PLATTE RIVER RECOVERY IMPLEMENTATION PROGRAM
Whooping Crane Monitoring Protocol – Migrational Habitat Use in the Central Platte River Valley

I. INTRODUCTION

In 2007, the Platte River Recovery Implementation Program ("Program" or "PRRIP") began its 13-year First Increment and implementation of an Adaptive Management Plan ("AMP") to learn more about the physical processes of the central Platte River and the response of four target species to management actions: interior least tern (*Sterna antillarum*), piping plover (*Charadrius melodus*), whooping crane (*Grus americana*), and pallid sturgeon (*Scaphirhynchus albus*). The AMP includes several protocols for monitoring target species, habitat, and physical processes to better understand interrelationships and provide data for evaluating species response to management actions. This document serves as the whooping crane monitoring protocol for the Program.

Information from this protocol will be used to help evaluate the biological response of whooping cranes and habitat to the land and water management activities of the Program. Several critical scientific and technical uncertainties about Program target species, physical processes, and the response of the target species to management actions will be the focus of the application of rigorous adaptive management in the First Increment through implementation of the Program's AMP. These uncertainties are captured in statements of broad hypotheses on pages 14-17 of the AMP and, as a means of better linking science learning to Program decision-making, those uncertainties comprise a set of "Big Questions" that provide a template for linking specific hypotheses and performance measures to management objectives and overall Program goals (see PRRIP 2007-2010 Synthesis Report, 2011) .

Two "Big Questions" relate directly to whooping cranes:

- **Big Question #5 –** Do whooping cranes select suitable riverine roosting habitat in proportions equal to its availability?
- **Big Question #10** – How do Program management actions in the central Platte River contribute to least tern, piping plover, and whooping crane recovery?

These uncertainties led to the development of a specific management objective for the whooping crane and indicators related to that objective, as noted in the AMP:

Management Objective	*Contribute to the survival of whooping cranes during migration*
Indicators	* Increase area of suitable roosting and foraging habitat * Increase crane use days * Increase proportion of whooping crane population use

To assess progress toward this objective and learn about the major whooping crane uncertainties, several finer-scale priority hypotheses were developed by Program participants. In 2010, those hypotheses were sequenced to develop a smaller set of Tier 1 hypotheses to receive focused attention in the First Increment. For whooping cranes, those Tier 1 hypotheses are:

- **WC-1:** Whooping crane use will increase as a function of Program land and water management activities.
- **WC-3:** Whooping crane use is related to habitat suitability. Riverine habitat suitability for whooping cranes is a function of channel characteristics such as water depth, channel width, and unobstructed-view widths.

This monitoring protocol is intended to provide standard implementation guidance for collecting whooping crane use and habitat (i.e., channel characteristics at roost sites and landscape level attributes at diurnal use sites) data necessary to test the Tier 1 whooping crane hypotheses, assess progress toward meeting the whooping crane management objective, and evaluate learning related to the whooping crane Big Questions. Use of the phrase "suitable channel habitat" relates to the Program's established minimum habitat criteria (see PRRIP Draft Whooping Crane Minimum Habitat Criteria (Updated 8-1-12)). This protocol will be used by the Program to gather information on whooping crane habitat use and to provide an index of whooping crane abundance in the study area. It is understood that regardless of survey method not all whooping cranes are certain of being detected during migration and therefore full implementation of this or any other protocol will not represent complete whooping crane use of the central Platte River valley.

II. PURPOSE

The purpose of this monitoring protocol is to describe the conceptual design, study methods, and procedures that will be used annually to gather repeatable information on whooping crane stopovers in the central Platte River valley, Nebraska. The protocol outlines information the Program's Whooping Crane Monitoring Consultant (Consultant) will collect in the field, as well as from FWS and state agencies, and describes the procedures to be used for these specific objectives:

1) Detect whooping crane stopovers in the study area (Appendix A) – systematic, but targeted aerial surveys of the river channel and wetlands within the study area will be conducted and the data will be used to comparatively evaluate changes in the frequency and distribution of stopovers within the study area over time. The Whooping Crane Tracking Partnership's (WCTP) telemetry project locations and opportunistic locates will also be used to detect whooping crane stopovers in the study area; however, telemetry data will only be used by the Consultant to relocate whooping cranes using the study area that were already observed by the monitoring crew. Additional whooping crane stopover locations identified via telemetry will be reported to the Consultant after the whooping crane group leaves the study area.

2) Identify the locations of use and crane group movements in the study area – crane group movements will be documented in order to identify use-sites and to describe the patterns of movement of each crane group.

3) Qualitatively document crane group activities at use-sites – observers will qualitatively document activities displayed by the crane groups. Observed activities may help identify factors that influence how cranes use the area and aid in the interpretation of crane behavior.

4) Document the physical and/or biological characteristics of use-sites – habitat parameters will be measured and described at all whooping crane stopover sites documented (via monitoring, telemetry, or opportunistic locates) in the central Platte River valley and will be used in comparative habitat selection analyses.

5) Landscape Data Collection – Basic landscape source data of whooping crane use-sites in the study area will be collected through this protocol. Habitat metrics will be collected at confirmed systematic, opportunistic, and telemetry-marked whooping crane use sites. This information will be used in future use/availability analyses using aerial photography, Geographic Information System (GIS) information, LiDAR data, and appropriate landscape data collected from other protocols. Currently the Program has available a complete land use/land cover GIS analyses of 1998 (baseline) and 2005 color infrared photography. Continued regular collection of landscape data sources of the study area through other protocols such as aerial photographs, LiDAR, geomorphology monitoring, GIS data, and annual habitat availability assessments will enable future habitat use/availability analyses.

III. DESIGN CONSIDERATIONS AND SPECIFICATIONS

III.A. Area of Interest

The area of interest for monitoring whooping crane migrational habitat use consists of an area 3.5-miles either side of the Platte River beginning at the junction of U.S. Highway 283 and Interstate 80 near Lexington, Nebraska and extending eastward to Chapman, Nebraska. When side channels of the Platte River extend beyond the 3.5-mile area, a 2-mile area is included around these channels (see Appendix A)). If crane groups being monitored move outside this study area the field crews will make a professional judgment on whether or not the cranes are migrating from the Platte River area. If the crane group is judged to be migrating from the area, ground crews will stop observations. If the crane group is judged to be just temporarily using habitat outside the primary study area the ground crew will continue to make observations.

III.B. Project Design

This protocol collects information on whooping cranes using the central Platte River, not necessarily on the entire whooping crane population. This may bias the sample for making inference to the entire whooping crane population. In addition, the results from this protocol may not be representative of the population, or subgroup of the population using the central Platte, because of the use of multiple observations per crane group and/or the lack of use by unique crane groups in the analysis (i.e., pseudo-replication). Options for addressing pseudo-replication are discussed in Section IV.D.

III.B.1. Detecting/Locating Whooping Crane Stopovers

Whooping crane stopovers will be documented using systematic aerial surveys, telemetry locations, and opportunistic sighting reports. Crane groups detected with systematic aerial surveys will have probabilities of inclusion estimated for the sample while crane groups detected opportunistically will compromise a non-probability based sample. Systematic riverine surveys cover the study area from east to west with equal effort, however, biases associated surveying the 'main channel' will be accounted for through detection trials. Inferences from analyses of riverine survey data will be applicable to all Platte River channels. Systematic return surveys cover the off-channel portion of the study area most likely to be used by whooping crane groups at or near sunrise. Targeted wetlands and all landcover within a ½ mile area of the return transect will be surveyed under this protocol. Inferences from analyses of return survey data are applicable to a ½ mile buffer surrounding the return transect. Inferences from analyses of opportunistic surveys will contain biases associated with unequal sampling effort that cannot be accounted for and therefore may not represent actual crane use of the study area.

