Implementation of the Whooping Crane Monitoring Protocol

Spring 2010

FINAL REPORT

Prepared by

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AIM Environmental Consultants

For
Committee's of the
Platte River Recovery and Implementation Program

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Assessment Impact Monitoring Environmental Consultants (AIM) was awarded a contract to assist the Governance Committee in implementing specific monitoring associated with the *Platte River Recovery and Implementation Program*. The specific task was to implement the protocols developed by the Technical Advisory Committee entitled *Monitoring Whooping Crane Migrational Habitat Use in the Central Platte River Valley* (dated 16 September 2005) and *Rebar Marker Placement Protocol* (dated 2/14/2008) during the spring and fall migrations. The contract specified the implementation of the draft protocol along with guidelines presented in the *Request for Proposal*. The term of the contract was January 1, 2008 through December 31, 2010. I present the results of spring 2010 Whooping Crane migration pursuant to the *Contract for Services* dated 2 February 2008.

Study Area and Methods

The study area was the Platte River reach between U.S. Highway 283 (near Lexington) and Chapman, Nebraska. This reach was about 90 miles long and included an area extending 3.5 miles either side of the outermost banks of the Platte River. I hired and trained fifteen technicians and conducted field work from 21 March through 1 May 2010. A set of six data sheets was provided by Headwaters Corporation and all data were entered into a Microsoft Access 2000 database template developed by the former Executive Director's Office.

Two air services were contracted and aerial surveys were conducted along specified routes near sunrise from 21 March through 29 April 2010 as weather permitted. Censuses were initiated no earlier than 30 minutes before sunrise and typically were completed within 2 hours. Start times were delayed when weather/visibility conditions dictated. Flights were cancelled due to unsafe weather or mechanical problems. Cessna 172's were equipped with GPS units and each had two observers to conduct the surveys. Waypoints for each survey route were programmed into the GPS units onboard the aircraft. Surveys were flown at an altitude of 750' and at a speed of about 100 mph.

The study area was divided into two legs. The east leg surveyed the Platte River reach between Chapman and the Minden (Highway 10) bridges and the west leg surveyed from the

Minden to the Lexington (Highway 283) bridges. Each census began flying upstream (east to west) along the south side of the main river channel with both observers looking out the passenger side of the aircraft. This provided optimum light conditions as observers looked away from the rising sun thereby minimizing glare off reflective surfaces. Start points were alternated for each leg to address the concern that one end of the river transect would always be flown earlier than the other end. On the east leg, day one began at Chapman, flew the river west to Minden then flew a predetermined route back to Chapman. Day two began at Wood River, flew the river to Minden, returned along a predetermined route back to Chapman, then flew the rest of the river transect from Chapman to Wood River. The start points for the west leg were Minden and Odessa bridges. Day one began at Minden, flew the river west to Lexington then flew a predetermined route back to Minden. Day two began at Odessa, flew the river to Lexington, returned along a predetermined route back to Minden, then flew the rest of the river transect from Minden to Odessa. When the initial portion of the river transect was completed, one of 7 possible return routes located along the centerline of the main channel and 1, 2, and 3 miles north and south of the river respectively was flown with observers looking out opposite sides of the aircraft (Figure 1).

Four ground observers were stationed along the survey routes. Communication between the ground observers and the aircraft was accomplished through the use of two-way radios. In the event of a possible Whooping Crane sighting by the air crew, the ground person nearest the sighting was contacted and immediately dispatched to the location in an effort to confirm the identity of the white object. Each technician had a set of color aerial photos of the river. The photos were inserted in polypropylene sheet protectors that enabled the observer to mark sighting locations on the photo for later reference. Efforts were made to photograph Whooping Cranes from the air using digital cameras. In addition, a GPS reading of the location was taken by air crew.

If a Whooping Crane was located by ground personnel, habitat use and activity monitoring commenced. Activity monitoring of a "focus" bird was recorded every 15 minutes using one of the following categories: courtship, preening, defensive, feeding, alert, resting, or other activity as defined by the observer. These observations were continuous until the bird was either lost from view or went to roost for the night. If a group was lost, observers spent a minimum of 2 hours attempting to re-locate the group. Each Whooping Crane sighting was assigned a unique number and later compared with the U.S. Fish and Wildlife Service's (USFWS) sighting records in Grand Island. A Whooping Crane sighting was defined as:

"…the observation of a single whooping crane or a group of whooping cranes that are migrating together through the area. Confirmed sightings in the same general area (within a reasonable distance of daily crane activities) along the Platte and within one to several days of another sighting is assumed to be the same bird/bird group, unless: 1) the number of birds differs, 2) the bird(s) constitute a bird/bird group in addition to those already known to be in the general area, or 3) the original birds were observed to migrate from the valley or are known to have moved to a different area of the valley. This assumption is necessary because individual cranes cannot be distinguished; very few birds are marked and continuous surveillance of a crane or crane group using the study area is not possible." (Aransas – Wood Buffalo Population

Whooping Crane Contingency Plan 2006, Whooping Crane Committee of the Central Flyway Council).

Whooping Crane movements, behavior, and diurnal habitat use were recorded when possible. All monitoring activities followed USFWS and Nebraska Game & Parks Commission guidelines. Jeanine Lackey, USFWS biologist, or Martha Tacha, USFWS Coordinator for the Cooperative Whooping Crane Tracking Project, kept our team apprised of the latest sighting reports and census results from the wintering grounds on a regular basis. Tom Stehn, refuge biologist of Aransas National Wildlife Refuge in Texas, conducted surveys on the wintering grounds and provided the results via email. Landowner permission was obtained prior to entering any property.

Whooping Crane decoys were placed in the river channel at 9 randomly selected locations provided by Headwaters Corporation (Table 1) for the purposes of determining survey detection rates. The air crew did not know when or where the decoys were placed. Decoys were placed either the morning of the flights or the day before. Observations of Whooping Crane decoys by the air crew were reported to the ground crew for confirmation.

Topographic profiles were measured at Whooping Crane roost sites and nine predetermined decoy locations on riverine sites using surveying equipment owned by the Program. Three parallel transects 25m apart were established perpendicular to the general flow of the river at each site such that the middle transect crossed the crane or decoy location. Elevation measurements were taken about every 3m along each transect using a stadia and transit. End points were determined when an obstruction greater than 1.5 m in height was encountered such that it formed a visual barrier to a crane. A 24-inch long steel rebar stake was driven level with the ground into the high bank or other location along one of the transects so that water elevation could be determined at a later date. A second rebar marker was driven level with the ground in case the first stake was lost due to bank sloughing. A GPS location was recorded for each stake. Stream flow data was collected from the U.S. Geological Survey (USGS) at gauging stations located at Overton, Kearney, and Grand Island. Leica laser rangefinders were used to measure the length of sandbars and distance to visual obstructions >1.5m above the water surface.

A toll-free telephone number for the public to report Whooping Crane sightings was sponsored by the Platte River Whooping Crane Habitat Maintenance Trust. This volunteer effort was known as *Whooper Watch*. AIM personnel distributed *Whooper Watch* flyers to prominent bird-watching centers alerting the public of this number. All Whooping Crane sightings reported to officials by the public were classified as opportunistic locates. Following a report, ground crew procedures were implemented as outlined above.

Results

Opportunistic Locates.—

We received 5 reports of possible Whooping Cranes from the public, Whooper Watch, or USFWS. One resulted in a confirmed Whooping Crane sighting. The others were American White Pelicans (2), Snow Geese (1), or object not found (1).

Aerial Survey.--

CONFIRMED WHOOPING CRANE SIGHTINGS-

Of a possible 40 morning flights per leg, the West Leg completed 31 (78%) flights while the East Leg flew 33 (82%). Fog, low ceiling, precipitation, mechanical problems, and high winds were factors in cancellations. No flights were delayed beyond the protocol. We recorded 20 confirmed Whooping Crane sightings. Seventeen sightings were on westbound transect 0S, 2 on eastbound transect 0R, and 1 on eastbound transect 2N (Figures 2-5). All were unique or new sightings for that flight. This was the first time a sighting occurred on a 2N transect.

INDEX OF USE-

We completed 128 (80%) aerial survey transects out of a possible 160. Twenty Whooping Crane sightings were made on these transects. This resulted in an index of use (frequency of occurrence) of .16 sightings per transect.

OPPORTUNISTIC FLIGHTS-

Three Whooping Crane sightings were considered opportunistic during the regular aerial surveys. The sightings occurred when the plane deviated from the survey route at the request of the ground observer. No additional flights were deployed.

OTHER WHITE OBJECT SIGHTINGS-

Twenty ground searches were conducted on objects at the request of the air crew. These resulted in confirmation of Whooping Cranes (n=6), leucistic Sandhill Crane (n=1), Snow Geese (n=1), or no finding (n=12).

Searcher Efficiency Trials.—

Whooping Crane decoys were placed at 9 riverine locations between April 3-22 (Table 1). Decoys were not placed at off-river locations this spring. One decoy was not placed due to safety concerns near the Kearney Canal diversion dam. The air observers detected a decoy at five sites for a detectability rate of 56%. Factors contributing to the detectability rate included decoys in the “blind spot” below the underbelly of the aircraft and inexperienced observers.

Table 1. Random locations of decoys for detectability trials.

Strata	Random number	Date Placed	Detected?
0	96	4/16/2010	yes
0	97	4/16/2010	yes
0	98	4/5/2010	no
0	99	4/17/2010	yes
0	100	4/22/2010	no
0	101	4/16/2010	no
0	102	4/17/2010	yes
0	103	Not placed	
0	104	4/3/2010	no
0	105	4/17/2010	yes

Use-Site Characteristics, Diurnal Movements, and Activity.--

FLOW-

Streamflow measured at the USGS gauging stations located near Grand Island, Kearney, and Overton was generally near the median streamflow for each site during the survey (Figures 6-8). Median flows were exceeded when releases were made for hydropower generation. Note all flow data are provisional and subject to revision. Table 2 depicts the minimum and maximum values for instantaneous flows at each station.

Table 2. Discharge values (cfs) at USGS gauging stations (provisional data).

	Overton	**Kearney**	**Grand Island**
Minimum	616	712	1060
Date	4/6	4/22	4/9,22
Maximum	2600	2870	2770
Date	4/11	3/21-22, 4/11-12	3/23

The streamflow at the nearest gauge when Whooping Cranes were observed on the river and when roost channel profiles were measured is shown in Table 3.

Table 3. Flow conditions during Whooping Crane use and channel profile measurements. (Discharge is at the Platte River gauging station near Kearney).

