Platte River Program Baseline Document

March 30, 2007

Introduction

As part of the 1997 Cooperative Agreement for Platte River Research and Other Efforts Relating to Endangered Species Habitats Along the Central Platte River, Nebraska (Cooperative Agreement), the States of Colorado, Wyoming, and Nebraska, and the Department of the Interior ("parties") agreed to implement certain activities relating to four target species (interior least tern, whooping crane, piping plover, and pallid sturgeon) listed as threatened or endangered. Attachment I of the Cooperative Agreement identifies several milestones by year and subject. This report has been prepared in support of Research Milestone R1-1. R1-1 states:

> The U.S. Fish and Wildlife Service ("FWS")[1] will document the habitat and species conditions existing in the central Platte River region as of the effective date of the Cooperative Agreement to compare against future changes/improvements in habitat and species status.

The Technical Committee agreed at their August 22-23, 2001 meeting that the means to complete milestone R1-1 should be: 1) Identify existing habitat and species parameters, the quantifiable data, and the methods/protocols used to collect the data, and 2) Identify habitat and species parameters needed by the Program that do not have adequate data and the protocols that will be used to collect these data during the Program. The purpose of this document is to satisfy milestone R1-1, as written above, by the means identified by the Technical Committee. To this end, each section (e.g., Whooping Crane) of the baseline contains: 1) Background, 2) Historic Data and Methods, 3) Data Gaps and Proposed Protocols, 4) Historic Data not being Replicated During Program, and 5) Data Adequacy. These baseline data will be used in conjunction with additional information collected utilizing approved monitoring and research efforts to assess changes/improvements in habitat and species status and to measure biological responses of targets species to Program habitat and species mitigation measures.

This document contains sections describing whooping crane data, least tern and piping plover data, pallid sturgeon data, landscape features (e.g., geomorphology), and other species of concern. Each section of this document is a stand-alone report with its own table of contents, figures, tables, literature cited, etc. The document focuses on data from associated habitats, as defined in the Program Document, but includes some discussion of the species and their habitats throughout their ranges. The other species of concern section primarily includes a table identifying those species that the Technical Committee decided should be considered when conducting monitoring and research efforts. The majority of specific research and monitoring for other species of concern will likely occur through agencies and organizations other than the Program, particularly off of Program lands.

[1] Although specific parties have been assigned responsibility for completing the activities set forth in the milestones, it is understood that such activities must be completed in cooperation with other interested parties and be reviewed and approved by the Governance Committee.

BASELINE DOCUMENT

WHOOPING CRANE SECTION

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I. BACKGROUND

The whooping crane (*Grus americana*) was listed as a federally endangered species on March 11, 1967, and critical habitat was designated on May 15, 1978. Its principal historic breeding range extended from central Illinois northwestward through northern Iowa, western Minnesota, northeastern North Dakota, southern Manitoba and Saskatchewan, and the general vicinity of Edmonton, Alberta, to the present nesting area of Wood Buffalo National Park (Wood Buffalo), Northwest Territories in Canada (USFWS 1994). Winter distribution was primarily along the Gulf of Mexico from Louisiana to northeastern Mexico. There were several migration routes, including a lesser migration route to wintering areas along the Atlantic Coast. Some whooping cranes were believed to have migrated to interior Mexico, following the migration route of sandhill cranes. The total population of whooping cranes as of 1869 was estimated at approximately 1,300 birds (Allen 1952). Two other estimates put the 1870 population at between 500 and 700 birds (USFWS 1994, Cannon 1996). By 1937 only two small breeding populations existed: a non-migratory group of about 10-15 birds in southwestern Louisiana, and the flock known as the Aransas-Wood Buffalo population which included about 20 migratory whooping cranes (McIlhenny 1938, Lynch 1984, Cannon 1996, Drewien et al. 2000). This section focuses on the Aransas-Wood Buffalo migratory population.

I.A. Aransas-Wood Buffalo Whooping Crane Population Estimates

The size of the Aransas-Wood Buffalo migratory population has increased from 18 in 1938-1939 (USFWS 1994) to 220 birds in 2005-06, based on peak winter counts at Aransas (W. Jobman, USFWS, pers. comm., CWS & USFWS 2006; Table 1). The peak count of 220 occurred in 2005-2006 and the low count of 15 occurred in 1941–1942 (USFWS 1994, W. Jobman, USFWS, pers. comm., CWS & USFWS 2006; Table 1).

I.B. Aransas-Wood Buffalo Whooping Crane Migration

Spring migration from Aransas National Wildlife Refuge begins as early as March 7 (W. Jobman, unpublished data *in* Austin and Richert 2001). Some cranes have been observed earlier in Oklahoma, Nebraska, and Kansas (February to early March) and it is assumed that these birds wintered in a location other than Aransas, Texas (Austin and Richert 2001). The earliest whooping crane observation in Nebraska occurred on February 10 and the latest spring migrant was observed on May 23 (Austin and Richer 2001). Peak migration, based on the median date of spring migration occurrence in Nebraska is April 12th (Austin and Richert 2001) with the 10th and 90th percent confidence intervals being March 29 and April 24 for the time period 1975 – 1999 (Austin and Richert 2001).

Fall migration from Wood Buffalo, Canada begins in September; with the earliest observation in the United States being in North and South Dakota in early September (Austin and Richert 2001). The earliest fall migrating whooping crane observation in Nebraska occurred on October 1 and the latest fall migrant was observed on November 21 (Austin and Richert 2001). The peak of fall migration, based on the median date of occurrence in Nebraska is October 27th, with the 10th and 90th percent confidence intervals being October 17 and November 7 for the time period 1975 – 1999 (Austin and Richert 2001). Breeding grounds, wintering areas, and the migration pathway of the Aransas-Wood Buffalo population of whooping crane are shown in Figure 1.

I.C. Platte River Recovery Implementation Program Habitat Area

For whooping cranes, the Platte River Recovery Implementation Program (Program) will focus on the Platte River valley beginning at the junction of U.S. Highway 283 and Interstate 80 near Lexington, Nebraska and extending eastward to Chapman, Nebraska. The protocol "Monitoring whooping crane migrational habitat use in the central Platte River valley" defines 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" (Figure 2). This area includes designated critical habitat for whooping cranes, which is defined as "a strip of river bottom with a north-south width of 3 miles, a south boundary paralleling Interstate 80, beginning at the junction of U.S. Highway 283 and Interstate 80 near Lexington to the interchange for Shelton and Denman" (USFWS 1978).

Studies that investigate migrational habitat and use within the study area are discussed below. Other "keystone" studies that investigate migrational habitat and use outside of this region are listed in Appendix A.

I.D. Whooping Crane Sightings

The first detailed list of whooping crane sightings in Nebraska was published in the early 1930's (Swenk 1933). Sightings during 1934–1944 were compiled by Brooking (1934, 1943a, 1943b, 1944). Allen (1952) re-assessed the sightings reported by Swenk and Brooking and developed a list which he felt represented valid sightings on or near the Platte River from 1820–1948. FWS confirmed sighting of whooping cranes from 1912-1949 are listed in Appendix C of the Platte River ecology study report (USFWS 1981). A review of the validity of these sightings can be found in EA Engineering, Science and Technology, Inc. (1985).

Information on whooping crane sightings along the Platte River during 1940–1974 was derived from FWS records, and information since 1975 was derived from the Cooperative Whooping Crane Migration Monitoring Project. These records are stored and maintained in a computer database and as paper hardcopies by the U.S. Fish and Wildlife Service, Ecological Services Field Office, at Grand Island, Nebraska (W. Jobman, USFWS, pers. comm.). A review of the validity of earlier sightings in the database can be found in EA Engineering, Science and Technology, Inc. (1985).

A ***sighting****,* as defined here, is the observation of a whooping crane group (single or multiple birds) that is migrating together through an area. Reported sightings are classified by the FWS database manager, using professional judgment, as confirmed, probable, or unconfirmed, based on the definitions given in the Whooping Crane Recovery Plan.

A ***confirmed sighting*** is an observation made by a state or federal biologist or officer, or by another known qualified observer (trained ornithologist or birder with experience in identification of whooping cranes). A photograph may also be used to confirm sightings. In the FWS database, 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 other sightings are assumed to be the same crane group (and thus given the same FWS number), 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 area or are known to have moved to a different area. 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 area is difficult. Confirmed sightings of whooping cranes in the Platte River valley from 1940–2000 are presented in Table 2.

A ***probable sighting*** is defined by FWS as no confirmation made by a state or federal biologist or officer, or by other known qualified observers, 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 the 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. Probable sightings of whooping cranes in the Plate River valley from 1980–2000 are listed in Table 3.

An ***unconfirmed sighting*** classification is assigned when details of the sighting meet some, but not all of the six factors listed for a probable sighting.

