

# Implementation of the Whooping Crane Monitoring Protocol Fall 2011



## FINAL REPORT

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# **Implementation of the Whooping Crane Monitoring Protocol Fall 2011**

**Final Report Prepared by  
AIM Environmental Consultants and  
Western Ecosystems Technology, Inc.**

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

**26 March 2012**

The team of Western Ecosystems Technology, Inc. (WEST) and AIM Environmental Consultants was awarded a contract (*Contract for Services Agreement between the Nebraska Community Foundation, PRRIP, and WEST* dated 1 September 2011) to assist the Governance Committee in implementing specific monitoring associated with the Platte River Recovery and Implementation Program (PRRIP). The specific task was to implement the protocol developed by the Technical Advisory Committee entitled *Whooping Crane Monitoring Protocol - Migrational Habitat Use in the Central Platte River Valley* dated 31 May 2011 during the spring and fall migrations along with corresponding analysis.

## **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. Twelve technicians were hired and trained to conduct field work from 9 October through 10 November 2011. A set of six data sheets was provided by Headwaters Corporation and all data were entered into a web-based Microsoft SharePoint database being developed by Riverside Technology, Inc. using Microsoft InfoPath 2010.

Two air services were contracted and aerial surveys were conducted along specified routes near sunrise from 9 October through 10 November 2011 as weather permitted. Flights 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 survey 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 such that 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 transect back to Chapman. Day two began at Wood River, flew the river to Minden, returned along a predetermined transect 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 transect back to Minden. Day two began at Odessa, flew the river to Lexington, returned along a predetermined transect 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 transects 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 aircrew, 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 (photos were developed by Headwaters Corporation and have been used since October 2008). 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 aircrew.

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 as 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. Landowner permission was obtained prior to entering any property.

Whooping Crane decoys were placed in the river channel at 10 randomly selected locations by personnel from Headwaters Corporation (Table 1) for the purposes of determining survey detection rates. The aircrew 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 aircrew were reported to the ground crew for confirmation.

Topographic profiles were measured at Whooping Crane roost sites using a Trimble GeoXH6000 GPS rented by AIM. 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. 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. Photographs were taken showing conditions upstream, downstream, left bank, and right bank from the roost site. Due to measurement or instrument error concerns, at the request of the PPRIP, we repeated data collection at the same locations using a Trimble GeoXH3000 GPS unit along with directly measuring depth to the nearest ¼ inch using a yardstick taped to the GPS pole. That enabled us to compare GPS recorded elevations with measured depths. Stream flow data were 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.

## Results

### *Opportunistic Locates.—*

We received 3 reports of Whooping Cranes from the public or PRRIP. At 10:40 AM on October 29, David Baasch reported 3 Whooping Cranes observed by hunters earlier that morning about 3 miles downstream of the Alda bridge. While recording this information, another call was received from a different party reporting the same 3 birds, seen in flight well before sunrise. From 10:45 AM until 12:00 noon, we did a ground search covering the area south of the Platte River from U.S. 281 to the Alda Road along the Platte River Road, Elm Island Road to Mormon Island Crane Meadows overlooking the wet meadows, and Wild Rose Ranch but did not locate the cranes. Weather conditions were favorable for migration so we did not conduct an aerial search at that time of day because of the high probability that they migrated or, if they had not migrated, we felt confident would find them the following morning. The cranes evidently migrated before we completed the search since they were not observed or reported after sunrise that morning or in subsequent mornings. We learned later that the Whooping Cranes were not

seen from the air that morning because they had flown from their roost prior to the plane's arrival. Photographs taken by the hunters prior to sunrise, which we obtained after the fact, confirmed them as Whooping Cranes (Crane Group 2011FA02).

At 10:04 AM on November 7, David Baasch received a report of 2 Whooping Cranes flying over the river 2 miles east of the Odessa bridge (north of 747 and V Roads). An airplane was dispatched to search for these birds and we were in the vicinity of the report by 10:34 AM. At 10:47 AM four American White Pelicans were located at that location. In addition, the systematic aerial survey spotted 2 pelicans there that morning. No Whooping Cranes were observed.

### ***Aerial Survey.--***

#### CONFIRMED WHOOPING CRANE SIGHTINGS-

Of a possible 33 morning flights scheduled per leg, the East Leg (Chapman – Minden) completed 27 (82%) flights while the West Leg (Minden – Lexington) flew 29 (88%). Weather and lack of a pilot were factors in cancellations. We recorded 1 confirmed Whooping Crane sighting (Crane Group 2011FA01) on transects (Figure 2).

#### INDEX OF USE-

We completed 112 (85%) aerial survey transects out of 132 transects scheduled (2 transects per leg). One Whooping Crane sighting was made on these transects. This resulted in an index of use (frequency of occurrence) of .009 sightings per transect. The sighting occurred on the westbound river transect of the East Leg (OSE).

#### OPPORTUNISTIC FLIGHTS-

Three opportunistic flights were conducted. Two occurred when the plane deviated from the systematic survey route at the request of the ground observer for confirmation of the presence of Whooping Cranes on the river and one occurred when an additional flight was deployed. On 10/25, the West Leg searched 2 miles east of the Minden bridge prior to starting the systematic survey and found Sandhill Cranes along with American White Pelicans. On 10/28, the East Leg deviated from their return route and confirmed that the 3 Whooping Cranes observed earlier were still present on the river. On 11/7, a flight was deployed to search for possible Whooping Cranes east of the Odessa bridge. A group of American White Pelicans was located. A total of 29 minutes of search time was expended to conduct these opportunistic flights.

#### OTHER WHITE OBJECT SIGHTINGS-

Two on-ground follow-ups were conducted on objects other than Whooping Cranes at the request of the aircrew. This resulted in confirmation of American White Pelicans on one occasion and “object not found” on one occasion.

**Searcher Efficiency Trials.—**

Whooping Crane decoys were placed at 10 riverine locations between October 14 and November 7 (Table 1). The air observers detected a decoy at seven sites for an overall detectability rate of 70%. No off-river locations were used this season.

Table 1. Random locations of decoys for detectability trials.

<b>NAME</b>	<b>DATE PLACED</b>	<b>X</b>	<b>Y</b>	<b>Detected</b>
2011FA decoy #1 (Crane Trust)	10/21/2011	551432.9572	4516865.2735	Yes
2011FA decoy #2 (PRRIP/NPPD Cottonwood Ranch)	10/25/2011	458398.2820	4503575.2443	No
2011FA decoy #3 (PRRIP Binfield)	10/22/2011	539482.2830	4511533.4406	Yes
2011FA decoy #4 (PRRIP Bartels)	11/7/2011	471235.0286	4503872.2436	Yes
2011FA decoy #5 (Broadfoot south)	10/31/2011	491821.2490	4500965.6974	Yes
2011FA Decoy #6 (Rathje)	10/14/2011	563595.3106	4528624.9784	No
2011FA decoy #7 (GI Well Field)	11/2/2011	558952.9279	4522821.2204	Yes
2011FA decoy #8 (CNPPID)	10/17/2011	451813.8921	4504028.4387	No
2011FA decoy #9 (PRRIP Hostetler)	10/27/2011	501345.3710	4501242.3634	Yes
2011FA decoy #10 (Bergen)	11/4/2011	565590.5173	4530712.2856	Yes

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

**FLOW-**

Streamflow measured at the USGS gauging stations located near Grand Island, Kearney, and Overton was nearly double the median streamflow for each site during the survey (Figures 3-5). Note all flow data are provisional and subject to revision. Table 2 depicts the minimum and maximum values for unit (instantaneous) flows at each station during the survey period.

