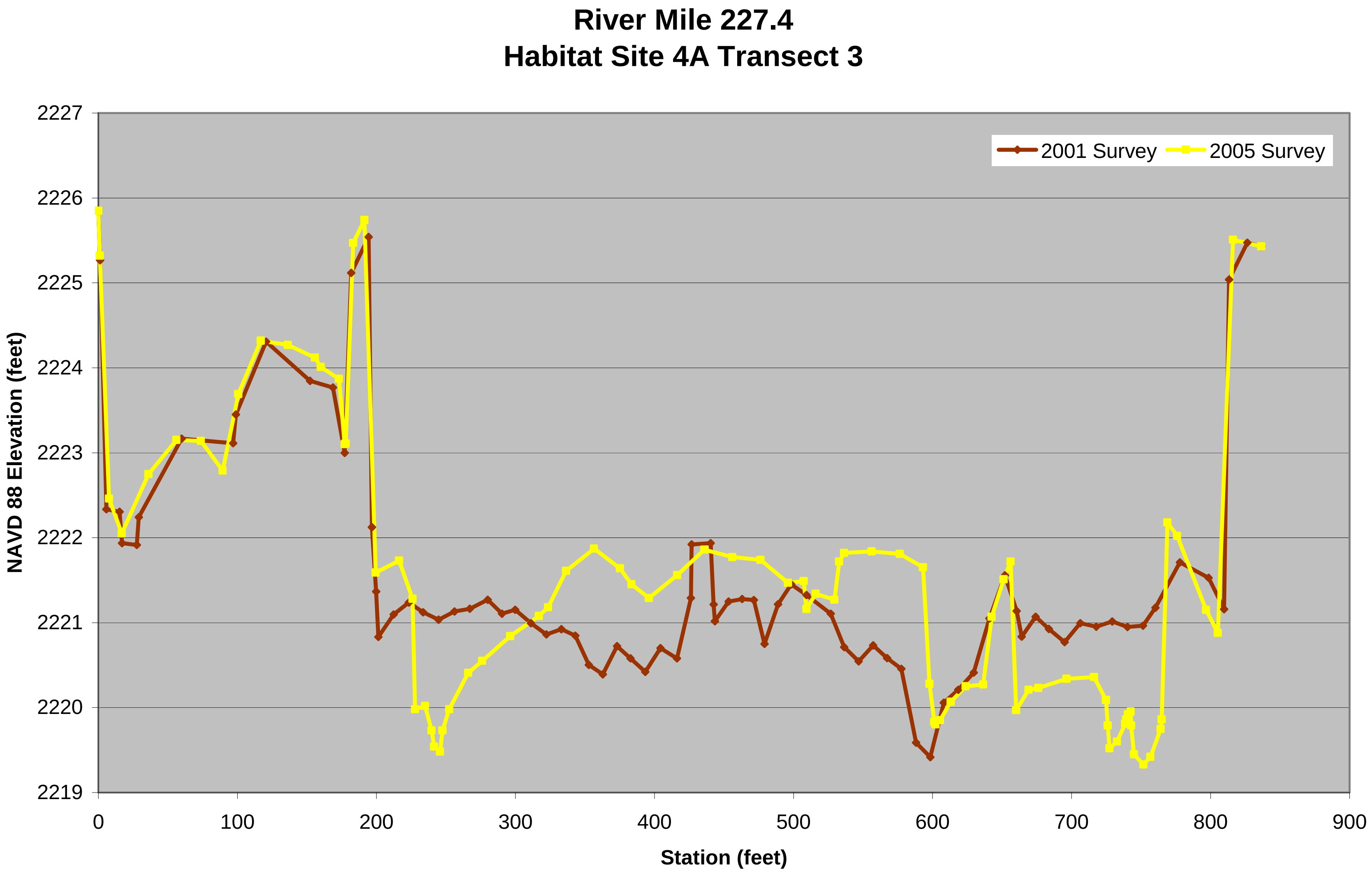


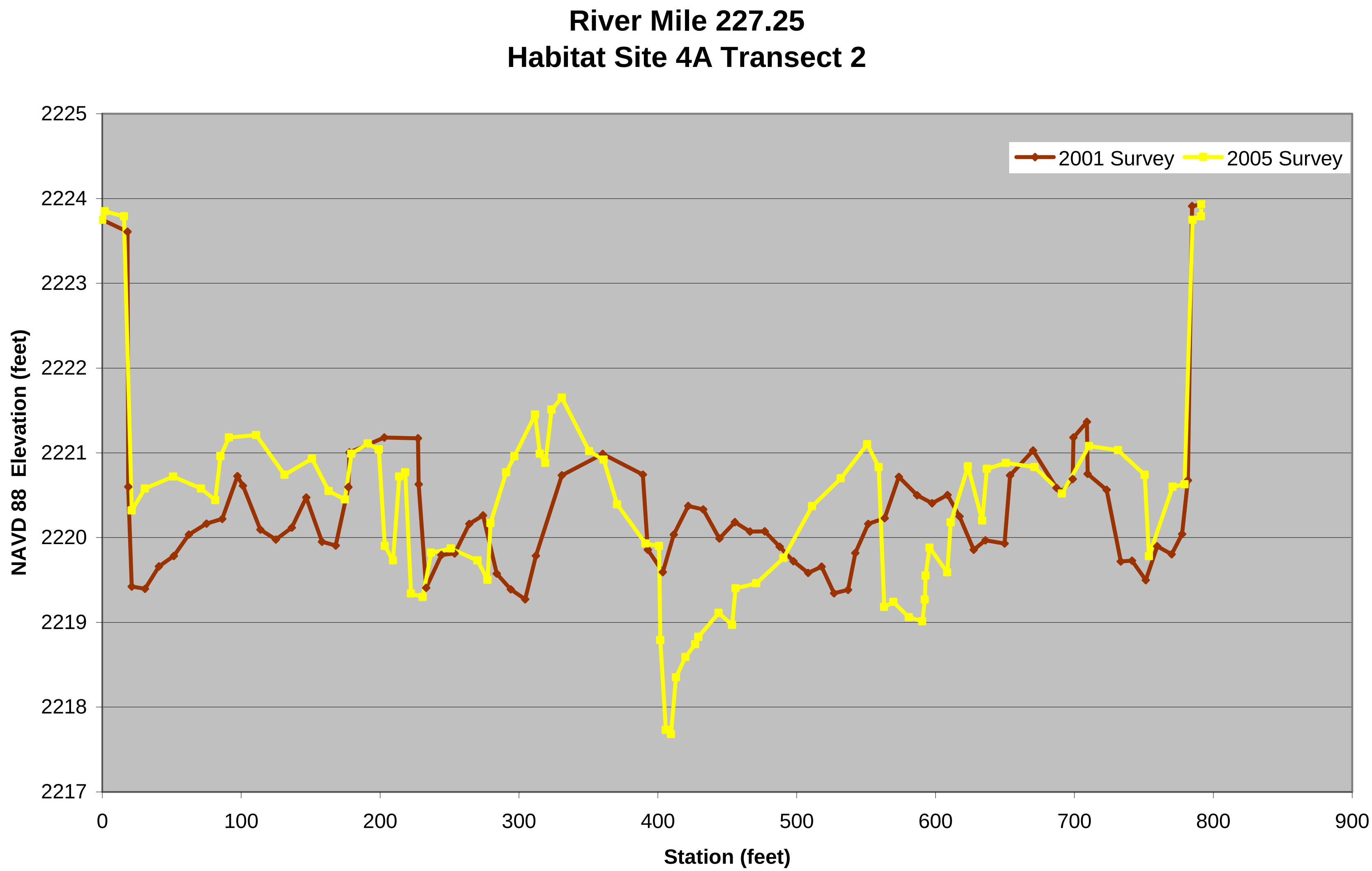
River Mile 167.85
Main Channel
1989 Survey
1998 Survey
One reference point removed from 1989 Survey
NAVD 88 Elevation (feet)
Station (feet)
1845
1844
1843
1842
1841
1840
1839
1838
1837
1836
1835
1834
1833
1832
1831
0
100
200
300
400
500
600
700
800
900
1000



River Mile 157.1
Main Channel
1989 Survey
1998 Survey
NAVD 88 Elevation (feet)
1780
1778
1776
1774
1772
1770
1768
1766
1764
1762
1760
1758
Station (feet)
0
100
200
300
400
500
600
700
800
900

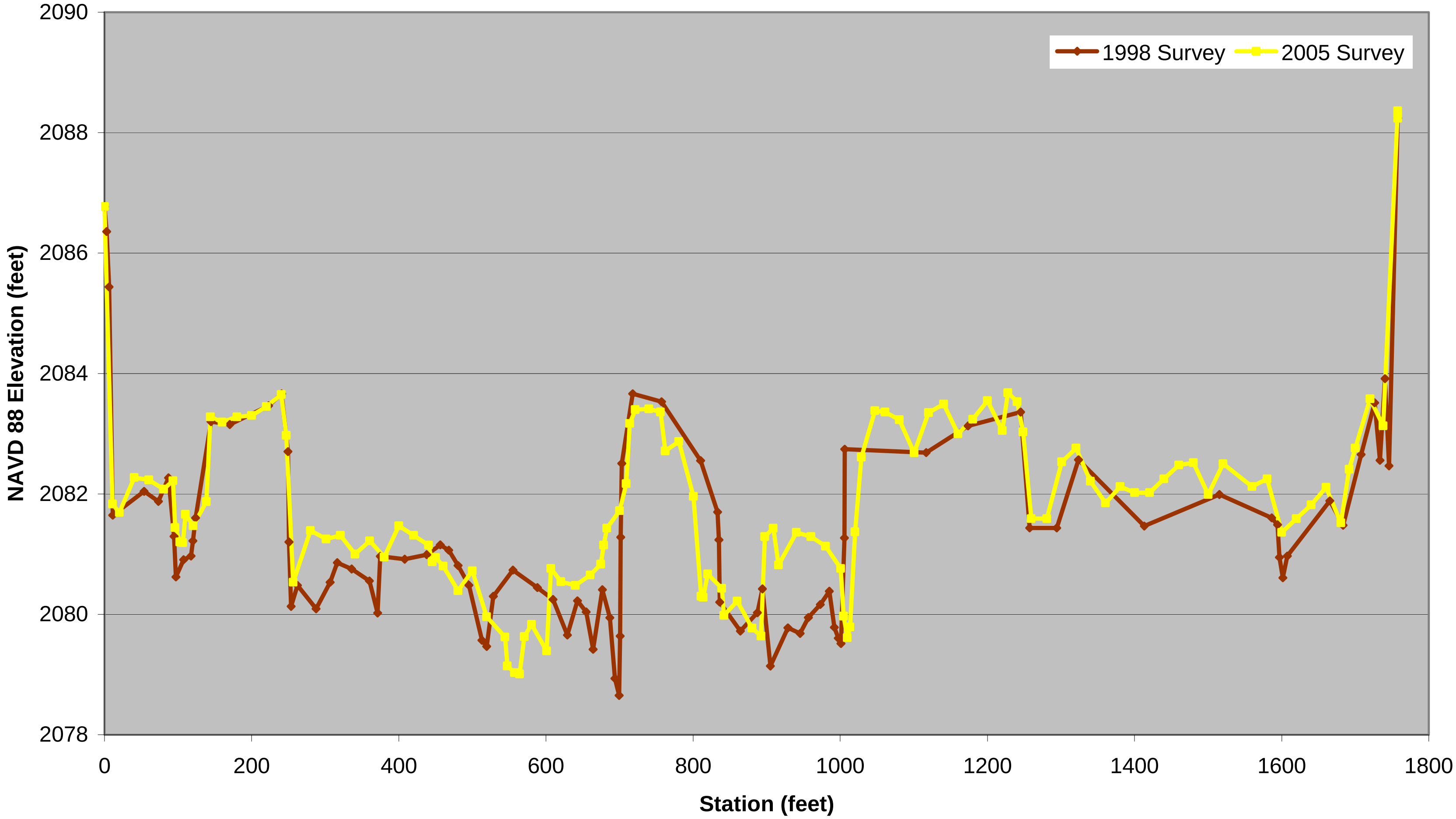
A.3.3 2005 Surveys

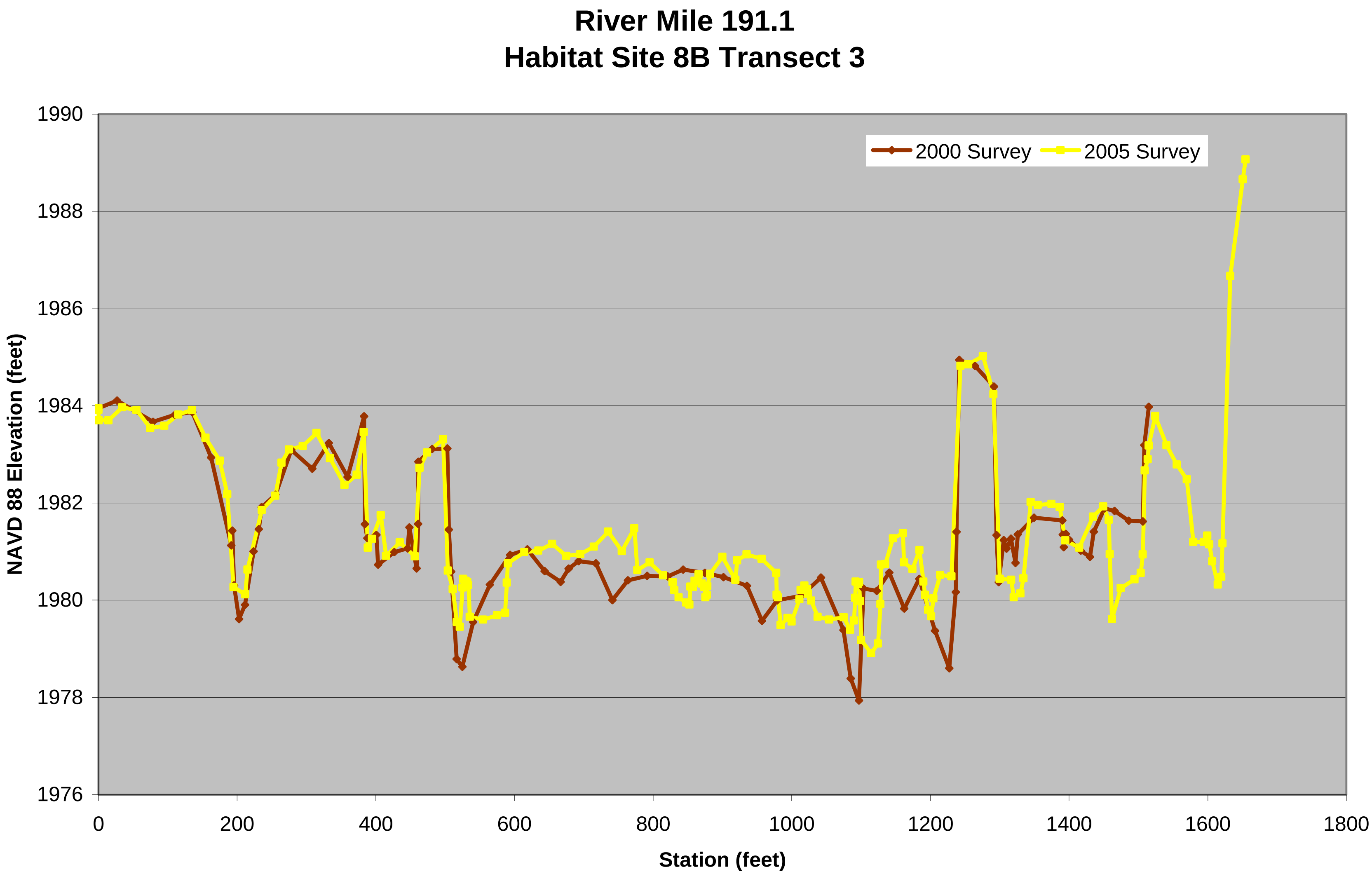


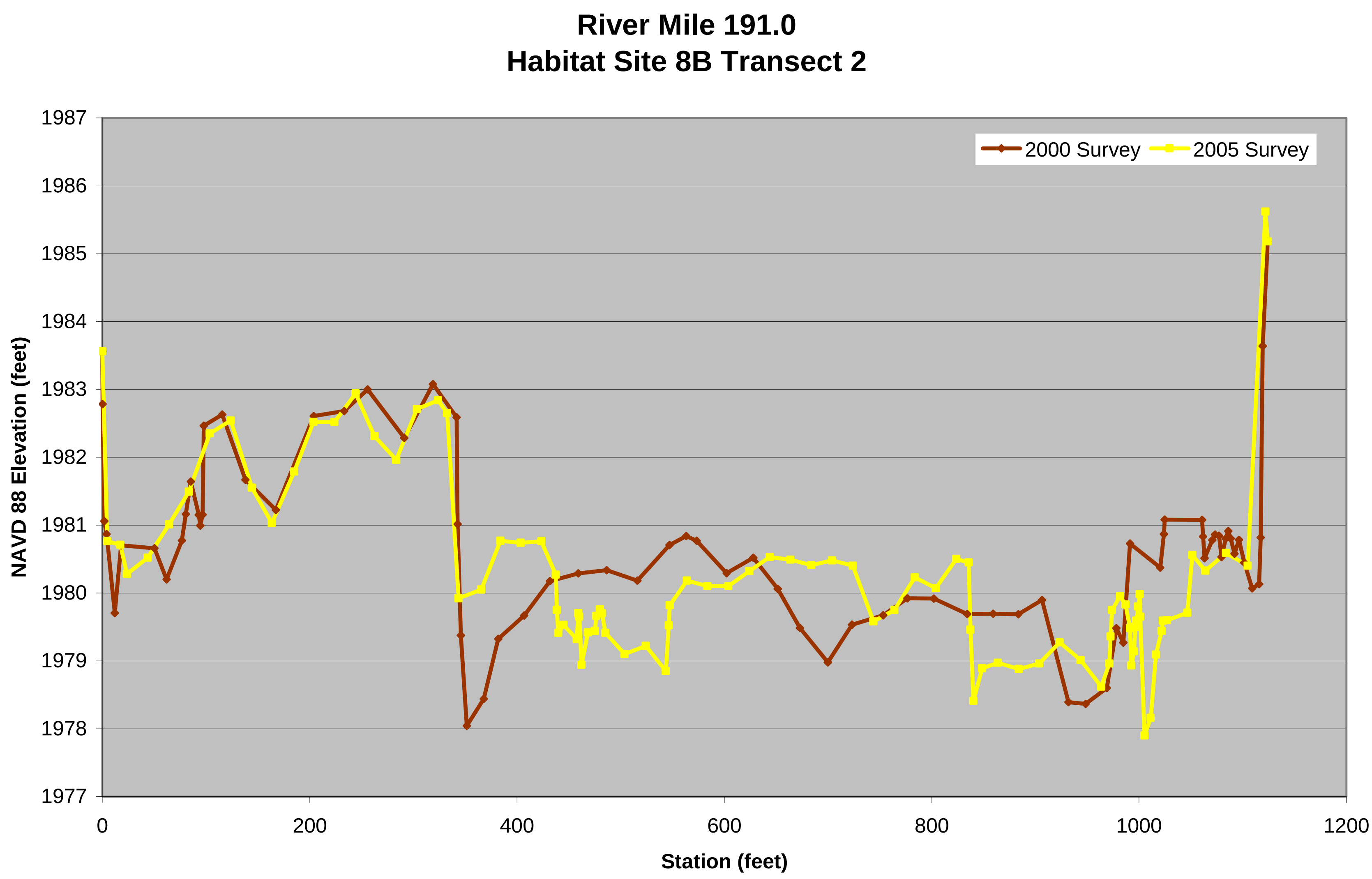

River Mile 227.25
Habitat Site 4A Transect 2
2001 Survey
2005 Survey
NAVD 88 Elevation (feet)
Station (feet)
2217
2218
2219
2220
2221
2222
2223
2224
2225
0
100
200
300
400
500
600
700
800
900