Attempts have been made by FWS biologists and others to investigate all reports in the Platte River study area that appear to have accurate whooping crane descriptions. However, a large proportion of the sightings that are reported are not confirmed due to late reporting of the birds to appropriate parties, inability to find reported birds, unavailability of personnel to investigate sighting reports, or misidentified birds. It is also assumed that not all whooping cranes are observed and not all observed birds are reported. Therefore, confirmed stopovers represent a subset of total whooping crane use of the study area, and it is not known how many stopovers actually occur. Also, it is difficult to compare number of sightings in the central Platte River area to other areas in Nebraska or elsewhere in the flyway due to inconsistent and non-standardized search efforts (i.e., public reports vary due to density and type of observers).

Austin and Richert (2001) summarized the confirmed sightings of fall and spring migrating whooping cranes throughout their flyway within the United States between 1943-1999. The data were derived from two databases maintained by the FWS: observational sightings; (1943–1999, 1,352 confirmed sightings) and site evaluation data (1977–1999, 1,060 sightings). All spring and fall whooping crane sightings from 1943–1999 in Nebraska are presented in Figure 3.

Observations of whooping cranes obtained during the implementation of the Cooperative Agreement protocol (Technical Committee 2005) are found in Table 4.

II. DATA/METHODS – AVAILABLE DATA

II.A. Aerial Surveys

The FWS conducted aerial surveys from 1984-1993 to detect whooping cranes in the central Platte River region (Sidle et al 2006). Early morning flights were made along the river and adjacent fields from March 23 to May 1, and October 1 to October 31. Approximately one-half of the scheduled flights were cancelled or terminated due to human error, poor weather conditions, etc. During survey period, surveys detected eight observations of 10 previously unreported whooping cranes in the study area.

Systematic aerial surveys have been conducted by the Cooperative Agreement beginning in the spring of 2001 (survey was not conducted the spring of 2003) and are ongoing. Flights are flown simultaneously out of Grand Island and Kearney airports to cover the entire study area in a timely manner. Aerial transects begin approximately 30 minutes prior to sunrise, and generally last about 1.5 hours. The East Crew (out of Grand Island) surveys the reach between Chapman and the Highway 10 (Minden) Bridge (Figure 2), and the West Crew (out of Kearney) surveys from Highway 10 to Highway 283 near Lexington. The protocol also specifies that whooping crane sightings reported by the public or other means (defined as opportunistic locates) will be confirmed, if possible, and field measurements taken. The whooping crane survey protocol and reporting forms are on file with the Cooperative Agreement Executive Director's office (Technical Committee 2005). Whooping crane use site locations documented during implementation of this protocol are found in Figure 4.

Reports were completed after each migration season as part of the Cooperative Agreement's surveys. These reports describe any deviations from the protocol in documenting season, numbers, and locations of crane groups, and field measurements at crane locations (described below). Reports summarize numbers of cancelled flights and reasons for cancellations. Reports also discuss sightability based on known whooping cranes in the area and decoys placed at random locations. Reports are on file with the Executive Director's office.

II.B. Migration stopover site characteristics

II.B.1. Whooping Crane Use Site Data

Characteristics of whooping crane use sites within the central Platte River valley corridor have been documented and compiled by the USWFS from 1966 to present. Data summarized in Table 5 include active channel width, water width, percent wetted, percent of water width <0.7 ft deep, approximate visibility upstream and downstream, and the flow at gage stations (cfs). A summary of 9 sites from 1983 to 1987 is found in Faanes (1992) and a summary of 19 sites from 1983 to 1990 is found in Faanes et al. (1992).

Whooping crane surveys conducted from 2001 to Spring of 2006 for the Cooperative Agreement include data collected at whooping crane use sites (Table 4). Three transects are measured perpendicular to the channel at each use site, with one at the use site, one 25 m upstream of the use site, and one 25 m downstream of the use site. Measurements recorded are channel width, water depth, bed/sandbar elevation, sediment/grain size distribution, and distance to visual obstructions. Qualitative determinations are also made of sediment size/type, activities, and potential disturbances. The protocol and methodologies used each survey period and the corresponding data reports are on file at the Executive Director's office. Raw data sheets and an Access database with collected data are also stored at the Executive Director's office. These data are provided to the FWS and are included in their files also.

Austin and Richert (2001) provide a comprehensive analysis of the FWS site-evaluation data collected from 1977-1999 throughout the Aransas-Wood Buffalo migration corridor. In Nebraska, whooping cranes used palustrine and riverine wetlands 56.0 and 39.6% of the time, respectively. Throughout the entire migrational corridor, palustrine wetlands accounted for >75% of all whooping crane observations, and roost sites were most common on riverine systems only in Nebraska (primarily the Platte, Niobrara, and North and Middle Loup Rivers). General information is also included for each state along the flyway in Austin and Richert (2001).

Lingle et al. (1991) reviewed and summarized site evaluations for length of stay within various habitats from 74 confirmed whooping crane use sites in Nebraska between 1977 and 1986. Comparisons were made between spring and fall sightings and between family and non-family groups. Lingle et al. (1991) found that family groups spend more time in Nebraska during the fall migration and non-family group spend more time in Nebraska during the spring migration. Both nocturnal and diurnal activities were in or near wetlands.

Howe (1987, 1989) collected data throughout the migration corridor on habitat use by 18 radio-marked whooping cranes during 5 migrations (3 southbound, 2 northbound) between 1981 and 1984. None of the radio-marked individuals stopped in the central Platte River valley during the study.

II.B.2. Active Channel Width and Unobstructed Width

Active channel width data have been collected since 1966 at whooping crane use sites and are included with the FWS site evaluation data in Table 5. Active channel widths at whooping crane use sites along the central Platte River ranged from 172 ft to 1,500 ft. When on-site measurements of use-sites were not conducted, channel width was estimated, but the method used to estimate channel width (from aerial photos or visual estimation while at the site) is not documented.

Channel widths at 109 crane-roost sites in Nebraska were between 82 and 492 m and averaged 250 ± 94 m (SD) (Austin and Richert 2001).

Unobstructed channel width was recorded during site evaluations conducted for the Cooperative Agreement surveys beginning in 2001. These data are summarized in Table 4 and in the individual survey reports. Unobstructed width at whooping crane use sites along the central Platte river based on this data ranged from 114 to 463 m.

II.B.3. Water Width

Water width is included in the FWS channel profiles database as the summed width of the channel profile transect inundated by water. Water width data were obtained by field evaluations at 59 sites since 1966. Measurements at use sites are summarized in Table 5. Faanes et al. (1992) reported the inundated channel width at 19 sites in the Platte River averaged 217 meters (SD=79 m, range=52-366 m).

Water width can also be determined using transect information collected during implementation of the whooping crane monitoring protocol by the Cooperative Agreement. These data are summarized in Table 4 and in the individual survey reports. Water width at whooping crane use sites along the central Platte river based on this data ranged from 33 to 262 m

II.B.4. Water Depth

Water depths were recorded across the entire channel at the riverine use sites using a transit and rod during the Cooperative Agreement surveys. These data are summarized in Table 4 and in the survey reports. Water depth at whooping crane use sites along the central Platte river based on this data ranged from 0.05 to 0.28 m

Howe (1987, 1989) collected data on habitat use by 18 radio-marked whooping cranes during 5 migrations between 1981 and 1984. Birds generally did not venture into water deep enough to cover the tibiotarsus-tarsometatarsus joint. Muddy substrates characterized the wetlands most often used by cranes (Howe 1987, 1989). Mean water depths were similar for roosting and feeding sites and were reported as follows: Roosting: $\bar{x}$ = 18.1cm, SD = 29.4, n = 80; Feeding: $\bar{x}$ = 20.2cm, SD = 38.9, n = 39 (Howe 1987, 1989).

Austin and Richert (2001) reported that specific sites within wetlands where cranes were observed feeding or roosting averaged 18.0 cm depth, SD = 10.7 cm (range = 2.5 – 61.0 cm; n=196). Maximum depths of wetlands in which cranes were observed averaged 50.8 cm, SD = 41.4 cm (range = 2.5-304.8 cm, n=297).

The FWS has also collected water depths across the entire channel at channel use sites and this information is included in the site evaluation database. Faanes et al. (1992) reported the water depth at 19 sites in the Platte River averaged 20.2 cm (SD=9.4 cm, range=3-94 cm).

II.B.5. Bed/Sandbar Elevation

Estimated bed/sandbar elevation is reported in the FWS site evaluation data. Lingle et al. (1984, 1986) also describe bed/sandbar elevations for two whooping crane roost sites. One roost site (FWS crane sighting number 83B-21) in Hall County was characterized as a shallow submerged sandbar, 15 m wide with a depth of 10–13 cm (Lingle et al. 1984). The other roost site (FWS crane sighting number 85B-18) in Buffalo County near Rowe Sanctuary was described as a shallow submerged sandbar, 15 m wide with a depth of 20-28 cm (Lingle et al. 1986).

Howe (1987) collected slope data throughout the migration corridor at sites used by 18 radio-marked whooping cranes during 5 migrations between 1981 and 1984. Mean slope estimates were 7.1 degrees for roosting sites (n=77) and 8.5 degrees for feeding sites (n=55).