Relative probabilities of detection and efficiency of sighting whooping crane groups using aerial surveys will be estimated through protocol implementation over the years (e.g., use of decoys, known birds in the area, etc.). As detection may differ across various habitat conditions surveyed (e.g., wide versus narrow channels, corn versus grassland, etc.), detection probabilities will be estimated via detection trials (i.e., decoys and/or telemetry-marked birds) and results will be used in analyses to account for potential biases.

Telemetry data, public reports, and reports from other monitoring efforts in the valley will also be used to document occurrences of whooping crane stopovers in the study area. These sighting reports increase the opportunity to gather crane movement and habitat use information. Data on movement and habitat use for birds detected through aerial surveys will be analyzed separately and in conjunction with all other observations of crane movement and habitat use in analyses of species-habitat relationships.

Aerial Survey

Aerial surveys will be used to detect whooping crane use-site locations (i.e., roost locations) in the study area. Systematic, but targeted aerial surveys are necessary to develop information on the spatial and temporal distribution of whooping crane use site locations in and along the Platte River for comparative evaluations. The design of the aerial surveys is intended to maximize opportunities to observe whooping crane use sites throughout the study area. Daily flights will be conducted in early morning during the

period when whooping cranes are most likely to be in route between the wintering and breeding grounds and at or near their roost location. Daily flights will take place over the main river channel (river transects) and upland areas with high densities of wetlands within the study area (return transects; Appendix B). The "main river channel" is defined as the widest channel when all channels have flowing water. It is recognized that this protocol only samples river channels and a 1-mile area surrounding the targeted wetland return transect and does not sample other areas of the study area (see inferences defined in III.B.1). River transects will be flown east to west and return transects will be flown west to east.

Telemetry Locations

Locations of whooping crane use of the study area may be documented by the Whooping Crane Tracking Partnership. Once telemetry-marked whooping cranes leave the study area, information regarding use of the study area will be provided to the consultant to document all known whooping crane stopover occurrences in the database. All telemetry-marked whooping crane groups that use the study area will be included in detection trials. Similar to unmarked whooping cranes, the probability telemetry-marked whooping cranes are included in the systematic sample will be estimated for groups observed by systematic aerial surveys.

Opportunistic Locates

Birdwatchers, outdoor enthusiasts, farmers, and other survey efforts might make initial observations of whooping crane groups in the study area. Sighting reports from these and other groups (labeled "opportunistic locates") may provide additional information on crane stopover occurrences, but the conclusions are only applicable to the areas searched by the people that would report a sighting. An analysis of habitat use by cranes sighted opportunistically is outlined in this protocol, however, locations of whooping cranes obtained through this method are biased and quantifying the bias due to the location and amount of effort expended to obtain these observations is not planned.

Survey Detection Rates

Telemetry-marked whooping cranes and/or decoys can be used to estimate the probability whooping crane groups are detected during aerial surveys. Decoys will be randomly placed on active Platte River channels and within ½ mile of the upland return transect. Decoys may be placed on private, Program, governmental or non-governmental organizations' lands in which Program personnel (EDO staff, partners, etc.) have permission to access. Program personnel will place decoys within the same landcover class and as close to the randomly generated locations as possible (i.e., nearest location that conforms to Program Minimum Habitat Criteria) and will record the UTM location of the decoy. Aerial survey crews will not know the location of decoys while conducting the survey and detection rates will be calculated as the percentage of decoys observed. Detection trials will also be used in detectability models to account for unequal probabilities of inclusion in the sample associated with surveying the main channel and potential differences in detection within the various off-channel landcover classes.

III.B.2 Movement Tracking

After a crane group has been located in the study area, either through aerial surveys or opportunistically, a ground crew will be notified to confirm the sighting and begin immediate monitoring to document habitat use. Air and ground crews will strictly adhere to guidelines regarding minimization or elimination of crane disturbance, to be provided by the FWS, while conducting the monitoring. The ground crew(s) will locate the cranes with directions from the sighting party and will document crane movements, document crane use-site activities, and describe the physical and biological attributes of use sites. Cranes will be observed at a distance from vehicles to document movements. Monitoring crews will be trained to be aware of crane sensitivity to human presence, to identify behavioral responses to disturbance, and to view cranes using methods that reduce the likelihood of disturbance. Each crane group will be tracked continuously until they are observed leaving the study site or are lost by the tracking crew. If the ground crew observes a crane group fly out of view in the direction of an area with limited access and/or uneven terrain, another aerial survey over these areas will be conducted each time

a plane and pilot are available unless the observer suspects the crane group migrated out of the area or it is after 4:00PM (CST) and it is believed the crane group went to a roost site for the night. The ground crew will attempt to locate lost crane groups for a minimum of two hours (or until dark). If the crane group is relocated, the ground crew will monitor the crane group as outlined in Section IV.B.2.

Locations of crane groups under observation will be recorded in two categories. *Instant Points* will identify the general location of the group every 15 minutes. *Location ID* will be used to identify the estimated location of the group during the initial observation period and *Location ID* will progress sequentially from A to Z or whatever the last *Location ID* may be. Whenever a crane group moves from the area of one contiguous habitat type to another, ground crews will document the time they first observe the crane group in each new contiguous habitat type, a new *Location ID* will be assigned, and *Instant Point* counts will start over at 1 (one). In the event that a crane group is observed in the same location from 2 observers (e.g., from the ground and from the air), the same *Location ID* will be recorded by each observer. Observations made from the air will be assigned *Instant Point* 0 (zero) and behavioral activity will be documented as unknown.

III.B.3. Activity Monitoring

While monitoring crane movements, ground crews will collect information on crane activities and attempt to obtain a high quality photograph (from the vehicle) of each crane group at each use site. The field crew will record the activity being conducted by a whooping crane at each of the 15 minute instantaneous points mapped for the movement tracking into one of the following categories: courtship, preening, resting, feeding, alert, agonistic, or other as described. If the crane group is comprised of more than one individual, the observer will select a "focus" crane that will be used to record activity information.

III.B.4. Use-Site Characteristics

Tracking crews will collect information on the physical and biological characteristics of riverine and non-riverine wetland whooping crane use-sites. Characteristics of crane use locations will be described and measured as soon as practical after the crane group leaves the study area. Habitat parameters will be described and measured for the purpose of comparative habitat analyses.

III.C. Timing

Aerial surveys of the study area will be conducted in the spring from March 6 to April 29 and in the fall from October 9 to November 10. These dates encompass the fifth and ninety-fifth percentile of initial observation dates of whooping cranes in Nebraska, 2001–2012 as well as the scheduled monitoring seasons, 2001–spring 2013 (Appendix C & D). Opportunistic and telemetry locations will be documented throughout the year; however, data collection efforts described in this protocol may not be implemented outside the scheduled monitoring seasons. Behavioral observations and habitat use data will occur immediately following each observation of whooping cranes in the study area regardless of whether the birds were detected through aerial surveys or opportunistically. Crane movements and habitat use will be monitored until the crane group leaves the study area or is no longer observable. Collection of wetland use site habitat characteristic measurements will be coordinated (i.e., identification of replicate wetland use sites versus unique use sites) with the Program's Technical Point of Contact and data collection will occur within 1 week of when the crane group is known to have left the study area.