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

	<b>Overton</b>	<b>Kearney</b>	<b>Grand Island</b>
Minimum	3230	2580	2820
Date	11/04	11/09-10	11/10
Maximum	5240	5570	5800
Date	10/09	10/10	10/10

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

Table 3. Flow conditions during Whooping Crane use and channel profile measurements. Measurements were taken at the same location on 2 different dates. (Discharge is at the Platte River near Grand Island gauging station).

Use Site	Use Date	Use Time	Measured Dates	Discharge (cfs)	
				Use	Measured
1	10/28	8:20	10/28 11/22	3290	2970 2970
2	10/28	8:40	10/31 11/22	3290	2870 2970
3	10/29	7:40	11/03 11/23	3290	3000 2870

Flow conditions across the 21 migration seasons monitored from 2001 to 2011 averaged 1002 cfs (95% CI: 882, 1122) from a sample of 277 use locations.

RIVERINE USE SITES-

We collected riverine channel profile data at 3 Whooping Crane use sites. A total of 230 stations from 9 transects were surveyed during each of 2 surveys. Apparent accuracy of GPS elevation readings between successive recorded transect points ranged from 0-177 inches (see Discussion and Recommendations for summary values and explanation) (Figures 6-8).

Photographs depicting the habitat used at the Whooping Crane Use Sites are shown in Figures 9-11. Use Site 3 was a duck hunting pond excavated in the river channel (Figure 11).

DISTANCE TO VISUAL OBSTRUCTION, SUBSTRATE, AND WATER DEPTH-

Visual obstructions from Whooping Crane use sites are given in Table 4. Substrate was characterized as fine sand to small gravel. The average water depth at the Whooping Crane roost locations was  $-6.7 \pm 5.3$  inches.

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

Use Site ID	UTM X	UTM Y	VO Upstream Distance	VO Right Distance	VO Downstream Distance	VO Left Distance	Fine Sand %	Coarse Sand %	Small Gravel %	Roost Depth "
1	550723	4516027	185	148	200	78	100			+ 0.5
2	549783	4515645	112	112	188	78	80	15	5	-8
3	546895	4513289	59	28	36	28	100			-12.5

Average distance to visual obstructions across the 21 migration seasons monitored from 2001 to 2011 averaged 495 feet (95% CI: 461, 530) from a sample of 249 use locations. Distance to nearest visual obstructions (i.e. the closest obstruction at each site, not the average of the four measurements at each site) across the 21 migration seasons monitored from 2001 to 2011 averaged 260 feet (95% CI: 236, 284) from a sample of 249 use locations.

Roost depth across the 21 migration seasons monitored from 2001 to 2011 averaged 6.5 inches (95% CI: 5.9, 7.2) for the 201 roosts detected in water. For roosts on sandbars above the

water surface, as measured across the 21 migration seasons monitored from 2001 to 2011, the average height was 2.9 inches (95% CI: 2.0, 3.8) for the 44 roosts detected.

#### UNOBSTRUCTED WIDTH-

Table 5 depicts unobstructed width as measured at riverine use locations.

Table 5. Unobstructed width at use sites (units in feet).

Use Site ID	Unobstructed Width
1	724
2	622
3	177

Unobstructed Width across the 21 migration seasons monitored from 2011 to 2011 averaged 775 feet (95% CI: 724, 826) from a sample of 143 use locations.

#### DIURNAL USE SITES-

Diurnal movements and activity data was collected when possible. We documented 1 diurnal use location during 1 day of observation (Figure 2).

Crane Group 2011FA01 consisting of 1 adult and 2 juvenile Whooping Cranes was not observed off their riverine roost location. They were observed from the air at 8:20 h and 8:40 h CDT on 28 October 2011. At 9:47 AM, they flew about ½ mi upstream and landed back on the river. Ground personnel monitored them from 9:47 h until 10:20 when they migrated. The next morning, 3 adult Whooping Cranes (Crane Group 2011FA02) were observed by hunters about 2 mi upstream from where 2011FA01 was last observed. AIM personnel did not observe this group.

#### 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 believed to be present in the study area 3 (9%) of the 33 days of the survey. We documented the presence of 2 Whooping Crane groups that contained 3 birds each. A total of 12 crane-use days by 6 individuals was recorded (Table 6).



Table 6. Whooping Crane dates of occurrence and crane-use days.

Crane Group	Number of Cranes (ad:juv)	Dates of Occurrence	# of days present	Crane-Use Days
2010FA01	1:2	October 27-28	2	6
2010FA02	3:0	October 28-29	2	6
TOTAL	4:2	October 27-29	3	12

LAND-COVER CLASS-

Wetted Channel was the cover-type Whooping Cranes were observed using during the day. One of the two nocturnal roost locations was in Wetted Channel and the other roost was Open Water Pond.

Land cover class usage across the 11 fall migration seasons monitored from 2001 to 2011 resulted in 226 observations with 55% of observations in wetted channel, 30% in corn, 6% in soybeans, 5% on barren beach or bar, 1% in emergents, and less than 1% in alfalfa, upland grasses, and other land cover types.

Land cover class usage across the 10 spring migration seasons monitored from 2001 to 2011 resulted in 440 observations with 49% of observations in corn, 32% in wetted channel, 6% in soybeans, 6% in emergents, 3% lowland grasses, 3% in other land cover types, 1% in alfalfa, and less than 1% in upland grasses.

About 0.5 hours of continuous and instantaneous use (time budget) data of Whooping Cranes was collected by ground personnel during 1 day of observation. Three data points of activity (time budget) were recorded in Wetted Channel. Resting was the only activity recorded.

***Search Effort.--***

Ground searches were initiated on 3 occasions. A total of 2.6 hours was expended in this effort and 70 miles were driven. Search duration extended from 0.6 to about 1.25 hours. American White Pelicans were found on 1 occasion.

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

Table 7 compares the Program numbering system with the USFWS database (Martha Tacha, personal communication). We documented two groups of Whooping Cranes present in the study area during the survey.

Table 7. Comparison of Program Crane ID and USFWS Crane ID.

<b>Program Crane ID (Prefix 2011FA)</b>	<b>Program Name</b>	<b>USFWS Crane ID</b>	<b>Dates of Occurrence</b>	<b># of cranes</b>
01	Trust Bunker Group	11B-15	10/28	3
02	Duck Pond Group	11B-21	10/29	3

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

The number of confirmed Whooping Crane sightings in Nebraska was 8 including those contained herein (Martha Tacha, personal communication). As of 23 November 2011, there were 70 confirmed sightings in the United States as follows: North Dakota- 19; South Dakota- 4; Nebraska- 8; Kansas- 23; Oklahoma- 9, Montana- 1, Missouri- 1, and Texas- 5. An estimated 316 (37 juveniles) Whooping Cranes were expected on their wintering grounds in Texas.