Bed and sandbar elevations have been measured at all whooping crane group use sites to which access has been gained since 2001 as part of the Cooperative Agreement's whooping crane monitoring. These measurements are taken using a survey transit and rod. Data are summarized in Table 4 and survey reports are stored at the Cooperative Agreements Executive Director's office. Sandbar elevation at whooping crane use sites along the central Platte river based on this data ranged from 0.04 to 0.52 m.

II.B.6. Substrate at Use Sites

Qualitative information on substrate/sediment was collected during the site evaluations conducted for the Cooperative Agreement from 2001 to present. This qualitative information includes a visual characterization of sediment type and grain size. Data are summarized in survey reports stored at the Cooperative Agreements Executive Director's office.

While information on substrate/sediment at use sites is limited for the central Platte River area, this information was collected at other areas throughout the Aransas-Wood River migration corridor at stopover sites, and reported by Austin and Richert (2001). Roosts in riverine wetlands were primarily composed of sand substrates (95.7%), while roosts in palustrine wetlands were mixed (38.5% sand, 52.6% soft mud). Feeding areas in palustrine wetlands also had mixed substrates (62.1% soft mud, 13.8% sand, 13.8% hard mud, and 10.3% other substrates), while feeding areas in riverine wetlands were composed of 100% sand.

II.B.7. Distance to Visual Obstructions
The FWS site evaluation data includes entries for "Approximate Visibility" (miles) upstream and downstream at some of the sites (Table 5). Faanes (1992) reported the combined upstream and downstream distance of visibility at 9 sites in the Platte River averaged 1.9 km (range= 731 m-3.2 km).

Site evaluations were conducted during the Cooperative Agreement surveys beginning in 2001. During these surveys, distance to closest visual obstruction was recorded upstream, downstream, and to either side of the roost site. Data are summarized in Table 4 and survey reports stored at the Executive Director's office. Distance to closest visual obstruction at whooping crane use sites along the central Platte River based on this data ranged from 44 to 412 m.

Austin and Richert (2001) found little differences among visibility in riverine, palustrine, or other wetland areas used by cranes throughout the flyway and mentioned that sites used in riverine areas had the lowest visibility and was never > 0.50 mi. Overall, over 50% of roost sites had visibilities < 0.25 mi and 67% of feeding sites had visibilities < 0.25 mi.

II.B.8. Proximity to Disturbance
Proximity to disturbance is reported in the FWS site evaluation data as "Distance to nearest human development." Lingle et al. (1984, 1986) also provide information on proximity to disturbance in the descriptions of two whooping crane roost sites. At one roost site (FWS crane sighting number 83B-21) in Hall County, woody vegetation along the river bank provided a visual barrier between the roost site and potential disturbances. Interstate 80 was 0.8 km to the north, and an occupied cabin was 0.2 km south of the roost (Lingle et al. 1984). At the other roost site (FWS crane sighting number 85B-18) in Buffalo County near Rowe Sanctuary, the closest dwelling was 80 m from the roost site (Lingle et al. 1986).

Distances to potential disturbances are estimated during whooping crane monitoring as part of the Cooperative Agreements whooping crane monitoring protocol. Data are summarized in survey reports stored at the Executive Director's office.

Austin and Richert (2001) reported that >66% of crane-use sites (feeding and roosting) throughout the migration corridor were within 0.5 mi of human developments. They also found no differences in distances to human disturbances among feeding or roosting cranes.

II.B.9. River Discharge and Stage

Discharge (cfs) and stage data are recorded at several gages in the central Platte River (see Landscape Section for locations). Discharge data are reported in the FWS site evaluation data provided in Table 5. The Cooperative Agreement also includes these data in survey reports. Both stage and discharge can be retrieved from USGS and Nebraska Department of Natural Resources archives for all gages.

II.B.10. Land Cover Class (Vegetation) and Proximity to Other Habitats

Information about land cover class (vegetation) and proximity to other habitats are reported in the FWS site evaluation data. Vegetation is reported as "emergent vegetation" and "crop type." Proximity to other habitats is reported as "primary adjacent habitat within 1-mile radius" and "extent of similar habitat within 10-mile radius." This information can also be obtained from data collected during vegetation surveys, and from aerial photographs.

Land cover class information was collected at use sites as part of whooping crane monitoring for the Platte River Cooperative Agreement. Vegetation is recorded according to the National Vegetation Classification Standard (NVCS). Data are summarized in survey reports stored at the Executive Director's office.

II.C. Time Budgets/Activity

Lingle et al. (1987) recorded 100.7 hours of time activity budgets from 1984-1986. Number of crane groups represented in these 100.7 hours of activity budgets was not reported, other than stating all fall observations were from one family group. Activities were recorded at specific time intervals (i.e., 10 sec, 12 sec, 15 sec, and 30 sec) with the aid of a spotting scope. Activity budget data were analyzed as frequency distributions of behavior categories in various vegetation community types.

Activity data is qualitatively collected at use sites as part of whooping crane monitoring for the Cooperative Agreement. Data are summarized in survey reports stored at the Executive Director's office.

II.D. Photo Documentation

Photographs were taken at most FWS site evaluation locations and are available from the FWS upon request (S. Whitmore, FWS, pers. comm.). Photographs were taken at all use sites measured by the Cooperative Agreement. These are part of the survey reports and are stored at the Executive Director's office.

II.E. Sources of Whooping Crane Mortality during Migration

There has been no documented incident of whooping crane mortality or injury of any sort within the study area, or known contact with disease in the study area. Implementation of the Cooperative Agreement's whooping crane monitoring protocol specifies that all dead or injured whooping cranes will be reported, and the protocol specifies the process for reporting these birds.

Several studies have been conducted throughout the flyway related to whooping crane mortality, including, but not necessarily limited to: Howe 1989, Brand et al. 1991, USFWS 1994, Brown and Drewien 1995, Meine and Archibald 1996.

III. DATA GAPS AND PROPOSED PROTOCOLS

This section discusses data or parameters that the Platte River Recovery Implementation Program is interested in and should be measuring during the First Increment, but for which existing data sets could not be found.

III.A. Suspended Sediment

The relationship between suspended sediment and whooping cranes was identified as an important data need by the FWS during the Cooperative Agreement period. While the Landscape section of this document discusses suspended sediment, no data sets were found specifically relating suspended sediment to whooping crane use sites. The Cooperative Agreement whooping crane monitoring protocol qualitatively collects sediment type and grain size information, but it does not quantitatively or qualitatively document suspended sediment information.

III.B. Groundwater Hydrology

The importance of groundwater hydrology to whooping cranes was identified as an important data need by the FWS during the Cooperative Agreement period. The Landscape section of this document discusses groundwater hydrology, but no data sets were found specifically relating groundwater hydrology to whooping crane use sites. Protocols identified in AMP Table 1 (Program Attachment 3) include research efforts to investigate groundwater hydrology and relations with wet meadows and whooping cranes.

IV. HISTORIC DATA NOT BEING COLLECTED DURING THE PROGRAM

IV.A. Overhead Visibility

The variable "overhead visibility" has been poorly defined and applied across years and states (Jane Austin, pers. comm.). Generally, overhead visibility, if recorded, has been applied to some form of powerline, telephone line, or other overhead transmission line. Austin and Richert (2001) summarized distances to utility lines across the migration flyway in the U.S. The Program will not collect information on overhead visibility at crane use sites, but this information could be determined in a GIS using use site information and utility line locations after field data collection.

IV.B. Water Velocity

Water velocity measurements will not be collected at whooping crane use sites during the Program. Water velocity information can be obtained at USGS and other gage stations in the central Platte River. These gages also have historic information (see Landscape section)

IV.C. Food Availability

Austin and Richert (2001) summarize 50 records of actual foods observed consumed by whooping cranes throughout the flyway. Grains were the food most often observed consumed (n=38). Other food items recorded were fish (n=4), invertebrates (n=3), mollusks (n=2), snakes or "other" (n=4), salamanders (n=1), frogs (n=1), and tubers (n=1).

Various inventories have been performed at wetlands and bottomland grasslands along the Platte River valley for potential whooping crane food items (*e.g*., Ballinger 1980, Cochnar and Jenson 1981, Ratcliffe 1981, USFWS 1981, USFWS 1994, Currier et al. 1985, Davis and Vohs 1993, Davis et al. 2006). According to these studies potential food items in these areas include plant tubers, small fish, snakes, frogs, frog egg masses, crayfish, grasshoppers, crickets, and other insects. For tilled agricultural lands, crop type and crop patterns can be determined from the land cover/land use GIS database. Further, trends in waste corn, based on periodic investigations by the USGS Northern Prairie Science Center, can be found in the Platte River Ecology Study (USFWS 1981; and Krapu and Brandt 1998). The FWS site evaluation database includes categories for "Potential food items" and "crop type." The Program does not anticipate conducting further monitoring and research into food availability for whooping cranes.

V. DATA ADEQUACY

The baseline information was evaluated for quantitative descriptions of pre-Program or pre-treatment (baseline) conditions that could be combined with Program monitoring data in before-after comparisons or trend estimations. The presence of quantitative baseline information will significantly enhance the analysis of the Program's monitoring data. The Program's monitoring is designed to detect statistically significant changes in measured parameters over time and document correlations between those changes and management activities. It is anticipated that the trends in the frequency of use, relative use of resources, and spatial distribution of use will be analyzed with Program data.