Use Site	Use Date	Use Time (AM)	Measured Date	Discharge (cfs)	
				Use	Measured
1	4/2	7:13	4/9	2280	1290
2	3/28	7:37	4/11	2640	2810
3	3/23	7:20	4/15	1160	959
4	3/24	8:13	4/16	995	1240
5	3/25	7:19	4/15	1130	959
6	3/26	8:14	4/8	1720	1000
7	4/1	7:03	4/21	1580	780
8	4/1	7:32	4/11	1580	2810
9	4/2	7:13	4/21	2280	787
10	4/3	7:03	4/29	2490	908
11	4/13	7:50	4/28	1060	1040

RIVERINE/WETLAND USE SITES-

We collected riverine channel profile data at 9 Whooping Crane decoy locations and 11 Whooping Crane roost sites (data entered into Microsoft Access database) (Figures 9-19). Eighteen profiles were surveyed; 2 of the decoy locations were at Whooping Crane use sites. A total of 980 stations (3 readings at each station) from 54 transects were surveyed. Photographs depicting the habitat used at the Whooping Crane Use Sites are shown in Figures 20-31.

DISTANCE TO VISUAL OBSTRUCTION, SUBSTRATE, AND WATER DEPTH-

Visual obstructions at Whooping Crane use sites are given in Table 4. Substrate was characterized as fine sand to coarse. The average water depth at the Whooping Crane roost locations was $0.08 \pm .16$m at the time transects were measured and do not necessarily reflect the depth when Whooping Cranes were present.

Table 4. Location, visual obstruction distance (m), substrate, and roost depth (m) at Whooping Crane riverine use sites.

Use Site ID	VO Upstream Distance	VO Right Distance	VO Downstream Distance	VO Left Distance	Fine Sand %	Coarse Sand %	Roost Depth
1	88	108	77	59	80	20	-.06
2	41	188	63	37	80	20	-.19
3	75	71	79	71	75	25	-.12
4	91	159	96	92	75	25	-.23
5	100	59	72	74	70	30	-.22
6	67	36	35	22	90	10	-.05
7	60	95	100	58	90	10	-.09
8	32	96	48	22	75	25	-.12
9	34	126	97	84	90	10	-.16
10	112	175	95	77	90	10	+.32
11	52	59	17	14	25	75	+.09

UNOBSTRUCTED WIDTH-

Table 5 depicts unobstructed width as measured at riverine use locations. The width was the average of the 3 river profiles measured at each Use Site.

Table 5. Unobstructed channel width at riverine use sites (units in m).

Use Site ID	Unobstructed Width	Standard Deviation	Minimum Width	Maximum Width
1	209.9	3.9	206	214
2	228.7	2.8	227	232
3	157.7	29.5	134	190
4	241.8	13.8	226	252
5	145.2	13.4	143	159
6	163.2	117.7	27	238
7	247.6	33.2	213	279
8	118.0	7.9	112	127
9	211.7	5.5	205	215
10	261.9	25.0	235	285
11	101.3	40.7	66	146

DIURNAL USE SITES-

Diurnal movements and activity data was collected when possible. We documented 13 sections of off-river diurnal use locations and three sections of riverine locations during 14 days of observation (Figures 2-5). Whooping Cranes were observed 0 – 6.4 miles from their riverine roost locations.

On March 21, a single Whooping Crane was observed on the river from 0722 h until 1615 h when the observer departed. We believe it remained on the river all day along with several hundred Sandhill Cranes. Likewise, a pair of Whooping Cranes observed near Shelton spent a considerable amount of time on the river during the day. They were present in the study area from March 30 until April 3. They would fly back and forth from the river to a cornfield and back again throughout the day. On April 1, this pair remained on the river from 1016 h until 1445 h when the observer departed. This type of behavior was unusual compared to most observations where the birds remain in the field throughout the day.

CRANE-USE DAYS

Crane-Use days were calculated by multiplying the number of Whooping Cranes by the number of days present. For this calculation, we assumed that a Whooping Crane observed during the morning aerial survey was present the previous day. Whooping Cranes were observed in the study area 15 (38%) of the 40 days of the survey. A minimum of 42 crane-use days was recorded (Table 6).

Table 6. Whooping Crane dates of occurrence and crane-use days (juveniles in parentheses).

Crane Group (Prefix 2010SP)	Number of Cranes	Dates of Occurrence	# of days present	Crane-Use Days
01, 02, 04-06, 08-12, 14, 16, 19-21,23	1	March 21- April 3	14	14
13,15,17,18,21	2	March 30- April 3	6	12
03, 07	1	March 22-25	4	4
24-25	6	April 13	2	12
TOTAL	10	March 21- April 13	17	42

LAND-COVER CLASS-

Ag-Corn, Ag-Soybeans, Grassland-Upland, Lowland Grasses, and Wetted Channel were the cover-types Whooping Cranes used during the day. Twenty-three locations were AG-Corn, 4 were Wetted Channel, 2 were Lowland Grasses, 2 were AG-Soybeans, and 1 was Grass-Upland. Ten of these sites were used 2 times and one was used 3 times. All of the known nocturnal roost locations (100%) were in Wetted Channel (Figures 20-30).

ACTIVITY-

A total of 75 hours of Whooping Crane continuous and instantaneous use (time budget) data was collected by ground personnel during 14 days of observation. The breakdown of observation time in various habitats is depicted in Table 7. Most of the diurnal activity recorded occurred in corn (56%) followed by wetted channel (16%), lowland grasses (7%), soybeans (1%), and upland grasses (1%). Three hundred data points of activity (time budget) were recorded. Feeding was the most frequently observed activity in all habitats (Table 8).

Table 7. Count of instant points by habitat.

Habitat	Hours	n	Percent
Ag-Corn	56	224	75%
Ag-SoyBean	.75	3	1%
Grassland-Upland	1	4	1%
Lowland Grasses	5	20	7%
Wetted Channel	12.25	49	16%

Table 8. Whooping Crane activity by habitat.

Habitat	Activity	n	Total	Percent
Ag-Corn	Alert	40	224	18
Ag-Corn	Out of View	9	224	4
Ag-Corn	Feeding	164	224	73
Ag-Corn	Preening	2	224	<1
Ag-Corn	Resting	9	224	4
Ag-SoyBean	Feeding	3	3	100
Grassland-Upland	Feeding	4	4	100
Lowland Grasses	Alert	2	20	10
Lowland Grasses	Feeding	11	20	55
Lowland Grasses	Out of View	1	20	5
Lowland Grasses	Resting	6	20	30
Wetted Channel	Alert	5	49	10
Wetted Channel	Defensive	1	49	2
Wetted Channel	Feeding	12	49	24
Wetted Channel	Out of View	30	49	61
Wetted Channel	Preening	1	49	2

Search Effort.--

Ground searches were initiated on 31 occasions. A total of 34.5 hours was expended on this effort and 411 miles were driven. Search duration extended from 0.1 to 3.8 hours. Objects were located on 13 occasions (42%) and resulted in 1 leucistic Sandhill Crane, 1 group of Snow Geese, and 11 Whooping Crane groups. Searches were terminated when the object was found or after a sufficient search effort was made.

Program ID and U.S. Fish & Wildlife Service ID Comparisons.--

Table 9 compares the Program numbering system with the USFWS database (Jeanine Lackey, personal communication). We had four groups of Whooping Cranes present in the study area during the survey. No juvenile Whooping Cranes were observed.

Table 9. Comparison of Program Crane ID and USFWS Crane ID.

Program Crane ID (Prefix 2010SP)	Program Name	USFWS Crane ID	Dates of Occurrence	# of cranes
01, 02, 04-06, 08-12, 14, 16, 19-20,23	MICM subadult	10A-02	3/5-4/3	1
13,15,17,18,21,22	Shelton pair	10A-14	3/29-4/3	2
03,07	Wood River subadult	10A-10	3/22-25	1
24-25	Odessa group	10A-29	4/12-13	6

Summary of Confirmed Sightings in the U.S.--

The number of confirmed Whooping Crane sightings in Nebraska was 16 including those contained herein (Jeanine Lackey, personal communication). As of 5 May 2010, there were 47 confirmed sightings in the United States as follows: North Dakota- 12; South Dakota- 7; Nebraska-16; Kansas- 9; Oklahoma- 2, and Texas- 1. A total of 264 Whooping Cranes (21 juveniles) were expected to migrate from their wintering grounds this spring.

Discussion and Recommendations

This was the fifth migration for the *Rebar Marker Placement Protocol*. The placement of rebar added time and additional expense to the project. We estimated that implementation of this protocol added about 10-15 minutes to the amount of time it took to survey each river channel profile location. This did not include the time required to obtain and prepare the rebar. Feedback from follow-up surveys of these sites by the surveying team will aid the Technical Advisory Committee in determining the efficacy of this effort.

We offer the following comments/suggestions to the Technical Advisory Committee as a result of this season's effort.

Data Sheets

- Add "Use Site ID" and "Crane Group ID" to the Aerial Observations form.
- Add "walking" as an activity to the "….. Instantaneous and Continuous Use Site Monitoring" sheet.
- Change "….. Instantaneous and Continuous Use Site Monitoring" to Time Budget.

Microsoft Access Database

- Correct the "Aerial Surveys II" form so that the correct number of flights appears in the "WC Flight Surveys" table. Currently, an extra line is added in the table.
- Correct the ""Use Site Monitoring" form so that the correct number of records appears in the "WC Use Instantaneous Points" table. Duplicate points are added in the table.
- Present discharge during use and when measured including dates for both in a Table.
- Add "Crane Group ID" to the Use Characteristics form.

- Add “Use Site ID” and “Crane Group ID” to the Aerial Observations form and link it to the Whooping Crane locations Table.
- Change Ground Monitoring to Ground Search
- Delete “activity” in locations subform of Use Site Monitoring form.
- Delete “vegetation” in the instant points subform of the Use Site Monitoring form.
- Automate “instant point ids” in the Use Site Monitoring form.
- Round the UTM’s to whole numbers in the Decoy Information table.
- Add a query to calculate count and percent of time in various habitats from the Use Locations table.

Methods

- 250 decoys have been placed since the inception of the Whooping Crane monitoring protocol. Consider whether it is necessary to continue collecting river profile information at decoy locations.

Spring 2010 Expenses

The cost of field implementation of this project was about $70,125. The total cost of the spring 2010 monitoring effort was about $81,200.

Supplements

Original Data Sheets

CD containing the Microsoft Access database, MS Word final report file, and a complete set of electronic photographs.