IV. METHODS

IV.A. Definitions

Crane Activity – Qualitative definitions:

- Feeding – any behavior suggesting the bird is in the act of feeding, such as a crane flipping over objects and/or probing for food, walking, or slow locomotion interrupted by these activities
- Loafing – crane standing still in one place
- Preening – crane preening feathers
- Agonistic – defensive or offensive display with other birds. Can be with other whooping cranes, sandhill cranes, etc.
- Courtship – crane performing unison call and/or dancing
- Alert – crane alert and scanning horizon

Crane Group – one or more cranes in a migrating unit. The group may consist of an individual crane, a family unit, or small flock. The social make-up of crane groups should be recorded whenever possible.

Stopover – Use of the study area during spring or fall migration.

Use Location – A location of a crane group that occurs in any landcover class within the study area. A single crane group may, and likely will have more than one use location per day.

Use Site – A location of a crane group within a wetland landcover class (wetted channel, open water pit/pond/lake, etc.) in the study area. Use sites are a special type of use location in that they only occur in wetland habitat. Use sites will be assigned a *Use Site ID* (e.g., 01) as well as a *Location ID* (e.g., A). A single crane group may have more than one use site per day.

Sighting – observation of a crane group in the study area.

Confirmed Sighting - Observation made by a State or Federal biologist or officer or by other known qualified observer (trained ornithologist or birder with experience identifying of whooping cranes). A photograph may also be used to confirm sightings. Aerial survey crew with previous aerial whooping crane observations may confirm a crane group during the survey.

Probable Sighting - No confirmation made by State or Federal biologist or officer or by other known qualified observer, yet details of the sighting seem to identify the birds as whooping cranes. To be classified as a probable sighting each of the following factors must be met: (1) location of sighting is within normal migration corridor and is an appropriate site for whooping cranes; (2) date of sighting is within period of migration; (3) accurate physical description; (4) number of birds is reasonable; (5) behavior of the birds does not eliminate whooping cranes; and (6) good probability that the observer would provide a reliable report.

Unconfirmed Sighting - Sighting details meet some, but not all six factors listed for a probable sighting.

Systematic Sighting – Aerial observation of whooping cranes made during a scheduled survey along specified transects as well as ground observations that are the result of such an aerial survey. Systematic observations do not include aerial observations made outside the scheduled monitoring season or off scheduled flight paths.

Opportunistic Sighting – Aerial observation of whooping cranes not made during a scheduled survey along specified transects as well as ground observations that are not the result of a scheduled aerial survey along transects. Opportunistic sightings include observations made outside the scheduled monitoring season, off scheduled flight paths, and observations made as the result of public, telemetry, ground crew, etc. reports.

Obstruction – Object (e.g., dense vegetation, bank, etc.) >1.5m above water line that obstructs the horizontal field of view.

Unobstructed View Width – The unobstructed view width is defined as the area between obstructions and includes all island/sandbars, vegetation, and banks <1.5m above the water. A line oriented perpendicular to the general flow within the channel will be drawn across the channel and through the use site.

Wetted Width – The wetted width is defined as the area of channel covered by water between obstructions greater than 1.5m tall. This measurement does not include sandbars and islands above the water surface but less than 1.5m tall. A line will be drawn across the channel, through the use-site and will be oriented perpendicular to the general flow within the channel.

Unobstructed Channel Width – Unobstructed channel width is defined as the distance along a line perpendicular to the channel and passing through the crane observation point that encompasses the total unobstructed width of wetted-channel (including sandbars) between stabilized banks.

IV.B. Field Techniques

IV.B.1. Detecting/Locating Whooping Crane Stopovers

Three methods will be used to locate migrating whooping crane stopovers along the central Platte River during spring and fall migration: aerial surveys, telemetry data, and opportunistic locates. The Program's Technical Advisory Committee may choose to implement each protocol component as necessary to obtain needed information, for example changing the survey effort based on results of past surveys.

Aerial Survey

Daily aerial surveys, weather permitting, will be conducted along the central Platte River valley between Lexington and Chapman, Nebraska to locate spring and fall migrating whooping crane groups. Aerial surveys will take place from March 6 to April 29 in the spring and October 9 to November 10 in the fall. These dates encompass the fifth and ninety-fifth percentile of initial sighting dates for all recorded sightings of whooping crane groups in Nebraska, 2001 – 2012 (timeframe the monitoring protocol has been implemented) as well as 1975 – 1999 (Jane Austin, USGS Northern Prairie Wildlife Research Center, pers. comm.). This protocol intends to collect a sample during possible migration time and does not intend to survey the entire time-period it would be possible for a crane group to migrate through the study area. Therefore, the survey dates will not be extended during times of delayed migration or initiated earlier in times of early migration. However, if the survey period extends past the migration time in a given season, the surveys will be stopped using the following rules. For the spring survey, flights will be discontinued 5 days after the last normally migrating whooping cranes have departed Aransas, if no whooping cranes have been sighted in the central Platte valley for 5 days, and there are no recent (5 days) reports of whooping cranes in the Central Flyway south of the Platte River. For the fall survey, flights will be discontinued if no whooping cranes have been sighted in the central Platte valley for 5 days, and there are no recent (5 days) reports of whooping cranes in the Central Flyway north of the Platte River. The Program Manager or Biologist responsible for managing these surveys will be in contact with Wade Harrell (or other Aransas official) at (361) 286-3559 to obtain information related to bird departure/arrival from Aransas and will determine whether to continue aerial surveys or not.

A Cessna 172 or similar aircraft will fly at a speed of 100 mph, as safety allows. One plane will fly the area between Chapman and the Nebraska Highway 10 (Minden) Bridge (the east leg). The second plane will fly the area between the Minden Bridge and the Lexington Bridge (the west leg). Two observers in addition to the pilot will be in each plane. Surveys will begin between a half-hour before sunrise and sunrise, unless weather during this time period precludes beginning the survey. All attempts should be made to begin the survey a half-hour before sunrise. If the survey cannot begin during this time period due to weather/visibility requirements, the survey start time will be extended up to two hours after sunrise. Surveys may be canceled two hours after sunrise due to unsafe weather conditions (e.g., rain, snow, fog, high winds) or if there is significant snow cover on the ground that greatly impedes the surveyors chances of locating a whooping crane group. Cancelled flights will be entered into the database with an explanation of why the flight was cancelled (i.e., include weather conditions, etc.).

All aerial surveys will be flown such that the flight direction when flying the river transect will be away from the rising sun. To help address the concern that one end of the river transect will always be flown early and the other late, there will be two start locations for each leg (east side and west side) of the study area. For the eastern section, on day one the flight will begin at Chapman, fly the river west to Minden, fly the primary wetland return transect back to Chapman, and fly the secondary wetland return transect back to the Burlington Northern railroad near Grand Island. On day two the flight will begin at the Wood River Bridge, fly the river transect west to Minden, fly the primary wetland return transect back to Chapman, and then fly the rest of the river transect from Chapman to Wood River. For the western section, on day one the flight will begin at Minden, fly the river west to Lexington, and then fly the primary wetland return transect back to Minden. On day two the flight will begin at the Odessa Bridge, fly the river transect west to Lexington, fly the primary wetland return transect back to HWY 10 south of the Minden Bridge, fly the rest of the river transect from Minden to Odessa, and then fly the secondary wetland return transect from Elm Creek back to HWY 10 north of the Minden Bridge. These patterns will continue through the survey period.