For baseline data to be useful, the data collection procedure should have followed detailed and scientific protocols. Methods of data collection should have been recorded and vigorously adhered to. Quality assurance procedures should have been conducted and any changes made to the data should have been documented. Finally, data should have been stored in an accessible medium along with the data collection protocols and other metadata. Even if data have the above characteristics the data must be entered into an electronic format (i.e. a data spreadsheet) before analysis can occur.

In addition, for baseline data to be useful for before-after comparisons or trend estimation, the study design should have incorporated statistical sampling procedures. The sampling frame should have been identified, and random sampling should have been employed to ensure the data would be unbiased for the region and/or time of interest.

The historical observations of whooping cranes from 1912-1948 represent a non-probability based sample with inherent biases (USFWS 1981, Appendix C). In addition, the location information is not precise. The relative use of resources and spatial distribution of this sample of points should not be used in a quantitative analysis with Program data for these reasons. An analysis on the trend in the frequency of whooping crane use cannot be conducted without an indication of the effort expended to obtain the pre-Program sightings.

For observations that have specific location information and were confirmed by the FWS (Table 2) from 1940-2000 there is little utility in performing comparisons with Program data due to the non-probability based sampling procedures. Analyses of the frequency of use, relative use of resources, and spatial distribution based on this sample of points would require warnings about inherent biases associated with the pre-Program data.

For the probable (as defined by the FWS) observations (Table 3) from 1980-2000, there is little utility in performing analyses with Program data due to the uncertainty in the spatial accuracy and the non-probability based sampling procedures. Specifically, these observations should not be used to provide information on migration timing or sight characteristics since their confirmation as a whooping crane sighting by the FWS was based on this information.

The observations that have resulted from the implementation of the Program's protocol for monitoring the migrational habitat of whooping cranes from 2001-2004 (Table 4), represent an unbiased survey of whooping crane use locations within a defined study area with precise documentation of the survey effort. These data will be appropriate for quantitative analyses of trends in the frequency of use, relative use of resources, and spatial distribution of use. The data collection procedures followed a detailed scientific protocol, the data were entered into an electronic format, the data were checked for quality assurance and changes made to the data were documented. The measurements taken at the in-channel use sites from these data (Table 4) will be appropriate for comparisons with data at post-Program initiating whooping crane use sites, if the Cooperative Agreement and Program actions are well documented.

Measurements at the in-channel use sites (Table 5) from 1966-2000 provide data appropriate for before-after comparisons with data collected after Program initiation on whooping crane use sites. Because this sample of observations was combined from multiple reporting sources, the data contains sampling bias. In addition, the data collection methods have been poorly documented resulting in questionable precision of the measurements within this sample. Before-after analyses of the relative use of resources based on this sample of points would require warnings about the biases and precision issues associated with the pre-Program data.

In general, the data described in the whooping crane section of the baseline document are historical observations with bias problems often associated with non-random or convenience sampling. There are no quantitative data available for a before-after comparison of the frequency of use of the Program study area since there has been no pre-Cooperative Agreement survey for whooping cranes with full documentation of survey effort. Before-after comparisons of relative use of resources and spatial distribution may be conducted with the confirmed (by FWS) data, though the conclusions based on these analyses must acknowledge the biases and precision issues in the pre-Cooperative Agreement data.

Qualitative analyses may be conducted if certain assumptions are made. Assumptions about the search effort expended in locating cranes each year may be necessary for analyses of long term trends in the frequency of use. Analyses of relative use of resources involving historical data may require assumptions of the available resources. Estimates of some factors may serve to improve these analyses. For example, search effort may be estimated using the number of visitors recorded in the area during migration. Available resources may be estimated using recent aerial photographs and details of management actions. The risks of making each assumption should be evaluated for each analysis.

VI. LITERATURE CITED

Allen, R. P. 1952. The whooping crane. National Audubon Society Research Report No. 3. 246pp.

Austin, J.E., and A.L. Richert. 2001. A comprehensive review of the observational and site evaluation data of migrant whooping cranes in the United States, 1943-99. U.S. Geological Survey, Northern Prairie Wildlife Research Center, Jamestown, North Dakota, and State Museum, University of Nebraska, Lincoln, Nebraska. 157pp.

Ballinger, R. E. 1980. Amphibians and reptiles of Mormon Island Preserve with notes on their management. Report for the Nature Conservancy. School of Life Sciences, University of Nebraska-Lincoln.

Brand, C. J., Langenberg, J., and Carpenter, J. W. 1991. Summary of diseases and disease recommendations in Whooping Cranes. Pages 73-78 in Mirande, C., Lacy, R., and Seal, U., editors. Whooping Crane Conservation Viability Assessment Workshop Report. IUCN Captive Breeding Specialist Group, Apple Valley, Minnesota, U. S. A.

Brooking, A. M. 1934. The whooping crane in the spring of 1934. Nebr. Bird Rev. 2:117-118.

Brooking, A. M. 1943a. The present status of the whooping crane. Nebr. Bird Rev. 11:5-8.

Brooking, A. M. 1943b. Additional records of the whooping crane. Nebr. Bird Rev. 11:47.

Brooking, A. M. 1944. Additional records of the whooping crane. Nebr. Bird Rev. 12:7.

Brown, W. M. and R. C. Drewien. 1995. Evaluation of two power line markers to reduce crane and waterfowl collision mortality. Wildlife Society Bulletin 23(2): 217-227.

Cannon, J. R. 1996. Whooping crane recovery: A case study in public and private cooperation in the conservation of endangered species. Conservation Biology 10:813–821.

Cochnar, J. and D. Jenson. 1981. 1980 Mormon Island Crane Meadows Fish Inventory. Report for The Nature Conservancy. 36 pp + app.

Currier, P. J., G. R. Lingle, and J. G. VanDerwalker. 1985. Migratory Bird Habitat on the Platte and North Platte Rivers in Nebraska. The Platte River Whooping Crane Critical Habitat Maintenance Trust. Grand Island, NB. 177 pp + index.

CWS & USFWS (Canadian Wildlife Service and U.S. Fish and Wildlife Service). 2006. International recovery plan for the whooping crane. Ottawa: Recovery of Nationally Endangered Wildlife (RENEW), and U.S. Fish and Wildlife Service, Albuquerque, New Mexico. 162 pp.

Davis, C. A. and P. A. Vohs. 1993. Role of macroinvertebrates in spring diet and habitat use of sandhill cranes. Trans. Nebraska Academy of Sciences, 20:81-86.

Davis, C.A., J.E. Austin, and D.A. Buhl. 2006. Factors influencing soil invertebrate communities in riparian grasslands of the central Platte River floodplain. Wetlands 26:438-454.

Drewian, R. C., J. Tautin, M. Lynch Courville, G. M. Gomez. 2000. Whooping cranes breeding at White Lake, Louisiana, 1939: Observations by John J. Lynch, U. S. Bureoau of Biological Survey. Pages 24-30 in Ellis, D. H., editor. Proceedings of the Eighth North American Crane Workshop, Albuquerque, New Mexico. North American Crane Working Group.

EA Engineering, Science and Technology, Inc. 1985. Migration Dynamics of the Whooping Crane with Emphasis on Use in the Platte River In Nebraska. Prepared for Interstate Task Force on Endangered Species. Tom Pitts Task Force Coordinator.

Faanes, C.A. 1992. Unobstructed visibility at whooping crane roost sites on the Platte River, Nebraska. Pages 117-120 In: D. Wood (ed.), Proceedings 1988 North American Crane Workshop, Wales Lake, Florida. Florida Game and Fresh Water Fish Commission, Nongame Wildlife Program Technical Report #12.

Faanes, C.A., D. Johnson, and G. Lingle. 1992. Characteristics of whooping crane roost sites in the Platte River. Pages 90-94 In: D. Wood (ed.), Proceedings 1988 North American Crane Workshop, Wales Lake, Florida. Florida Game and Fresh Water Fish Commission, Nongame Wildlife Program Technical Report #12.

Howe, M. A. 1987. Habitat use by migrating whooping cranes in the Aransas-Wood Buffalo corridor. Pages 303-311 in J. C. Lewis, editor. Proceedings 1985 Crane Workshop, Grand Island, Nebraska. Platte River Whooping Crane Maintenance Trust, Grand Island, NE.

Howe, M.A. 1989. Migration of radio-marked whooping cranes from the Aransas-Wood Buffalo population: Patterns of habitat use, behavior, and survival. U.S. Fish and Wildlife Service, Fish Wildl. Tech. Report 21. 33 pp.

Krapu, G. and D. A. Brandt. 1998. Staging Ecology of Sandhill Cranes in the Central Platte Valley; An Evaluation of Long-term Changes in Habitat Use, Food Resources, Nutrient Storage, and Carrying Capacity (Abstract). Proceedings of the Ninth Platte River Basin Ecosystem Symposium, February 24-25, Kearney, Nebraska. p. 77.