Figure 1. River flight transects and 7 return flight transects flown during the aerial surveys. Only a portion of the study area from East to West is shown (taken from *Monitoring Whooping Crane Migrational Habitat Use in the Central Platte River Valley* 16 September 2005).

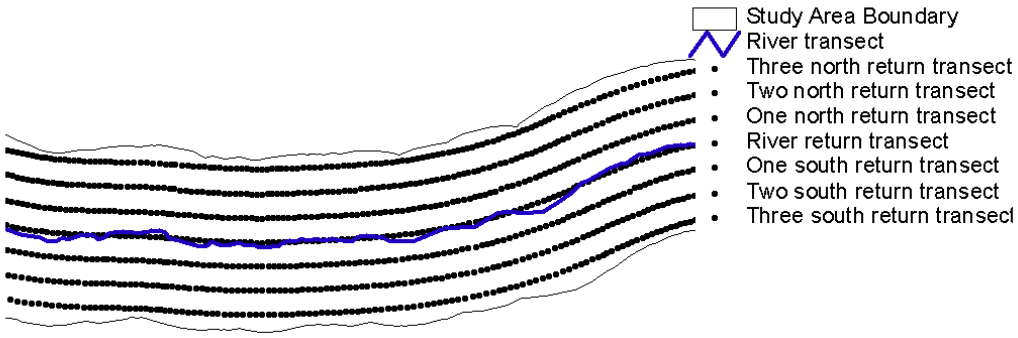


Figure 2. Whooping Crane Use Sites 3, 4, 5, 6, 2, 1, and 8 (left to right) (blue), and diurnal use areas (yellow) south of I-80 near Doniphan.

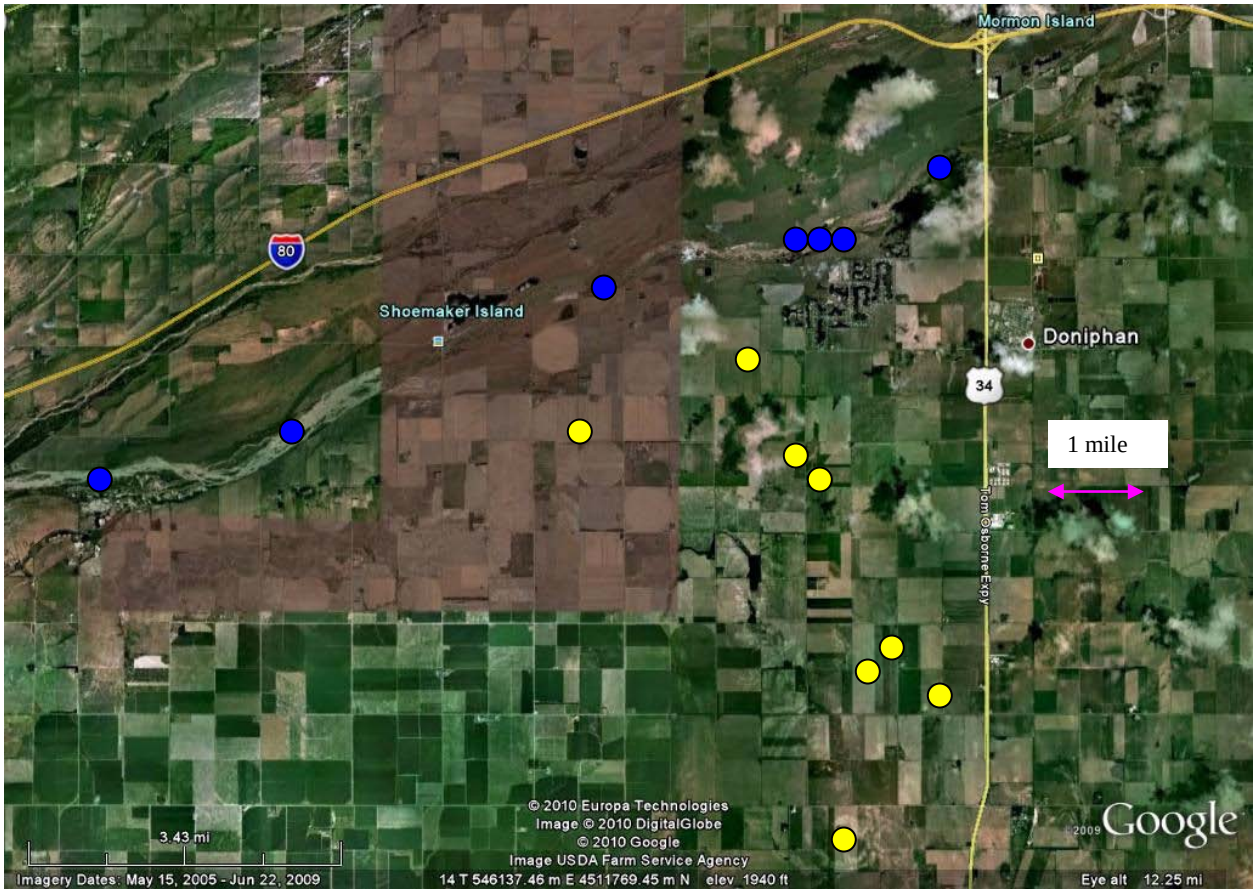


Figure 3. Whooping Crane diurnal use areas north of I-80 southwest of Grand Island.

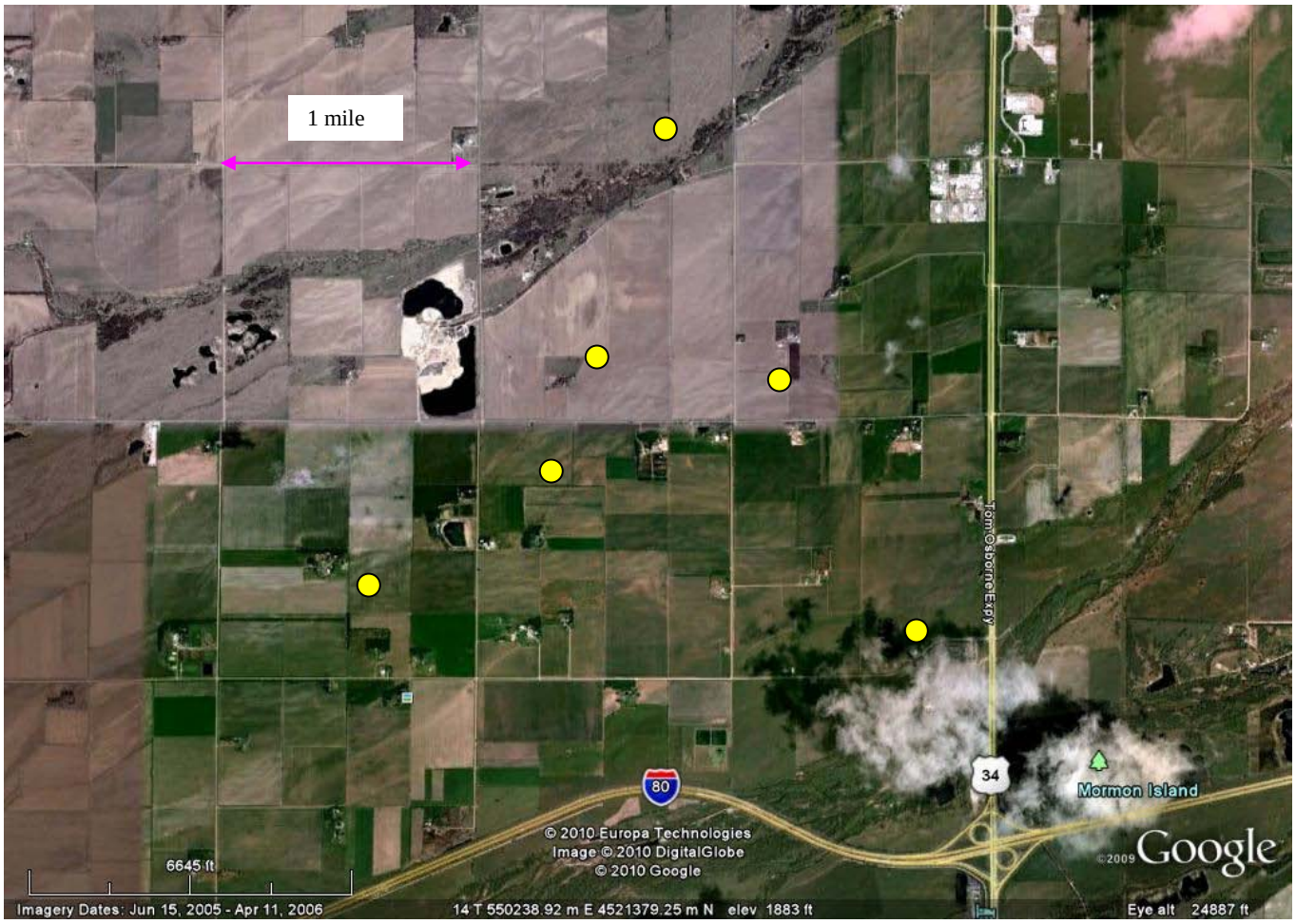


Figure 4. Whooping Crane Use Site 10, 9, and 7 (left to right) (blue) and diurnal use areas (yellow) southwest of I-80 Shelton Exit.