***Radio-marked Birds and Platte River Use.—***

Since 2009, 22 GPS radios have been affixed to the legs of Whooping Cranes and were active prior to this fall’s migration. None of the radio-marked cranes stopped on the Platte this fall.

The six individual Whooping Cranes that were confirmed on the Platte River represented 1.9% of the Aransas-Wood Buffalo Whooping Crane population believed to be alive at the end of the nesting season in late August. This percentage was the maximum since 100% survival of the pre-fall migration population was highly unlikely. On average, 4.0% of the population stopped on the Platte River (0.5% to 13.4%) during 2001 through 2011 (Table 8).

Table 8. A comparison of the Whooping Crane population change and the percent of that population stopping on the Platte River.

Year	SPRING				FALL			
	WC Pop March	# Platte	Crane- Use Days	% Using Platte	WC Pop Dec	# Platte	Crane- Use Days	% Using Platte
2001	174	1	11	0.6	174	1	2	0.5
2002	174	1	26	0.6	185	19	121	9.8
2003	184	NA	NA	NA	194	1	2	0.5
2004	193	1	1	0.5	214	6	18	2.8
2005	214	4	13	1.9	216	2	2	0.9
2006	211	7	54	3.3	237	3	45	1.3
2007	237	9	71	3.8	266	10	23	3.8
2008	266	3	27	1.1	270	20	42	7.4
2009	247	6	42	2.4	264	12	44	4.6
2010	263	10	42	3.8	281	15	32	5.3
2011	269	36	120	13.4	316*	6	12	1.9

\*August population

***Incidental Take.—***

The USFWS requested information and documentation of any human activity that occurred in the proximity of Whooping Cranes that could constitute “take” as defined by the Endangered Species Act i.e. “...to harass, harm, pursue, hunt, shoot, wound, kill, capture, or collect, or attempt to engage in any such conduct”.

**LETHAL OR CRIPPLING TAKE-**

AIM’s monitoring effort did not result in any crippling or lethal take of Whooping Cranes this season.

**HARRASSMENT-**

AIM personnel did not observe or engage in any activity that could be construed as “harassment” as defined by USFWS.

**PUBLIC DISTURBANCE-**

AIM personnel did not observe any such activity by the public this season.

**Discussion and Recommendations**

The occurrence of a 3-bird group consisting of 1 adult and 2 chicks was puzzling. No twins were reported on the breeding grounds although the possibility a nest was missed exists. The fact that 3 adults occurred within 2 miles of this location several hours after the departure of the first group brings to question of whether these birds were the parents of the chicks and were separated somehow. It is documented that chicks will separate from their parents during the fall migration and have wintered in areas outside of the traditional wintering grounds away from their parents. We may have a better idea of what happened after winter territories are established and the flock composition is documented.

By comparing successive pairs of measured water depth readings with the corresponding pairs of GPS elevation readings at use sites, we were able to quantify the degree of GPS vertical accuracy. If the water depth between two points changed by 5 inches, then the difference in GPS elevation readings between the same two points should also be 5 inches, assuming 100% accuracy by the GPS unit. To determine the degree of GPS accuracy we: 1) calculated the absolute difference (inches) between the two water depth values for each successive pair of points along each transect; 2) calculated the absolute difference (inches) between the two GPS elevation readings for each successive pair of points along each transect; and then 3) calculated the absolute difference (inches) between the values generated in steps 1 and 2. A summary of the resulting values is given in Table 9.

Table 9. Absolute difference in measured water depth between successive transect points compared to estimated water depth changes based on GPS elevation readings. For each transect the values are based on the total number of “successive transect point pairs” available (not given).

Use site/transect	Values in inches	
	Mean (SD)	Range
1-upstream	11.9 (34.3)	0.1-177.1
1-middle	7.3 (8.4)	0-37.4
1-downstream	14.7 (14.3)	0.3-57.8
2-upstream	7.1 (7.3)	0.1-30.9
2-middle	3.6 (3.2)	0.1-15.5
2-downstream	4.6 (5.2)	0-21.2
3-upstream	2.8 (3.5)	0.1-15.6
3-middle	4.9 (3.3)	0.9-12.4
3-downstream	3.1 (2.3)	0-6.9

### ***Microsoft SharePoint Database***

The transition from the Microsoft Access database to Microsoft SharePoint continued during this monitoring effort. The process will be more efficient next spring as this transition moves forward and bugs are worked out.

### ***Methods***

- Limitations to the Trimble GPS methodology were elucidated this fall. Elevations (Z) were less accurate than the UTM (XY) coordinates.

## **Supplements**

Original Data Sheets

CD containing a Microsoft Word final report file in both Microsoft Word and PDF format and selected photographs.

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

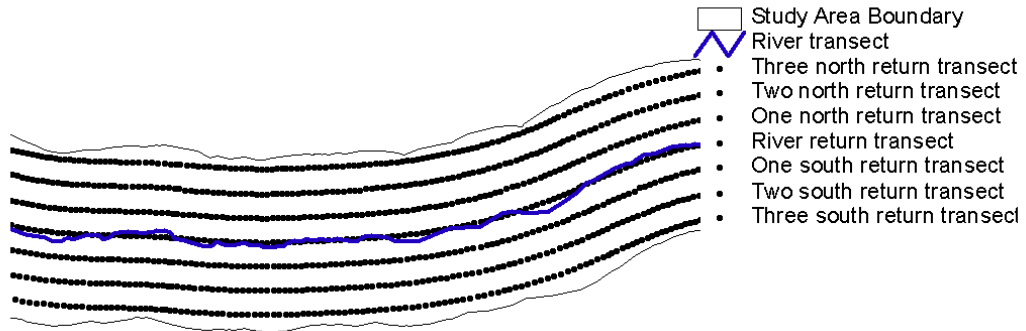


Figure 2. Whooping Crane Use Sites 1, 2, and 3 on Mormon Island Crane Meadows located west of the U.S. 281 bridge in Hall County. Crane Group 2011FA01 used Use Sites 1 and 2. Crane Group 2011FA02 used Use Site 3. Rabbe (FWS) indicated Use Site 2 was located on a submerged macroform that was managed for tern and plover nesting up through 2009, but was eroded away by the high-flow events during 2010 and 2011.