During the river transect, observers will be situated such that the main channel(s) can be clearly viewed by both observers looking out the passenger side of the plane. This will necessitate that the plane fly just south of the main channel. An exception to this rule occurs west of the Overton Bridge when the plane will fly over Jeffery Island and observers position themselves to observe both the north and south channel of the Platte River. On the return transect, observers will look out different sides of the plane so that they can survey a half-mile on each side of the targeted wetland return transect. This design provides a systematic aerial survey to locate whooping crane groups within the channel as well as outside the channel within the targeted wetland survey area. If additional wetlands are created or are identified, the Program's Technical Advisory Committee may choose to alter the return transects to sample these areas and indices of use (e.g., # whooping cranes/flight mile) may need to be adjusted to account for change in area surveyed. Again, it is recognized that this sampling scheme over-samples the river and targeted wetland areas compared to upland areas not covered by the return transects.

All transects will be flown at 750' altitude unless FAA regulation dictate a higher altitude (e.g., a minimum of 1000' altitude when flying over towns and cities). The 750' altitude for transects is selected for safety reasons. Extremely large numbers of migratory waterfowl are present in the central Platte River valley each spring. The 750' altitude allows pilots to fly over most of the airborne waterfowl and to decrease the chance of flushing additional waterfowl into the air as the plane approaches. If a suspected whooping crane is seen, the plane is encouraged to circle to an altitude of 500' (when safety allows) to provide a better viewing opportunity of the suspected whooping crane.

Each plane will have aerial photos, maps, and a global position system (GPS) unit to aid in flight-path orientation and documentation of crane group locations. When a whooping crane group is located, an air to ground radio will be used to immediately contact ground personnel that are geographically closest to the sighting. UTM coordinates taken either from the plane's GPS system or hand held unit will be recorded on the data sheet and relayed to the ground crew. The aerial survey crew will photograph the whooping crane group and the general location using a digital camera with an 18 × 105 mm Vibration Reduction (VR) zoom lens or similar setup approved by the Program. All observations will be recorded on the aerial observation datasheet. If the ground crew has not located the whooping crane group by the time the aerial survey is complete, the plane will return to the crane group's original coordinates and attempt to relocate the group. Deviations from return transect flight paths may be implemented (and documented on the datasheet) at the request of the ground crew to relocate crane groups known to be in the area; however, river transects should be completed without interruption. If the crane group is relocated from the air, the plane will maintain visual contact with the crane group and direct the ground crew to the location. The procedures to be followed by the ground crew once the crane group is located are in Section IV.B.2.

During the aerial flights, ground crew members will be stationed at four strategic points within the study area. When the aerial survey crew notifies the ground crew of a possible crane group sighting, the nearest two ground personnel will immediately attempt to locate the group. The ground crew will search for a minimum of two hours in the suspected area (or until dark) in an attempt to locate the sightings of crane groups made by the aerial flight crew. If the ground crew observes a crane group that flies out of view in the direction of an area with limited access and/or uneven terrain, another aerial survey over the area the whooping crane group is suspected to have gone will be conducted each time a plane and pilot are available unless the observer suspects the crane group migrated out of the area or it is after 4:00PM (CST) and it is believed the crane group went to a roost site for the night. If the lost crane group is relocated by the air crew, a ground crew will monitor the crane group as outlined in Section IV.B.2. All effort expended by ground and air crews to locate whooping crane groups will be documented on the datasheets and in the database.

Telemetry Location Data

In the event the Consultant observes a radio-marked whooping crane within the study area and loses sight of it, the Consultant will contact the Program's Technical Point of Contact to attempt to determine the location of the radio-marked whooping crane group. If the location of the radio-marked crane is available, air and/or ground crew members will be deployed to the area to search for the whooping crane group. If the crane group is relocated by the air or ground crew, a ground crew will monitor the crane group as outlined in Section IV.B.2 and the datasheet will be noted to document the events that occurred to collect this additional data. The Program's Technical Point of Contact will not provide information about the use of the study area by radio-marked whooping cranes to the Consultant until they have first been observed and documented by the Consultant's crew. The Consultant will collect habitat characteristic data at all whooping crane use sites documented in the study area via telemetry as described in Section IV.B.5.

Opportunistic Locates

The quality and timing of public sighting reports are highly variable. For example, several reports of a single group may be made by different individuals; sightings may be reported after the group has left the area; geese, white sandhill cranes, pelicans, or egrets may be reported as whooping cranes; etc. In an effort to document the validity of a sighting in a timely manner, a toll free number will be used to relay reports of possible whooping crane sightings to the ground crew. This number should be publicized at local areas frequented by birders, FWS offices, NGPC offices, and possibly in newspapers, to mail carries, bus drivers, etc. The ground monitoring crew will attempt to confirm and monitor all crane groups reported to be in the study area. As a prioritization after "confirmed" sightings, the crew will check "probable" sightings, and then check "unconfirmed" sightings as warranted. The ground monitoring crew will monitor all confirmed whooping cranes in the study area as described in Section IV.B.2.

All sightings relayed to the ground crew will be searched for by the ground crew for at least two hours. The ground crew will fill out ground monitoring observation forms for all effort expended to locate confirmed and probable sightings of crane groups in the study area. In addition, the crew will collect use-site characteristics (i.e., profiles) and fill out a use-site characteristics form for all crane sightings classified by the FWS as "confirmed" or documented via telemetry. Information on all confirmed and probable sightings made by the aerial or ground crew will be forwarded to the FWS Nebraska field office. Incidental observations reported to the ground crew from inside or outside the study area will be immediately forwarded to the FWS Nebraska field office, Whooping Crane Migration Information Coordinator.

Survey Detection Rates

Whooping crane decoys will be placed at randomly selected locations in the riverine and upland survey areas in which Program personnel has permission to access. Aerial crews will not be aware of the presence of the decoys during the flight. When the aerial crew observes a decoy, the location of the sighting should be relayed to the ground crew for confirmation of the decoy location. Decoy

observations will be recorded on the aerial observation datasheet and information pertaining to detected and undetected decoys will be entered into the Program's electronic database. Detected and undetected telemetry-marked whooping cranes can also provide the Program information on aerial detection rates.

Aerial flight crews shall not be notified of the location of whooping cranes in the study area as this information clearly influences detection probabilities. In the event aerial flight crews are notified of the location of whooping cranes in the study area, they will include a note in the datasheet indicating they were aware of the presence of whooping cranes prior to the survey and will describe how they were made aware of this information.