Lingle, G.R., P.J. Currier, and K.L. Lingle. 1984. Physical characteristics of a whooping crane roost site on the Platte River, Hall County, Nebraska. Prairie Nat. 16(1): 39-44.

Lingle, G. R., K. J. Strom, and J. W. Ziewitz. 1986. Whooping crane roost site characteristics on the Platte River, Buffalo County, Nebraska. Nebraska Bird Review 54(2):36-39.

Lingle, G.R., G.A. Wingfield, and J.W. Ziewitz. 1991. The migration ecology of whooping cranes in Nebraska, U.S.A. Pages 395-401 in J. Harris, editor. Proc. 1987 International Crane Workshop, Baraboo, WI.

Lynch, J. J. 1984. A field biologist. Pages 35-40 in A. S. Hawkins, R. C. Hanson, H. K. Nelson, and H. M Reeves, editors. Flyways: pioneering waterfowl management in North America. U. S. Fish and Wildlife Service, Washington, D. C., USA.

McIlhenny, E. A. 1938. Whooping crane in Louisiana. Auk 55:670.

Meine, C. D. and G. W. Archibald (*eds*). 1996. The cranes: Status survey and conservation action plan. IUCN, Gland Switzerland and Cambridge, U.K. 294 pp.

Ratcliffe, B. C. 1981. A preliminary inventory of the insects of Mormon Island Refuge. 22 pp. June.

Sidle, J.G., W.G. Jobman, C.A. Faanes. 2006. Aerial searches for whooping cranes along the Platte River, Nebraska. The Nebraska Bird Review, 74:95-98.

Swenk, M. H. 1933. The present status of the whooping crane. Nebr. Bird Rev. 1:111-129.

Technical Committee of the Platte River Cooperative Agreement (Technical Committee). 2005. Monitoring whooping crane migrational habitat use in the central Platte River valley, unpublished material, September 16, 2005.

USFWS (U. S. Fish and Wildlife Service). 1978. Determination of Critical Habitat for the Whooping Crane. Federal Register 43:20938-20942.

USFWS (U.S. Fish and Wildlife Service). 1981. The Platte River ecology study. Special Research Report. U.S. Northern Prairie Wildlife Research Center, Jamestown, ND. 187 pp.

USFWS (U.S. Fish and Wildlife Service). 1994. Whooping Crane Recovery Plan. U.S. Fish and Wildlife Service, Albuquerque, NM. 92 pp.

Table 1. Peak winter populations of the Aransas-Wood Buffalo whooping crane population, 1938-2006, based on original count data.

Winter	Aransas-Wood Buffalo Population		
	Adult	Young	Total
1938-39	14	4	18
1939-40	15	7	22
1940-41	21	5	26
1941-42	13	2	15
1942-43	15	4	19
1943-44	16	5	21
1944-45	15	3	18
1945-46	14	3	17
1946-47	22	3	25
1947-48	25	6	31
1948-49	27	3	30
1949-50	30	4	34
1950-51	26	5	31
1951-52	20	5	25
1952-53	19	2	21
1953-54	21	3	24
1954-55	21	0	21
1955-56	20	8	28
1956-57	22	2	24
1957-58	22	4	26
1958-59	23	9	32
1959-60	31	2	33
1960-61	30	6	36
1961-62	34	5	39
1962-63	32	0	32
1963-64	28	7	35
1964-65	32	10	42
1965-66	36	8	44
1966-67	38	5	43
1967-68	39	9	48
1968-69	44	6	50
1969-70	48	8	56
1970-71	51	6	57
1971-72	54	5	59
1972-73	46	5	51
1973-74	47	2	49
1974-75	47	2	49
1975-76	49	8	57
1976-77	57	12	69
1977-78	62	10	72
1978-79	68	7	75
1979-80	70	6	76
1980-81	72	6	78
1981-82	71	2	73

Winter	Aransas-Wood Buffalo Population		
	Adult	Young	Total
1982-83	67	6	73
1983-84	68	7	75
1984-85	71	15	86
1985-86	81	16	97
1986-87	89	21	110
1987-88	109	25	134
1988-89	116	18	134
1989-90	126	20	146
1990-91	133	13	146
1991-92	124	8	132
1992-93	121	15	136
1993-94	127	16	143
1994-95	125	8	133
1995-96	130	28	158
1996-97	144	16	160
1997-98	152	30	182
1998-99	165	18	183
1999-2000	171	17	188
2000-01	171	9	180
2001-02	161	15	176
2002-03	169	16	185
2003-04	169	25	194
2004-05	183	34	217
2005-06	190	30	220

Source: USFWS 1994; W. Jobman, USFWS, pers comm.; CWS & USFWS 2006

Table 2. Confirmed sightings of whooping cranes in the Platte River valley between Lexington and Chapman, 1940-2000 (data from FWS records).

	Group ID	No. Cranes	Year	River Use	Dates of Use[1]	Location[2, 3]	Bridge Segment	River Miles[4]	Comment
1	42A-1	3	1942	Y	4/5	3 E Lexington Bridge	W	--	
2	43A-1	1	1943	Y	4/4	4 W Kearney Bridge	9	--	
3	50A-1	1	1950	N	5/4	SE of Overton	11	NA	
4	59B-2	2	1959	N	10/26	6 S 5 E of Overton	11	NA	
5	66B-2	5	1966	Y	10/20-21	6 NE of Philips	1	158	
6	74B-5	2	1974	Y	10/31 – 11/1	2 E Minden (#10) Bridge	7	206	
7	75A-6	7	1975	Y	4/18-19	1/2 E Odessa Bridge	--	223.5	Part of 9 birds hazed from Funk basin
8	75A-7	5	1975	Y	4/19-20	1/2 E Odessa Bridge	9	223.5	
9	77A-4	1	1977	Y	3/29	2 E Minden (#10) Bridge	7	206	Seen flying
10	80A-11	2	1980	Y	4/16-18	Audubon Sanctuary	6,7	207	Assumed same birds as 80A-12
11	80A-12	2	1980	Y	4/18	1 E Minden/I-80 Interchange	7	--	
12	83B-21	5	1983	Y	10/27-28	6 SE of Shelton	5	191.1	
13	83B-22	3	1983	N	10/28	7 SE of Shelton	5	NA	Joined group 83B-21
14	85A-6	4	1985	N	4/8	6 S 2W of Shelton	6	NA	Early AM; probable river use
15	85B-18	3	1985	Y	10/20-21	1 1/2 E Minden (#10) Bridge	7	206.4	
16	86B-58	3	1986	Y	11/4-5	2 E Kearney Bridge	8	213	Assumed same birds as 86B-88
17	86B-88	3	1986	N	11/7	1 ½ S 1 E of Hwy 44/I-80 Interchange	8	NA	
18	87A-1	1	1987	Y	3/17 - 4/19	W of Gibbon Bridge (Lowell area)	6,7	202.9 - 206.4	
19	87A-13	2	1987	N	4/16	Mormon Is. Crane Meadows	3	NA	Brief stop during day's migration
21	87B-2	2	1987	Y	10/21-22	0.75 E Gibbon Bridge	6	201.2	
22	88A-1	2	1988	Y	3/24-26	0.50 W Minden	8	208.6, 209.6	Group moved to Odessa (88A-2)
23	88A-2	2	1988	Y	3/26 - 4/7	3 W Odessa Bridge	9,10	226.3 - 227.6	see 88A-1