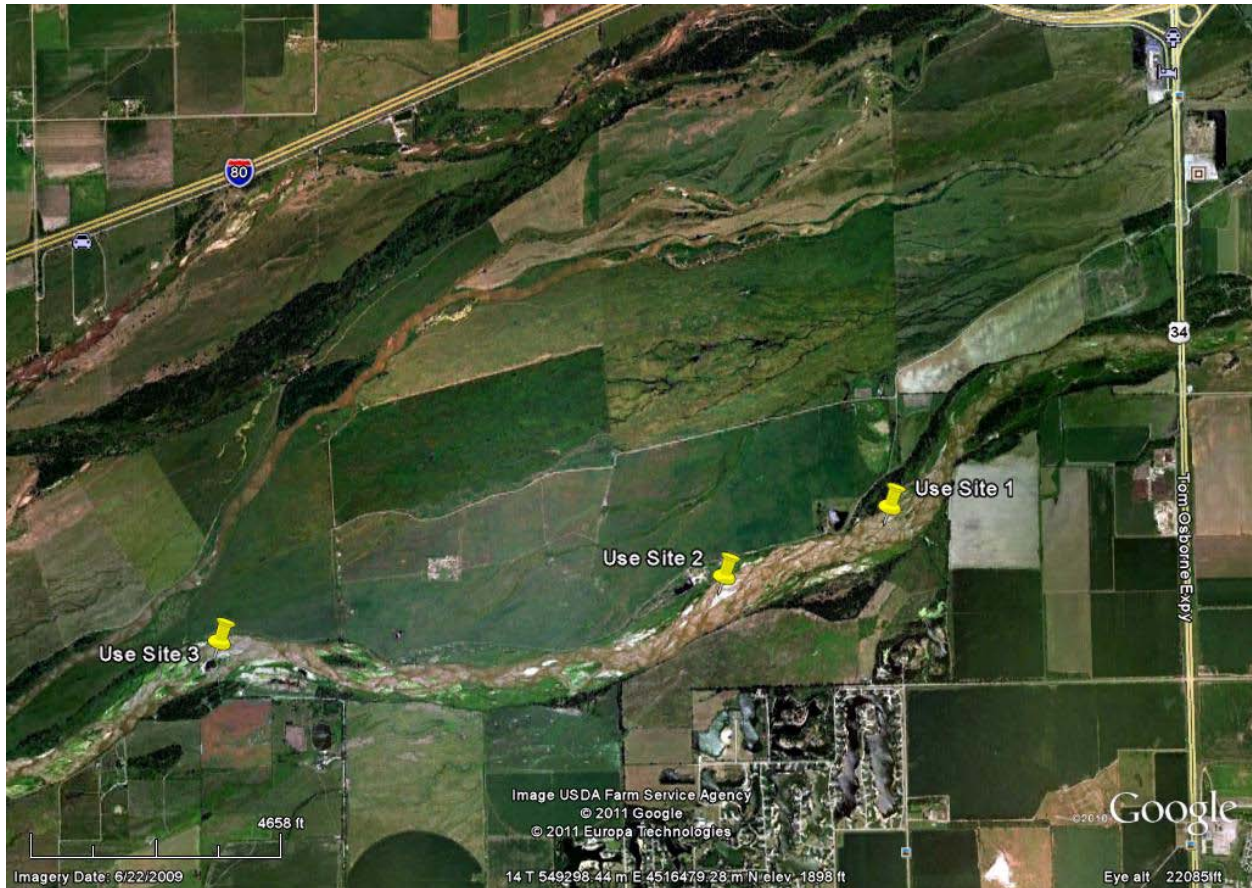


Figure 3. Platte River discharge (cfs) and gage height at Grand Island.

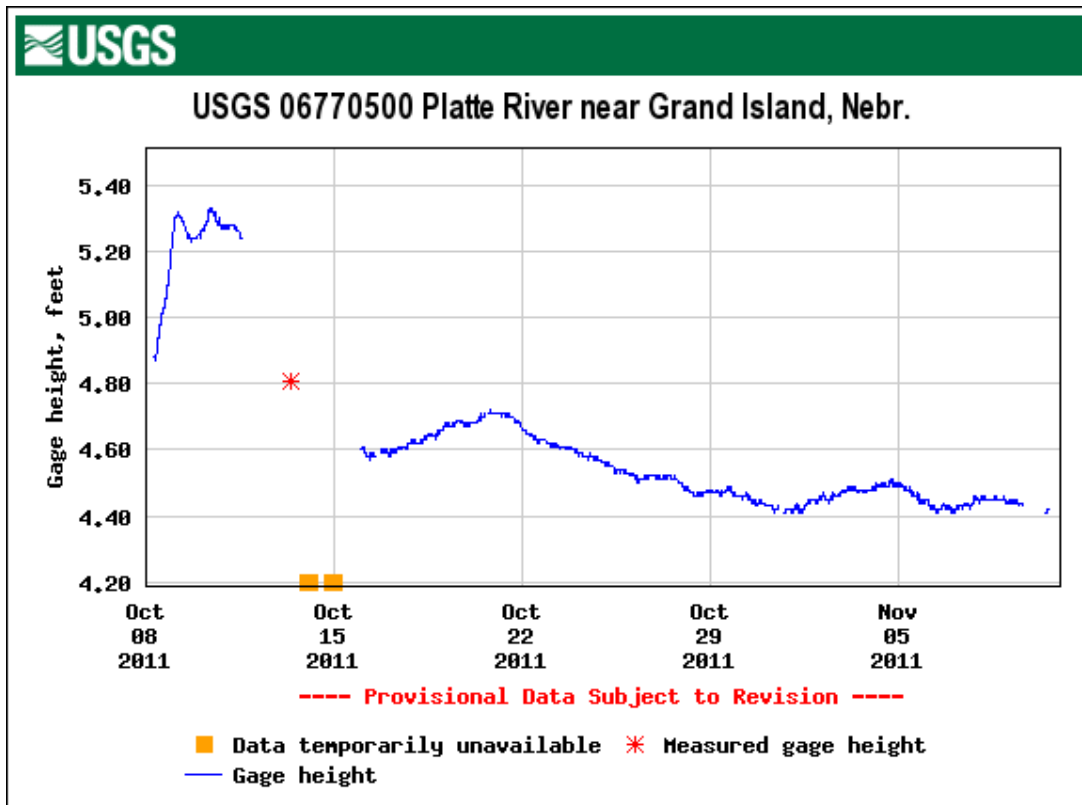
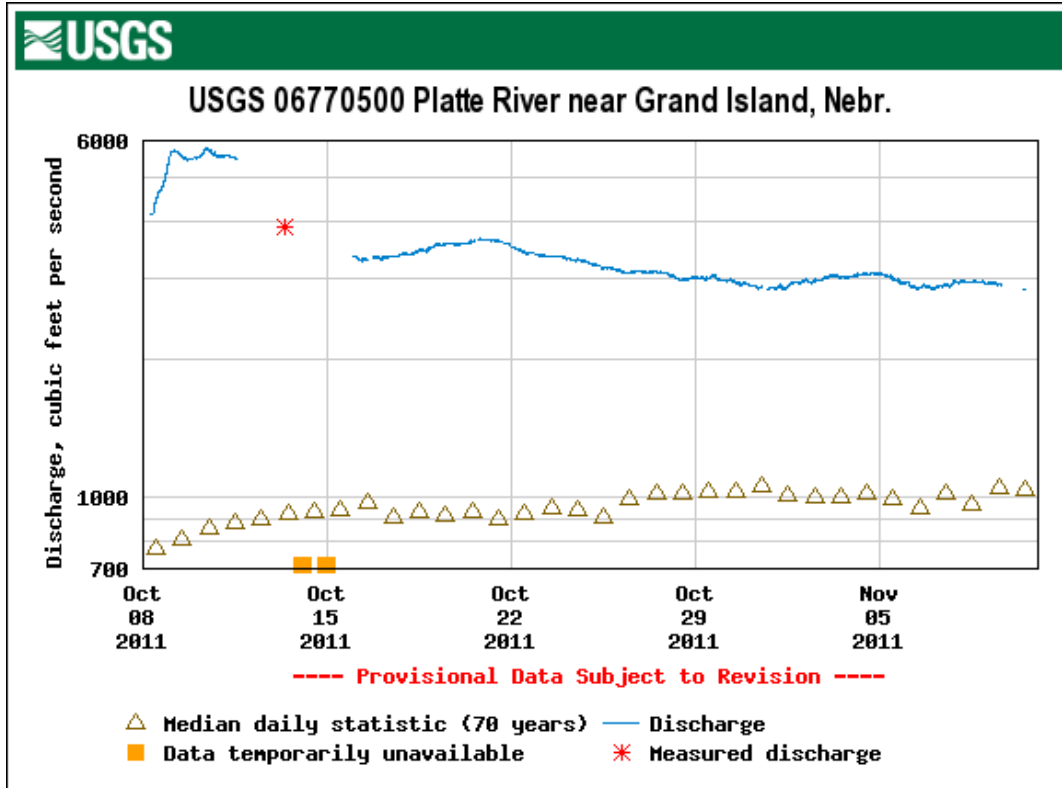


Figure 4. Platte River discharge (cfs) at Kearney.