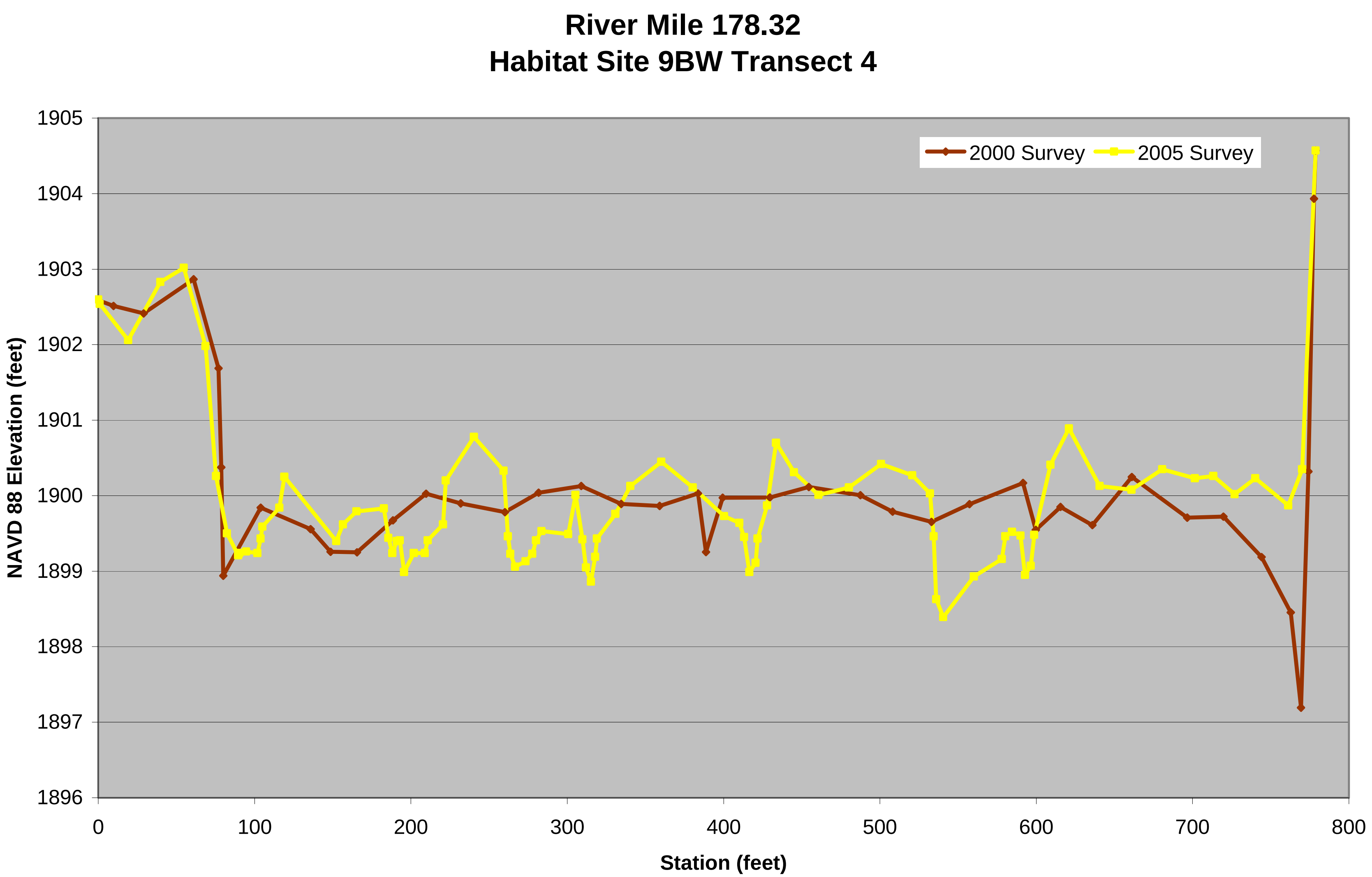
River Mile 206.4
Habitat Site 6 Transect 4
1998 Survey
2005 Survey
NAVD 88 Elevation (feet)
2092
2090
2088
2086
2084
2082
2080
2078
0
200
400
600
800
1000
1200
1400
1600
1800
Station (feet)

River Mile 206.2
Habitat Site 6 Transect 3

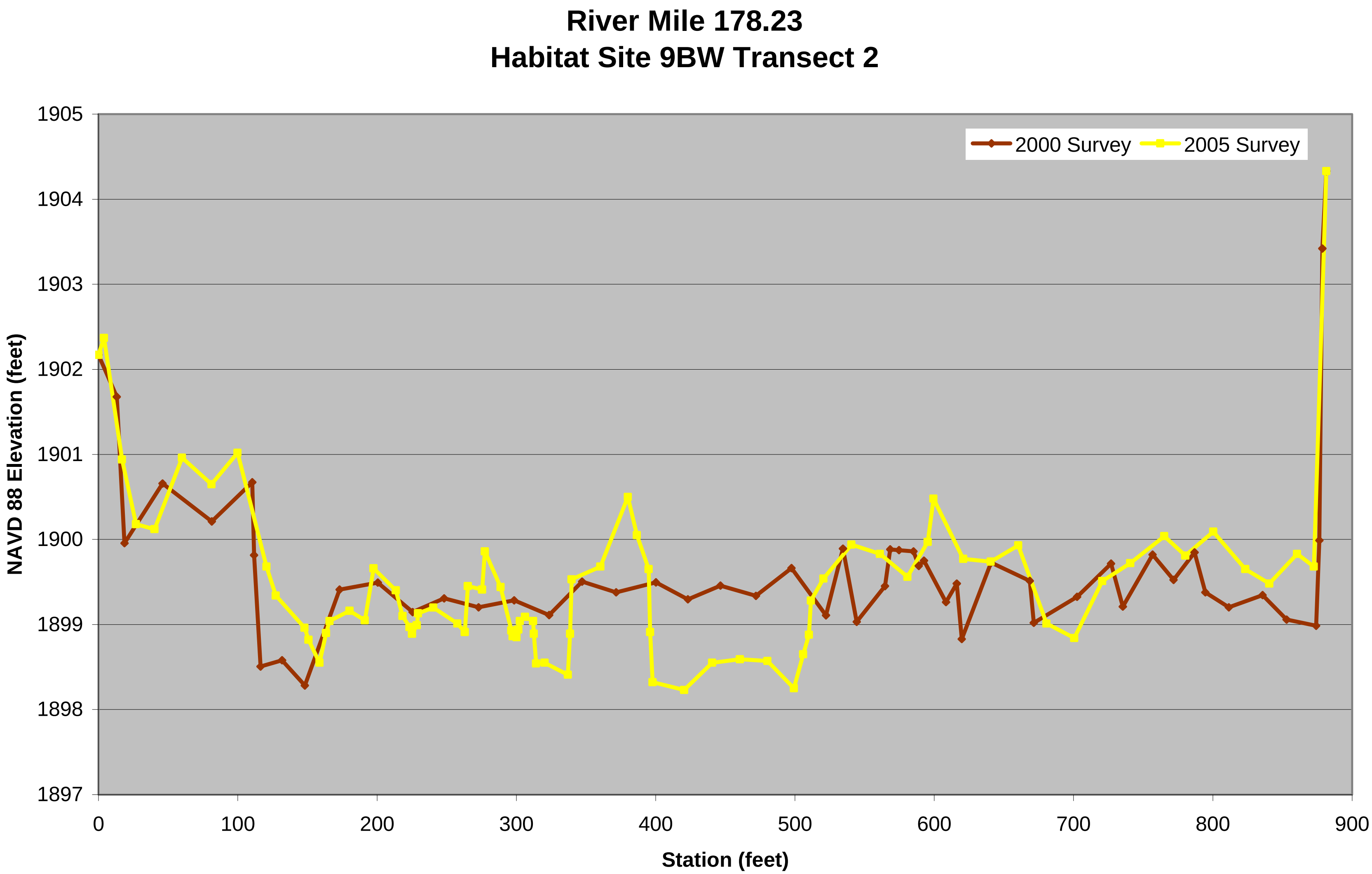


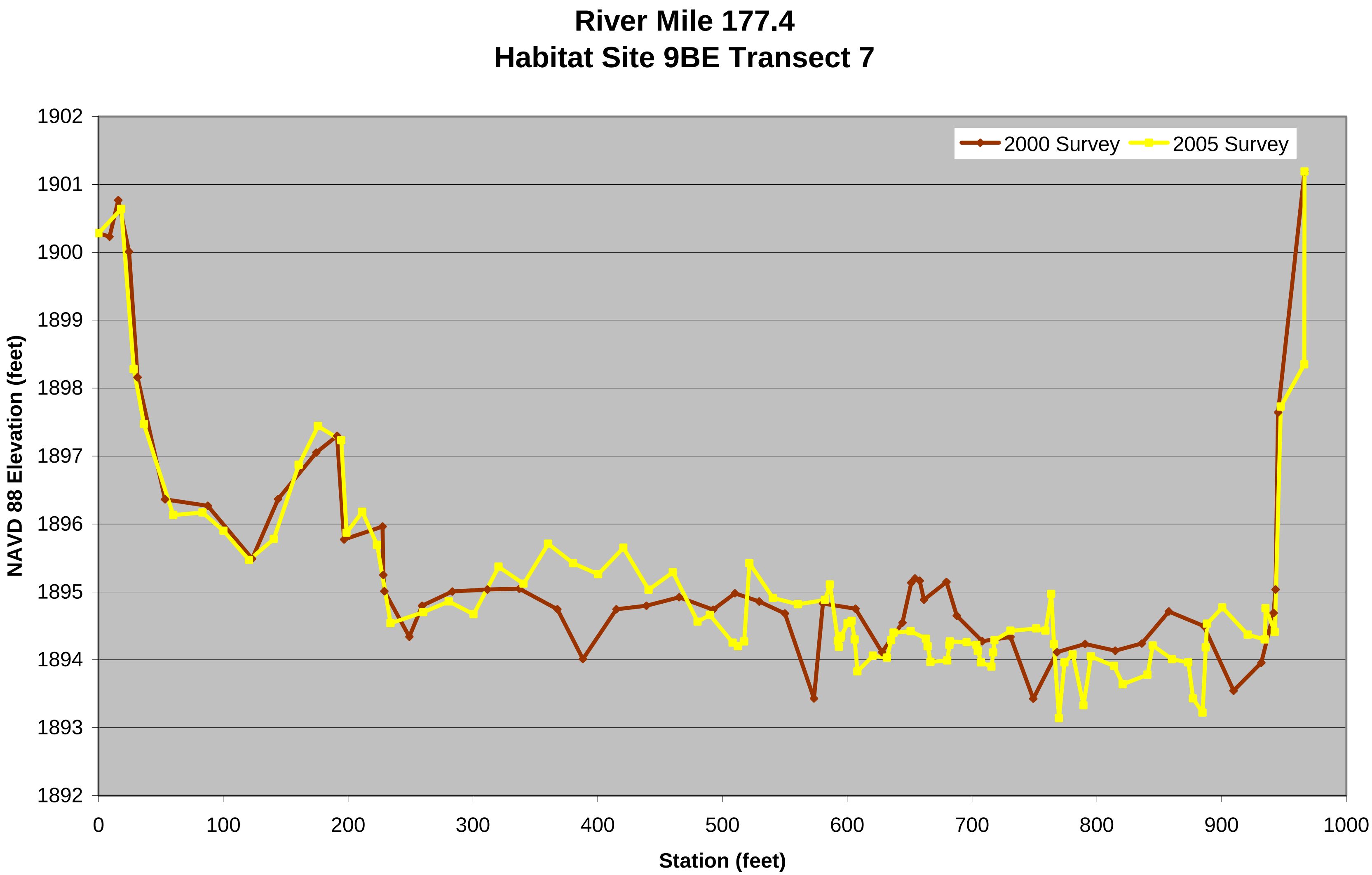

River Mile 191.1
Habitat Site 8B Transect 3
2000 Survey
2005 Survey
NAVD 88 Elevation (feet)
Station (feet)
1990
1988
1986
1984
1982
1980
1978
1976
0
200
400
600
800
1000
1200
1400
1600
1800


River Mile 191.0
Habitat Site 8B Transect 2
2000 Survey
2005 Survey
NAVD 88 Elevation (feet)
1987
1986
1985
1984
1983
1982
1981
1980
1979
1978
1977
0
200
400
600
800
1000
1200
Station (feet)



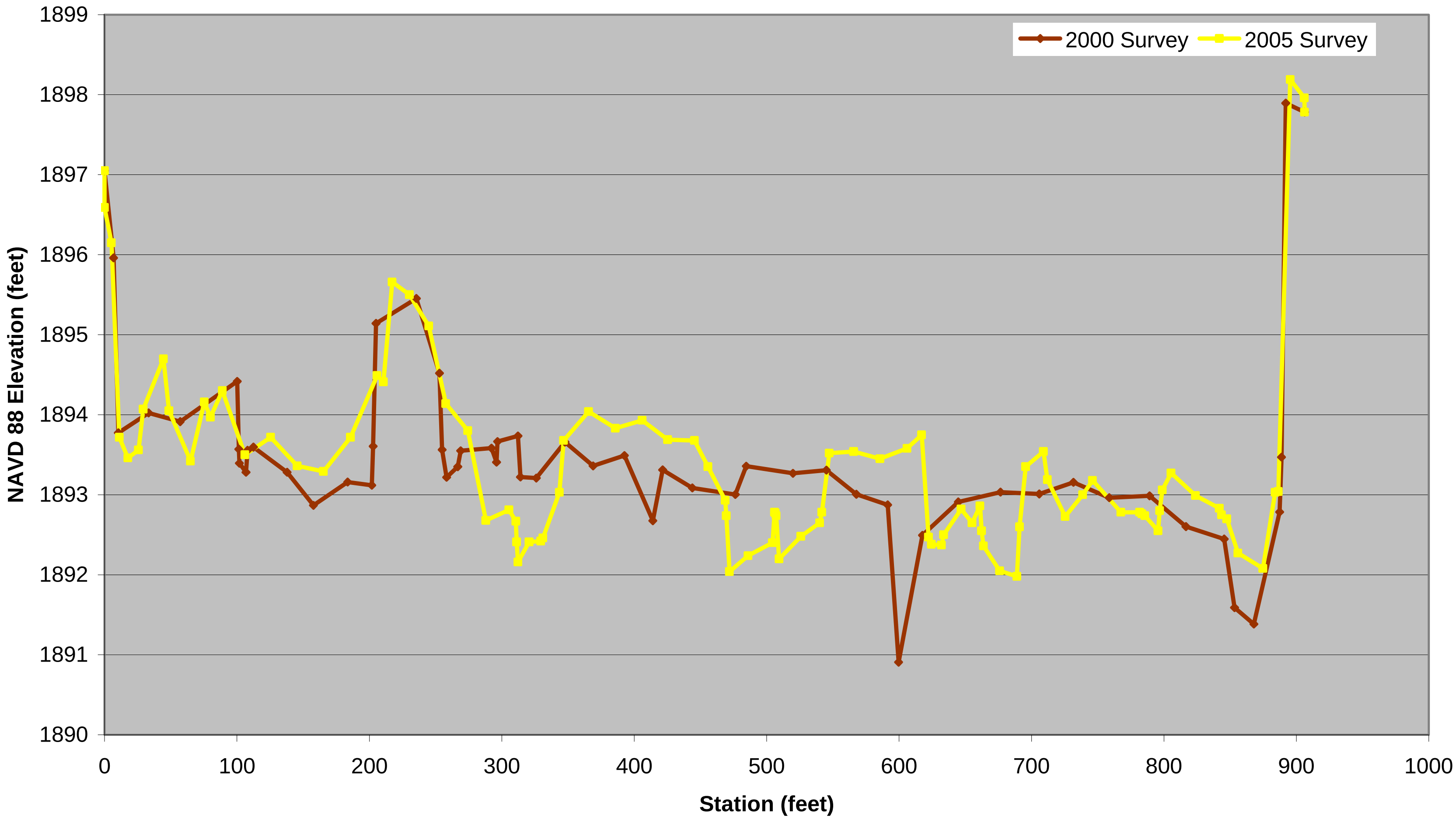
River Mile 178.32
Habitat Site 9BW Transect 4
NAVD 88 Elevation (feet)
Station (feet)
2000 Survey
2005 Survey
1905
1904
1903
1902
1901
1900
1899
1898
1897
1896
0
100
200
300
400
500
600
700
800