	Group ID	No. Cranes	Year	River Use	Dates of Use[1]	Location[2, 3]	Bridge Segment	River Miles[4]	Comment
24	88A-3	1	1988	Y	4/1-11	3 W Wood River Bridge	5	189.5 - 189.8	
25	88A-4	1	1988	Y	4/3-4	1 W Alda Bridge	4	183	Possibly same bird as 88A-3
26	89A-1	1	1989	Y	3/24 - 4/14	2 1/2 W Wood River Bridge	5	188-191.1	
27	89A-13	1	1989	Y	4/16-17	3 W Minden (#10) Bridge	8	211	
28	89B-5	4	1989	Y	10/13-14	2 ½ W Wood River Bridge	5		
29	89B-18	2	1989	Y	11/4	2 E Alda Bridge	3-4	180	2nd site 2 mi. W. Alda Bridge
30	90A-4	3	1990	Y	4/14-15	1/2 W Minden (#10) Bridge	7	207.5	
31	90B-15	3	1990	Y	10/26-27	2 1/4 E Shelton Bridge	5	193.5	Originally 2 1/2 mi. W. Wood River
32	92A-3	2	1992	Y	4/10	1/2 E Gibbon Bridge	6	201.5	Joined 92A-4 to roost
33	92A-4	4	1992	Y	4/10-11	2 W Gibbon Bridge	7	204.3	Includes 92A-3 birds
34	92A-5	6	1992	Y	4/10-11	1/4 E Overton Bridge	11	239.0	
35	92A-10	5	1992	Y	4/14	2 1/2 W Gibbon Bridge	7	204.7	Probably roosted night of 4/13-14
36	93A-2	5	1993	Y	4/9-10	1 1/2 W Gibbon Bridge	7	206.5	
37	93A-3	2	1993	Y	4/9-10	E of Alda Bridge	3	180.2	
38	93A-4	2	1993	Y	4/9-10	1 W Wood River Bridge	5	188.1	
39	93B-16	1	1993	N	10/23	1 S, 1 E Elm Creek	10	NA	
40	94A-1	6	1994	N	4/4	3.5 S Of Grand Island	2	NA	Corn stubble, mid-late morning
41	94A-3	2	1994	Y	4/4	1 E Gibbon Bridge	6		
42	94A-4	2	1994	Y	4/4-6	2.5 E of Minden Bridge	7	205.6, 206.6	2nd site 1.25 E. of Minden Bridge
43	94A-8	2	1994	N	4/5	1 N, 1 W Hwy 10/I-80 Exit	8		
44	94A-14	1	1994	Y	4/14	1 downstream I-80 Bridge	2	171.5	
45	94A-15	1	1994	Y	4/14	1.5 upstream Gibbon Bridge	7	203.8	Rowe Sanctuary
46	95A-8	2	1995	Y	4/14	5 S, 1 W Gibbon	7	203.1	
47	95A-21	1	1995	Y	5/8-14	1/2 N, 5 W Doniphan	3	180.6	
48	95B-5	5	1995	Y	10/25	2 3/4 E Hwy 10 Bridge	7	205.25	
49	96A-3	1	1996	N	3/30	2 E Elm Creek	10	NA	
50	96A-9	3	1996	N	4/7-9	3 ½ S 1 ½ Odessa	9		
51	96A-10	2	1996	Y	4/10	3.5 upstream Wood R Bridge	5	191.1	

	Group ID	No. Cranes	Year	River Use	Dates of Use[1]	Location[2, 3]	Bridge Segment	River Miles[4]	Comment
52	96A-11	3	1996	Y	4/11	0.5 upstream Wood R Bridge	4,5	187.8	
53	96A-21	3	1996	N	4/20	2 N, 1 W Doniphan	3	NA	wet meadow, mid-day
54	96A-22	3	1996	Y	4/20-21	1 W, 2 N Doniphan	3	176.6	
55	96A-31	2	1996	Y	5/8-13	2 S, 2 E Elm Creek	10	228.6	
56	97A-1	1	1997	Y	3/9	4.5 S, 1.75 W Gibbon	7	203.9	
57	97A-2	1	1997	Y	3/10 - 4/17	3 W Doniphan	3,4	183.1, 180.7, 178.4	
58	97A-3	1	1997	Y	3/19 - 4/7	4.5 S, 4 W Gibbon	7	205.7, 203.0, 204.0	
59	97A-6	1	1996	N	4/14	6 S Gibbon	7	NA	
60	97A-7	2	1997	Y	4/14-16	2 S Gibbon	7	203.4	
61	97A-17	3	1997	Y	4/21-24	5 S, 2 W Gibbon	6,7	204.1	
62	97A-18	1	1997	N	4/16-19	4 ½ S 1 W Overton	11,12		
63	98A-1	1	1998	Y	2/15 - 3/25	3 W Doniphan	3,4	NA	
64	98A-3	1	1998	Y	3/23 - 4/9	5.5 N, 4 E Doniphan	2	NA	
65	98A-4	1	1998	N	3/27-28	4 S I-80 Alda Interchange	3,4	NA	likely roost on river
66	98A-6	1	1998	Y	3/30	1.25 N, 1 ¾ W Doniphan	3	NA	Adult with sandhills
67	98A-7	1	1998	N	4/3	2 N, 3 E I-80 Alda Exit	3	NA	5:00 PM, feeding with sandhills
68	98A-16	2	1998	N	4/14	6.5 S, 2.5 W Wood River	5	NA	8 AM - 11:15, flooded pasture
69	98B-8	3	1998	Y	10/22 – 11/9	1.25 E, Hwy 10 Bridge	7	204, 207.6	Rowe Sanctuary
70	99A-1	1	1999	Y	3/4-23	3 S, E Gibbon	2,3,4,6		
71	99A-3	1	1999	N	3/23	2 S, 2 W Wood River/I-80	5	NA	Assumed same birds as 99A-2
72	99A-4	1	1999	N	3/21	1 ¾ S, 2 W Shelton/I-80	6		
73	99A-7	2	1999	N	4/3	2 ½ S, 1 ½ E Overton/I-80	11	NA	
74	99A-28	2	1999	Y	3/15	2.5 W Gibbon Bridge	7	NA	
75	00A-2	1	2000	Y	3/2-4/4	2.5 W Doniphan	3		
76	00A-4	1	2000	Y	3/8-16	2.5 W Doniphan	3		
77	00B-30	2	2000	Y	11/3	1.5 W Gibbon Bridge	7		
The following birds were only observed in flight over the Platte River									
1	77A-4	1	1977	Y	3/29	2 E Minden (#10) Bridge	7	206	

	Group ID	No. Cranes	Year	River Use	Dates of Use[1]	Location[2, 3]	Bridge Segment	River Miles[4]	Comment
2	80A-14	7	1980	NA	4/19	Interstate 80/#44	8-9	NA	
3	84B-60	2	1984	NA	10/28	1 E Minden (#10) Br	8-7	NA	
4	85B-11	4	1985	NA	10/12	SE Grand Is. Camp Augustine	3	NA	
5	90B-13	3	1990	NA	10/23	Gibbon Br	6-7	NA	
6	90B-17	1	1990	NA	11/1	1/2 W. Minden (#10) Br.	8	NA	
7	95B-16	1	1995	NA	11/3	Over Kearney	9	NA	
8	96B-25	1	1996	NA	11/1	5 S, 2 W Gibbon	7	NA	Flying over Rowe Sanctuary, mid AM
9	96B-30	2	1996	NA	11/3	I-80 & Hwy 44 Jct	9	NA	Flying early afternoon
10	98B-25	1	1998	NA	11/11	S of Wood River I-80 exit	5	187	Flying over river at 11:30 AM
11	99A-2	1	1999	NA	3/21	3 S, 2 W Gibbon	7	NA	Assumed same birds as 99A-3
11	99A-9	2	1999	NA	4/6	1 E Gibbon	6	NA	
13	99B-26	3	1999	NA	10/26	4 ½ W Overton/I-80 Exit	12	NA	

Source: NGPC 1993; USFWS - Grand Island, unpublished data.

Notes:

1 When initial sighting occurred in early morning, arrival was assumed to be the previous day.

2 Only 2 Platte valley sightings west of Lexington.

3 Locations are distance in miles from identified landmark.

4 COE river miles

Table 3. Probable sightings of whooping cranes in the Platte River valley, 1980-2000. (These sightings are not included in Table 2).

	Group ID	No. Cranes	Year	River Use	Dates of Use[1]	Location[2, 3]	Bridge Segment	Comment
1	80A-3	2	1980	N	4/18	1 S Odessa	9	Assumed same as 80A-1, 80A-2
2	84A-15	2	1984	N	4/11	1 E, 1 ½ S Kearney Br	9	
3	85A-4	4	1985	Y	4/3	Alda Br	3	South Channel Platte
4	85B-61	2	1985	Y	4/17	1 S, 2 E Wood River I-80 Exit	4	Uridil Property
5	86B-82	4	1986	Y	11/11	1/8 E Gibbon Br	6	
6	88A-25	2	1988	N	3/13	2 ½ - 3 W Alda Rd	4	
7	88A-26	2	1988	N	3/21	2 ½ E Hwy 10 Br	7	
8	88A-27	3	1988	N	4/1	¾ W Wood River, S I-80	5	
9	90A-15	4	1990	N	4/4	4 ½ W Kearney Br	9	
10	90A-18	3	1990	N	4/30	3 E Hwy 44, Ft. Kearny Rd	8	
11	90A-21	1	1990	N	4/30	3 E Hwy 10 Br	7	
12	95A-46	1	1995	N	5/16	2 S Alda Br	3	
13	00A-22	7	2000	N	4/8 or 4/9	2 W Platte/Alda Rd Intersection	4	
Groups flying over river (use of river not confirmed)								
1	84B-37	3	1984	NA	10/28	3 S, 1 ¼ E Overton	11	
2	84B-45	2	1984	NA	10/28	S Wood River	5	
3	86B-95	3	1986	NA	11/3	E Kearney Br	9	
4	87A-30	5	1987	NA	4/10	1 W Doniphan	3	
5	87B-77	2	1987	NA	10/27	Grand Island	2	With sandhills
6	91A-24	2	1991	NA	4/11	1 ½ E Hwy 10 Br	7	
7	92A-27	8	1992	NA	4/13	4 ½ S, 5 E Kearney	8	
8	92B-35	8	1992	NA	11/20	4 W Kearney	9	
9	93B-37	2	1993	NA	10/23	Near Ft. Kearny	8	
10	93B-39	3	1993	NA	10/21	2 ½ W Wood River Br	5	
11	95B-24	7	1995	NA	10/24	Near Overton / I-80	11	
12	95B-26	8	1995	NA	11/3	Near Kearney Br	8	
13	99B-58	3	1999	NA	10/29	W Grand Island	2	
14	99B-59	3	1999	NA	11/2	SW Kearney	9	

Source: NGPC 1993; USFWS - Grand Island, unpublished data. NA = not available. See definition of Probable Sighting for Whooping Crane.