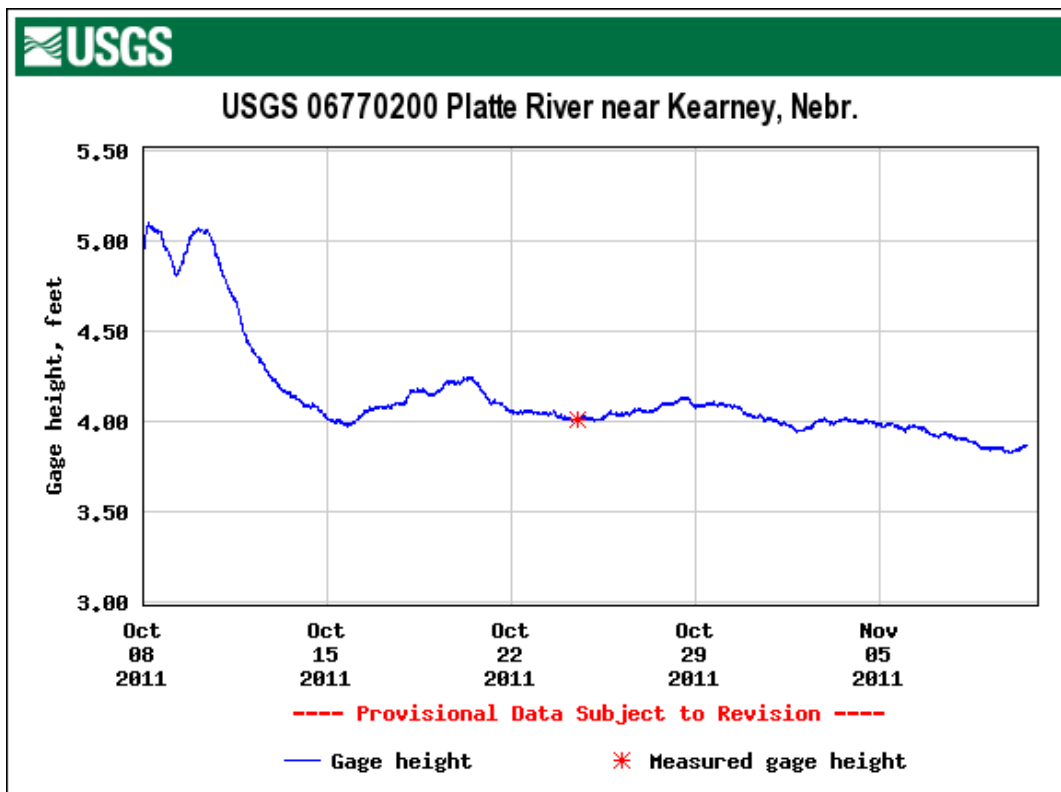
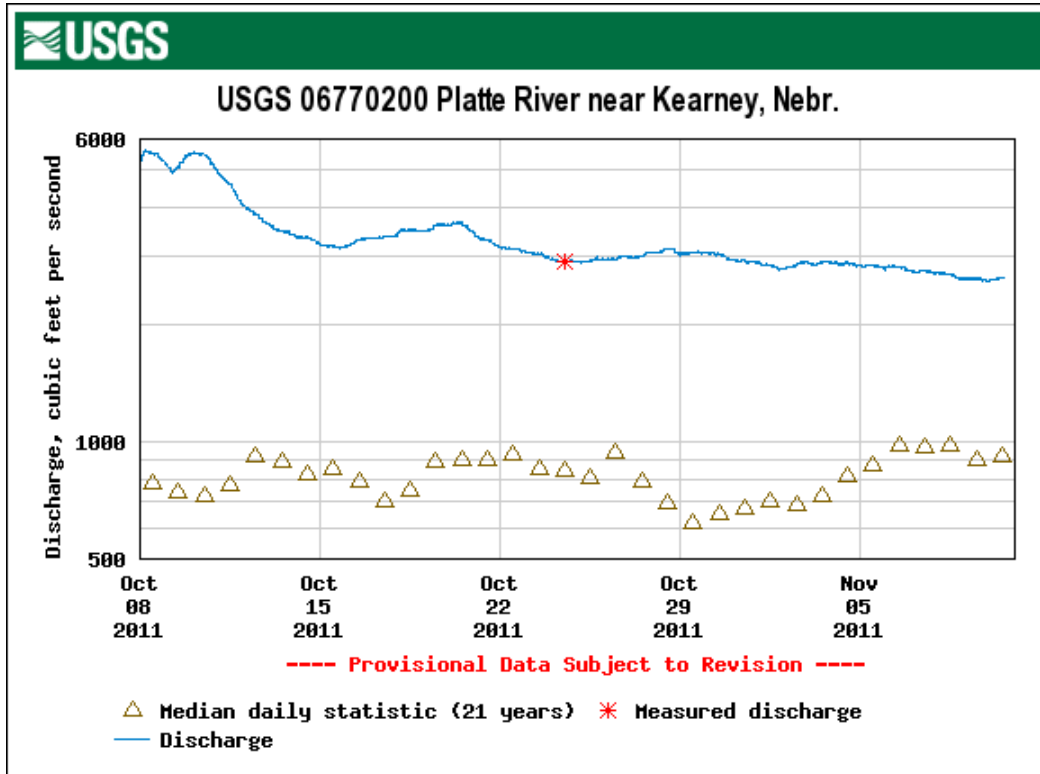




Figure 5. Platte River discharge (cfs) at Overton.