River Mile 178.23
Habitat Site 9BW Transect 2
2000 Survey
2005 Survey
NAVD 88 Elevation (feet)
Station (feet)
1905
1904
1903
1902
1901
1900
1899
1898
1897
0
100
200
300
400
500
600
700
800
900

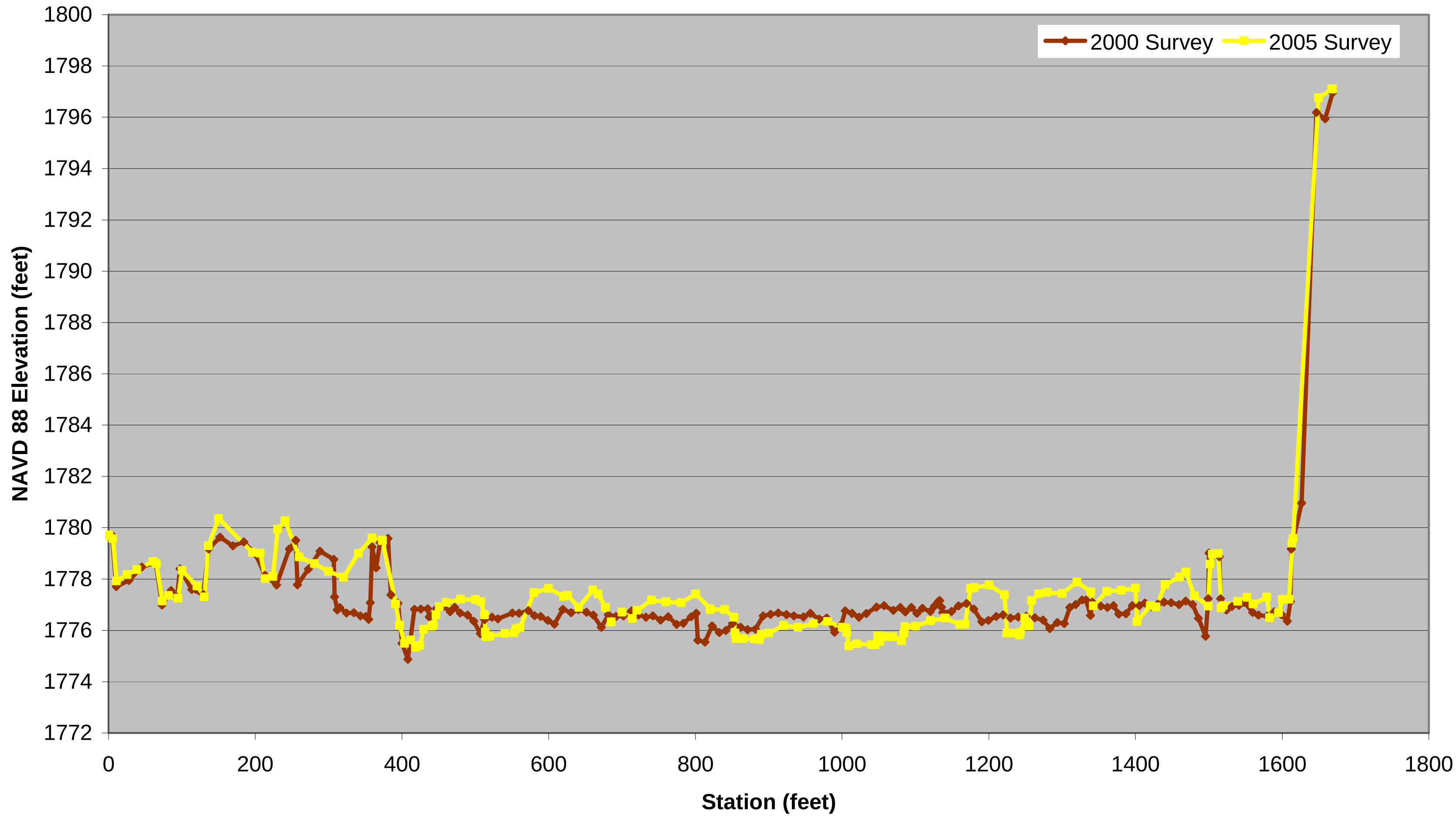


River Mile 177.4
Habitat Site 9BE Transect 7
2000 Survey
2005 Survey
NAVD 88 Elevation (feet)
1902
1901
1900
1899
1898
1897
1896
1895
1894
1893
1892
0
100
200
300
400
500
600
700
800
900
1000
Station (feet)

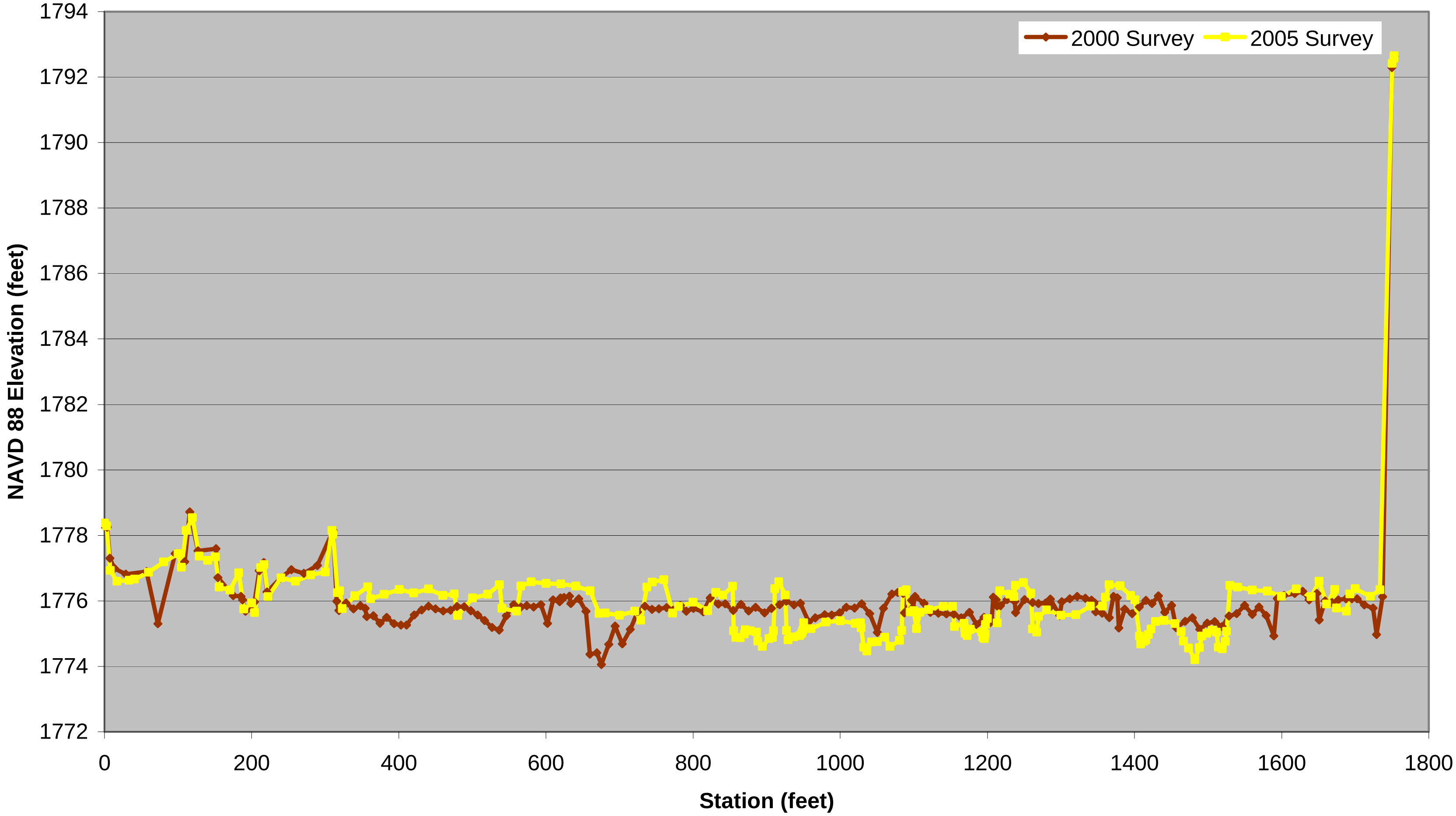
River Mile 177.15
Habitat Site 9BE Transect 2



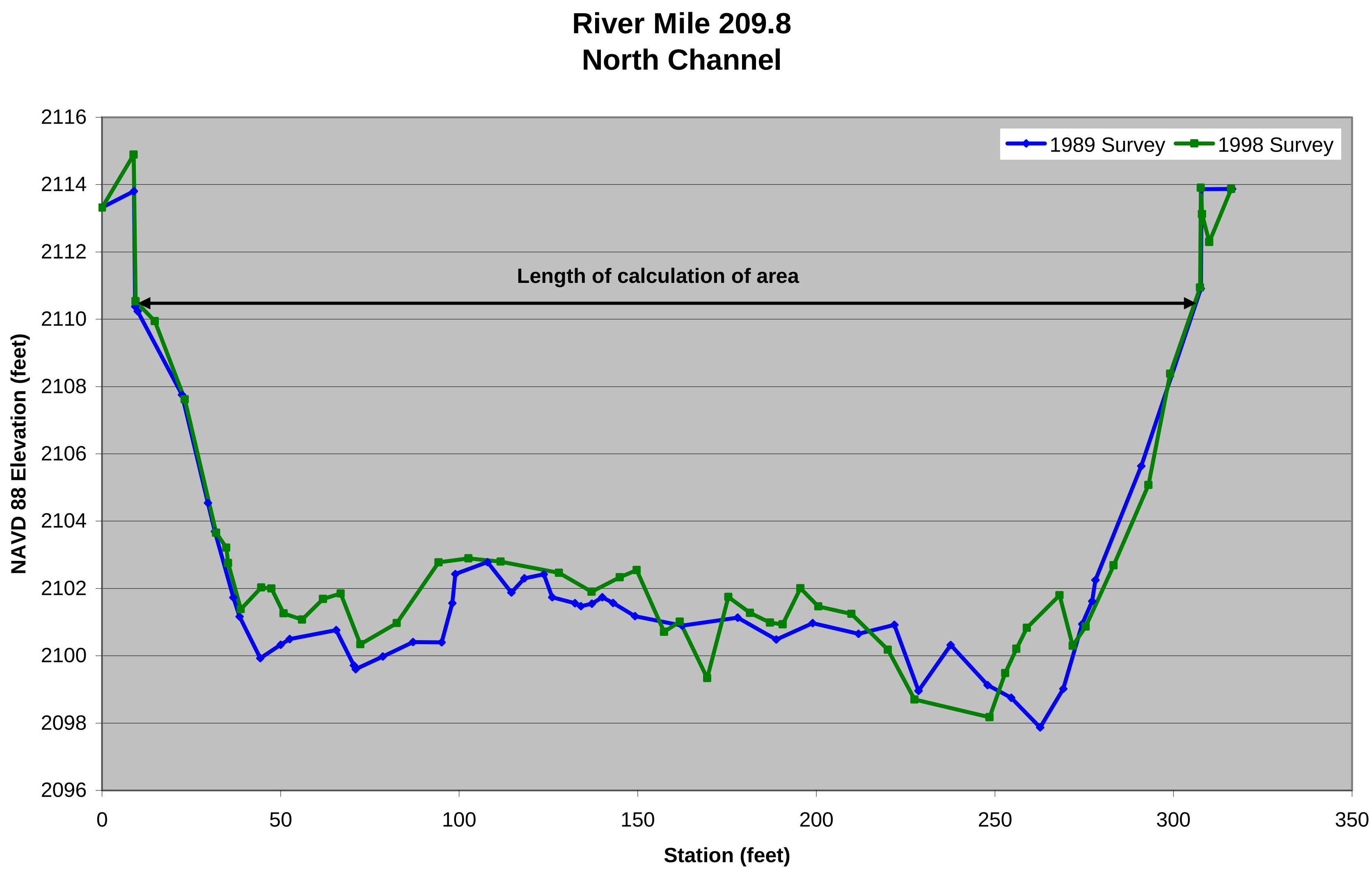
River Mile 158.7
Habitat Site 12A Transect 2

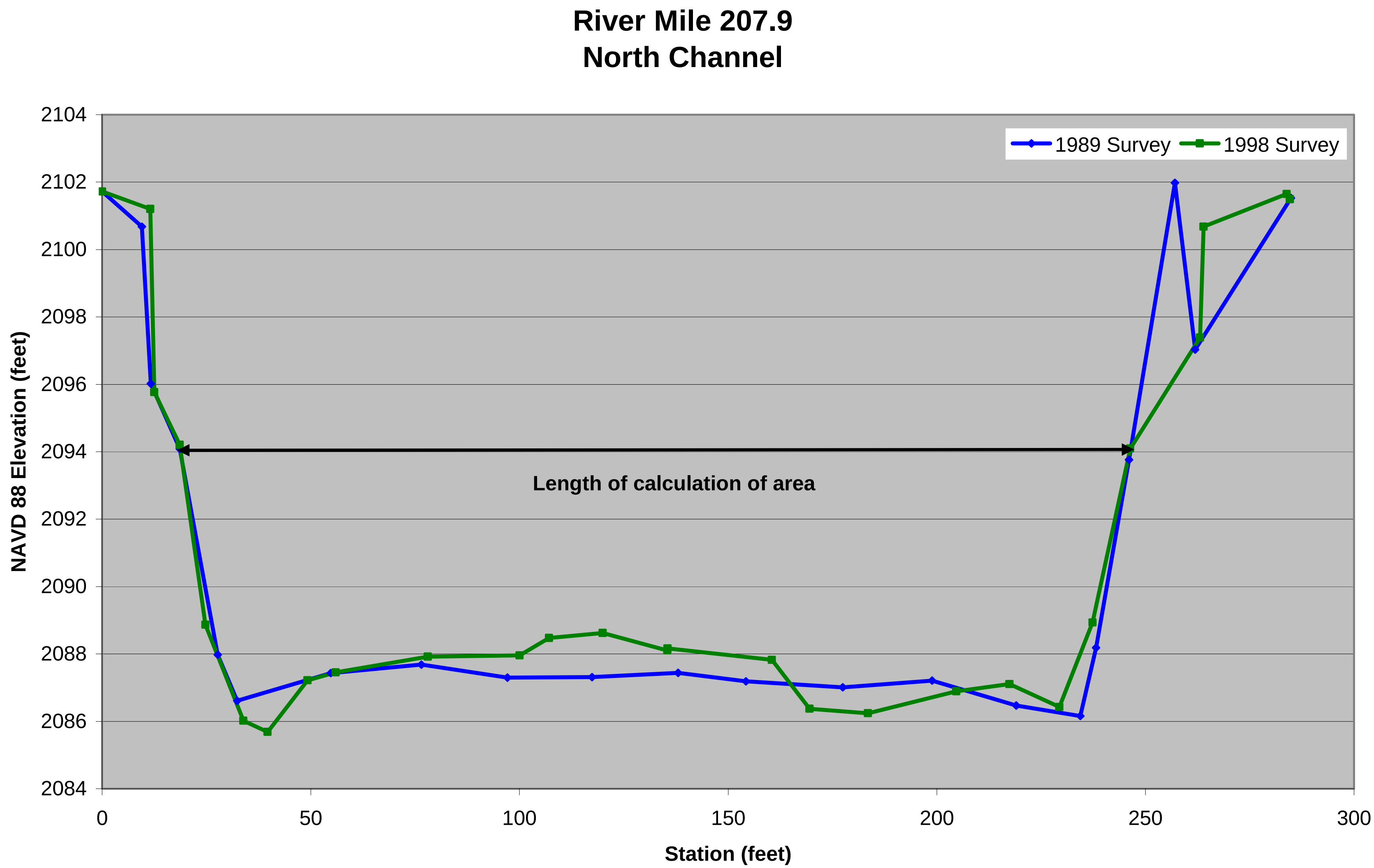


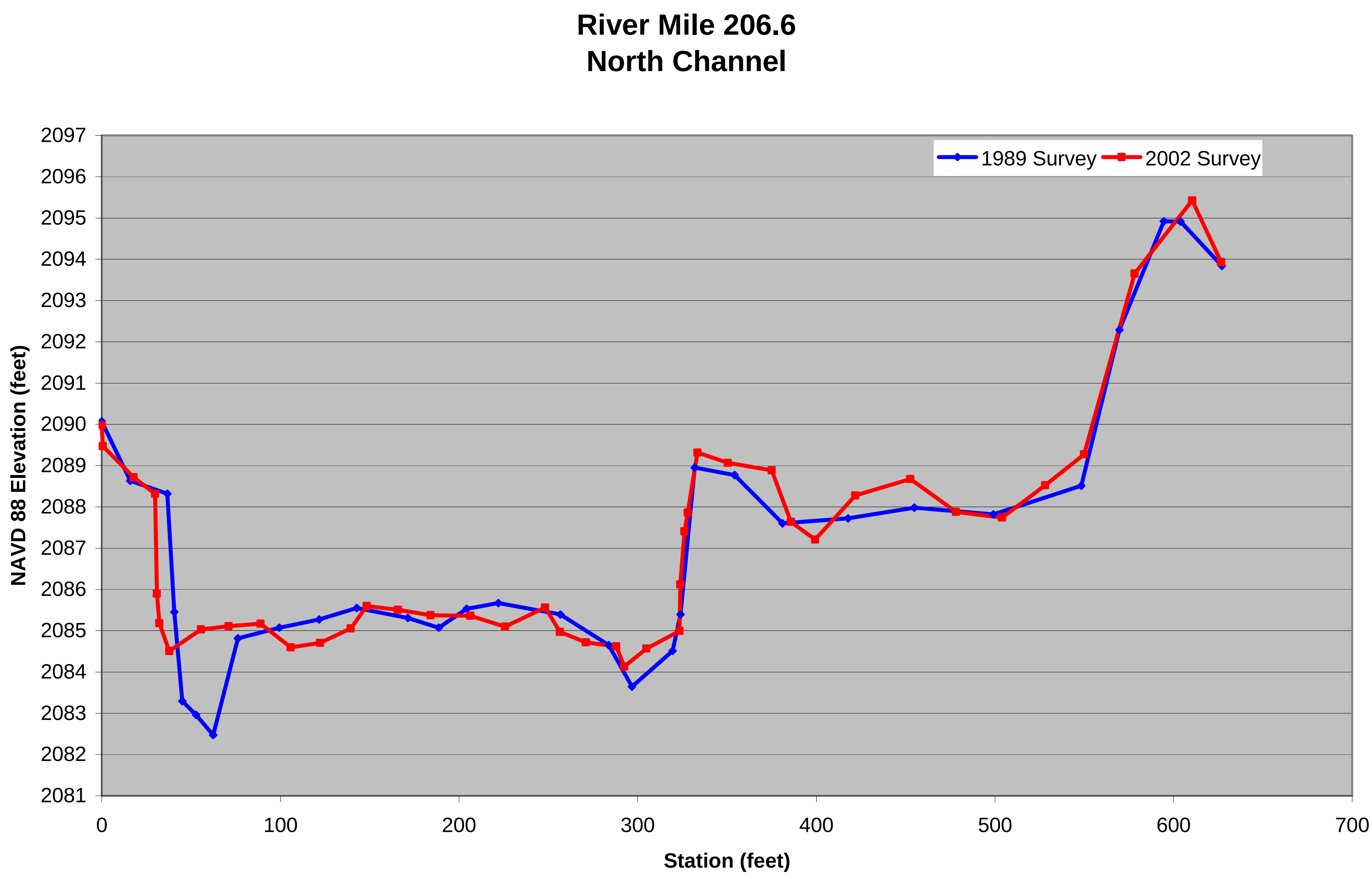
River Mile 158.55
Habitat Site 12A Transect 1