1 When initial sighting occurred in early morning, arrival was assumed to be the previous day.

2 Only 2 Platte valley sightings west of Lexington. 3 Locations are distance in miles from identified landmark. 4 COE river miles

Table 4. Sightings of whooping cranes in the Platte River Cooperative Agreement study area, 2001 to Fall 2006. Data was obtained following the Cooperative Agreement's protocol to monitor migrational habitat use. Standard deviations in parentheses after means. Surveys were not conducted in Spring 2003.

Crane Group ID	USFWS Crane Group ID	No. Cranes	No. Locations[1]	No. Channel Locations[1]	No. Use Dates	First Use Date	Distance to Visual Obstruction (meters)	Unobstructed Width (meters)	Water Width (meters)	Water Depth (meters)	Sandbar Elevation (meters)	n[2]
2001 Spring												
2001SP01	01A-03	1	9	3	3	3/23/2001	256.5 (43.73)	270.29 (26.6)	262.11 (16.94)	0.2309 (0.02)	0.1161 (0.01)	3
2001SP03	01A-03	1	30	5	8	3/29/2001	106 (39.49)	166.08 (73.55)	163.95 (74.28)	0.2463 (0.1)	0.1675 (0.18)	5
2001 Fall												
2001FA01	01B-13	1	1	1	1	10/23/2001	187.5	373.48	132.67	0.0928	0.315	1
2002 Spring												
2002SP01	02A-01	1	1	1	1	3/21/2002	168.75	219.66	96.77	0.0931	0.3553	1
2002SP02	02A-01	1	5	1	1	3/23/2002	161.5	264.16	114.67	0.1283	0.3327	1
2002SP03	02A-01	1	13	1	1	3/24/2002	196	275.74	199.33	0.1247	0.3807	1
2002SP04	02A-01	1	1	1	1	3/26/2002	226.5	370.03	233.33	0.1697	0.3267	1
2002SP05	02A-01	1	1	1	1	3/27/2002	121	377.14	159.67	0.1313	0.186	1
2002SP06	02A-01	1	2	1	1	3/28/2002	229.5	316.79	176.33	0.134	0.19	1
2002SP07	02A-01	1	2	1	1	3/30/2002	411.75	349.71	169.67	0.0922	0.228	1
2002SP08	02A-01	1	2	0	1	3/31/2002	.	.	.	.	.	0
2002SP09	02A-01	1	5	1	1	4/1/2002	355.25	344.73	236.33	0.28	0.4263	1
2002SP10	02A-01	1	1	0	1	4/2/2002	.	.	.	.	.	0
2002SP11	02A-01	1	1	1	1	4/3/2002	.	.	.	.	.	0
2002SP12	02A-01	1	1	1	1	4/4/2002	.	.	.	.	.	0
2002SP13	02A-01	1	1	0	1	4/6/2002	.	.	.	.	.	0
2002SP14	02A-01	1	1	0	1	4/11/2002	.	.	.	.	.	0
2002SP15	02A-01	1	1	1	1	4/13/2002	130.25	152.65	38.43	0.0532	0.178	1
2002 Fall												
2002FA01	02B-1	1	2	2	2	10/14/2002	164.75 (0)	221.13 (0)	33.37 (0)	0.1172 (0)	0.5233 (0)	2
2002FA02	02B-40	8	37	15	11	11/1/2002	133.88 (63.79)	195.06 (97.33)	95.69 (52.62)	0.145 (0.06)	0.292 (0.1)	13
2002FA03	02B-41	2	9	6	2	11/1/2002	90	246.89	124.67	0.1543	0.1507	1
2002FA04	02B-42	3	33	17	9	11/2/2002	168.22 (77.05)	225.18 (85.44)	147.83 (17.42)	0.2062 (0.04)	0.1876 (0.16)	16

2002FA05	02B-43	1	13	7	4	11/6/2002	162.07 (70.53)	257.67 (99.84)	195.61 (92.78)	0.1628 (0.02)	0.2659 (0.06)	7
2002FAI01	02B-3	1	1	1	1	10/14/2002	120	247.04	69.37	0.0742	0.1123	1
2002FAI02		2	1	0	1	10/14/2002	.	.	.	.	.	0
2003 Fall												
2003FA01	03B-7	1	2	1	1	10/15/2003	165.75	128.32	45.1	0.0872	0.173	1
2004 Spring												
2004SP01	04A22	2	1	1	1	4/4/2004	132.5	144.17	62.7	0.1253	0.1427	1
2004 Fall												
2004FA01	04B-55	6	1	1	1	11/6/2004	223.75	363.32	160	0.1083	0.1065	1
2004FA02	04B-55	6	1	1	1	11/5/2004	130.5	220.07	142.67	0.1563	0.1209	1
2005 Spring												
2005SP01	05A-02	1	1	0	1	3/28/2005	.	.	.	.	.	0
2005SP02	05A-02	1	1	1	1	3/29/2005	175	252.58	169.67	0.2217	0.0743	1
2005SP03	05A-02	1	1	1	1	3/29/2005	165	225.35	143.67	0.198	0.081	1
2005SP04	05A-02	1	1	0	1	3/29/2005	.	.	.	.	.	0
2005SP05	05A-02	1	1	1	1	3/29/2005	165	225.35	143.67	0.198	0.081	1
2005SP06	05A-19	1	1	1	1	3/29/2005	175.5	231.14	106.83	0.0906	0.1227	1
2005SP07	05A-19	1	1	1	1	3/29/2005	175.5	231.14	106.83	0.0906	0.1227	1
2005SP08	05A-02	1	8	0	1	3/30/2005	.	.	.	.	.	0
2005SP09	05A-02	1	1	1	1	3/31/2005	165	225.35	143.67	0.198	0.081	1
2005SP10	05A-02	1	1	0	1	3/31/2005	.	.	.	.	.	0
2005SP11	05A-02	1	1	1	1	4/2/2005	235.25	316.18	195.67	0.2107	0.1213	1
2005SP12	05A-02	1	1	0	1	4/2/2005	.	.	.	.	.	0
2005SP13	05A-05	2	1	1	1	4/7/2005	.	.	.	.	.	0
2005 Fall												
2005FA01	05B-26	2	1	1	1	11/3/2005	.	.	.	.	.	0
2006 Spring												
2006SP01	06A-01 or 02	1	1	1	1	3/23/2006	179.25	253.29	102.6	0.1693	0.147	1
2006SP02	06A-01 or 02	1	1	0	1	3/23/2006	.	.	.	.	.	0
2006SP03	06A-01 or 02	2	1	1	1	3/24/2006	153.5	189.48	90.63	0.208	0.1086	1
2006SP04	06A-01 or 02	1	1	0	1	3/25/2006	.	.	.	.	.	0
2006SP05	06A-01 or 02	1	1	0	1	3/25/2006	.	.	.	.	.	0

2006SP06	06A-01 or 02	1	1	0	1	3/25/2006	.	.	.	.	.	0
2006SP07	06A-01 or 02	1	2	2	1	3/26/2006	385 (0)	462.58 (0)	189.33 (0)	0.1487 (0)	0.2277 (0)	2
2006SP08	06A-01 or 02	1	1	0	1	3/26/2006	.	.	.	.	.	0
2006SP09	06A-01 or 02	1	1	1	1	3/28/2006	385	462.58	189.33	0.1487	0.2277	1
2006SP10	06A-01 or 02	1	1	1	1	3/28/2006	136.5	240.89	129.67	0.207	0.0885	1
2006SP11	06A-01 or 02	1	2	0	1	3/28/2006	.	.	.	.	.	0
2006SP12	06A-01 or 02	1	1	0	1	3/28/2006	.	.	.	.	.	0
2006SP13	06A-01 or 02	2	1	1	1	3/29/2006	385	462.58	189.33	0.1487	0.2277	1
2006SP14	06A-01 or 02	1	5	0	1	3/29/2006	.	.	.	.	.	0
2006SP15	06A-01 or 02	1	1	0	1	3/29/2006	.	.	.	.	.	0
2006SP16	06A-03	2	1	1	1	3/30/2006	81.25	113.79	69.7	0.254	0.0975	1
2006SP17	06A-03	2	1	0	1	3/30/2006	.	.	.	.	.	0
2006SP18	06A-01 or 02	1	2	0	1	3/30/2006	.	.	.	.	.	0
2006SP19	06A-01 or 02	1	1	1	1	3/31/2006	385	462.58	189.33	0.1487	0.2277	1
2006SP20	06A-03	2	1	1	1	3/31/2006	78.5	114.91	90.77	0.218	0.0831	1
2006SP21	06A-03	2	4	0	1	3/31/2006	.	.	.	.	.	0
2006SP22	06A-01 or 02	1	1	0	1	3/31/2006	.	.	.	.	.	0
2006SP23	06A-03	2	1	1	1	4/1/2006	78.5	114.91	90.77	0.218	0.0831	1
2006SP24	06A-03	2	2	0	1	4/1/2006	.	.	.	.	.	0
2006SP25	06A-01 or 02	1	1	1	1	4/1/2006	153.5	189.48	90.63	0.208	0.1086	1
2006SP26	06A-01 or 02	1	3	0	1	4/1/2006	.	.	.	.	.	0
2006SP27	06A-01 or 02	1	1	0	1	4/1/2006	.	.	.	.	.	0
2006SP28	06A-01 or 02	1	2	0	1	4/1/2006	.	.	.	.	.	0