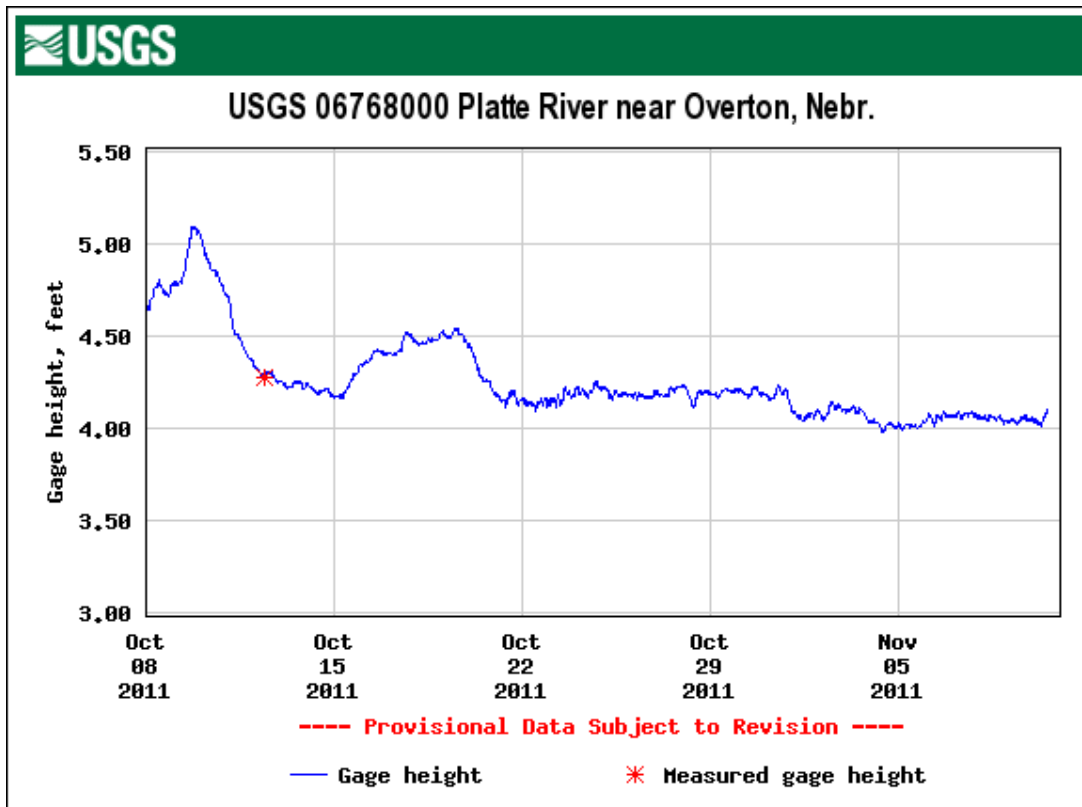
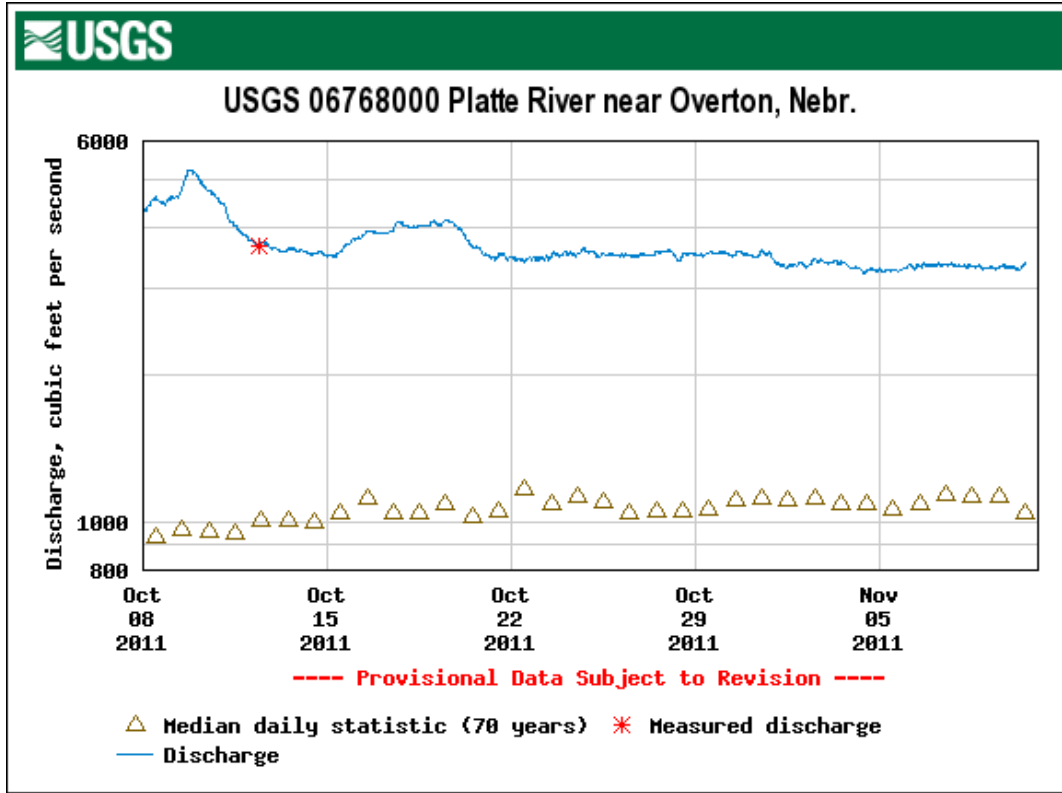


Figure 6. Use Site 1 Crane Group 2011FA01 east of Trust's bunker blind. Top chart is elevations taken from GPS readings, bottom chart is water depths measured at the same points. Right-most point is right bank waters edge.

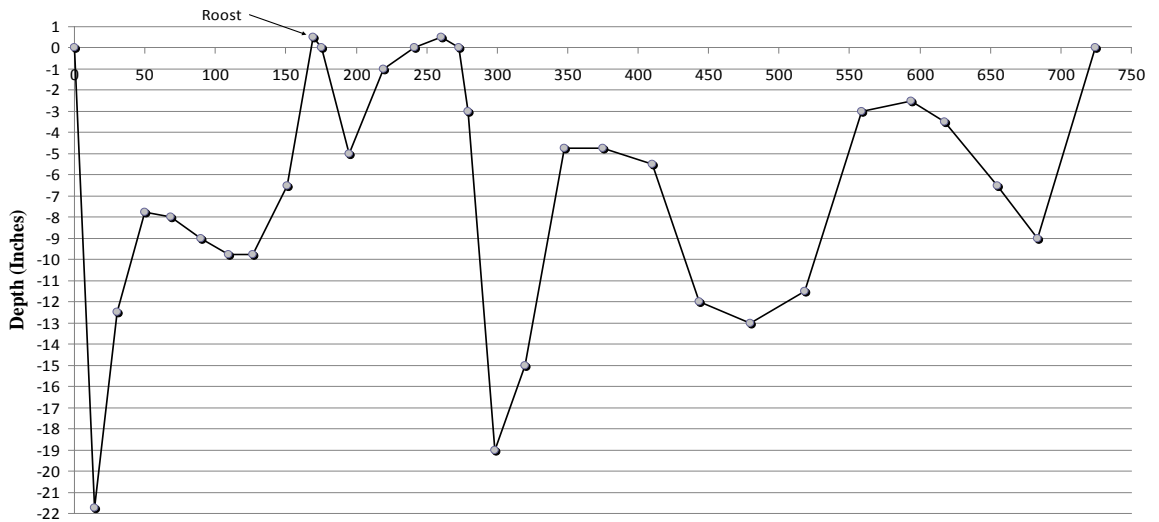
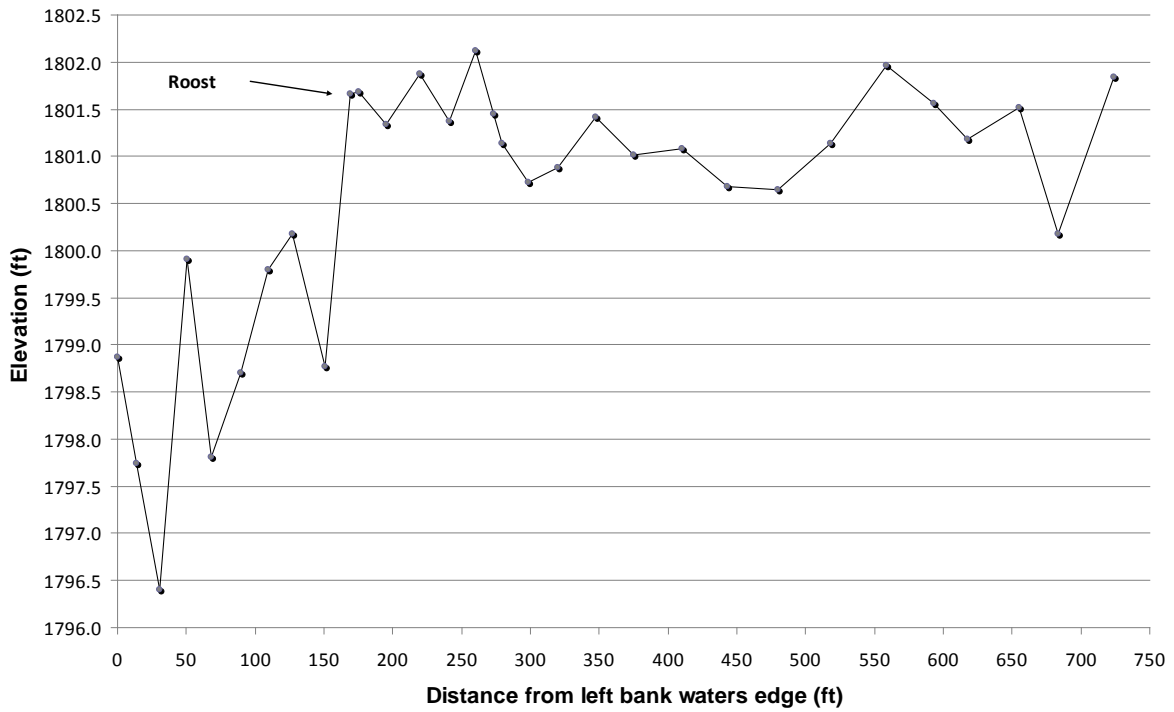