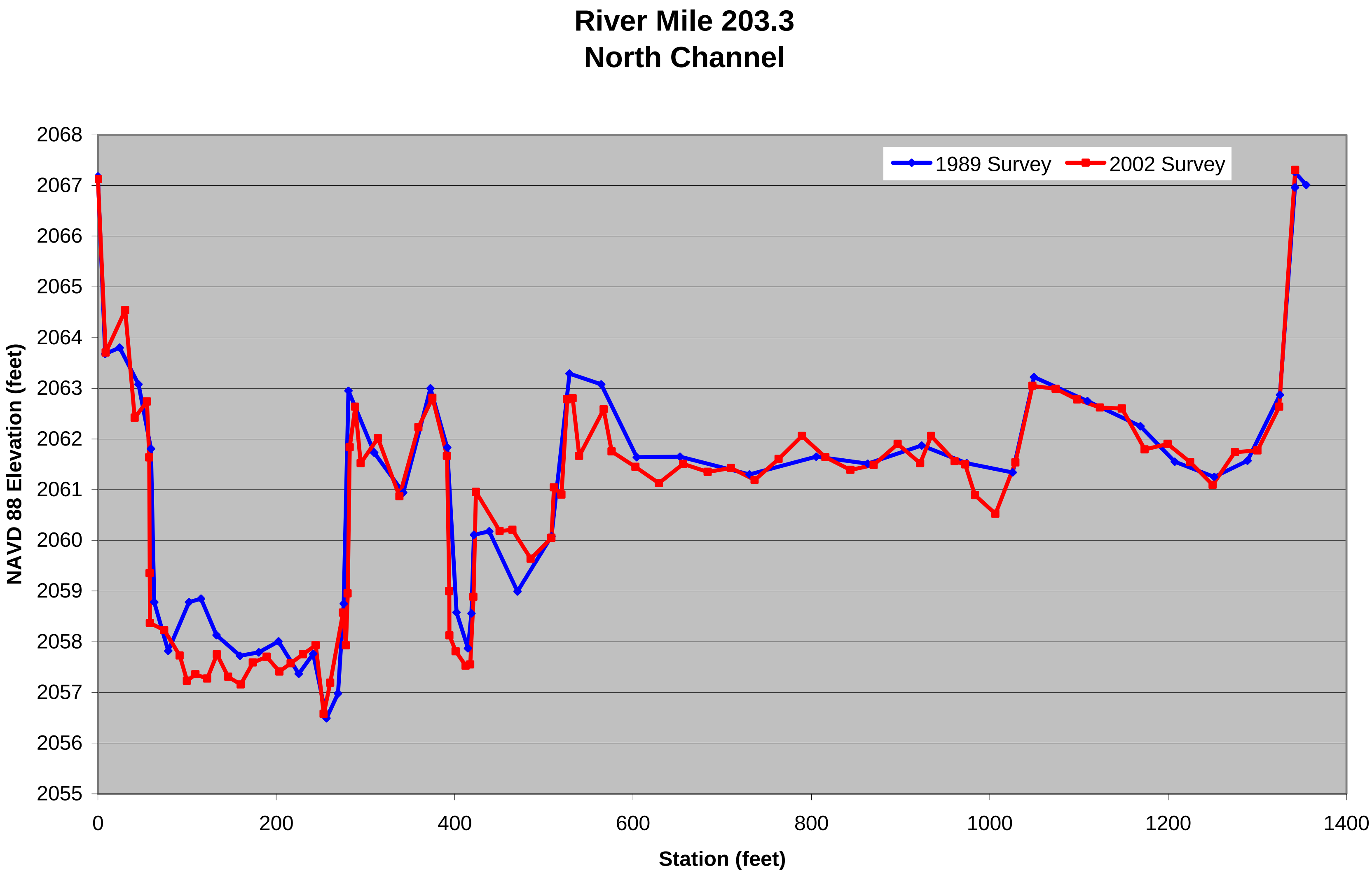


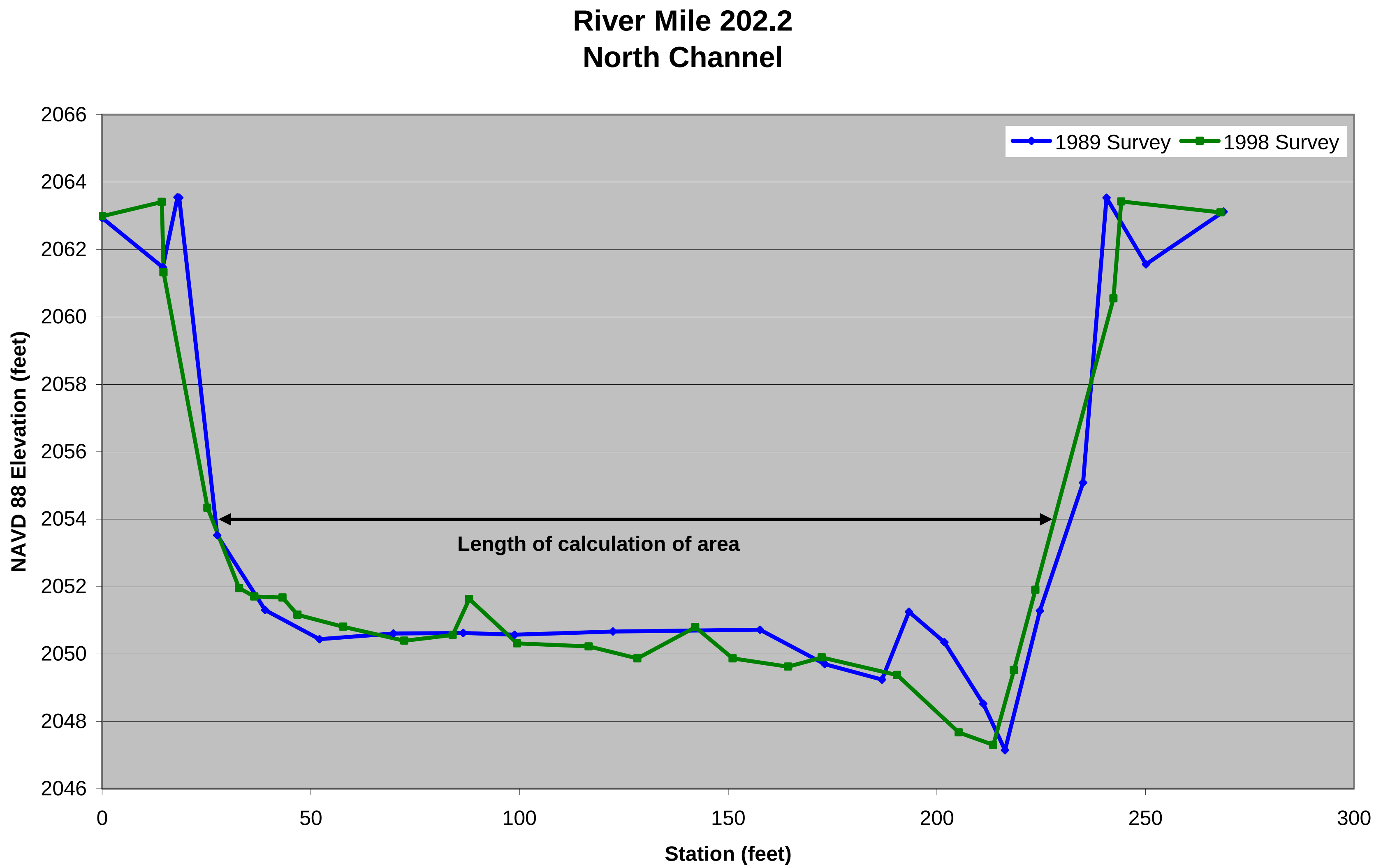
A.3.4 Side Channel 1



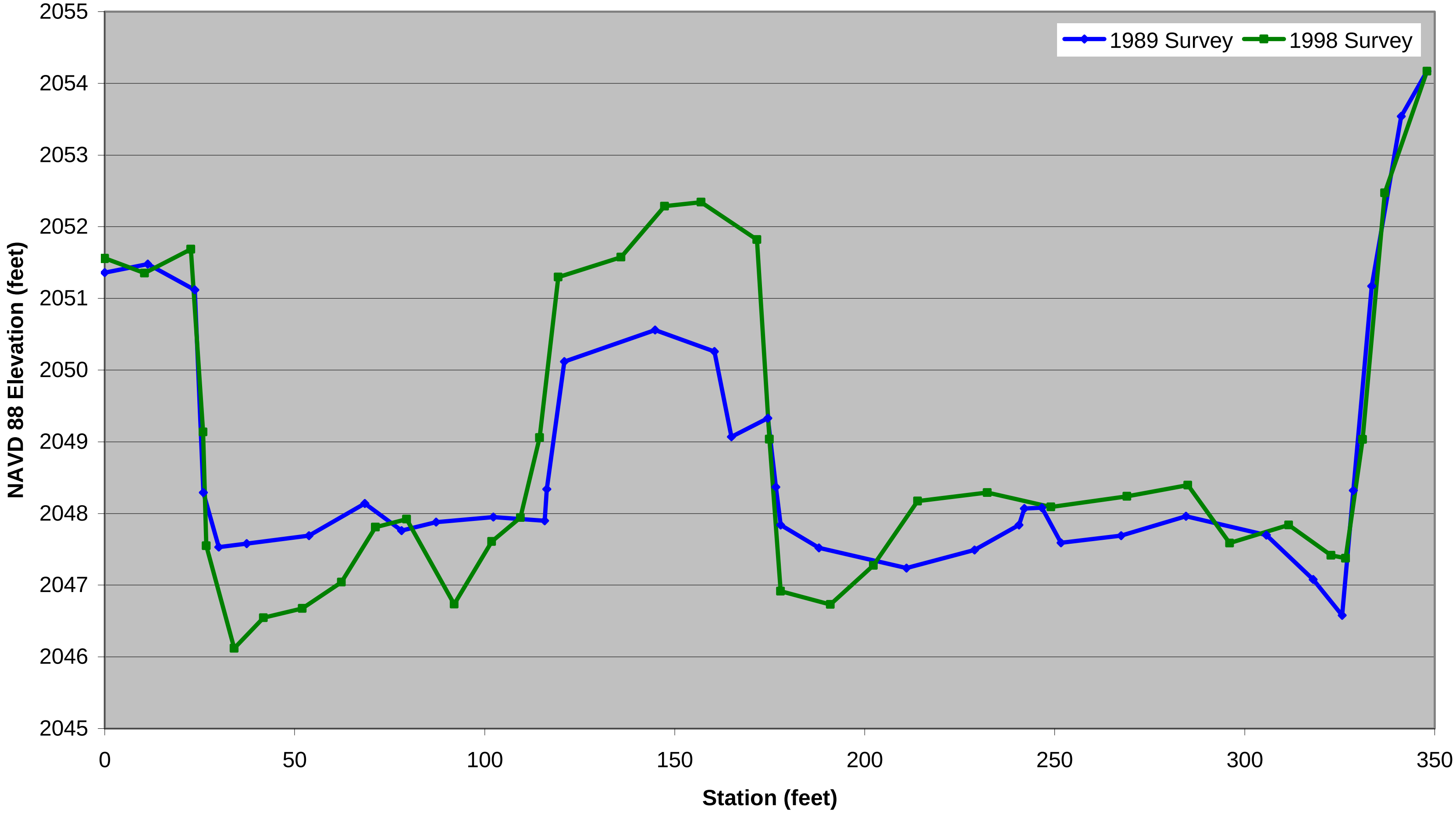

River Mile 207.9
North Channel
NAVD 88 Elevation (feet)
2104
2102
2100
2098
2096
2094
2092
2090
2088
2086
2084
Station (feet)
0
50
100
150
200
250
300
1989 Survey
1998 Survey
Length of calculation of area


River Mile 206.6
North Channel
1989 Survey
2002 Survey
NAVD 88 Elevation (feet)
2097
2096
2095
2094
2093
2092
2091
2090
2089
2088
2087
2086
2085
2084
2083
2082
2081
0
100
200
300
400
500
600
700
Station (feet)

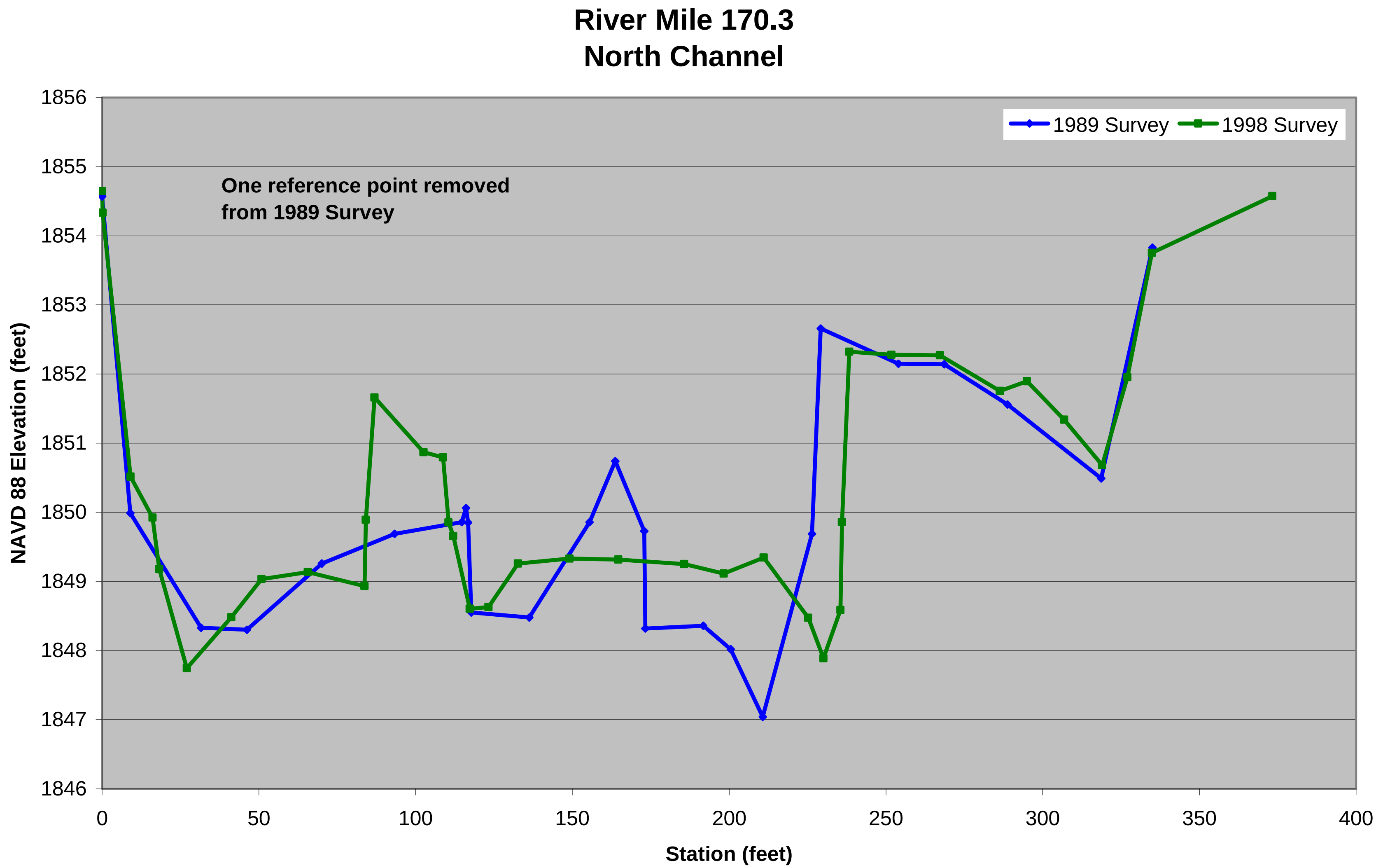

River Mile 203.3
North Channel
NAVD 88 Elevation (feet)
2068
2067
2066
2065
2064
2063
2062
2061
2060
2059
2058
2057
2056
2055
0
200
400
600
800
1000
1200
1400
Station (feet)
1989 Survey
2002 Survey