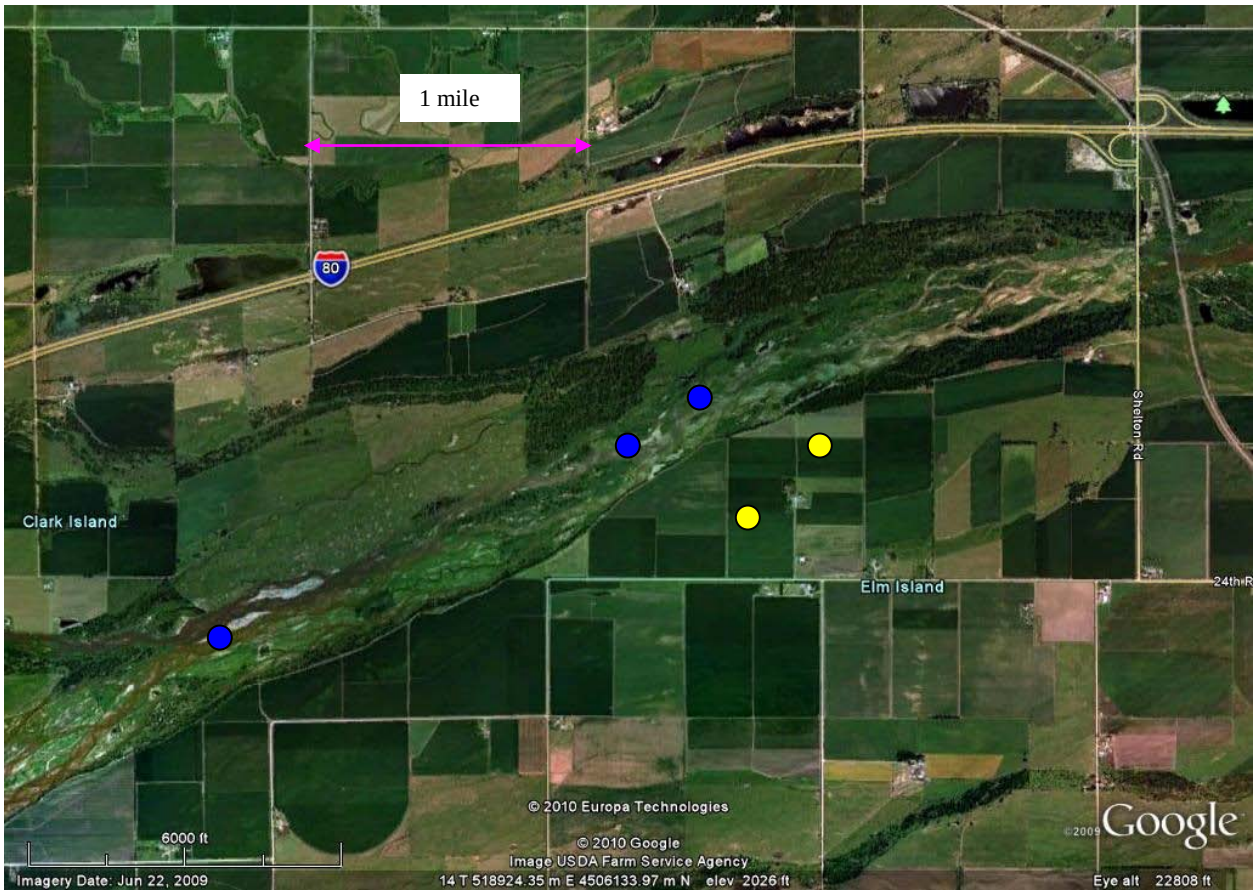
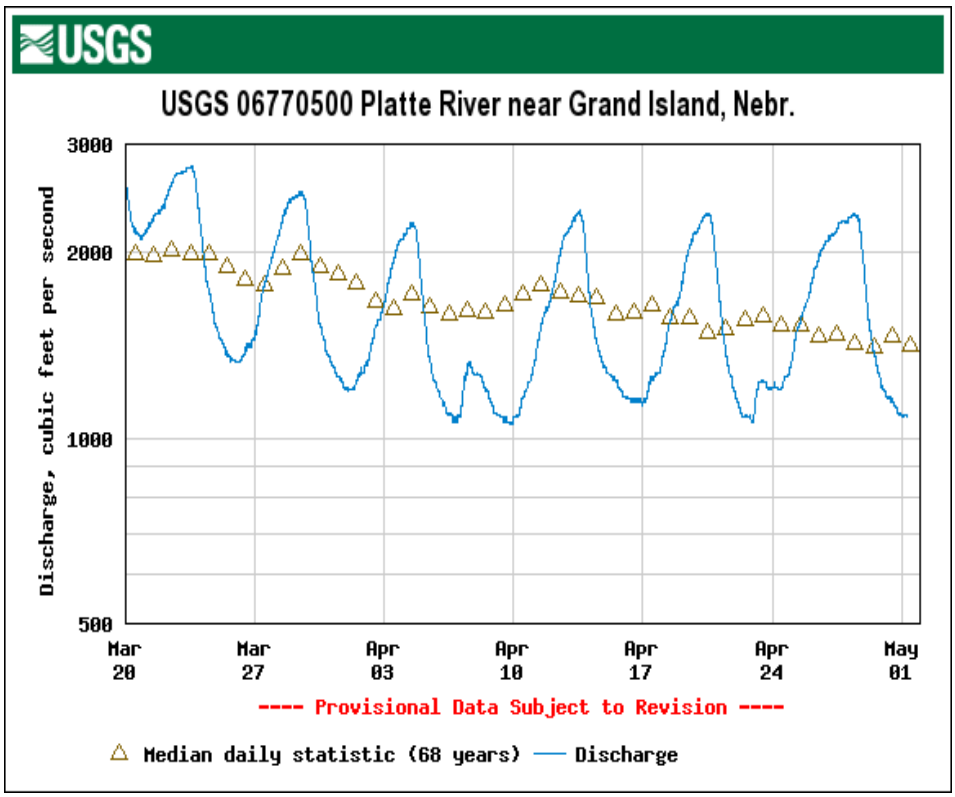


Figure 5. Whooping Crane Use Site 11 southeast of I-80 Odessa exit.

Figure 6. Platte River discharge (cfs) at Grand Island.



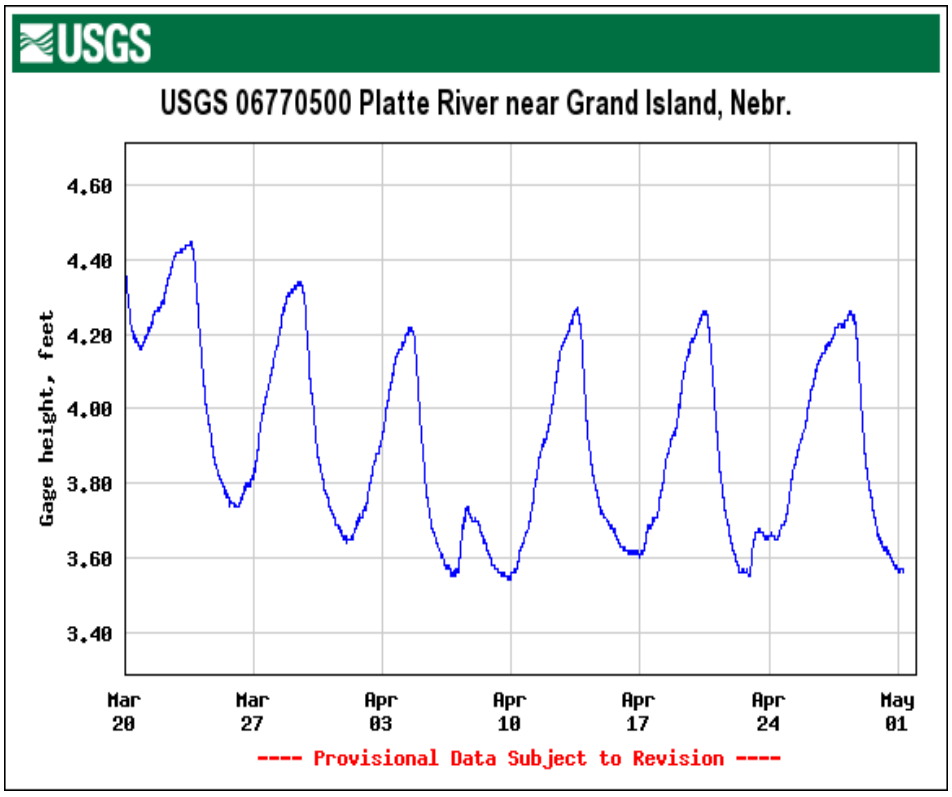
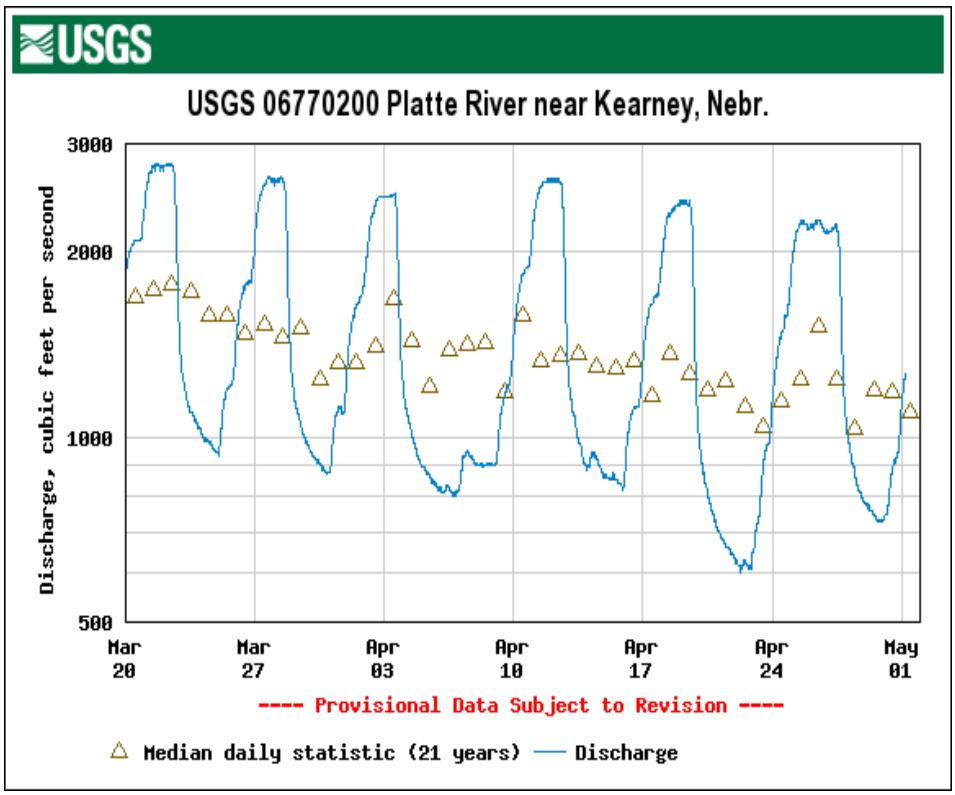


Figure 7. Platte River discharge (cfs) at Kearney.