Figure 7. Use Site 2 Crane Group 2011FA01. Top chart is elevations taken from GPS readings, bottom chart is water depths measured at the same points. Right-most point is right bank waters edge.

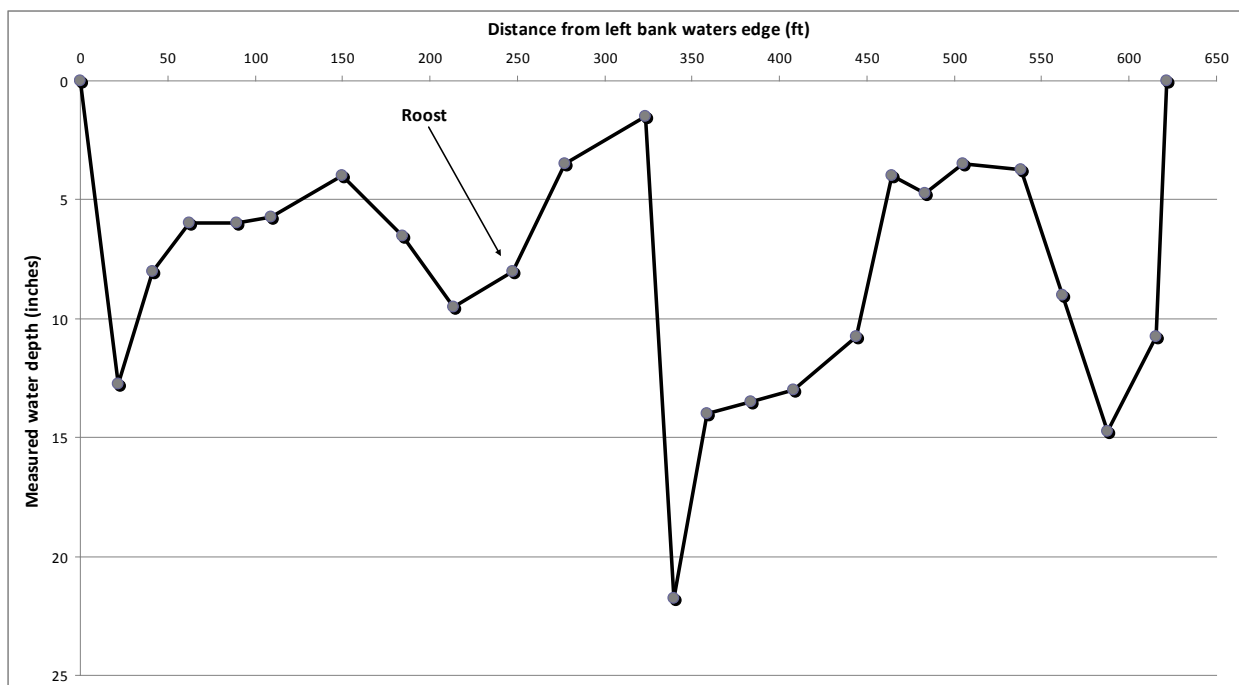
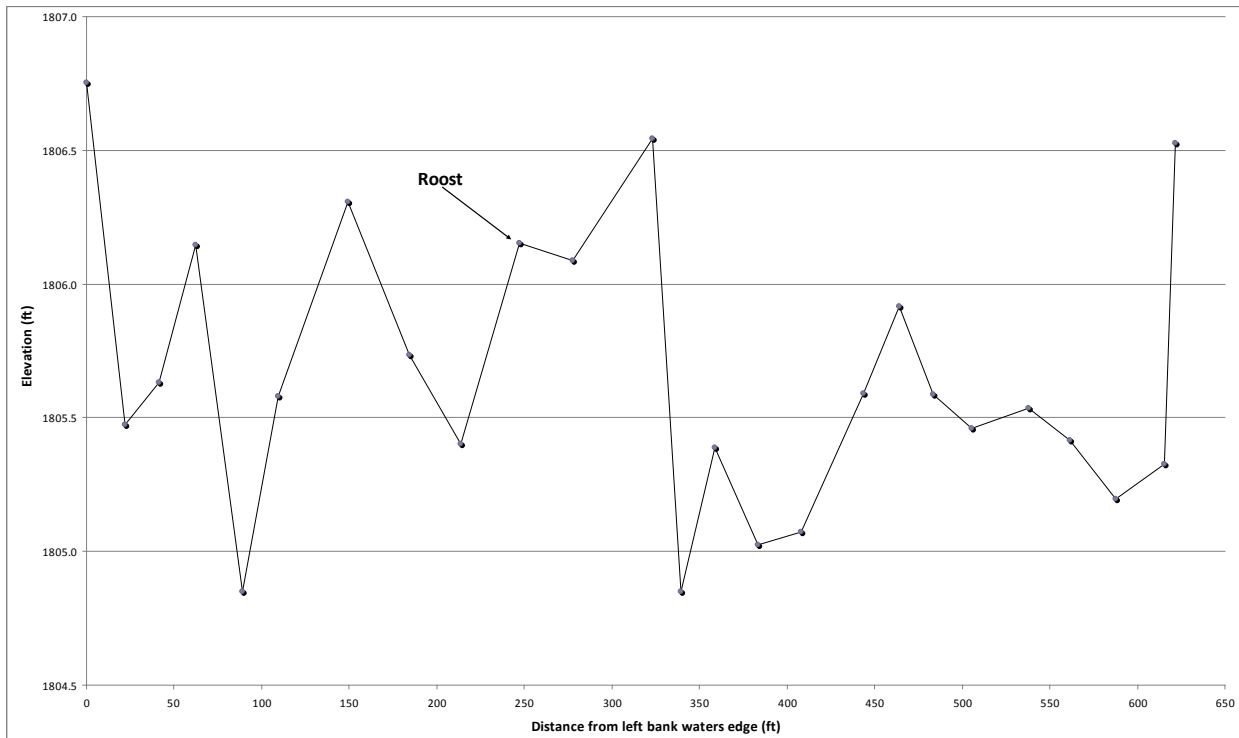