IV.B.2 Movement Tracking

Each crane group will be continuously tracked from the roost in early morning until arriving back at roost in the evening unless the crane group leaves the study area or the ground crew loses the group. If a crane group is lost, observers will spend a minimum of two hours attempting to relocate the group in the suspected area or until dark. If the ground crew cannot relocate a crane group that is believed to be in the area, an aerial survey will be conducted over the area where the group was observed to be heading or likely would be located each time a plane and pilot are available and it is before 4:00PM (CST). If search efforts fail to relocate a lost crane group, the Consultant will notify the Program's Technical Point of Contact within 90 minutes to explain the circumstances and determine if further actions could or should have been taken. All observations of crane groups by the ground crew will take place at a distance identified in the FWS guidelines and from vehicles.

All observations of cranes will be recorded on Instantaneous and Continuous Use-site Monitoring data sheets. Both instantaneous and continuous movement data will be collected during movement tracking monitoring and recorded on this datasheet. Continuous locations will be recorded and documented with a sketch map on the back of the datasheet or aerial photograph. Ground crews will document the time they first observe crane groups in each new contiguous habitat type and a unique *Location ID* will be assigned to each contiguous habitat type used during the movement tracking monitoring.

Instantaneous locations will be recorded at fifteen-minute intervals. The specific location of the crane group will be marked on the map. A unique *Instant Point ID* will be assigned during the movement tracking monitoring. The following information will also be recorded for the observation period: crane group composition (single bird, family group, or flock); group size; age estimation if possible (adult/juvenile); weather conditions; leg band color if present; and the association of the crane group with other avian species (sandhill cranes, waterfowl, etc).

IV.B.3 Crane Group Numbering

The *Crane Group ID* will consist of the following information: year; "SP" for spring monitoring period or "FA" for fall; sequential number (e.g. 2002FA01, 2002FA02, 2002FA03, etc). Any time a crane group is observed in the study area by the survey crew, a new *Crane Group ID* will be assigned unless the surveyor notes on the data sheets the reasons why they believe this is a previously recorded group (using their professional judgment). In this case, the same *Crane Group ID* will be used. FWS crane group numbers for confirmed sightings will be included in the Program database and linked to the Program crane group numbers. This will assist in future cross-referencing between unique whooping crane groups in the FWS and Program databases.

Each field or location used by a crane group will get a new *Location ID* and UTM location. *Location ID* will be a sequential alphabetical letter (A, B, etc.). The variables *Crane Group ID* and *Location ID* and *Time* will be used to connect information about sightings in a field through all the datasheets and associated data tables. Specifically, this identifier will document when the crane group used a location on the ground. For example, if a crane group is observed in the Fall 2002 survey from the air and relayed to the ground crew, the first location observed from the air will be assigned *Location ID* A (*Crane Group ID*=2002FA01), *Instant Point* 0 (zero), and the *Time* will be recorded. The first observation made by the

ground crew would be assigned *Location ID* A (*Crane Group ID*=2002FA01), *Instant Point* 1 (one), and the *Time* will be recorded. Subsequent observations made by the ground crew at *Location ID* A will be numbered sequentially. In the event that a crane group is observed by two people (e.g. from air and from the ground) in the same location and at the same time, the two observations should have the same *Crane Group ID* (*Crane Group ID*=2002FA01), the same *Location ID* (A), and the same *Time*. If the ground observer observes the crane group moving to another field, the location would be assigned *Location ID* B (*Crane Group ID*=2002FA01) and the *Time* recorded. If the ground observer observes the crane group return to a previously used field, say A, the location would be assigned *Location ID* A (*Crane Group ID*=2002FA01) and the *Time* recorded. If the crane group goes out of sight, the next time a crane group is observed in the area, the *Crane Group ID* will be assigned 02 (*Crane Group ID*=2002FA02; unless the observers have evidence (same group size, composition, etc.) it is the same group as 01 and the supporting justification is documented); and the first location observed by this group will be assigned *Location ID* A. The project leader will need to continually review the datasheets to ensure the *Crane Group ID* and *Location ID* are correct, since field crew members may not know what the next sequential *Crane Group ID* should be.

Instantaneous data will be taken every 15 minutes at each crane group location. Each point within each use location will get a new and sequential *Instant Point ID*. The variables *Crane Group ID, Location ID,* and *Instant Point ID* will be used to connect information about sightings at instant points through all the datasheets and associated data tables.

IV.B.4. Activity Monitoring

Crane activity will be monitored during the course of movement tracking. As the observer watches the crane group, he/she will record the activity being conducted by the whooping crane at each of the 15 minute instantaneous points documented during the movement tracking as one of the following categories: courtship, preening, resting, feeding, alert, agonistic or other activity as defined by the observer. If the crane group is comprised of more than one individual, the observer will select a "focus" crane that will be used to record activity information from. The ground survey crew will photograph the whooping crane group using a digital camera with a 70 × 300 mm Vibration Reduction (VR) zoom lens or similar equipment approved by the Program. Each photograph will be numbered and this number will be recorded on the datasheet for later cross-referencing.

IV.B.5. Use Location Characteristics

The National Vegetation Classification Standard (NVCS) vegetation type will be documented for each continuous and instantaneous use location using the Instantaneous and Continuous Use Monitoring datasheet. Time in, time out, and UTM location will also be recorded at use locations. The time, distance to potential disturbance (road, house, etc.), and the type of disturbance will also be recorded at the instantaneous use-sites.

Additional physical and geomorphologic characteristics of crane use locations will be measured for wetland use-site locations with standing or flowing water. These measurements will be made as soon as practical after the cranes leave the study area using the Use Site Characteristics datasheets. In all instances, proper landowner permission will be secured before Program and/or Consultant personnel enter private property to collect the measurements. FWS and/or NGPC personnel that have previously conducted use-site evaluations will help train Program staff and Consultants for future site evaluations.

Photographs taken of crane use-sites observed from the air will be used to locate the use area on the ground and to improve the accuracy of locations recorded from the air. A general sketch of the area and/or photograph will be taken for each use-site. The following characteristics will be recorded for each site with standing or flowing water.

- *IV.B.5.a. Water depth profiles and sandbar location/elevation*
  - When a crane group utilizes an area containing standing or flowing water, three parallel transects 25m apart will be established such that the middle transect crosses through the most recent crane group location. This procedure will allow the calculation of a mean and variance for each roost characteristic in the area a crane group used while acknowledging the difficulty in determining the exact crane group location when viewed from a distance.
  - Profile transects will be situated perpendicular to the general flow for river locations and perpendicular to the long axis of non-flowing water bodies. A laser level and rod (or RTK GPS unit) will be used to measure channel depths and sandbar heights across the transects. GPS locations will be taken along each transect using a GPS unit (horizontal accuracy $\leq \pm 6$ inches after post-processing) or other means approved by the Program. One GPS location and depth measurement will be taken at approximately every 3m, when changes in topography are encountered, at water lines, and at visual obstructions at each end of the transect. When a sandbar is encountered along a profile transect, a location will be recorded at each waterline, as well as where the topography along the transect changes, and the length will be estimated. Each profile transect will begin and end where the transect line reaches an obstruction. All transects; however, should include at least one location on a stabilized bank or island (even if the location is beyond the obstruction) to enable the Program to link the transects to LiDAR data. When channel-depths prohibit data collection, the observer will travel upstream, downstream, or to the other side of the channel to locate an area they can cross the channel and will return to the transect line and resume data collection as near to where they left off as possible. When profile transects cannot be completed, the field crew will collect data along as much of the transect as possible, will note on the datasheet why they couldn't collect all data, and the Consultant will notify the Program's Technical Point of Contact within 90 minutes.
  - The channel morphology profile measurements will be interpolated during the analysis stage to produce a continuous profile of relative water surface elevation across the channel. Linear interpolation between adjacent points along the transect will be used to sample from the profile at equally spaced increments. Water depth will be calculated as the average of equally spaced measurements of the relative water surface elevation profile that are at and below zero (water surface elevation). Sandbar elevation will be calculated as the average of equally spaced measurements of the relative water surface elevation profile that are at and above zero.
- *IV.B.5.b. Distances to visual obstruction*
  - Distances from the crane group location to the nearest obstructions in each of four quadrats oriented perpendicular/parallel to the channel for riverine use-sites and in the four cardinal directions for standing water will be made using a laser range finder.
- *IV.B.5.c. Unobstructed View Width*
  - The distance between obstructions along a line perpendicular to the channel and passing through and/or parallel to the crane observation point will be measured. Unobstructed view width can, and often will extend beyond the stabilized banks of the channel. Unobstructed view width can be calculated from water depth profile data, LiDAR data, and/or aerial imagery.
- *IV.B.5.d. Wetted Width*
  - Wetted width will be measured directly in the field or calculated from water depth profile data as the distance covered by water and between visual obstructions along a line perpendicular to the channel and passing through and/or parallel to the crane observation point.
- *IV.B.5.e. Unobstructed Channel Width*
  - Unobstructed channel width will be calculated from water depth profile data, LiDAR data, and/or aerial imagery.