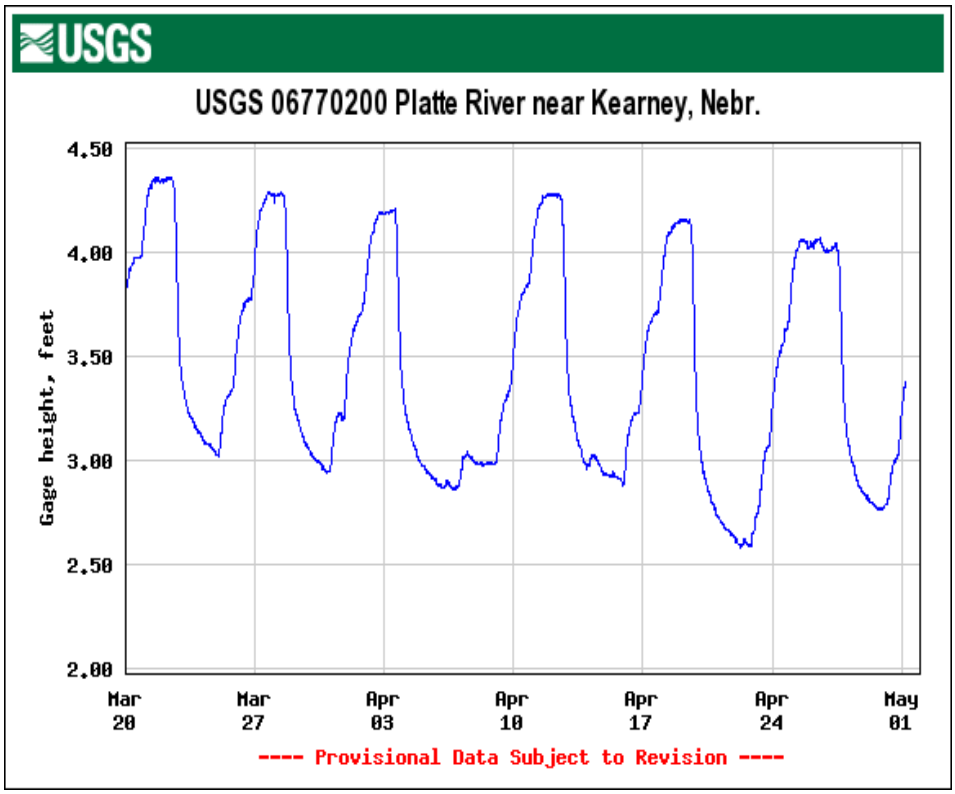
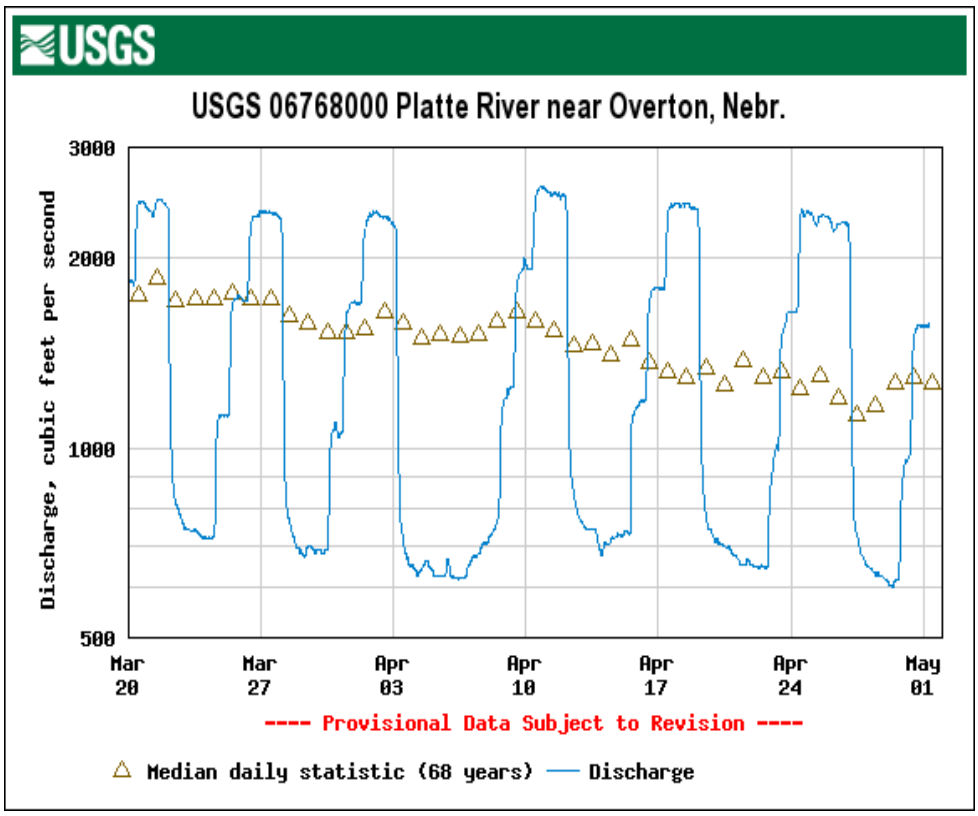


Figure 8. Platte River discharge (cfs) at Overton.



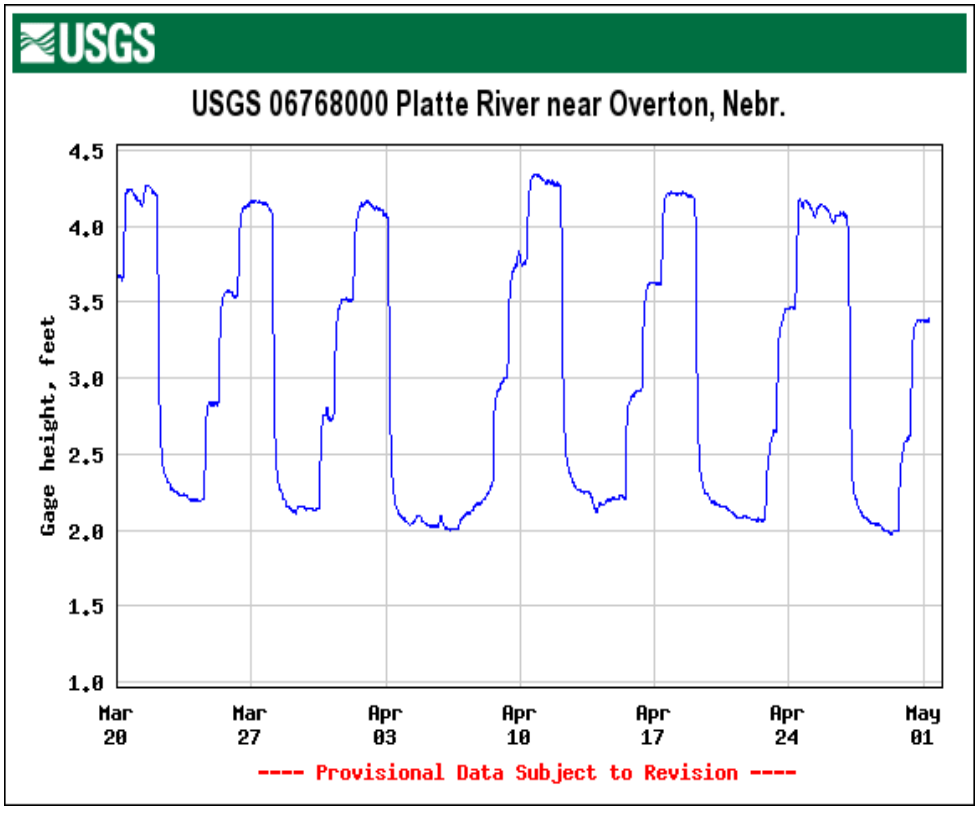


Figure 9. Roost channel profile for Use Site 1 (left to right bank).

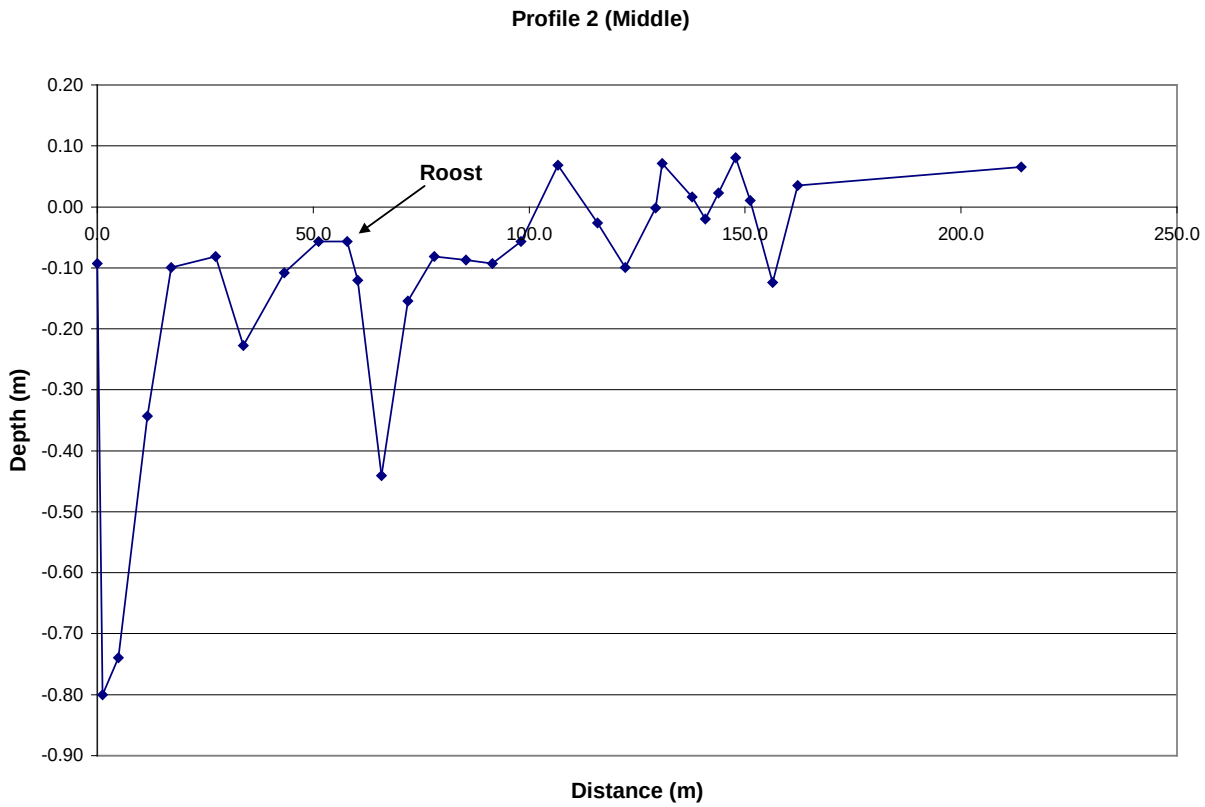


Figure 10. Roost channel profile for Use Site 2 (left to right bank).