Figure 8. Use Site 3 Crane Group 2011FA02. Top chart is elevations taken from GPS readings, bottom chart is water depths measured at the same points. Right-most point is right bank waters edge.

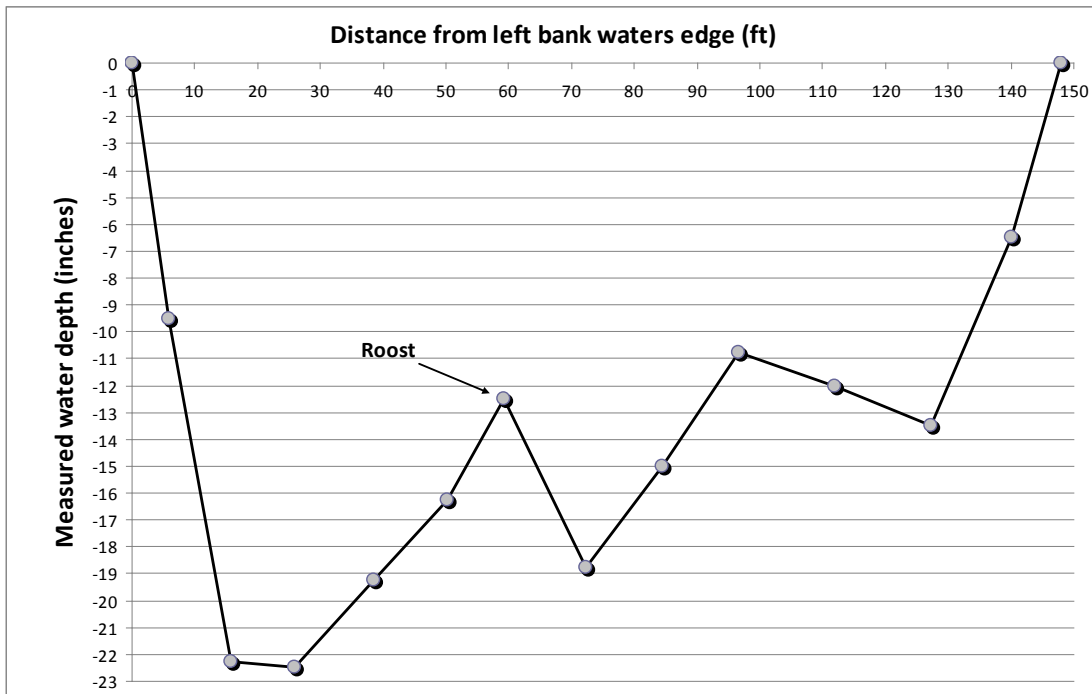
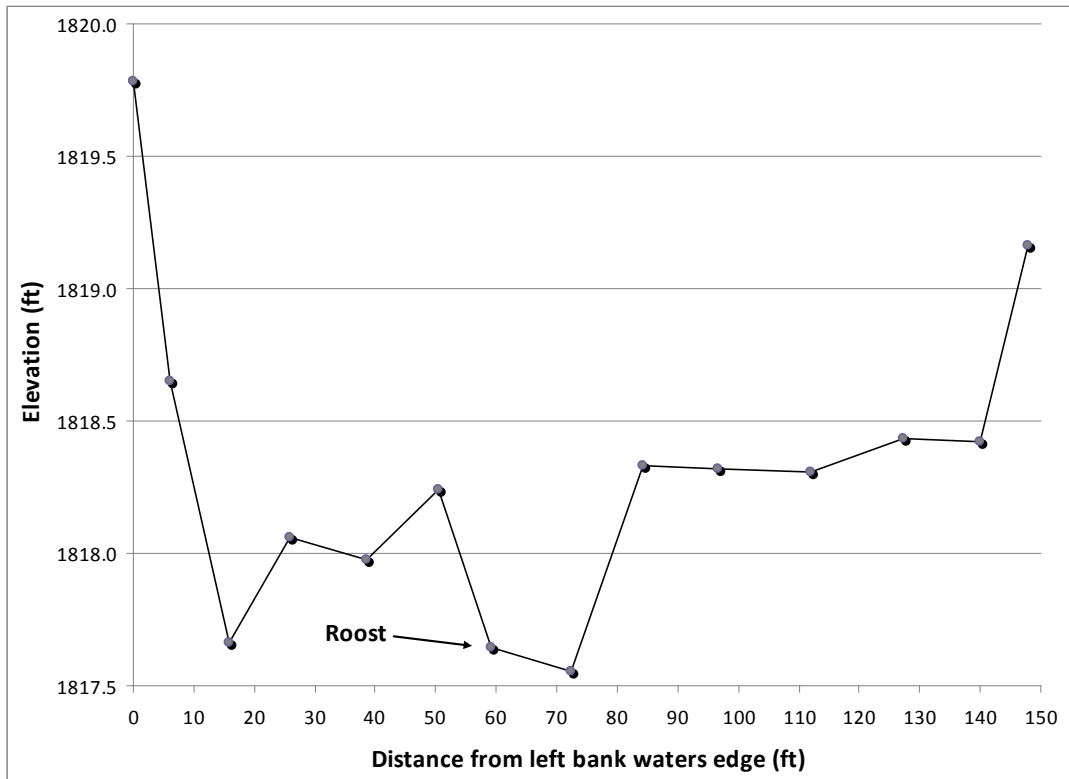


Figure 9. Whooping Crane Use Site 1 1.25 miles west of the U.S. 281 bridge (Sec 35 T10 R10 Hall County). Crane Group 2011FA01.



Upstream



Left Bank



Downstream



Right Bank



Aerial view looking downstream. O= Whooping Cranes

Figure 10. Whooping Crane Use Site 2 1.75 miles west of the U.S. 281 bridge (Sec 35 T10 R10 Hall County). Crane Group 2011FA01.



Upstream



Left Bank



Downstream



Right Bank

Figure 11. Whooping Crane Use Site 3 2.5 miles east of the Alda bridge (Sec 33 T10 R10 Hall County). Crane Group 2011FA02. Duck hunting pond in river channel.



Facing West



Facing North



Facing East (river in background)



Facing South (river in background)



Aerial view looking SSW. X= roost.