- *IV.B.5.f. Substrate*
  - The percentage of each substrate type at a crane use-site will be classified into four classes: <1mm, 1-4.9mm, 5-14.9mm, ≥15mm.
- *IV.B.5.g. Flow*
  - Flows recorded at the Overton (06768000), Kearney (06770200), and Grand Island (06770500) USGS gaging stations will be recorded to document provisional instantaneous flows during the period of crane use and when aquatic habitat measures are made.
- *IV.B.5.h. Land cover class*
  - The National Vegetation Classification Standard (NVCS) vegetation type will be documented for each continuous and instantaneous use location.
- *IV.B.5.i. Distances to potential disturbance features*
  - Distance to potential disturbance will be measured in the field or documented in the office using the most recent aerial imagery. Potential disturbance features include house, road, hunting or viewing blind, railroad, etc. that may cause the crane to move to another location.

The *Use Site ID* variable connects each location used by a crane group to the use characteristics measured on the ground. The *Use Site ID* is a sequential number assigned when the measurements are made (beginning with 01). The project manager will record the *Use Site ID* on the datasheets with the corresponding *Crane Group ID*, *Location ID* and *Time*. In cases where a crane group has used the same location multiple times, there may be multiple *Location ID's* linked to one *Use Site ID* (assuming the use characteristics were measured only once).

IV.C. Data Collection from State and Federal Agencies

The report will contain a summary of all whooping crane migrational sightings within Nebraska and specifically the central Platte River corridor as obtained from the FWS, Grand Island Field Office. FWS crane group identification numbers will be recorded in the database to identify individual crane groups that use the study area for multiple days.

IV.D. Additional Metrics

Metrics outlined in Table 1 may be included in habitat selection analyses along with the physical and geomorphologic characteristics of crane use locations that are measured in the field by the Consultant. Most metrics outlined in Table 1 will be measured remotely via GIS, LiDAR data, aerial imagery, HEC-RAS model, and data collected under other protocols (e.g., Channel Geomorphology and In-channel Vegetation Monitoring Protocol).

Table 1. Additional metrics and measurements that may be included in whooping crane habitat selection analyses that generally will not be recorded or measured by the Consultant.

Metric	Metric Description	Use Site Data Source	Available Site Data Source
Proportion of Corn	Proportion of landcover surrounding use locations classified as corn	USDA NASS	USDA NASS
Proportion of Wet Meadow	Proportion of landcover surrounding use locations classified as wet meadow	PRRIP WM Coverage	PRRIP WM Coverage
Proportion of Grassland	Proportion of landcover surrounding use locations classified as grassland	PRRIP WM Coverage	PRRIP WM Coverage
Proportion of Forest	Proportion of landcover surrounding use locations classified as forest	PRRIP HA Coverage	PRRIP HA Coverage
Maximum Unforested Width	Maximum width of river corridor unobstructed by riparian forest	Aerial Photo	Aerial Photo
Total Unforested Width	Total width of river corridor unobstructed by riparian forest	Aerial Photo	Aerial Photo
Maximum Unobstructed Channel Width	Maximum width of channel unobstructed by dense vegetation	Aerial Photo and/or LiDAR	Aerial Photo and/or LiDAR
Total Unobstructed Channel Width	Total width of channel unobstructed by dense vegetation	Aerial Photo and/or LiDAR	Aerial Photo and/or LiDAR
Total Flow	Total river flow (cfs)	USGS stream gage records	USGS stream gage records
Split Channel Flow	Flow computed in channel of interest (cfs)	HEC-RAS model	HEC-RAS model
Total Channel Width	Total width of channel from left bank to right bank (ft)	HEC-RAS model	HEC-RAS model
Wetted Width	Top width of wetted channel	HEC-RAS model	HEC-RAS model
Proportion Wetted	Proportion of total channel width that is wetted	HEC-RAS model	HEC-RAS model
Mean Depth	Mean depth of the wetted portion of the channel (ft)	HEC-RAS model	HEC-RAS model
Unit Discharge	Flow (cfs) per linear foot of channel width (Split Flow/Total Channel Width)	HEC-RAS model	HEC-RAS model
Width Depth Ratio	Ratio of channel width to depth (Wetted Width / Mean Depth)	HEC-RAS model	HEC-RAS model

IV.E. Analysis Methods

Information collected through this protocol will be used to evaluate changes in distribution of use and habitat characteristics for whooping crane use-sites in the study area. As such, the Consultant will perform basic data analyses requested by the Program and will report findings that include explanatory as well as graphical representations of their findings on a migrational-season basis and will relate trends in findings such as an increase/decrease in use, increase/decrease in proportion of population stopping in the study area, foraging behavior, stop-over duration, etc. to whooping crane population sustainability and growth. This protocol is designed to provide information on crane groups with an estimated probability of inclusion in the sample regardless of location in the study area. Since aerial survey provide this information, but opportunistically located cranes have an unknown probability of inclusion, separate analyses will be conducted for each of these types of data.

Habitat Use

Since the whooping crane is a rare species and identifying individual cranes is usually not possible, all analyses will need to balance small sample sizes with pseudo-replication. There are two options for analyzing habitat use, one will retain the sample size as the number of individual whooping crane groups, as identified by the FWS, as the first step of the analysis and the second will include every observation of each crane group and will contain multiple observations per group.

There are several analysis methods available for summarizing the habitat characteristics of whooping crane use-sites. The methods range from calculating means and variances, to modeling habitat use, to documenting changes through time, to methods that are not currently developed. With each analysis, the probability-based sample of whooping crane use-sites collected under this protocol will provide data adequate for inferences to all crane stop-over-sights within the central Platte River study area.