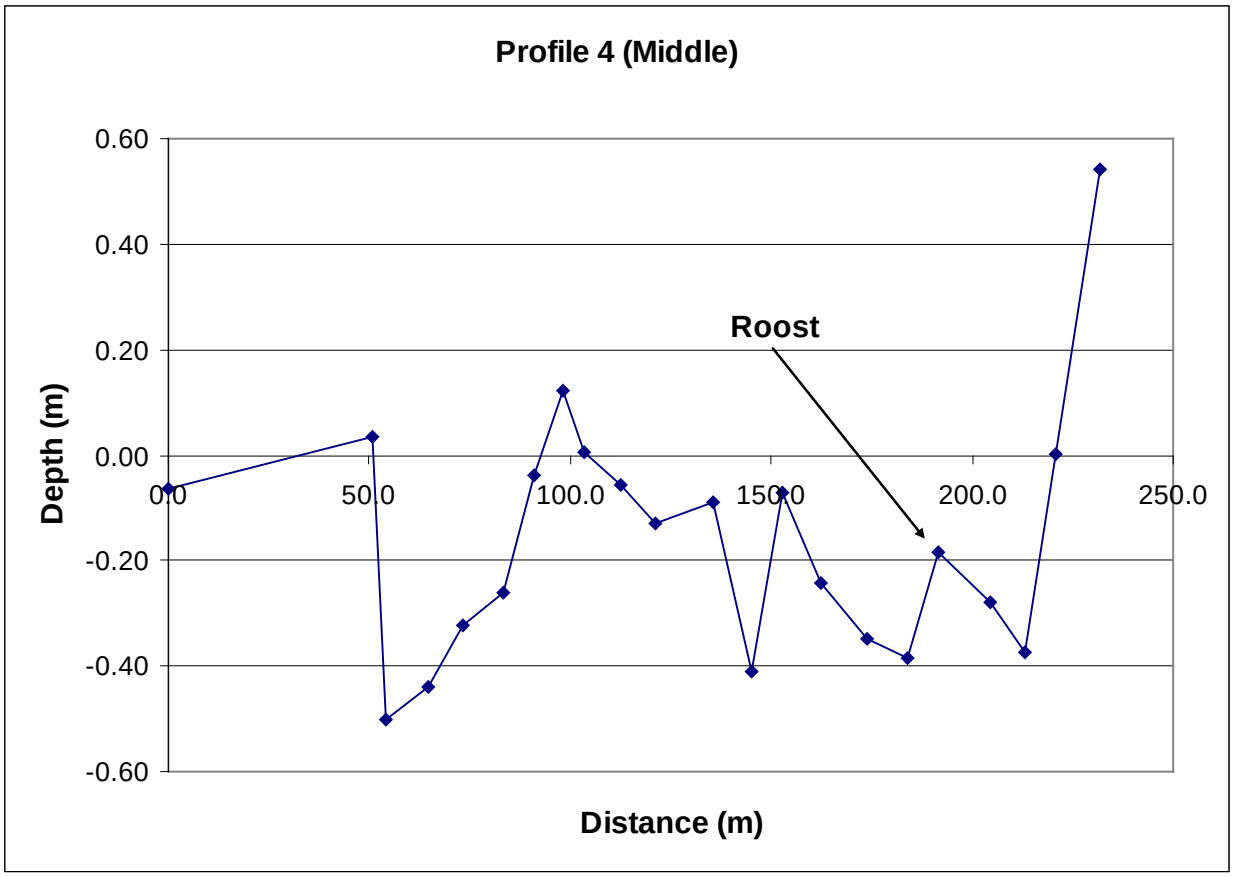


Figure 11. Roost channel profile for Use Site 3 (left to right bank).

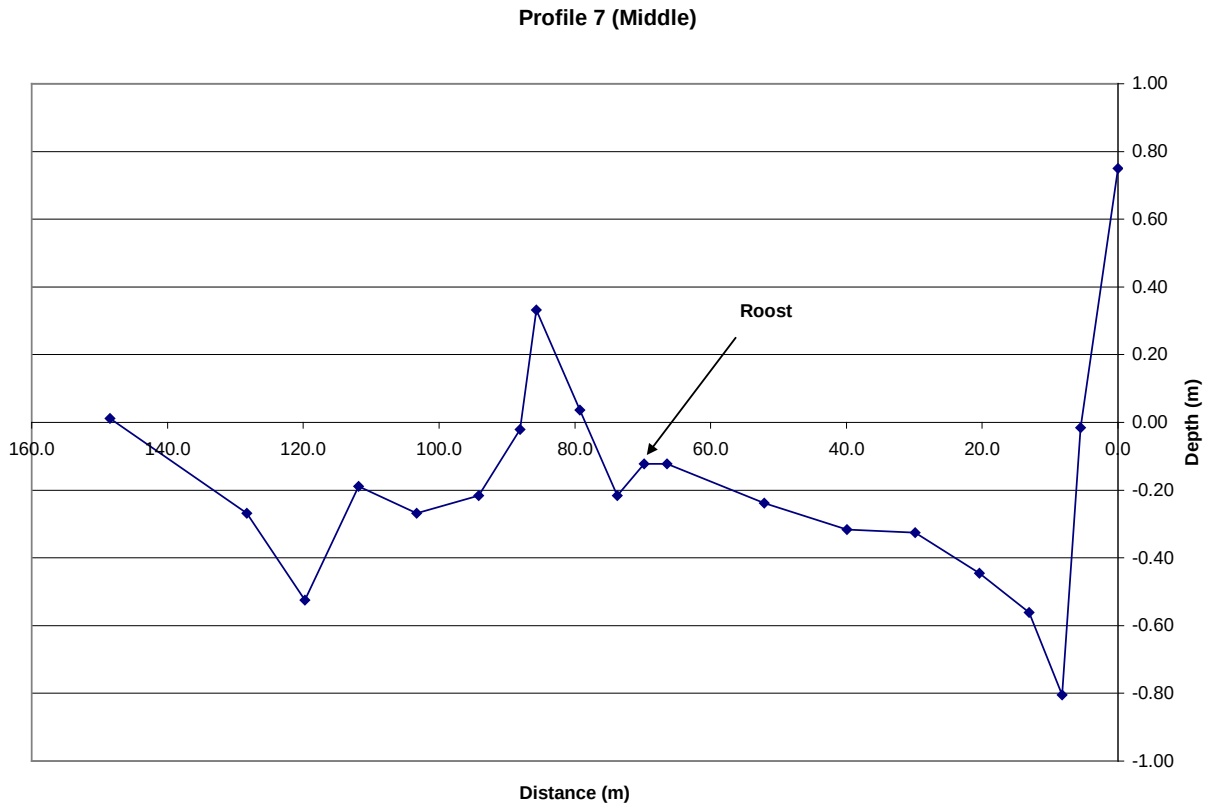


Figure 12. Roost channel profile for Use Site 4 (left to right bank).

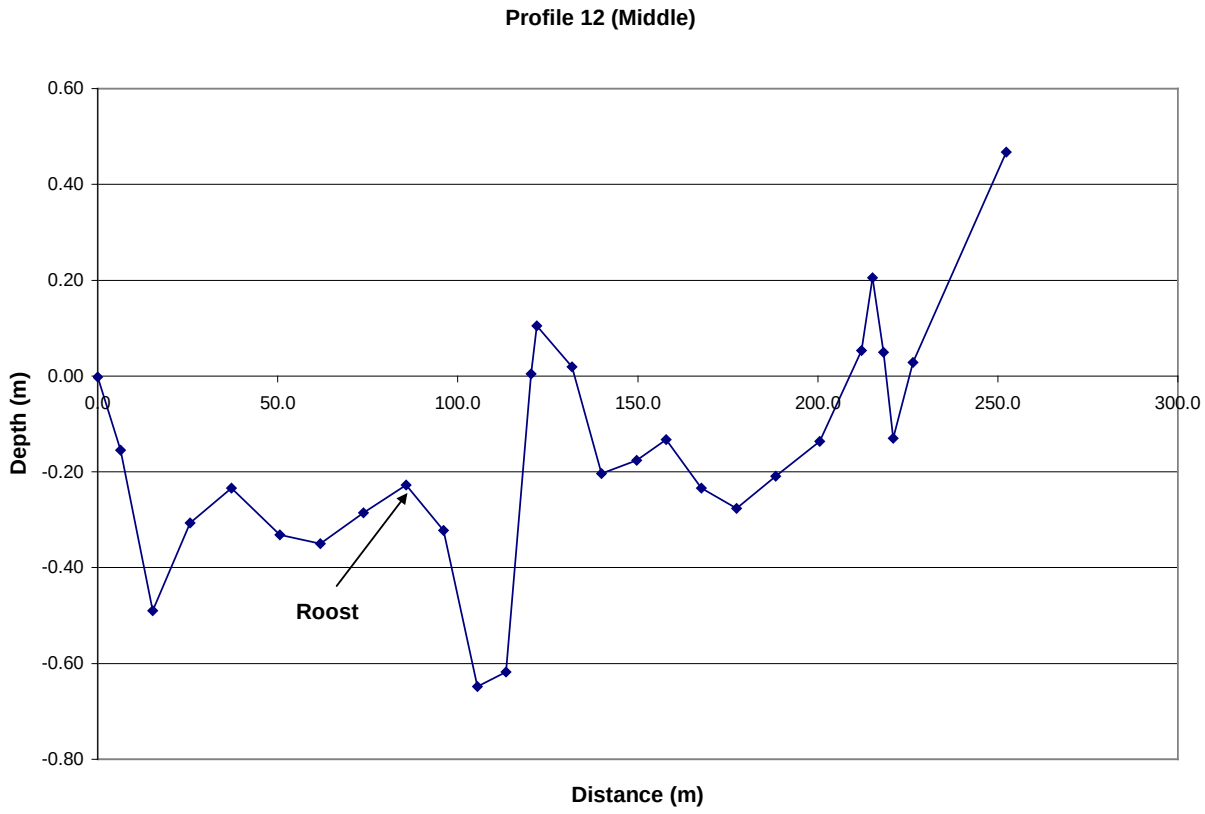


Figure 13. Roost channel profile for Use Site 5 (left to right bank).