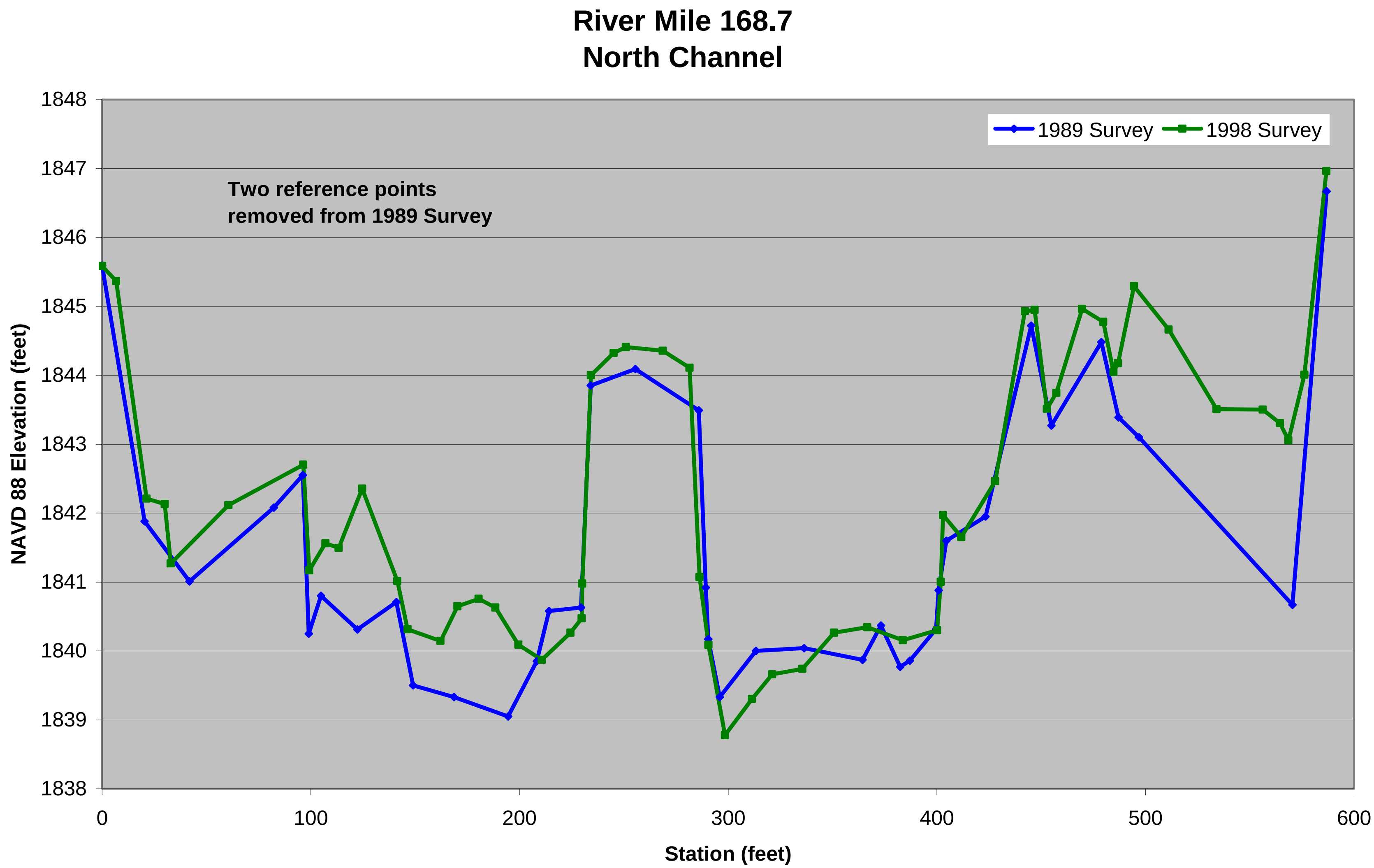

River Mile 202.2
North Channel
1989 Survey
1998 Survey
NAVD 88 Elevation (feet)
Station (feet)
Length of calculation of area
2066
2064
2062
2060
2058
2056
2054
2052
2050
2048
2046
0
50
100
150
200
250
300

River Mile 201.2
North Channel



A.3.5 Side Channel 2




River Mile 168.7
North Channel
NAVD 88 Elevation (feet)
Station (feet)
1989 Survey
1998 Survey
Two reference points
removed from 1989 Survey
1848
1847
1846
1845
1844
1843
1842
1841
1840
1839
1838
0
100
200
300
400
500
600

APPENDIX B: CONTROL POINTS SUMMARY TABLE

Table B.1. Summary of control points, including headpins, established for all surveys

		NAD 83			NAD 83 STATE PLANE NEBRASKA				
Survey Point ID	Approximate River Mile	Latitude	Longitude	Ellipsoid Height (Meters)	Northing (Meters)	Easting (Meters)	NAVD88 Elevation (Meters)	Description	Year Established
179	157.10	40° 59' 03.04952"N	98° 08' 33.91945"W	516.74	129452.7877	656238.0312	542.02	T-BAR (Found)	1998
180	157.10	40° 59' 09.04810"N	98° 08' 42.53037"W	516.69	129633.4156	656032.8765	541.97	3" X 3" Steel Plate (Found)	1998
6.8/31-12-7	158.60	40° 57' 45.08200" N	98° 9' 27.79011" W	539.77	127021.9641	655030.6220	565.04	3 1/2" BC (USBR BM) (Found)	2000
12A-1S	158.60	40° 57' 56.21466" N	98° 9' 30.70542" W	521.13	127363.7539	654955.1739	546.40	T-BAR (Found)	2000
12A-1N	158.60	40° 58' 7.71153" N	98° 9' 47.79844" W	516.79	127709.7268	654548.1651	542.05	T-BAR (Found)	2000
12A-2S	158.70	40° 57' 49.14135" N	98° 9' 37.58392" W	522.50	127142.2472	654799.0588	547.76	T-BAR (Found)	2000
12A-2N	158.70	40° 58' 1.11642" N	98° 9' 52.53324" W	517.20	127504.0360	654441.8317	542.46	T-BAR (Found)	2000
8.7/31-12-7	159.00	40° 57' 28.81728" N	98° 9' 39.94893" W	540.27	126514.4398	654757.1148	565.53	3 1/2" BC (USBR BM) (Found)	2000
12A-3S	159.00	40° 57' 37.06742" N	98° 9' 49.45219" W	522.03	126764.0866	654529.5871	547.29	T-BAR (Found)	2000
12A-3N	159.00	40° 57' 48.79074" N	98° 10' 3.84904" W	517.38	127118.4003	654185.4325	542.64	T-BAR (Found)	2000
162.2S	162.20	40° 56' 4.87386" N	98° 12' 29.21797" W	523.93	123843.1824	650854.3304	549.15	3" X 3" Steel Plate (Found)	2000
162.2N	162.20	40° 56' 18.93436" N	98° 12' 46.77380" W	524.30	124268.2038	650434.8766	549.52	3" X 3" Steel Plate (Found)	2000
177	167.85	40° 52' 20.14566"N	98° 16' 47.63612"W	536.58	116791.4324	644949.7957	561.75	3" X 3" Steel Plate (Set)	1998
178	167.85	40° 52' 26.40637"N	98° 16' 56.24787"W	537.08	116980.4604	644744.4041	562.25	3" X 3" Steel Plate (Found)	1998
4	168.70	40° 51' 52.97797"N	98° 17' 36.26492"W	537.57	115931.2144	643828.1862	562.72	T-BAR (Found)	1998
5	168.70	40° 52' 00.90199"N	98° 17' 47.32854"W	537.42	116170.4277	643564.3996	562.57	T-BAR (Found)	1998
169	168.70	40° 52' 05.11040"N	98° 17' 49.88233"W		116299.0079	643502.0678	562.95	T-BAR (Found)	1998
3468	168.70	40° 52' 08.08088"N	98° 17' 51.82686"W	537.04	116389.7003	643454.7500	562.18	3" X 3" Steel Plate (Set)	1998
170	168.70	40° 52' 10.30309"N	98° 17' 53.28160"W	537.40	116457.5474	643419.3515	562.54	T-BAR (Found)	1998
170.3SR	170.30	40° 50' 42.18499" N	99° 18' 13.72044" W		113731.1964	642994.2728	564.77	T-BAR (Found)	2000
170.3SL	170.30	40° 50' 47.73770" N	99° 18' 24.39525" W		113897.5035	642740.9733	565.29	T-BAR (Found)	2000
173	170.30	40° 50' 47.37319"N	98° 18' 31.88503"W		113882.8320	642565.8272	565.31	3" X 3" Steel Plate (Found)	1998
174	170.30	40° 50' 53.84379"N	98° 18' 40.72147"W	540.27	114078.2960	642355.0326	565.39	3" X 3" Steel Plate (Found)	1998
3618	170.30	40° 50' 55.22266"N	98° 18' 42.60459"W	539.82	114119.9496	642310.1121	564.95	3" X 3" Steel Plate (Set)	1998
3545	170.30	40° 51' 18.79202"N	98° 19' 04.19643"W	540.16	114836.8122	641790.4340	565.27	T-BAR (Set)	1998
171	170.30	40° 51' 19.09833"N	98° 19' 04.49500"W	539.91	114846.1209	641783.2604	565.03	3" X 3" Steel Plate (Found)	1998
172	170.30	40° 51' 21.75927"N	98° 19' 07.08277"W	540.18	114926.9875	641721.0823	565.30	3" X 3" Steel Plate (Found)	1998
167	172.60	40° 49' 16.74126"N	98° 20' 17.31631"W	544.75	111040.4771	640150.9625	569.85	Wooden Stake (Set)	1998

		NAD 83			NAD 83 STATE PLANE NEBRASKA				
Survey Point ID	Approximate River Mile	Latitude	Longitude	Ellipsoid Height (Meters)	Northing (Meters)	Easting (Meters)	NAVD88 Elevation (Meters)	Description	Year Established
168	172.60	40° 49 21.53519"N	98° 20' 22.71748"W	544.10	111185.8590	640021.6108	569.20	3" X 3" Steel Plate (Found)	1998
175	175.20	40° 48' 05.41409"N	98° 22' 42.98409"W	551.91	108776.4110	636780.1880	576.97	3" X 3" Steel Plate (Found)	1998
176	175.20	40° 48' 11.54011"N	98° 22' 42.98605"W	551.97	108965.2975	636776.5993	577.03	T-BAR (Found)	1998
9BE-1R	177.10	40° 47' 19.68143" N	98° 24' 33.03461" W	553.27	107318.3925	634227.5904	578.29	T-BAR	2000
9BE-1L	177.10	40° 47' 27.00132" N	98° 24' 41.45495" W	552.98	107540.4641	634026.1111	578.00	T-BAR	2000
9BE-5.7	177.10	40° 47' 29.48423" N	98° 24' 43.17738" W	554.46	107616.2801	633984.3406	579.48	3 1/2 INCH BRASS CAP	2000
9BE-2R	177.15	40° 47' 18.77429" N	98° 24' 35.81951" W	553.42	107289.2210	634162.8402	578.44	T-BAR	2000
9BE-2L	177.15	40° 47' 25.74287" N	98° 24' 43.21609" W	553.20	107500.9029	633985.5524	578.22	T-BAR	2000
9BE-3R	177.20	40° 47' 17.92823" N	98° 24' 38.47437" W	553.15	107261.9899	634101.1025	578.17	T-BAR	2000
9BE-3L	177.20	40° 47' 24.96765" N	98° 24' 44.73174" W	553.16	107476.3477	633950.4727	578.18	T-BAR	2000
9BE-4R	177.25	40° 47' 16.80522" N	98° 24' 41.68348" W	553.19	107225.9807	634026.5320	578.22	T-BAR	2000
9BE-4L	177.25	40° 47' 24.62731" N	98° 24' 46.72642" W	553.03	107464.9954	633903.9207	578.05	T-BAR	2000
9BE-5R	177.30	40° 47' 15.74647" N	98° 24' 43.89597" W	553.91	107192.3830	633975.2809	578.94	T-BAR	2000
9BE-5L	177.30	40° 47' 23.87176" N	98° 24' 49.45265" W	553.45	107440.5263	633840.4598	578.47	T-BAR	2000
9BE-6R	177.36	40° 47' 13.71705" N	98° 24' 46.84998" W	553.79	107128.5369	633907.2007	578.82	T-BAR	2000
9BE-6L	177.36	40° 47' 22.13783" N	98° 24' 53.04563" W	553.15	107385.5181	633757.2395	578.17	T-BAR	2000
9BE-7R	177.43	40° 47' 12.04337" N	98° 24' 51.37454" W	554.46	107074.9850	633802.1107	579.48	T-BAR	2000
9BE-7L	177.43	40° 47' 20.31421" N	98° 24' 57.65225" W	554.19	107327.3099	633650.3138	579.21	T-BAR	2000
9BE-8.8	177.55	40° 47' 20.19261" N	98° 25' 4.02022" W	553.75	107320.8275	633501.1480	578.77	3 1/2 INCH BRASS CAP	2000
65	178.03	40° 47' 4.77585" N	98° 25' 28.98537" W	554.73	106834.7840	632924.7472	579.74	T-BAR (OLD 9BW-1R)	2000
9BW-8.7	178.17	40° 47' 16.95769" N	98° 25' 39.31717" W	555.50	107205.9897	632675.7716	580.51	3 1/2 INCH BRASS CAP	2000
9BW-1R	178.18	40° 47' 4.89842" N	98° 25' 39.36838" W	555.24	106834.1332	632681.3345	580.25	T-BAR (SET NEW 9BW-1R)	2000
9BW-1L	178.18	40° 47' 14.82549" N	98° 25' 39.89369" W	554.60	107139.9998	632663.4561	579.61	T-BAR	2000
9BW-2R	178.23	40° 47' 5.58467" N	98° 25' 42.96214" W	555.44	106853.7615	632596.7241	580.44	T-BAR	2000
9BW-2L	178.23	40° 47' 14.29434" N	98° 25' 42.78708" W	554.78	107122.3894	632595.9451	579.78	T-BAR	2000
9BW-3R	178.27	40° 47' 5.97852" N	98° 25' 45.69071" W	555.32	106864.7433	632532.5547	580.32	T-BAR	2000
9BW-3L	178.27	40° 47' 14.23039" N	98° 25' 45.48743" W	554.87	107119.2674	632532.6961	579.87	T-BAR	2000
9BW-4R	178.32	40° 47' 6.37277" N	98° 25' 48.81665" W	555.51	106875.5686	632459.0724	580.51	T-BAR	2000
9BW-4L	178.32	40° 47' 14.06081" N	98° 25' 48.39806" W	554.91	107112.7996	632464.5780	579.91	T-BAR	2000