Indices of Use

Annual Indices of crane use will be developed using information obtained by this protocol. Indices of use will document the proportion of the population and number of cranes and crane groups observed per survey effort (flight, migration season, etc.) using Program defined and evaluated suitable habitat, Program habitat complexes, and habitat classified as 'unsuitable' by existing Program standards. Habitat availability assessments will be conducted annually under a separate Program contract and the results will be available to the Consultant. If the protocol is implemented in a consistent manner, a change in these indices through time will estimate changes in the frequency of use of the study area, Program habitat complexes, as well as Program-defined suitable and unsuitable habitat throughout the first increment.

Activity Monitoring Data

Annual analyses of activity monitoring data will only include instantaneous data that is collected every 15 minutes.

V. QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

QA/QC measures will be implemented at all stages of the study, including field data collection, data entry, data analysis, and report preparation. Observers will be trained and tested in the methods used and on their ability to identify whooping cranes. Data forms will be completed on a daily basis. At the end of each survey day, each observer will be responsible for inspecting his or her data forms for completeness, accuracy, and legibility. The study team leader will review data forms to insure completeness and legibility, and correct the forms as needed. Any changes made to the data forms will be initialized by the person making the change.

To help train observers that will be conducting the aerial surveys, each individual will be required to fly practice transects, or a portion of one transect. During this flight there will be whooping crane decoys placed in the river channel to allow observers the opportunity to see a "whooping crane" from the air at the speed and altitude of the surveys.

Data will be entered into the Program's database by qualified technicians. These files will be compared to the raw data forms and checked for errors. Irregular codes detected or any ambiguous data will be discussed with the observer and study team leader to clarify and document changes.

After data have been keyed and verified, the study team leader or QA/QC technician will check data forms against the final computer file and any problems identified will be traced back to raw data forms, observer(s), and data-entry personnel and corrections will be documented.

VI. DATA COMPILATION AND STORAGE

The Program's database will be used to store, retrieve, and organize field observations. Microsoft Office InfoPath is required to enter data into the database. The data for each survey will be incorporated within the larger Program database. All field data forms, field notebooks, and electronic data files will be

retained for ready reference.

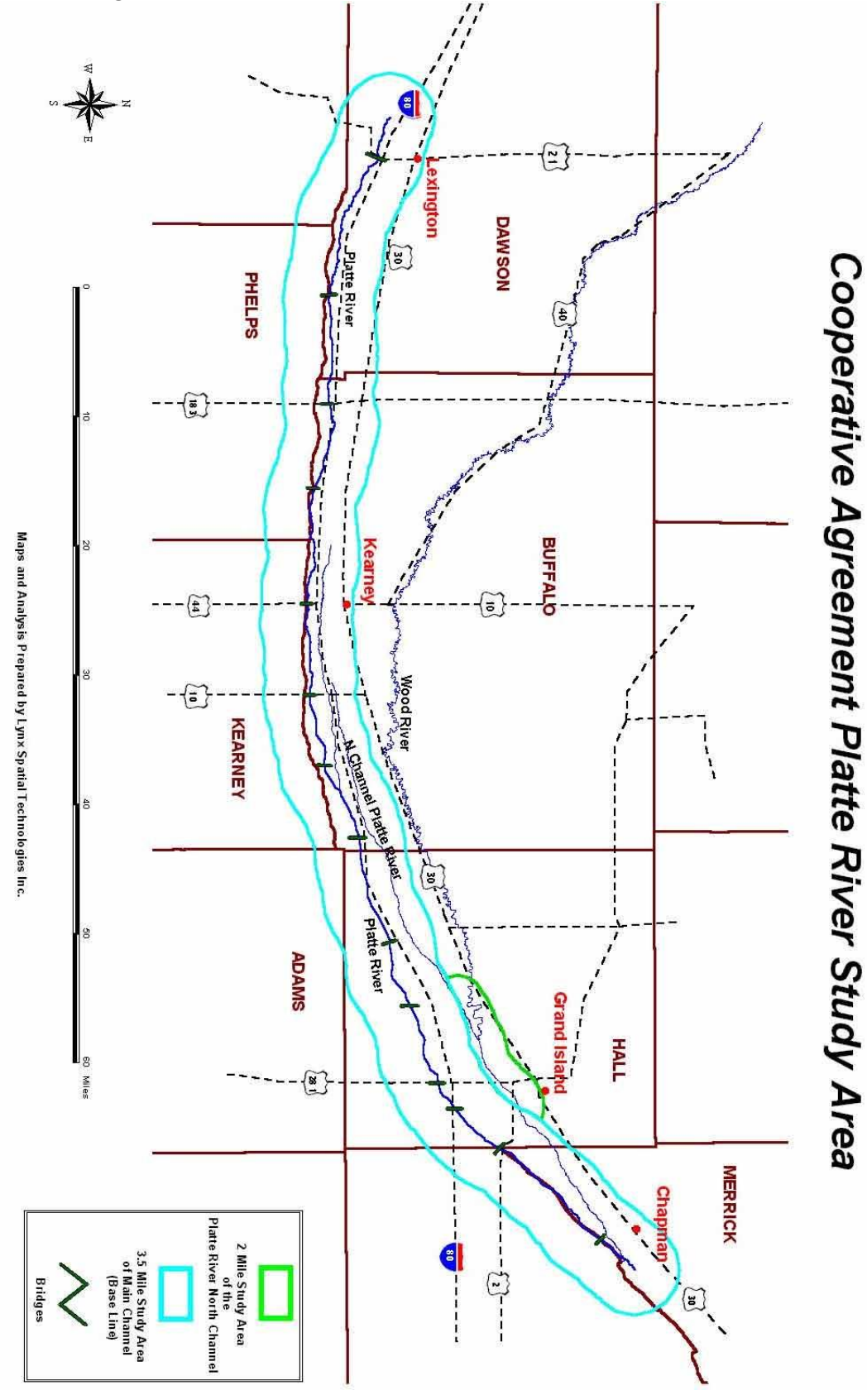
VII. REPORT FORMAT

Data on whooping crane habitat use will be compiled, summarized, and incorporated within the larger Program database following each migration season. Migration-period reports will be submitted to the Program's Executive Director's Office (EDO) for review and distribution following each migration season. Draft and final reports that summarize findings and describes methods, analyses (including descriptive statistics of whooping crane use), results, and any conclusions that can be drawn will have both written and graphical components and will also contain maps and/or aerial photos showing crane use-sites. Reports will be submitted to the Program's EDO for review and distribution to the Technical Advisory and Governance Committees.