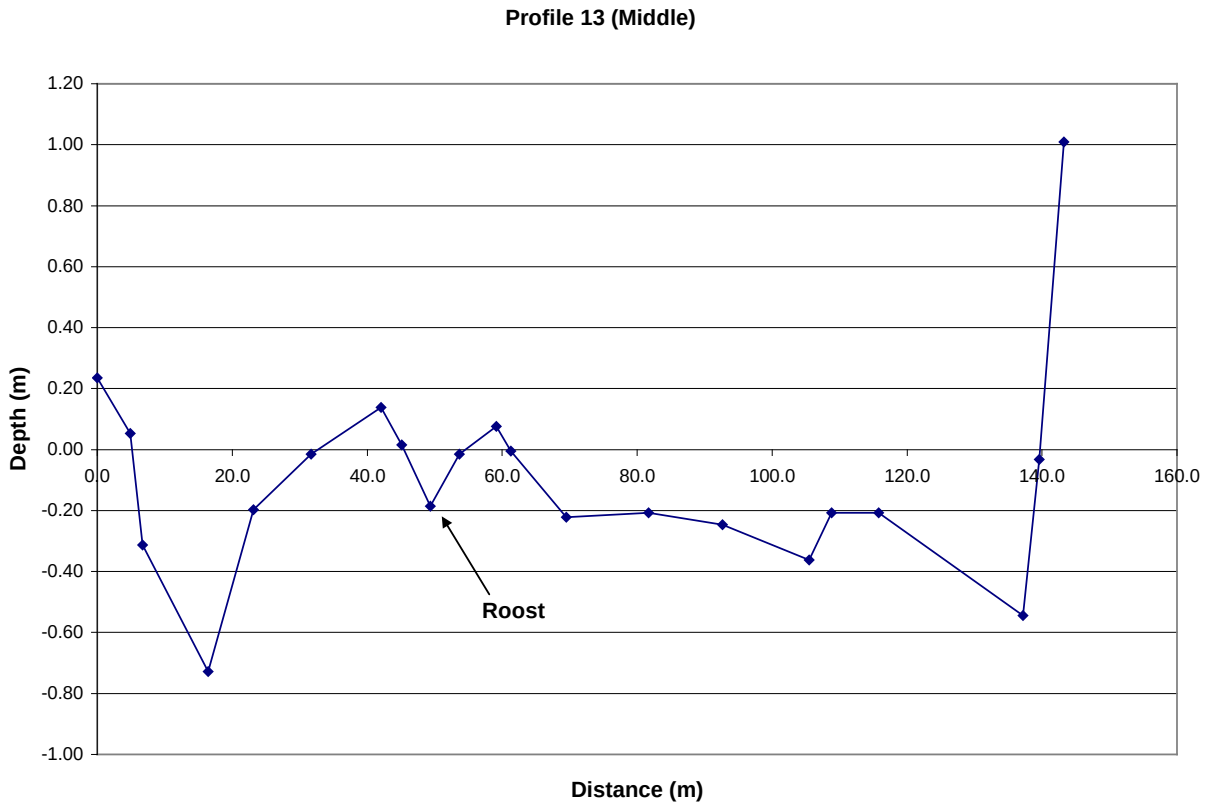


Figure 14. Roost channel profile for Use Site 6 (left to right bank).

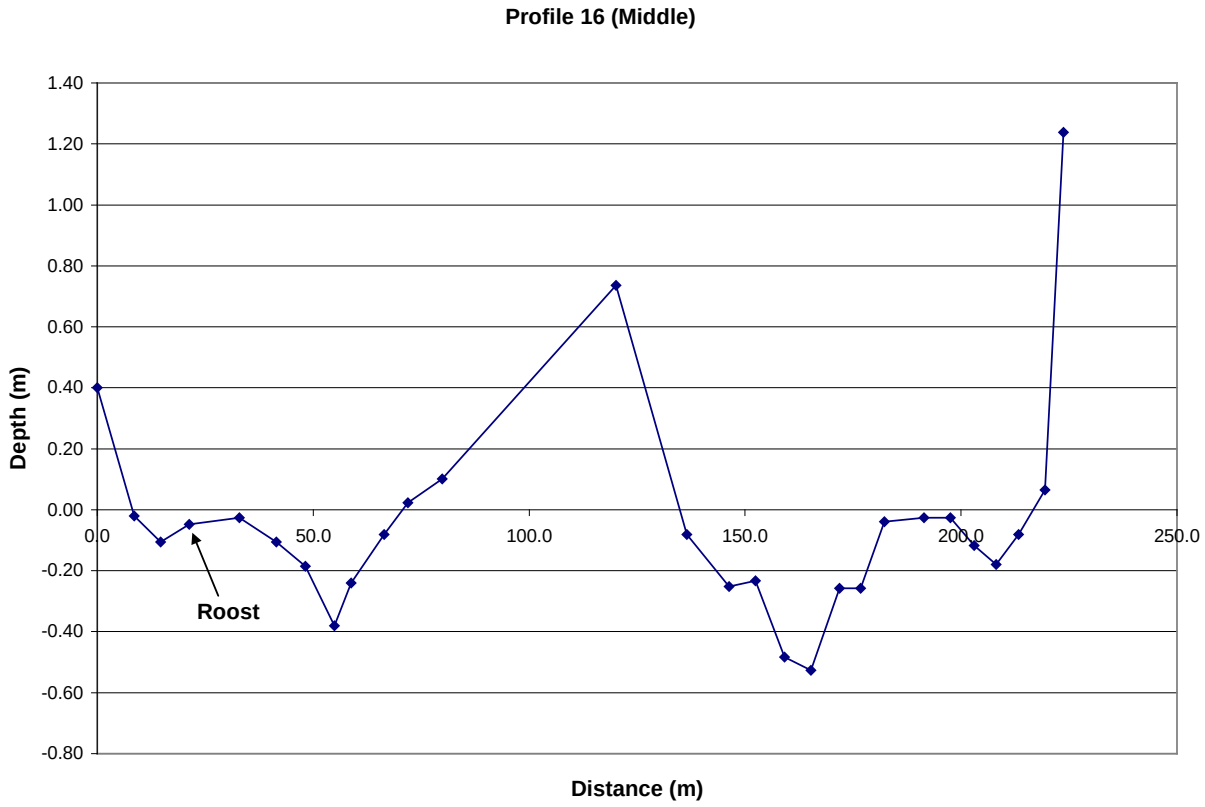


Figure 15. Roost channel profile for Use Site 7 (left to right bank).

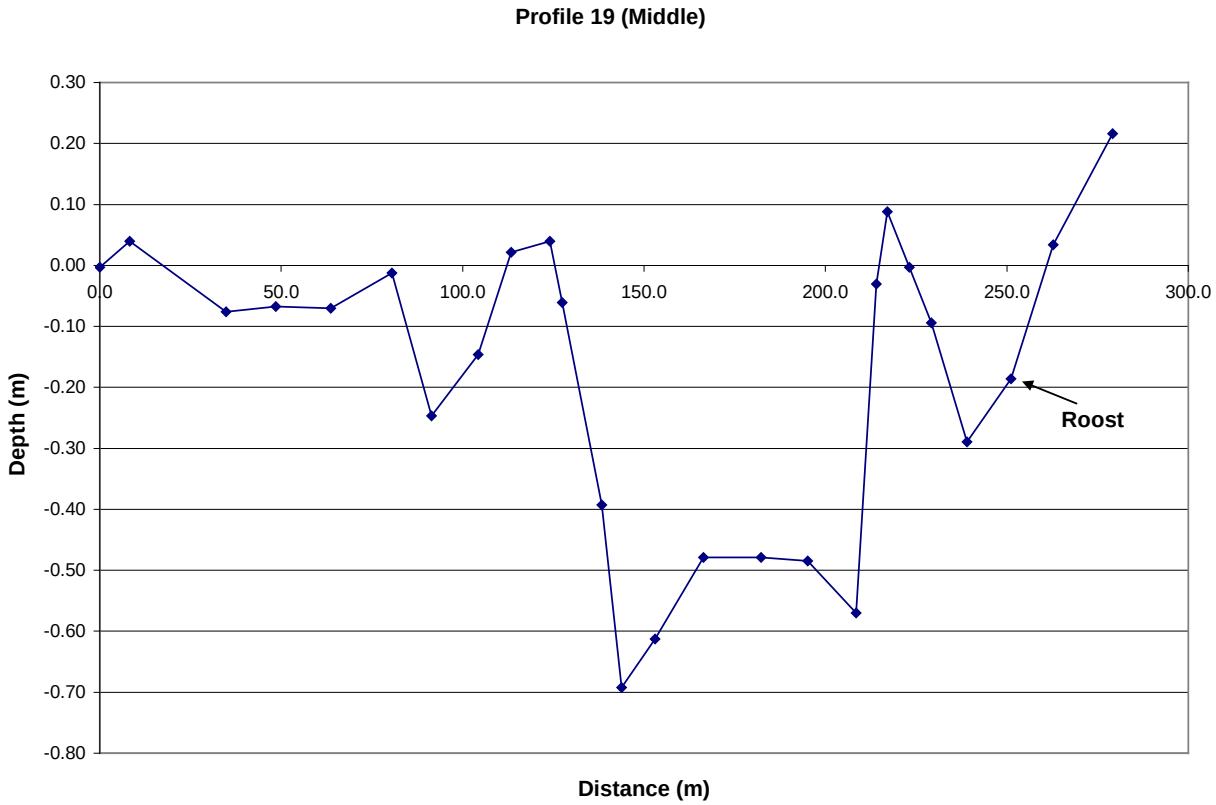


Figure 16. Roost channel profile for Use Site 8 (left to right bank).

Figure 17. Roost channel profile for Use Site 9 (left to right bank).