		NAD 83			NAD 83 STATE PLANE NEBRASKA				
Survey Point ID	Approximate River Mile	Latitude	Longitude	Ellipsoid Height (Meters)	Northing (Meters)	Easting (Meters)	NAVD88 Elevation (Meters)	Description	Year Established
9BW-5R	178.38	40° 47' 6.29990" N	98° 25' 52.44383" W	555.89	106871.7789	632374.1046	580.89	T-BAR	2000
9BW-5L	178.38	40° 47' 13.73898" N	98° 25' 53.20560" W	555.07	107100.8311	632352.0892	580.08	T-BAR	2000
9BW-6.7	178.60	40° 47' 20.24903" N	98° 26' 7.26453" W	555.55	107295.5911	632018.9729	580.55	3 1/2 INCH BRASS CAP	2000
165	181.90	40° 46' 12.65537"N	98° 29' 34.11012"W	563.83	105125.2593	627207.8028	588.80	3" X 3" Steel Plate (Found)	1998
166	181.90	40° 46' 19.22719"N	98° 29' 34.18535"W	563.69	105327.8666	627202.5064	588.67	T-BAR (Found)	1998
163	187.30	40° 44' 54.48965"N	98° 35' 06.21011"W	574.11	102583.4476	619462.0183	599.02	3" X 3" Steel Plate (Found)	1998
164	187.30	40° 45' 00.40389"N	98° 35 08.69844"W	574.44	102764.8580	619400.6828	599.35	3" X 3" Steel Plate (Found)	1998
161	187.30	40° 45' 16.85458"N	98° 35' 15.69174"W	574.21	103269.4337	619228.4043	599.11	3" X 3" Steel Plate (Found)	1998
162	187.30	40° 45' 19.45271"N	98° 35' 16.80411"W	574.32	103349.1212	619201.0130	599.22	3" X 3" Steel Plate (Found)	1998
8B-1R	190.90	40° 43' 32.36155" N	98° 38' 45.33629" W	579.48	99968.7051	614363.0603	604.33	T-BAR	2000
8B-1L	190.90	40° 43' 42.47677" N	98° 38' 49.68418" W	579.72	100279.0148	614256.1832	604.56	T-BAR (SET)	2000
8B-2R	191.00	40° 43' 29.36365" N	98° 38' 52.89018" W	580.23	99873.4904	614187.3008	605.08	T-BAR	2000
8B-2L	191.00	40° 43' 40.05739" N	98° 38' 56.83471" W	579.75	100201.7893	614089.6133	604.59	T-BAR	2000
8B-3R	191.10	40° 43' 26.45454" N	98° 38' 58.89020" W	579.87	99781.5868	614047.9471	604.72	T-BAR	2000
8B-3L	191.10	40° 43' 41.11489" N	98° 39' 02.86815" W	579.87	100232.1875	613947.5716	604.71	T-BAR	2000
8B-3R	191.10	40º 43' 25.09909"N	98º 38' 58.52265"W	581.42	99739.9260	614057.2220	606.27	Set 5/8" Rebar	2005
8B-4R	191.20	40° 43' 25.72684" N	98° 39' 6.11356" W	580.77	99756.5030	613878.8413	605.62	T-BAR	2000
8B-4L	191.20	40° 43' 39.42988" N	98° 39' 12.18647" W	580.24	100176.8214	613729.7922	605.07	T-BAR	2000
8B-5R	191.35	40° 43' 24.63336" N	98° 39' 16.42036" W	580.37	99719.0182	613637.5739	605.21	T-BAR	2000
8B-5L	191.35	40° 43' 36.46235" N	98° 39' 20.37864" W	580.00	100082.3255	613539.0423	604.84	T-BAR	2000
157	195.80	40° 42' 50.71938"N	98° 44' 25.87288"W	592.26	98563.8787	606393.1243	617.04	3" X 3" Steel Plate (Found)	1998
158	195.80	40° 43' 00.13399"N	98° 44' 25.91310"W	592.36	98854.1726	606387.9515	617.13	Wooden Stake (Set)	1998
195.8R	195.80	40°42'50.71938"N	98°44'25.87288"W	592.26	98563.8790	606393.1240	617.04	3" X 3" Steel Plate (Found)	2001
C 287	195.80	40°44'32.96419"N	98°44'27.77027"W	588.83	101716.0370	606302.6930	613.57	NGS PID LH0485	2001
8C-1S	196.30	40°42'45.98665"N	98°44'48.61314"W	590.38	98410.1870	605861.6780	615.13	T-BAR	2001
8C-1N	196.30	40°42'57.14293"N	98°44'51.06861"W	590.32	98753.3660	605799.0790	615.07	T-BAR	2001
8C-2S	196.40	40°42'44.34306"N	98°44'55.15719"W	590.40	98357.2810	605708.8630	615.15	T-BAR	2001
8C-2N	196.40	40°42'58.06537"N	98°44'57.36207"W	590.53	98779.6730	605651.0060	615.28	T-BAR	2001
5.7	196.40	40°43'06.04666"N	98°45'00.90750"W	591.40	99024.5800	605564.2640	616.14	3 1/2" BC (USBR BM) (Found)	2001

		NAD 83			NAD 83 STATE PLANE NEBRASKA				
Survey Point ID	Approximate River Mile	Latitude	Longitude	Ellipsoid Height (Meters)	Northing (Meters)	Easting (Meters)	NAVD88 Elevation (Meters)	Description	Year Established
8C-3S	196.50	40°42'41.72325"N	98°45'02.93656"W	590.87	98273.8570	605527.4960	615.62	T-BAR	2001
8C-3N	196.50	40°42'57.78086"N	98°45'02.86006"W	590.72	98769.0340	605522.1360	615.47	T-BAR	2001
8C-4S	196.60	40°42'40.78433"N	98°45'16.20035"W	591.31	98240.4140	605216.6880	616.06	T-BAR	2001
8C-4N	196.60	40°42'55.09201"N	98°45'19.91173"W	591.24	98680.3510	605123.2520	615.98	T-BAR	2001
199.5SB	199.50	40° 41' 29.39150" N	98° 48' 2.40742" W	597.54	95983.7844	601347.2739	622.25	NAIL (Set)	2000
199.5S	199.50	40° 41' 36.97211" N	98° 48' 5.51988" W	598.37	96216.5290	601270.9790	623.08	3" X 3" Steel Plate (Found)	2000
199.5N	199.50	40° 41' 57.44595" N	98° 48' 25.95744" W	597.97	96841.2318	600782.5816	622.66	WC 1' Tall Concrete Post (Found)	2000
19	201.20	40° 40' 52.16083"N	98° 49' 47.12253"W	601.40	94802.0417	598904.9782	626.12	3" X 3" Steel Plate (Found)	1998
155	201.20	40° 41' 34.60449"N	98° 50' 17.44708"W	601.42	96101.2513	598175.5084	626.11	3" X 3" Steel Plate (Found)	1998
156	201.20	40° 41' 37.57704"N	98° 50' 19.71792"W	600.63	96192.1981	598120.9777	625.32	Wooden Stake (Set)	1998
201.2R	201.20	40°40'52.16083"N	98°49'47.12253"W	601.40	94802.0420	598904.9780	626.12	3" X 3" Steel Plate (Found)	2001
2950	202.20	40° 40' 30.63517"N	98° 50' 52.57589"W		94117.6281	597377.2783	629.25	3" X 3" Steel Plate (Found)	1998
20	202.20	40° 40' 30.63537"N	98° 50' 52.56583"W	604.53	94117.6376	597377.5143	629.24	T-BAR (Found)	1998
153	202.20	40° 40' 36.09857"N	98° 50' 52.27324"W	604.65	94286.1951	597382.1387	629.35	3" X 3" Steel Plate (Found)	1998
154	202.20	40° 40' 40.40078"N	98° 50' 52.03490"W	604.52	94418.9349	597385.9661	629.22	3" X 3" Steel Plate (Found)	1998
151	202.20	40° 41' 26.94810"N	98° 50' 49.54325"W	604.15	95855.0705	597425.3203	628.83	3" X 3" Steel Plate (Found)	1998
152	202.20	40° 41' 29.59789"N	98° 50' 49.40248"W	604.12	95936.8248	597427.5348	628.80	3" X 3" Steel Plate (Found)	1998
203.3SR	203.30	40° 40' 28.32611" N	98° 52' 8.86207" W	605.00	94022.7774	595587.1914	629.66	3" X 3" Steel Plate (Found)	2000
203.3SL	203.30	40° 40' 44.57824" N	98° 52' 9.05452" W	604.92	94523.8788	595576.1177	629.57	3" X 3" Steel Plate (Found)	2000
203.3SB	203.30	40° 40' 46.04402" N	98° 52' 0.19398" W	604.35	94571.8021	595783.5377	629.00	NAIL (Set)	2000
203.3NR	203.30	40° 41' 17.74439" N	98° 52' 9.46955" W	605.48	95546.4824	595552.9983	630.12	3" X 3" Steel Plate (Found)	2000
203.3NL	203.30	40° 41' 31.00752" N	98° 52' 9.59943" W	605.44	95955.4320	595544.6007	630.06	3" X 3" Steel Plate (Found)	2000
101	205.90	40° 39' 50.46217"N	98° 54' 54.96057"W		92805.2038	591702.1849	636.27	AL1 T-BAR (Found)	1998
100	205.90	40° 40' 06.46646"N	98° 54' 52.86118"W	609.99	93299.3442	591745.2868	634.63	AL1 T-BAR (Found)	1998
104	206.00	40° 39' 49.92266"N	98° 54' 58.94813"W		92787.3927	591608.7584	635.99	AL2 3" X 3" Steel Plate (Found)	1998
102	206.00	40° 40' 05.33950"N	98° 55' 01.40327"W	611.37	93262.0772	591545.1519	636.02	AL2 Wooden Stake (set)	1998
107	206.20	40° 39' 47.99439"N	98° 55' 09.65216"W		92724.7848	591358.1511	636.50	AL3 Wooden Stake (set)	1998
106	206.20	40° 40' 04.89182"N	98° 55' 14.91946"W	611.41	93244.3036	591227.9595	636.05	AL3 Wooden Stake (set)	1998
6-3R	206.20	40º 39' 47.99440"N	98º 55' 09.65216"W	611.86	92724.7850	591358.1510	636.50	Set 5/8" Rebar	2005

		NAD 83			NAD 83 STATE PLANE NEBRASKA				
Survey Point ID	Approximate River Mile	Latitude	Longitude	Ellipsoid Height (Meters)	Northing (Meters)	Easting (Meters)	NAVD88 Elevation (Meters)	Description	Year Established
21	206.32	40° 40' 06.14086"N	98° 55' 22.71367"W	611.50	93280.5378	591044.4685	636.14	USBR BM 6.5/17-8-14	1998
109	206.40	40° 39' 46.52084"N	98° 55 20.58075"W		92676.1418	591102.0916	637.08	AL4 Wooden Stake (set)	1998
108	206.40	40° 40' 03.09719"N	98° 55' 26.98345"W	611.32	93185.4322	590945.3809	635.95	AL4 Wooden Stake (set)	1998
6-4R	206.40	40º 39' 46.52084"N	98º 55' 20.58073"W	612.44	92676.142	591102.092	637.08	Set 5/8" Rebar	2005
111	206.50	40° 39' 45.46344"N	98° 55' 28.85345"W		92641.1160	590908.2356	636.72	AL5 Wooden Stake (set)	1998
110	206.50	40° 40' 01.89754"N	98° 55' 36.18287"W	611.99	93145.7542	590729.8325	636.63	AL5 T-BAR (Set)	1998
113	206.60	40° 39' 44.16527"N	98° 55' 39.42410"W		92598.0014	590660.5086	637.45	AL6 Wooden Stake (set)	1998
112	206.60	40° 39' 59.16028"N	98° 55' 48.48630"W	612.53	93057.7648	590441.9837	637.16	AL6 T-BAR (Set)	1998
206.6NR	206.60	40°41'00.11194"N	98°56'34.31129"W	613.67	94924.0911	589342.9837	638.23	3" X 3" Steel Plate (Found)	2002
206.6NL	206.60	40°41'06.11724"N	98°56'36.28509"W	612.47	95108.7098	589294.3855	637.03	3" X 3" Steel Plate (Found)	2002
114	206.80	40° 39' 55.11341"N	98° 55' 59.91587"W	612.47	92929.6554	590175.1457	637.10	AL7 T-BAR (Set)	1998
115	206.80						637.53	AL7 Wooden Stake (set)	1998
22	206.80	40° 40' 05.17906"N	98° 56" 00.58041"W	612.23	93239.857	590155.712	636.86	USBR BM 6.6/17-8-14	1998
117	207.00	40° 39' 37.49954"N	98° 56' 03.22018"W		92385.5407	590104.2517	637.31	AL8 T-BAR (Set)	1998
116	207.00	40° 39' 53.88995"N	98° 56' 05.74517"W	612.50	92890.2401	590038.7302	637.13	AL8 T-BAR (Set)	1998
119	207.20	40° 39' 35.85086"N	98° 56' 18.09116"W	612.90	92330.4039	589755.6582	637.34	AL9 Wooden Stake (set)	1998
118	207.20	40° 39' 51.90314"N	98° 56' 24.49451"W	612.99	92823.5624	589599.2180	637.62	AL9 T-BAR (Set)	1998
120	207.90	40° 39' 31.73172"N	98° 57' 05.83027"W	616.14	92189.701	588636.124	640.77	3" X 3" Steel Plate (Found)	1998
121	207.90	40° 39' 40.15741"N	98° 57' 05.84589"W	616.12	92449.520	588632.607	640.75	3" X 3" Steel Plate (Found)	1998
123	207.90	40° 41' 00.03273"N	98° 57' 06.03843"W	615.96	94912.579	588598.218	640.54	3" X 3" Steel Plate (Found)	1998
122	207.90	40° 41' 02.84505"N	98° 57' 06.01246"W	616.03	94999.310	588597.776	640.61	3" X 3" Steel Plate (Found)	1998
208.6SR	208.60	40° 39' 34.80285"N	98° 57' 44.49837"W	614.48	92273.45	587726.91	639.08	Set 2 1/2" USBR AC	2002
208.6SL	208.60	40° 39' 47.06796"N	98° 57' 38.38979"W	618.51	92653.39	587865.82	643.12	Set 2 1/2" USBR AC	2002
208.6NR	208.60	40°40'51.41840"N	98°57'24.84829"W	613.48	94641.60	588159.86	638.03	Set 2 1/2" USBR AC	2002
208.6NL	208.60	40°41'02.44630"N	98°57'32.03843"W	614.01	94979.63	587986.97	638.55	Set 2 1/2" USBR AC	2002
159	209.80	40° 39' 35.41929"N	98° 59' 13.95853"W	619.94	92267.547	585625.849	644.54	T-BAR (Found)	1998
160	209.80	40° 39' 44.95478"N	98° 59' 16.63533"W	619.07	92560.859	585559.546	643.66	3" X 3" Steel Plate (Found)	1998
4401	209.80	40° 40' 33.44219"N	98° 59' 29.89111"W	619.75	94052.436	585230.826	644.31	3" X 3" Steel Plate (Found)	1998
4400	209.80	40° 40' 36.49634"N	98° 59' 30.75262"W	619.59	94146.381	585209.502	644.14	3" X 3" Steel Plate (Found)	1998

		NAD 83			NAD 83 STATE PLANE NEBRASKA				
Survey Point ID	Approximate River Mile	Latitude	Longitude	Ellipsoid Height (Meters)	Northing (Meters)	Easting (Meters)	NAVD88 Elevation (Meters)	Description	Year Established
210.6SR	210.60	40° 39' 32.95059"N	99° 00' 10.30487"W	620.40	92176.04	584303.51	644.98	3" X 3" Steel Plate (Found)	2002
210.6SL	210.60	40° 39' 42.89519"N	99° 00' 11.22657"W	619.59	92482.45	584278.33	644.15	3" X 3" Steel Plate (Found)	2002
210.6NR	210.60	40°40'07.71597"N	99° 00' 11.27683"W	621.22	93247.84	584268.33	645.77	Set 2 1/2" USBR AC	2002
210.6NL	210.60	40°40'18.46784"N	99°00'10.36503"W	619.41	93579.65	584285.91	643.94	Set 2 1/2" USBR AC	2002
25	214.90	40° 38' 53.63967"N	99° 05' 05.98984"W	629.66	90886.995	577372.493	654.22	ROW MON SOUTH	1998
26	214.95	40° 39' 51.78566"N	99° 05' 11.26067"W	629.96	92678.767	577229.745	654.48	ROW MON	1998
219.8R	219.80	40° 39' 45.16308"N	99° 10' 40.46458"W	638.12	92396.94	569501.21	662.58	Set 2 1/2" USBR AC	2002
219.8L	219.80	40°40'14.21992"N	99° 10' 44.39828"W	638.33	93292.12	569400.32	662.77	Set 2 1/2" USBR AC	2002
222.0SR	222.00	40° 39' 35.71308"N	99° 13' 05.28978"W	642.77	92073.98	566102.89	667.22	T-BAR (Found)	2002
222.0SL	222.00	40° 39' 54.88345"N	99° 13' 04.98434"W	642.85	92665.22	566104.72	667.30	Set 2 1/2" USBR AC	2002
222.0NR	222.00	40°40'13.19686"N	99° 13' 06.38846"W	642.46	93229.67	566066.64	666.89	3" X 3" Steel Plate (Found)	2002
222.0NL	222.00	40°40'18.39896"N	99° 13' 05.57930"W	643.05	93390.26	566084.19	667.48	3" X 3" Steel Plate (Found)	2002
125	224.00	40° 39' 53.67129"N	99° 15' 21.53170"W	649.28	92599.541	562898.592	673.73	3" X 3" Steel Plate (Set)	1998
124	224.00	40° 40' 03.05858"N	99° 15' 21.10429"W	649.28	92889.114	562906.137	673.73	3" X 3" Steel Plate (Set)	1998
224.0L	224.00	40° 40' 03.05858"N	99° 15' 21.10429"W	649.28	92889.114	562906.137	673.73	3" X 3" Steel Plate (Found)	2001
224.3R	224.30	40° 39' 55.83980"N	99° 15' 44.14807"W	648.43	92661.86	562366.93	672.85	Set 2 1/2" USBR AC	2002
224.3L	224.30	40°40'14.29896"N	99° 15' 41.43467"W	647.77	93231.65	562425.79	672.18	Set 2 1/2" USBR AC	2002
225.1R	225.10	40°40'05.65186"N	99° 16' 24.53741"W	648.39	92956.42	561415.96	672.81	Set 2 1/2" USBR AC	2002
225.1L	225.10	40°40'30.59771"N	99°16'22.90599"W	649.99	93726.02	561447.80	674.39	3" X 3" Steel Plate (Found)	2002
D322 RESET	225.10	40°42'16.37014"N	99°16'28.09019"W	653.96	96986.825	561298.704	678.31	3 1/4" BRASS CAP (Found)	2001
E 435 RESET	226.70	40° 42' 28.11528" N	99° 17' 57.33764" W	656.89	97,331.75	559,201.27	681.20	NGS PID AG9621	2000
4A-2S (1S*)	227.20	40°40'43.32340"N	99°18'48.44010"W	653.65	94090.529	558027.700	678.04	T-BAR	2001
4A-2N (1N*)	227.20	40°40'50.77263"N	99°18'47.28036"W	653.41	94320.467	558053.103	677.80	T-BAR	2001
5.6	227.20	40°41'00.21190"N	99°18'46.79013"W	655.37	94611.649	558062.299	679.75	3 1/2" BC (USBR BM) (Found)	2001
4A-3S (2S*)	227.25	40°40'44.39067"N	99°18'53.23298"W	653.41	94122.549	557914.914	677.80	T-BAR	2001
4A-3N (2N*)	227.25	40°40'52.01973"N	99°18'50.98882"W	653.47	94358.234	557965.735	677.86	T-BAR	2001
4A-4S (3S*)	227.40	40°40'46.79432"N	99°19'04.23662"W	654.05	94194.631	557655.990	678.44	T-BAR	2001
4A-4N (3N*)	227.40	40°40'54.10783"N	99°18'59.17767"W	653.93	94421.105	557772.977	678.31	T-BAR	2001
4A-5S (4S*)	227.50	40°40'48.73019"N	99°19'11.18841"W	654.21	94253.044	557492.311	678.60	T-BAR	2001