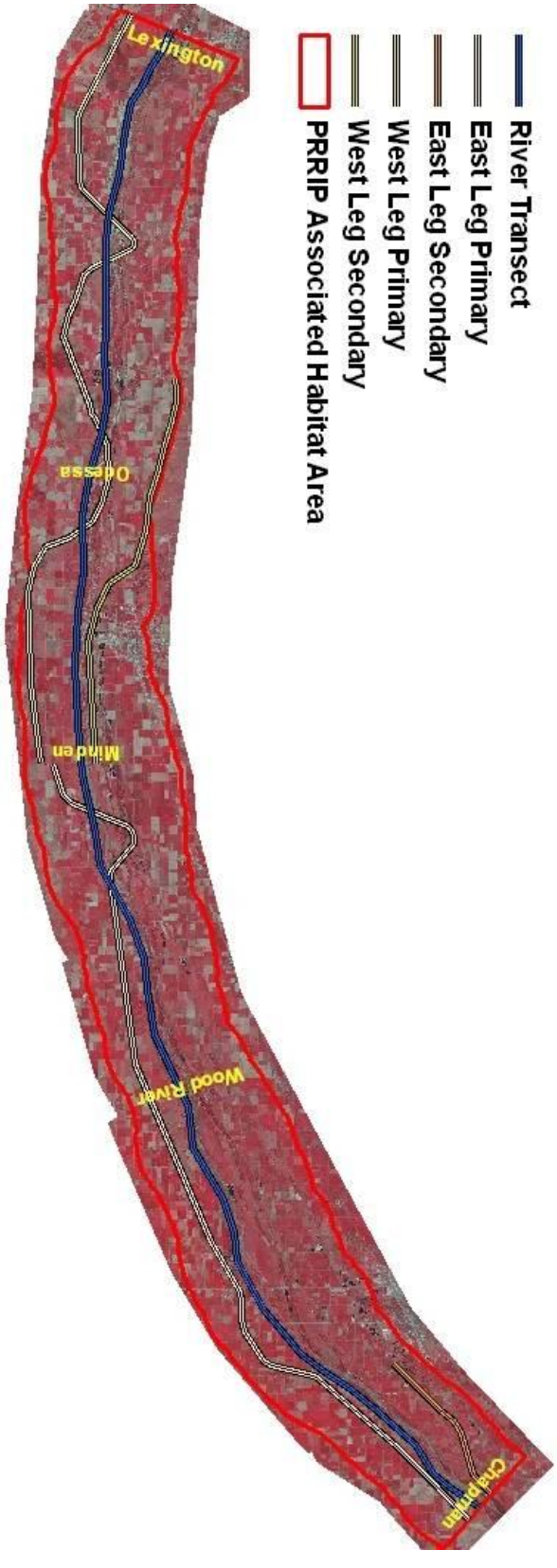
VIII. DATA SHEETS – *To be provided prior to survey implementation*

- Aerial Survey
- Aerial Observation
- Ground Monitoring
- Instantaneous and Continuous Use Site Monitoring
- Use-site Characteristics Summary
- Use-site Characteristics Profile

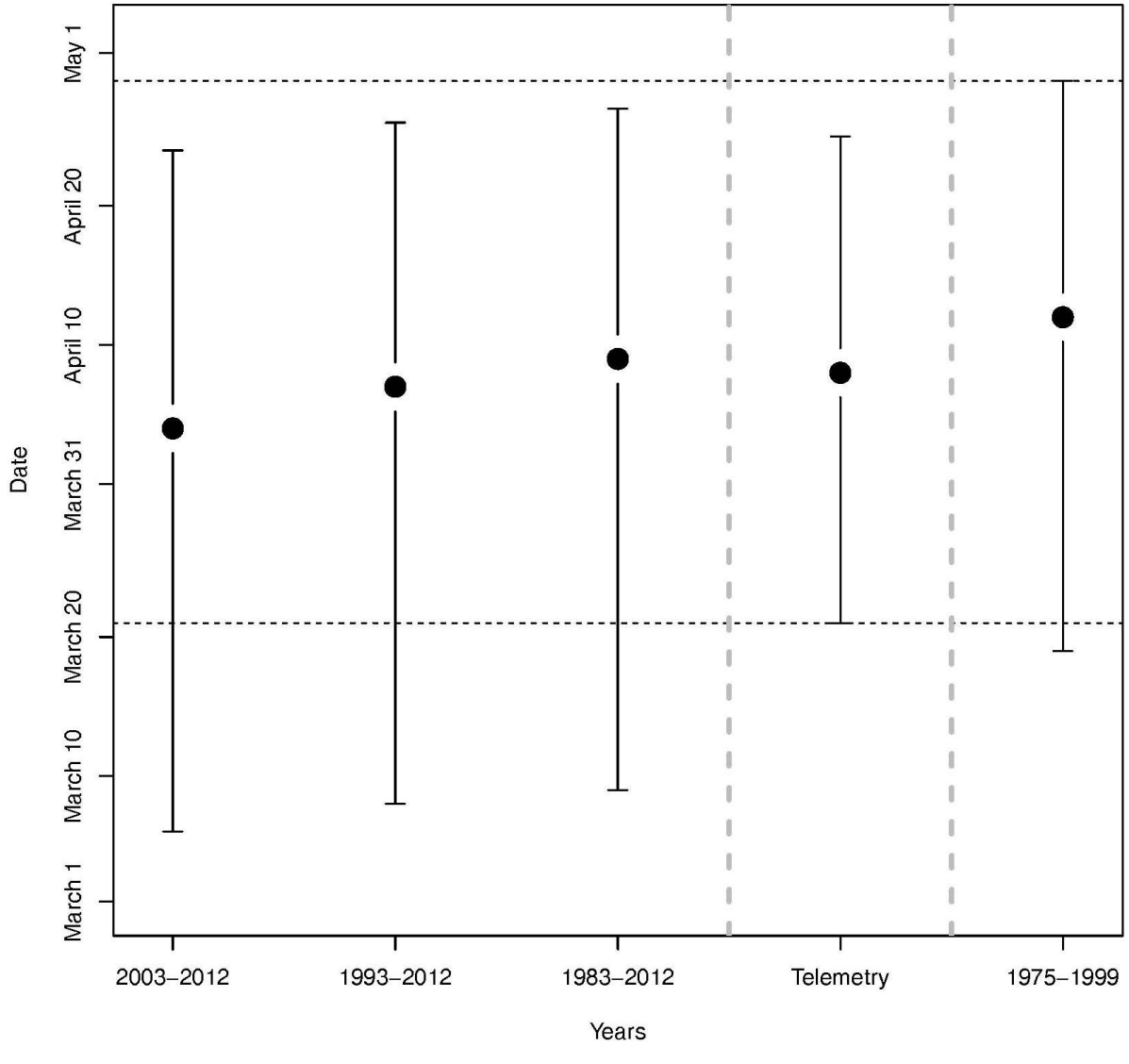
Appendix A. Program Associated Habitat Area.



Appendix B. Riverine and targeted primary and secondary wetland return flight transects that will be flown daily during systematic aerial wetland roost surveys.



Appendix C. Median (dots) and fifth and ninety-fifth percentiles (bars) of initial observation dates of whooping cranes in Nebraska during spring migration. Horizontal dashed lines represent the spring monitoring season in the Program's whooping crane monitoring protocol that that was implemented Spring 2001-Spring 2013. These dates were based on the fifth and ninety-fifth percentiles of initial observation dates of whooping cranes in Nebraska, 1975-1999 (~reproduced in the right plot). Vertical dashed lines separate the 10, 20, and 30 year analyses from analyses of telemetry data (2010–2013) and the 1975–1999 USFWS whooping crane data.



Appendix D. Median (dots) and fifth and ninety-fifth percentiles (bars) of initial observation dates of whooping cranes in Nebraska during fall migration. Horizontal dashed lines represent the fall monitoring season in the Program's whooping crane monitoring protocol that was implemented Spring 2001-Spring 2013. These dates were based on the fifth and ninety-fifth percentiles of initial observation dates of whooping cranes in Nebraska, 1975-1999 (~reproduced in the right plot). Vertical dashed lines separate the 10, 20, and 30 year analyses from analyses of telemetry data (2010–2012) and the 1975–1999 USFWS whooping crane data.