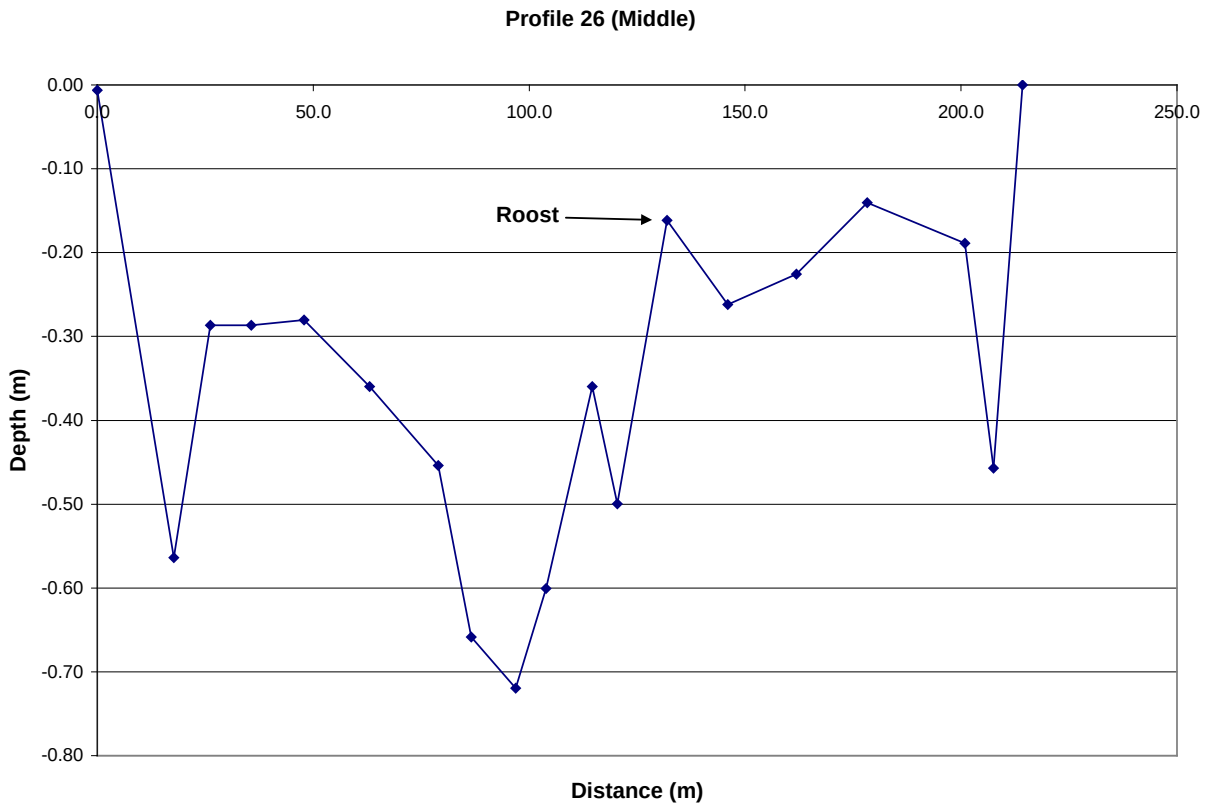


Figure 18. Roost channel profile for Use Site 10 (left to right bank).

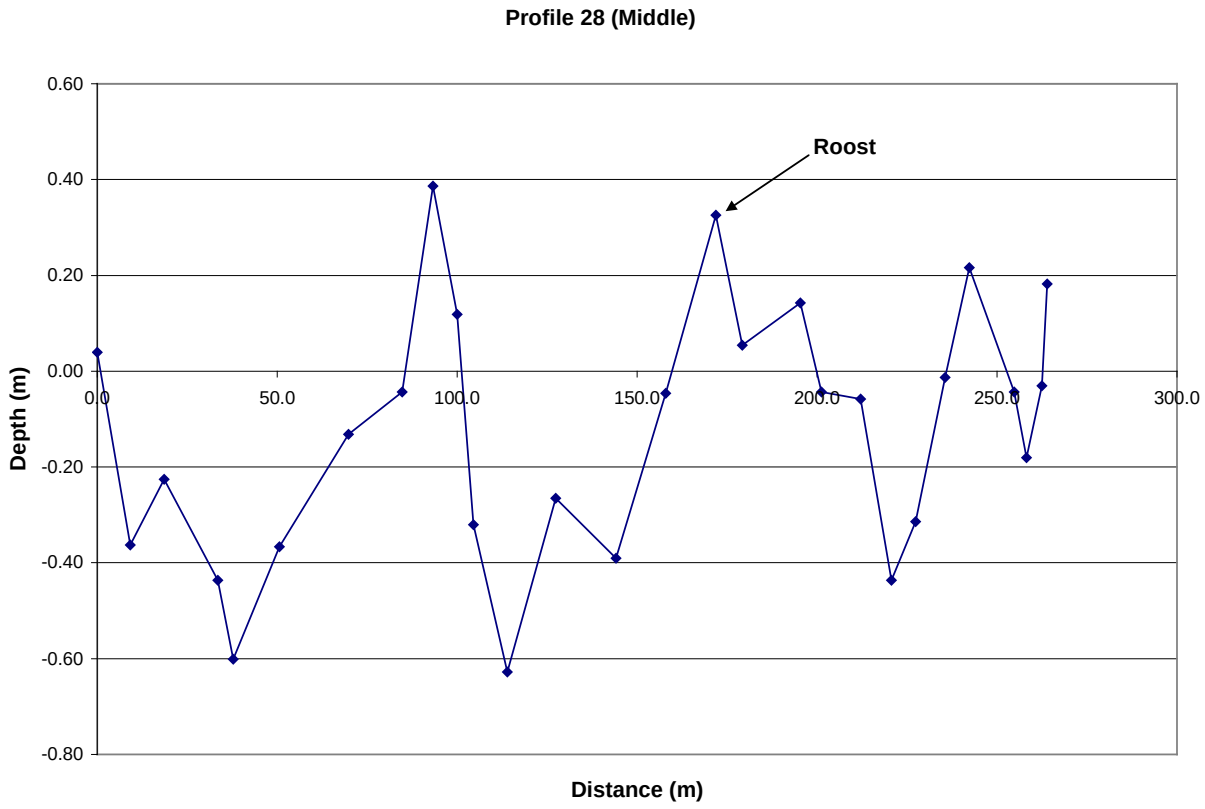


Figure 19. Roost channel profile for Use Site 11 (left to right bank).

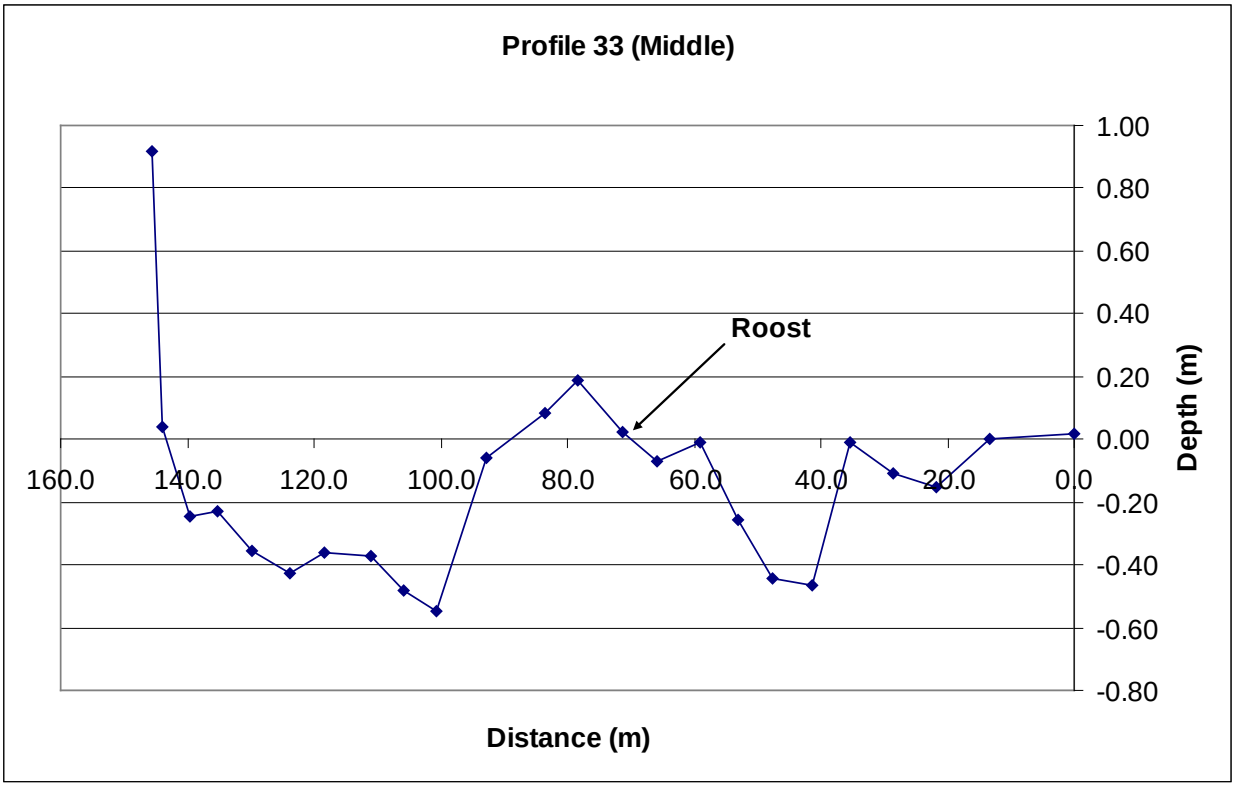


Figure 20. Whooping Crane Use Site 1 west of the Highway 281 bridge (Sec 35 T10 R10 Hall County).

Upstream

Left Bank

Downstream

Right Bank

Figure 21. Whooping Crane Use Site 2 west of the Highway 281 bridge (Sec 34 T10 R10 Hall County).

Upstream

Left Bank

Downstream

Right Bank

Figure 22. Whooping Crane Use Site 3 west of the Alda bridge (Sec 15 T9 R11 Hall County).

Upstream

Left Bank

Downstream

Right Bank

Figure 23. Whooping Crane Use Site 4 (Decoy 101) west of the Alda bridge (Sec 11 T9 R11 Hall County).

Upstream

Left Bank

Downstream

Right Bank

Figure 24. Whooping Crane Use Site 5 east of the Alda bridge (Sec 5 T9 R10 Hall County).

Figure 25. Whooping Crane Use Site 6 west of the Highway 281 bridge (Sec 35 T10 R10 Hall County).

Upstream

Left Bank

Downstream

Right Bank

Figure 26. Whooping Crane Use Site 7 west of the Shelton bridge (Sec 34 T9 R13 Buffalo County).

Upstream

Left Bank

Downstream

Right Bank

Figure 27. Whooping Crane Use Site 8 (Decoy 102) west of the Highway 281 bridge (Sec 25 T10 R10 Hall County).

Upstream

Left Bank

Downstream

Right Bank

Figure 28. Whooping Crane Use Site 9 west of the Shelton bridge (Sec 34 T9 R13 Buffalo County).

Upstream

Left Bank

Downstream

Right Bank

Figure 29. Whooping Crane Use Site 10 easst of the Gibbon bridge (Sec 5 T8 R13 Buffalo County).

Upstream

Left Bank

Downstream

Right Bank

Figure 30. Whooping Crane Use Site 11 east of the Odessa bridge (Sec 14 T8 R17 Buffalo County).

Upstream

Left Bank

Downstream

Right Bank

Figure 31. Whooping Crane use sites.

Use Site 6 west of Hwy 281

Use Site 11 east of Odessa

2010SP16 near Bosselman's s. of Grand Island

Day use site near Bosselman's (Sec 13-10-10 Hall County)