		NAD 83			NAD 83 STATE PLANE NEBRASKA				
Survey Point ID	Approximate River Mile	Latitude	Longitude	Ellipsoid Height (Meters)	Northing (Meters)	Easting (Meters)	NAVD88 Elevation (Meters)	Description	Year Established
4A-5N (4N*)	227.50	40°40'56.09943"N	99°19'05.75479"W	654.08	94481.303	557618.085	678.46	T-BAR	2001
4A-6S (5S*)	227.60	40°40'50.00737"N	99°19'14.83718"W	654.30	94291.756	557406.339	678.68	T-BAR	2001
4A-6N (5N*)	227.60	40°40'58.10637"N	99°19'11.64881"W	654.25	94542.104	557479.227	678.60	T-BAR	2001
6.6	227.60	40°41'05.36731"N	99°19'07.59124"W	654.45	94766.769	557572.719	678.83	3 1/2" BC (USBR BM) (Found)	2001
228.7S	228.70	40° 41' 2.89900" N	99° 20' 19.41434" W	656.20	94677.56	555887.22	680.56	3" X 3" Steel Plate (Found)	2000
228.7N	228.70	40° 41' 15.72423" N	99° 20' 16.67315" W	657.83	95073.56	555948.54	682.18	3" X 3" Steel Plate (Found)	2000
230.0R	230.00	40° 40' 54.17152"N	99°21'55.07252"W	660.14	94391.59	553643.54	684.49	Set 2 1/2" USBR AC	2002
230.0L	230.00	40° 41' 14.11214"N	99°21'55.85660"W	660.05	95006.39	553620.62	684.39	Set 2 1/2" USBR AC	2002
131	230.80	40° 40' 50.16420"N	99° 22' 48.73667"W	664.18	94258.867	552384.566	688.55	3" X 3" Steel Plate (Set)	1998
130	230.80	40° 40' 59.98549"N	99° 22' 48.61845"W	664.16	94561.760	552385.170	688.52	3" X 3" Steel Plate (Set)	1998
231.5R	231.50	40° 40' 37.72665"N	99°23'34.41535"W	662.89	93867.70	551314.85	687.24	3" X 3" Steel Plate (Found)	2002
63	233.80	40° 40' 36.48970"N	99° 26' 11.34109"W	666.87	93804.614	547630.733	691.22	3" X 3" Steel Plate (Found)	1998
64	233.80	40° 41 08.15324"N	99° 26' 11.91537"W	667.03	94780.985	547610.887	691.36	3" X 3" Steel Plate (Found)	1998
4250	233.80	40° 41' 37.55401"N	99° 26' 11.02571"W	667.03	95687.798	547625.862	691.34	T-BAR (Found)	1998
4000	237.50	40° 40' 30.10300"N	99° 30' 02.47486"W	675.34	93574.301	542205.162	699.65	3" X 3" Steel Plate (Found)	1998
2054	237.50	40° 40' 56.46291"N	99° 30' 04.81127"W		94386.890	542145.616	698.37	3" X 3" Steel Plate (Found)	1998
127	237.50	40° 41' 15.88883"N	99° 30' 06.53275"W	675.26	94985.728	542101.749	699.54	3" X 3" Steel Plate (Found)	1998
126	237.50	40° 41' 26.49017"N	99° 30' 07.45782"W	674.30	95312.534	542078.151	698.58	3" X 3" Steel Plate (Found)	1998
239.0R	239.00	40° 40' 45.63787"N	99°32'00.61530"W	677.80	94037.88	539428.72	702.05	3" X 3" Steel Plate (Found)	2002
239.0L	239.00	40° 40' 56.35849"N	99°32'00.03975"W	677.88	94368.57	539440.44	702.12	3" X 3" Steel Plate (Found)	2002
129	239.30	40° 40' 47.88472"N	99° 32' 24.91943"W	680.34	94104.117	538857.738	704.62	3" X 3" Steel Plate (Found)	1998
128	239.30	40° 40' 57.42027"N	99° 32' 25.44610"W	680.43	94398.117	538843.810	704.71	3" X 3" Steel Plate (Found)	1998
239.3R	239.30	40° 40' 47.88115"N	99°32'24.91914"W	680.34	94104.01	538857.75	704.58	Set 2 1/2" USBR AC	2002
239.3L	239.30	40° 40' 57.41679"N	99°32'25.44674"W	680.50	94398.01	538843.80	704.74	Set 2 1/2" USBR AC	2002
239.9 R	239.90	40° 40' 47.23878"N	99°33'10.15294"W	679.48	94078.63	537795.86	703.72	3" X 3" Steel Plate (Found)	2002
239.9 L	239.90	40° 41' 09.59361"N	99°33'06.76616"W	678.89	94768.44	537871.81	703.11	Set 2 1/2" USBR AC	2002
2-1S	243.10	40° 40' 56.50442" N	99° 36' 33.63227" W	685.54	94,341.22	533,017.34	709.72	T-BAR (Found)	2000
2-1N	243.10	40° 41' 3.88083" N	99° 36' 28.40802" W	686.04	94,569.26	533,138.95	710.22	T-BAR (Found)	2000
7.5/8-8-20	243.25	40° 40' 46.84247" N	99° 36' 47.58076" W	687.16	94,041.79	532,691.20	711.35	3 1/2" BC (USBR BM) (Found)	2000

		NAD 83			NAD 83 STATE PLANE NEBRASKA				
Survey Point ID	Approximate River Mile	Latitude	Longitude	Ellipsoid Height (Meters)	Northing (Meters)	Easting (Meters)	NAVD88 Elevation (Meters)	Description	Year Established
2-2S	243.25	40° 40' 57.67421" N	99° 36' 40.16970" W	685.75	94,376.61	532,863.70	709.93	T-BAR (Found)	2000
2-2N	243.25	40° 41' 4.72808" N	99° 36' 39.61348" W	685.34	94,594.20	532,875.78	709.51	T-BAR (Found)	2000
2-3S	243.30	40° 40' 58.20954" N	99° 36' 47.53595" W	686.02	94,392.34	532,690.69	710.20	T-BAR (Found)	2000
2-3N	243.30	40° 41' 4.60878" N	99° 36' 44.54181" W	685.58	94,590.00	532,760.09	709.76	T-BAR (Found)	2000
8.6/8-8-20	243.50	40° 40' 51.44213" N	99° 37' 6.55034" W	688.12	94,181.66	532,245.21	712.30	3 1/2" BC (USBR BM) (Found)	2000
2-4S	243.50	40° 41' 1.87233" N	99° 37' 2.28907" W	686.06	94,503.75	532,343.83	710.23	T-BAR (Found)	2000
2-4N	243.50	40° 41' 9.24426" N	99° 36' 57.14199" W	685.87	94,731.63	532,463.66	710.04	T-BAR (Found)	2000
2-5S	243.60	40° 41' 2.33734" N	99° 37' 6.71993" W	686.87	94,517.63	532,239.75	711.04	T-BAR (Found)	2000
2-5N	243.60	40° 41' 9.98104" N	99° 37' 3.78552" W	685.70	94,753.66	532,307.60	709.87	T-BAR (Found)	2000
2-6S	243.80	40° 41' 4.23583" N	99° 37' 13.81187" W	687.63	94,575.45	532,073.00	711.80	T-BAR (Found)	2000
2-6N	243.80	40° 41' 12.84463" N	99° 37' 19.68135" W	687.22	94,840.33	531,934.05	711.38	T-BAR (Found)	2000
2-7S	243.90	40° 41' 3.50797" N	99° 37' 23.45649" W	687.84	94,552.01	531,846.68	712.01	T-BAR (Found)	2000
2-7N	243.90	40° 41' 13.18467" N	99° 37' 25.37257" W	687.34	94,850.24	531,800.40	711.50	T-BAR (Found)	2000
244.0sS	244.00	40° 41' 2.63812" N	99° 37' 30.69651" W	687.40	94524.45	531676.83	711.57	T-BAR (Found)	2000
2-8S	244.00	40° 41' 3.61265" N	99° 37' 30.82863" W	687.66	94,554.49	531,673.59	711.82	T-BAR (Found)	2000
2-8N	244.00	40° 41' 12.94999" N	99° 37' 31.91143" W	687.25	94,842.33	531,646.93	711.41	T-BAR (Found)	2000
244.0nS	244.00	40° 41' 29.33703" N	99° 37' 33.85706" W		95347.49	531599.07	713.21	T-BAR (Found)	2000
244.0nN	244.00	40° 41' 54.81706" N	99° 37' 36.55283" W		96133.00	531532.40	712.33	T-BAR (Set)	2000
246.0R	246.00	40°41'03.42632"N	99°39'49.40488"W	692.70	94535.37	528420.37	716.82	Set 2 1/2" USBR AC	2002
246.0L	246.00	40°41'24.01806"N	99°39'37.89965"W	691.46	95171.45	528687.98	715.57	Set 2 1/2" USBR AC	2002
246.5SR	246.50	40°41'21.40519"N	99°40'19.71239"W	692.65	95087.08	527706.76	716.75	Set 2 1/2" USBR AC	2002
246.5SL	246.50	40°41'30.14463"N	99°40'12.29245"W	692.70	95357.26	527879.91	716.79	Set 2 1/2" USBR AC	2002
246.5NR	246.50	40°41'52.56796"N	99°39'59.23298"W	693.21	96049.95	528183.80	717.30	Set 2 1/2" USBR AC	2002
246.5NL	246.50	40°42'20.49251"N	99°39'52.65090"W	693.43	96911.71	528334.95	717.49	Set 2 1/2" USBR AC	2002
247.8R	247.80	40°42'35.51027"N	99°41'38.97079"W	696.33	97365.59	525838.13	720.34	Set 2 1/2" USBR AC	2002
247.8L	247.80	40°42'57.97246"N	99°41'22.46396"W	696.54	98059.68	526223.01	720.56	Set 2 1/2" USBR AC	2002
249.8R	249.80	40°43'01.50852"N	99°42'45.65434"W	698.53	98161.98	524270.59	722.51	3" X 3" Steel Plate (Found)	2002
249.8L	249.80	40°43'36.29381"N	99°42'14.13218"W	698.67	99237.22	525006.57	722.64	Set 2 1/2" USBR AC	2002
145	250.50	40° 43' 25.56886"N	99° 43' 45.34958"W	701.13	98899.459	522867.542	725.12	3" X 3" Steel Plate (Found)	1998

		NAD 83			NAD 83 STATE PLANE NEBRASKA				
Survey Point ID	Approximate River Mile	Latitude	Longitude	Ellipsoid Height (Meters)	Northing (Meters)	Easting (Meters)	NAVD88 Elevation (Meters)	Description	Year Established
146	250.50	40° 43 35.57844"N	99° 43' 37.33025"W	700.23	99208.736	523054.719	724.22	3" X 3" Steel Plate (Found)	1998
143	251.60	40° 44' 00.05140"N	99° 44' 41.64484"W	705.37	99958.850	521543.592	729.33	Wooden Stake (Set)	1998
144	251.60	40° 44' 09.03483"N	99° 44' 36.88008"W	705.32	100236.220	521654.546	729.27	Wooden Stake (Set)	1998
147*	258.00	40° 46' 20.49376"N	99° 51' 20.46953" W	717.73	104,268.35	512,180.39	741.45	3" X 3" Steel Plate (Found)	2000
147	258.00	40° 46' 20.49489"N	99° 51' 20.48687"W	718.14	104268.382	512179.984	741.90	3" X 3" Steel Plate (Found)	1998
148	258.00	40° 46' 22.24266"N	99° 51' 15.80194"W	718.14	104322.465	512289.731	741.90	3" X 3" Steel Plate (Found)	1998
149	258.00	40° 46' 33.28134"N	99° 50' 55.85446"W	718.01	104663.690	512756.801	741.76	3" X 3" Steel Plate (Found)	1998
150	258.00	40° 46' 36.36146"N	99° 50' 51.74402"W	717.76	104758.847	512852.997	741.52	3" X 3" Steel Plate (Found)	1998
1 MC	258.10	40° 46' 19.42315" N	99° 51' 47.53047" W	716.86	104,234.30	511,546.00	740.57	3 1/2" BC (USGS BM) (Found)	2000
258.3S	258.30	40° 46' 31.74315" N	99° 51' 54.10996" W	717.85	104,613.99	511,391.15	741.55	3" X 3" Steel Plate (Found)	2000
258.3N	258.30	40° 46' 48.24605" N	99° 51' 1.17800" W	718.37	105,124.97	512,631.20	742.07	1 1/2" Post (Set)	2000
133	297.00	41° 02' 07.11784"N	100° 27' 45.52969"W		133555.158	461108.042	817.31	3" X 3" Steel Plate (Found)	1998
132	297.00	41° 02' 07.56631"N	100° 27' 45.10645"W	796.15	133568.935	461118.000	818.86	Nail (Set)	1998
2300	297.00	41° 02' 08.24367"N	100° 27' 44.46717"W	794.03	133589.744	461133.039	816.74	Nail (Set)	1998
134	297.00	41° 02' 12.88647"N	100° 27' 40.08528"W		133732.375	461236.123	816.52	T-BAR (Found)	1998
46	304.00	41° 04' 17.09174"N	100° 34' 44.68107"W	808.31	137622.301	451347.373	830.84	Reference Monument (Set)	1998
141	304.00	41° 04' 18.52263"N	100° 34' 44.32367"W	809.03	137666.371	451356.009	831.56	3" X 3" Steel Plate (Found)	1998
142	304.00	41° 04' 26.42428"N	100° 34' 42.34992"W		137909.737	451403.702	831.53	3" X 3" Steel Plate (Found)	1998
139	310.00	41° 06' 41.96338"N	100° 39' 52.45941"W	819.03	142141.536	444198.865	841.38	Wooden Stake (Set)	1998
140	310.00	41° 06' 51.97504"N	100° 39' 50.09694"W	819.19	142449.855	444256.337	841.53	3" X 3" Steel Plate (Found)	1998
137	310.20	41° 06' 42.74374"N	100° 40' 08.98557"W	819.79	142168.575	443813.607	842.13	3" X 3" Steel Plate (Found)	1998
138	310.20	41° 06' 53.58355"N	100° 40' 07.05141"W	819.46	142502.506	443861.303	841.80	3" X 3" Steel Plate (Found)	1998
135	310.50	41° 06' 49.61820"N	100° 40' 28.09552"W	819.88	142384.034	443369.556	842.21	3" X 3" Steel Plate (Set)	1998
136	310.50	41° 06' 54.36150"N	100° 40' 27.32709"W	821.45	142530.168	443388.618	843.78	3" X 3" Steel Plate (Set)	1998

* Original surveys were labeled as shown. During repeat surveys, the landowner of site 4a-transect 1 refused access, and the surveyors relabeled transects with the original transect 2 labeled as transect 1. This was repeated for all transects. Labels in parentheses indicate the labels from repeat surveys performed in 2001.

APPENDIX C: FLOW ON DATE OF SURVEY TABLE

Only three USGS streamflow gages on the Platte River are located within the project area and had sufficient data to represent the time period from July of 1985 to present day. The nearest flow gage for each cross section was determined by first approximating the river mile of each gage and then separating the river into three sections. The divisions of the sections lie halfway between two consecutive gages. As such, the streamflow gages may not be representative of the quantity of flow that actually passed through a particular cross section. In many cases, a cross section may represent only one channel of a multi-channel section of the Platte River. In addition, actual flow at each cross section is impacted by river diversions and ground water influences. The flows are included to provide insight as to probable processes acting at the time of survey. For example, under high flow conditions, one might expect more degradation of the channel bed to be noted than under low flow conditions.

Table C.1. USGS streamflow gages within project vicinity and corresponding range of representation

USGS Flow Gage	Approximate River Mile	Range of Gage Representation
Platte River Near Overton, Nebr.	239.00	upstream of 227.00
Platte River Near Kearney, Nebr.	215.00	194.50 to 227.00
Platte River Near Grand Island, Nebr.	174.00	downstream of 194.5

Table C.2. Mean daily discharge values on the day of each survey.

File Name	River Mile	Nearest USGS Flow Gage[1]	Date of Survey 1	Mean Daily Discharge (CFS)	Date of Survey 2	Mean Daily Discharge (CFS)	Date of Survey 3	Mean Daily Discharge (CFS)
310_5	310.50	Platte River Near Overton, Nebr.	10/26/89	609	10/9/98	1870		
310_2	310.20	Platte River Near Overton, Nebr.	10/26/89	609	10/9/98	1870		
310_0	310.00	Platte River Near Overton, Nebr.	10/26/89	609	10/9/98	1870		
309_0	309.00	Platte River Near Overton, Nebr.	10/25/89	740				
307_5	307.50	Platte River Near Overton, Nebr.	10/26/89	609				
305_4	305.40	Platte River Near Overton, Nebr.	10/25/89	740				
304_0	304.00	Platte River Near Overton, Nebr.	10/25/89	740	10/9/98	1870		
302_0	302.00	Platte River Near Overton, Nebr.	10/25/89	740				
298_5	298.50	Platte River Near Overton, Nebr.	10/25/89	740				
297_0	297.00	Platte River Near Overton, Nebr.	10/25/89	740	10/9/98	1870		
288_1N	288.10	Platte River Near Overton, Nebr.	10/25/89	740				
288_1S	288.10	Platte River Near Overton, Nebr.	10/24/89	676				
287_7	287.70	Platte River Near Overton, Nebr.	10/24/89	676				
284_9	284.90	Platte River Near Overton, Nebr.	10/24/89	676				
281_8	281.80	Platte River Near Overton, Nebr.	10/24/89	676				
277_3N	277.30	Platte River Near Overton, Nebr.	10/23/89	731				
277_3S	277.30	Platte River Near Overton, Nebr.	10/23/89	731				
276_8N	276.80	Platte River Near Overton, Nebr.	10/23/89	731				
269_9N	269.90	Platte River Near Overton, Nebr.	10/17/89	512				
269_9S	269.90	Platte River Near Overton, Nebr.	10/17/89	512				
267_9N	267.90	Platte River Near Overton, Nebr.	10/18/89	522				
267_9S	267.90	Platte River Near Overton, Nebr.	10/17/89	512				
266_7	266.70	Platte River Near Overton, Nebr.	10/16/89	624				
261_7	261.70	Platte River Near Overton, Nebr.	10/16/89	624				
258_3	258.30	Platte River Near Overton, Nebr.	10/15/89	690				
258_0N	258.00	Platte River Near Overton, Nebr.	10/15/89	690	10/10/98	1950		

File Name	River Mile	Nearest USGS Flow Gage[1]	Date of Survey 1	Mean Daily Discharge (CFS)	Date of Survey 2	Mean Daily Discharge (CFS)	Date of Survey 3	Mean Daily Discharge (CFS)
258_0S	258.00	Platte River Near Overton, Nebr.	10/15/89	690	10/10/98	1950		
254_4	254.40	Platte River Near Overton, Nebr.	10/15/89	690				
251_6	251.60	Platte River Near Overton, Nebr.	10/12/89	750	10/10/98	1950		
250_5	250.50	Platte River Near Overton, Nebr.	10/14/89	710	10/10/98	1950	3/13/02	1690
249_8	249.80	Platte River Near Overton, Nebr.	10/15/89	690	3/24/02	684		
247_8	247.80	Platte River Near Overton, Nebr.	10/22/89	772	3/24/02	684		
246_5S	246.50	Platte River Near Overton, Nebr.	10/22/89	772	3/24/02	684		
246_5N	246.50	Platte River Near Overton, Nebr.	10/19/89	586	3/23/02	463		
246_0S	246.00	Platte River Near Overton, Nebr.	10/18/89	522	3/24/02	684		
244_0S	244.00	Platte River Near Overton, Nebr.	10/23/89	731	3/23/02	463		
244_0N	244.00	Platte River Near Overton, Nebr.	10/19/89	586	3/23/02	463		
2-TR8	244.00	Platte River Near Overton, Nebr.	7/22/85	713	10/18/00	1050		
2-TR7	243.90	Platte River Near Overton, Nebr.	7/22/85	713	10/18/00	1050		
2-TR6	243.80	Platte River Near Overton, Nebr.	7/22/85	713	10/18/00	1050		
2-TR5	243.60	Platte River Near Overton, Nebr.	7/22/85	713	10/18/00	1050		
2-TR4	243.50	Platte River Near Overton, Nebr.	7/22/85	713	10/18/00	1050		
2-TR3	243.30	Platte River Near Overton, Nebr.	7/22/85	713	10/18/00	1050		
2-TR2	243.25	Platte River Near Overton, Nebr.	7/22/85	713	10/18/00	1050		
2-TR1	243.10	Platte River Near Overton, Nebr.	7/22/85	713	10/18/00	1050		
239_9	239.90	Platte River Near Overton, Nebr.	10/14/89	710	3/23/02	463		
239_3	239.30	Platte River Near Overton, Nebr.	10/13/89	753	10/8/98	1890	3/22/02	543
239_0	239.00	Platte River Near Overton, Nebr.	10/13/89	753	3/22/02	543		
237_5	237.50	Platte River Near Overton, Nebr.	10/22/89	772	11/18/98	2180	3/21/02	1300
233_8	233.80	Platte River Near Overton, Nebr.	10/21/89	748	11/18/98	2180	3/21/02	1300
231_5	231.50	Platte River Near Overton, Nebr.	10/20/89	748				
230_8	230.80	Platte River Near Overton, Nebr.	10/5/89	986	10/8/98	1670	3/19/02	1490
230_0	230.00	Platte River Near Overton, Nebr.	10/5/89	986	3/19/02	1490		
228_7	228.70	Platte River Near Overton, Nebr.	10/5/89	986	3/19/02	1490		
4A-TR6	227.60	Platte River Near Overton, Nebr.	7/8/85	378	10/26/01	892		

File Name	River Mile	Nearest USGS Flow Gage[1]	Date of Survey 1	Mean Daily Discharge (CFS)	Date of Survey 2	Mean Daily Discharge (CFS)	Date of Survey 3	Mean Daily Discharge (CFS)
4A-TR5	227.50	Platte River Near Overton, Nebr.	7/8/85	378	10/26/01	892		
4A-TR4	227.40	Platte River Near Overton, Nebr.	7/8/85	378	10/26/01	892	9/28/05	226
4A-TR3	227.25	Platte River Near Overton, Nebr.	7/8/85	378	10/26/01	892	9/28/05	226
4A-TR2	227.20	Platte River Near Overton, Nebr.	7/8/85	378	10/26/01	892		
4A-TR1	227.00	Platte River Near Overton, Nebr.	7/8/85	378				
225_1N	225.10	Platte River Near Kearney, Nebr.	10/4/89	612	3/18/02	1540		
225_1S	225.10	Platte River Near Kearney, Nebr.	10/4/89	612				
224_3	224.30	Platte River Near Kearney, Nebr.	10/4/89	612	3/18/02	1540		
224_0	224.00	Platte River Near Kearney, Nebr.	10/4/89	612	10/8/98	1670		
222_0N	222.00	Platte River Near Kearney, Nebr.	10/2/89	616	3/17/02	1570		
222_0S	222.00	Platte River Near Kearney, Nebr.	10/2/89	616	3/17/02	1570		
219_8	219.80	Platte River Near Kearney, Nebr.	10/2/89	616				
210_6N	210.60	Platte River Near Kearney, Nebr.	9/28/89	674	3/16/02	1630		
210_6S	210.60	Platte River Near Kearney, Nebr.	9/28/89	674	3/16/02	1630		
209_8N	209.80	Platte River Near Kearney, Nebr.	9/27/89	699	11/18/98	2330		
209_8S	209.80	Platte River Near Kearney, Nebr.	9/27/89	699	10/11/98	2010		
208_6S	208.60	Platte River Near Kearney, Nebr.	9/28/89	674	3/16/02	1630		
208_6N	208.60	Platte River Near Kearney, Nebr.	9/27/89	699	3/15/02	1500		
207_9N	207.90	Platte River Near Kearney, Nebr.	9/27/89	699	10/7/98	1590		
207_9S	207.90	Platte River Near Kearney, Nebr.	9/27/89	699	10/7/98	1590		
6-TR9	207.20	Platte River Near Kearney, Nebr.	7/17/85	461	10/7/98	1590		
6-TR8	207.00	Platte River Near Kearney, Nebr.	7/17/85	461	10/7/98	1590		
6-TR7	206.80	Platte River Near Kearney, Nebr.	7/17/85	461	10/7/98	1590		
206_6S	206.60	Platte River Near Kearney, Nebr.	10/1/89	657	10/6/98	1500		
206_6N	206.60	Platte River Near Kearney, Nebr.	9/27/89	699	3/15/02	1500		
6-TR6	206.60	Platte River Near Kearney, Nebr.	7/17/85	461	10/6/98	1500		
6-TR5	206.50	Platte River Near Kearney, Nebr.	7/17/85	461	10/6/98	1500		
6-TR4	206.40	Platte River Near Kearney, Nebr.	7/17/85	461	10/6/98	1500	9/27/05	55
6-TR3	206.20	Platte River Near Kearney, Nebr.	7/17/85	461	10/6/98	1500	9/27/05	55

File Name	River Mile	Nearest USGS Flow Gage[1]	Date of Survey 1	Mean Daily Discharge (CFS)	Date of Survey 2	Mean Daily Discharge (CFS)	Date of Survey 3	Mean Daily Discharge (CFS)
6-TR2	206.00	Platte River Near Kearney, Nebr.	7/17/85	461	10/6/98	1500		
6-TR1	205.90	Platte River Near Kearney, Nebr.	7/17/85	461	10/6/98	1500		
203_3N	203.30	Platte River Near Kearney, Nebr.	9/30/89	654	3/14/02	1400		
203_3S	203.30	Platte River Near Kearney, Nebr.	9/29/89	668	3/14/02	1400		
202_2M1	202.20	Platte River Near Kearney, Nebr.	9/29/89	668	10/11/98	2010		
202_2S1	202.20	Platte River Near Kearney, Nebr.	9/29/89	668	10/11/98	2010		
202_2N	202.20	Platte River Near Kearney, Nebr.	9/29/89	668	10/10/98	1920		
201_2N	201.20	Platte River Near Kearney, Nebr.	9/30/89	654	10/11/98	2010		
201_2S	201.20	Platte River Near Kearney, Nebr.	9/30/89	654				
199_5	199.50	Platte River Near Kearney, Nebr.	9/30/89	654	3/14/02	1400		
197_4	197.40	Platte River Near Kearney, Nebr.	9/26/89	745				
8C-TR4	196.60	Platte River Near Kearney, Nebr.	7/19/85	569	10/25/01	296		
8C-TR3	196.50	Platte River Near Kearney, Nebr.	7/19/85	569	10/25/01	296		
8C-TR2	196.40	Platte River Near Kearney, Nebr.	7/19/85	569	10/25/01	296		
8C-TR1	196.30	Platte River Near Kearney, Nebr.	7/19/85	569	10/25/01	296		
195_8	195.80	Platte River Near Kearney, Nebr.	9/22/89	704	10/11/98	2010		
194_9	194.90	Platte River Near Kearney, Nebr.	9/26/89	745				
193_9	193.90	Platte River Near Grand Island, Nebr.	9/22/89	1050				
8B-TR5	191.30	Platte River Near Grand Island, Nebr.	7/12/85	399	6/1/00	1620		
8B-TR4	191.20	Platte River Near Grand Island, Nebr.	7/12/85	399	6/1/00	1620		
8B-TR3	191.10	Platte River Near Grand Island, Nebr.	7/12/85	399	6/1/00	1620	9/27/05	82
8B-TR2	191.00	Platte River Near Grand Island, Nebr.	7/12/85	399	6/1/00	1620	9/27/05	82
8B-TR1	190.90	Platte River Near Grand Island, Nebr.	7/12/85	399	6/1/00	1620		
189_3	189.30	Platte River Near Grand Island, Nebr.	9/22/89	1050				
188_3	188.30	Platte River Near Grand Island, Nebr.	9/15/89	1960				
187_4SN	187.40	Platte River Near Grand Island, Nebr.	9/15/89	1960				
187_4SS	187.40	Platte River Near Grand Island, Nebr.	9/15/89	1960				
187_3N	187.30	Platte River Near Grand Island, Nebr.	9/17/89	1700	10/11/98	1970		
187_3S	187.30	Platte River Near Grand Island, Nebr.	9/15/89	1960	10/12/98	1940		

File Name	River Mile	Nearest USGS Flow Gage[1]	Date of Survey 1	Mean Daily Discharge (CFS)	Date of Survey 2	Mean Daily Discharge (CFS)	Date of Survey 3	Mean Daily Discharge (CFS)
187_0SM	187.00	Platte River Near Grand Island, Nebr.	9/15/89	1960				
183_2N	183.20	Platte River Near Grand Island, Nebr.	10/1/89	835				
183_2S	183.20	Platte River Near Grand Island, Nebr.	10/1/89	835				
182_1N	182.10	Platte River Near Grand Island, Nebr.	9/17/89	1700				
182_1S	182.10	Platte River Near Grand Island, Nebr.	9/17/89	1700				
181_9S	181.90	Platte River Near Grand Island, Nebr.	9/17/89	1700	10/12/98	1940		
181_85S	181.85	Platte River Near Grand Island, Nebr.	10/1/89	835				
180_3N	180.30	Platte River Near Grand Island, Nebr.	9/21/89	1130				
180_3S	180.30	Platte River Near Grand Island, Nebr.	9/21/89	1130				
180_1	180.10	Platte River Near Grand Island, Nebr.	9/17/89	1700				
178_4N	178.40	Platte River Near Grand Island, Nebr.	9/20/89	1250				
178_4M	178.40	Platte River Near Grand Island, Nebr.	9/19/89	1350				
178_4S	178.40	Platte River Near Grand Island, Nebr.	9/19/89	1350				
9BW-TR5	178.38	Platte River Near Grand Island, Nebr.	7/10/85	429	6/2/00	1600		
9BW-TR4	178.32	Platte River Near Grand Island, Nebr.	7/10/85	429	6/2/00	1600	9/26/05	84
9BW-TR3	178.27	Platte River Near Grand Island, Nebr.	7/10/85	429	6/2/00	1600		
9BW-TR2	178.23	Platte River Near Grand Island, Nebr.	7/10/85	429	6/2/00	1600	9/26/05	84
9BW-TR1	178.18	Platte River Near Grand Island, Nebr.	7/10/85	429	6/2/00	1600		
9BE-TR7	177.40	Platte River Near Grand Island, Nebr.	7/11/85	403	5/31/00	1620		
9BE-TR6	177.35	Platte River Near Grand Island, Nebr.	7/11/85	403	5/31/00	1620		
177_3M	177.30	Platte River Near Grand Island, Nebr.	9/20/89	1250				
177_3N	177.30	Platte River Near Grand Island, Nebr.	9/20/89	1250				
177_3S	177.30	Platte River Near Grand Island, Nebr.	9/19/89	1350				
9BE-TR5	177.30	Platte River Near Grand Island, Nebr.	7/11/85	403	5/31/00	1620		
9BE-TR4	177.25	Platte River Near Grand Island, Nebr.	7/11/85	403	5/31/00	1620		
9BE-TR3	177.20	Platte River Near Grand Island, Nebr.	7/11/85	403	5/31/00	1620	9/23/05	92
9BE-TR2	177.15	Platte River Near Grand Island, Nebr.	7/11/85	403	5/31/00	1620	9/23/05	92
9BE-TR1	177.10	Platte River Near Grand Island, Nebr.	7/11/85	403	5/31/00	1620		
175_5M	175.50	Platte River Near Grand Island, Nebr.	9/18/89	1510				

File Name	River Mile	Nearest USGS Flow Gage[1]	Date of Survey 1	Mean Daily Discharge (CFS)	Date of Survey 2	Mean Daily Discharge (CFS)	Date of Survey 3	Mean Daily Discharge (CFS)
175_5N	175.50	Platte River Near Grand Island, Nebr.	9/18/89	1510				
175_5S	175.50	Platte River Near Grand Island, Nebr.	9/18/89	1510				
175_2S	175.20	Platte River Near Grand Island, Nebr.	9/1/89	2330	10/13/98	1900		
174_65S	174.65	Platte River Near Grand Island, Nebr.	9/1/89	2330				
174_6N	174.60	Platte River Near Grand Island, Nebr.	10/3/89	775				
174_6NM	174.60	Platte River Near Grand Island, Nebr.	10/3/89	775				
174_6S	174.60	Platte River Near Grand Island, Nebr.	10/3/89	775				
174_6SM	174.60	Platte River Near Grand Island, Nebr.	10/3/89	775				
172_8S	172.80	Platte River Near Grand Island, Nebr.	8/29/89	1010				
172_7S	172.70	Platte River Near Grand Island, Nebr.	8/30/89	2050				
172_6N	172.60	Platte River Near Grand Island, Nebr.	8/31/89	2640				
172_6NM	172.60	Platte River Near Grand Island, Nebr.	8/30/89	2050				
172_6SM	172.60	Platte River Near Grand Island, Nebr.	8/30/89	2050				
172_6S	172.60	Platte River Near Grand Island, Nebr.	8/29/89	1010	10/12/98	1940		
172_4S	172.40	Platte River Near Grand Island, Nebr.	8/31/89	2640				
172_1S	172.10	Platte River Near Grand Island, Nebr.	8/31/89	2640				
170_3M	170.30	Platte River Near Grand Island, Nebr.	9/21/89	1130	10/12/98	1940		
170_3S	170.30	Platte River Near Grand Island, Nebr.	9/21/89	1130				
170_3N	170.30	Platte River Near Grand Island, Nebr.	9/13/89	1990	10/12/98	1940		
168_7S	168.70	Platte River Near Grand Island, Nebr.	9/13/89	1960				
168_7N	168.70	Platte River Near Grand Island, Nebr.	9/1/89	2330	10/12/98	1940		
167_9N	167.90	Platte River Near Grand Island, Nebr.	9/16/89	1870				
167_9S	167.90	Platte River Near Grand Island, Nebr.	9/14/89	2100				
167_85	167.85	Platte River Near Grand Island, Nebr.	9/16/89	1870	10/13/98	1900		
166_9	166.90	Platte River Near Grand Island, Nebr.	9/14/89	2100				
165_9	165.90	Platte River Near Grand Island, Nebr.	8/16/89	304				
165_85	165.85	Platte River Near Grand Island, Nebr.	8/16/89	304				
165_8	165.80	Platte River Near Grand Island, Nebr.	8/16/89	304				
162_2	162.20	Platte River Near Grand Island, Nebr.	8/16/89	304				

File Name	River Mile	Nearest USGS Flow Gage[1]	Date of Survey 1	Mean Daily Discharge (CFS)	Date of Survey 2	Mean Daily Discharge (CFS)	Date of Survey 3	Mean Daily Discharge (CFS)
12A-TR3	159.00	Platte River Near Grand Island, Nebr.	7/16/85	354	10/20/00	998		
12A-TR2	158.70	Platte River Near Grand Island, Nebr.	7/16/85	354	10/20/00	998	9/29/05	95
12A-TR1	158.60	Platte River Near Grand Island, Nebr.	7/16/85	354	10/20/00	998	9/29/05	95
157_2	157.20	Platte River Near Grand Island, Nebr.	8/15/89	221				
157_1	157.10	Platte River Near Grand Island, Nebr.	8/14/89	226	10/13/98	1900		

APPENDIX D: ELECTRONIC FORM OF 1989 USBR SURVEY DATA AND PHOTOGRAPHS

APPENDIX E: ELECTRONIC FORM OF ALL OTHER SURVEY DATA USED

APPENDIX F: ELECTRONIC FORM OF 1989 USBR SEDIMENT SAMPLE DATA