2006SP29	06A-05	3	1	1	1	4/2/2006	131.75	280.44	120.33	0.228	0.0977	1
2006SP30	06A-05	3	1	0	1	4/2/2006	.	.	.	.	.	0
2006SP31	06A-05	3	1	1	1	4/3/2006	62.5	144.86	86.1	0.2617	0.1132	1
2006SP32	06A-05	3	1	0	1	4/3/2006	.	.	.	.	.	0
2006SP33	06A-01 or 02	1	1	1	1	4/3/2006	246.5	451.61	154	0.2753	0.326	1
2006SP34	06A-01 or 02	1	3	0	1	4/3/2006	.	.	.	.	.	0
2006SP35	06A-01 or 02	1	1	1	1	4/4/2006	179.25	253.29	102.6	0.1693	0.147	1
2006SP36	06A-01 or 02	1	1	0	1	4/4/2006	.	.	.	.	.	0
2006SP37	06A-05	3	1	1	1	4/4/2006	93.5	256.13	110.33	0.222	0.2907	1
2006SP38	06A-05	3	2	0	1	4/4/2006	.	.	.	.	.	0
2006SP39	06A-01 or 02	1	1	0	1	4/5/2006	.	.	.	.	.	0
2006SP40	06A-01 or 02	1	1	1	1	4/6/2006	385	462.58	189.33	0.1487	0.2277	1
2006SP41	06A-01 or 02	1	2	2	1	4/8/2006	355.25 (0)	411.07 (0)	181.33 (0)	0.1233 (0)	0.2663 (0)	2
2006SP42	06A-01 or 02	1	2	0	1	4/8/2006	.	.	.	.	.	0
2006SP43	06A-01 or 02	1	1	1	1	4/9/2006	286.5	332.84	198	0.1387	0.0717	1
2006SP44	06A-01 or 02	1	1	1	1	4/1/2006	385	462.58	189.33	0.1487	0.2277	1
2006SP45	06A-01 or 02	1	1	1	1	3/31/2006	286.5	332.84	198	0.1387	0.0717	1
2006SP46	06A-01 or 02	1	2	0	1	3/26/2006	.	.	.	.	.	0
2006SP47	06A-05	3	1	0	1	4/3/2006	.	.	.	.	.	0
2006SP48	06A-01 or 02	2	1	0	1	3/30/2006	.	.	.	.	.	0
2006SP49	06A-01 or 02	1	1	1	1	3/14/2006	342.5	324.41	262	0.2257	0.0787	1
2006 Fall												
2006FA02	06B-22	3	5	3	1	10/24/2006	88.25 (0)	270.05 (0)	63.27 (0)	0.078 (0)	0.1947 (0)	3
2006FA03	06B-22	3	1	1	1	10/25/2006	43.5	120.9	79.7	0.1907	0.0373	1

2006FA04	06B-22	3	5	3	1	10/25/2006	68.75 (33.77)	195.17 (129.69)	53.46 (16.99)	0.1134 (0.06)	0.1471 (0.08)	3
2006FA07	06B-22	3	3	2	1	10/26/2006	118.88 (43.31)	326.64 (80.03)	76.23 (18.34)	0.0901 (0.02)	0.28 (0.12)	2
2006FA09	06B-22	3	6	3	1	10/27/2006	149.5 (0)	383.24 (0)	89.2 (0)	0.1021 (0)	0.3653 (0)	3
2006FA10	06B-22	3	1	1	1	10/28/2006	113.5	227.58	83.97	0.132	0.1367	1
2006FA11	06B-22	3	3	1	1	10/28/2006	90.25	237.24	85.43	0.1887	0.184	1
2006FA13	06B-22	3	7	4	1	10/29/2006	157.13 (63.08)	359.16 (59.93)	81.11 (12.27)	0.094 (0.01)	0.2953 (0.08)	4
2006FA14	06B-22	3	5	3	1	10/30/2006	201.33 (69.14)	350.28 (86.29)	77.52 (9.08)	0.0955 (0)	0.2703 (0.02)	3
2006FA17	06B-22	3	6	3	1	10/31/2006	129.08 (35.36)	345.51 (65.35)	80.56 (14.97)	0.0941 (0.01)	0.3084 (0.1)	3
2006FA19	06B-22	3	8	6	1	11/1/2006	118.88 (33.55)	326.64 (61.99)	76.23 (14.2)	0.0901 (0.01)	0.28 (0.09)	6
2006FA21	06B-22	3	7	4	1	11/2/2006	218.31 (45.88)	395.88 (8.43)	84.38 (3.22)	0.096 (0)	0.2833 (0.05)	4
2006FA22	06B-22	3	9	5	1	11/3/2006	222.9 (41.03)	396.73 (7.54)	84.05 (2.88)	0.0955 (0)	0.2779 (0.05)	5
2006FA25	06B-22	3	5	2	1	11/4/2006	90.25 (0)	237.24 (0)	85.43 (0)	0.1887 (0)	0.184 (0)	2
2006FA27	06B-22	3	2	2	1	11/5/2006	164.75 (108.19)	335.08 (91.96)	73.02 (13.79)	0.086 (0.01)	0.2253 (0.04)	2
2006FA28	06B-22	3	3	2	1	11/6/2006	165.75 (106.77)	318.67 (115.16)	84.1 (1.89)	0.1413 (0.07)	0.22 (0.05)	2

1 Number of locations represents each time a crane group was observed in a different but not necessarily unique location.
2 Sample size (n) for each average represents the number of channel locations with data.

Table 5. Summary of measurements at whooping crane use sites along the central Platte River, 1966-2000.

Sighting Number[1]	Roost Night (Mo/Day/Year)	No. of Cranes	Active Channel Width[2] (feet)	Water Width[2] (feet)	Percent Wetted Width[2]	% of Water Width <0.7 ft	Approx. Visibility (Miles)		Location		River Information	
							Upstream	Downstream	River Mile	Bridge Segment	Flow[3] (cfs)	Nearest Gage
66B-2	10/21/66	5	827	827	"full"	---	unlim	unlim	~158	1	1200	Grand Island
74B-5	10/31/74	2	856	---	---	---	good	good	~206	7	838	Odessa
75A-6	4/18/75	7							223.5			
75A-7	4/19/75	5	696	696	"full"	---	---	---	223.5	9	1240	Odessa
77A-4	3/29/77	1	755	755	"full"	---	---	---	~206	7	1560	Odessa
80A-11	4/17/80	2	606	606	"full"	---	v good	v good	~207	7	5030	Odessa
80A-12	4/18/80	2								7		
83B-21	10/27/83	5	1152	748	65	47	---	---	191.1	5	1210	Grand Island
85B-18	10/20/85	3	1019	826	81	40	---	---	206.4	7	1850	Kearney
86B-58	11/4/86	3	699	646	92	49	---	---	213	8	3030	Kearney
87A-1	3/21/87	1	1207	1207	100	21	---	---	202.9	7	3760	Kearney
87A-1	4/7/87	1	1087	1087	100	15	---	---	206	7	3580	Kearney
87A-1	4/9/87	1	975	948	97	47	---	---	203.6	7	2900	Kearney
87A-1	4/10/87	1	1048	1048	100	16	---	---	206.4	7	2760	Kearney
87A-1	4/11/87	1	881	861	98	26	---	---	203.6	7	2420	Kearney
87B-2	10/21/87	2	986	963	98	55	---	---	201.2	6	773	Kearney
88A-1	3/24/88	2	374	356	95	17	0.5	0.8	208.6	8	2360	Kearney
88A-1	3/25/88	2	831	831	100	32	0.3	0.6	209.6	8	2170	Kearney
88A-2	3/28/88 3/29/88	2	552	520	94	29	---	---	226.3	10	2350	Odessa
88A-2	3/30/88	2	172	172	100	72	---	---	226.5	10	2260	Odessa
88A-2	4/1/88	2	495	495	100	28	---	---	227	10	2210	Odessa
88A-2	4/4/88	2	475	475	100	18	---	---	224.6	10	2150	Odessa
88A-2	4/6/88	2	507	507	100	6	---	---	224.9	10	2450	Odessa
88A-3	4/3/88	1	850	843	99	28	1+	1+	189.8	5	2260	Grand Island
88A-3	4/4/88	1	570	562	99	38	1+	1+	189.5	5	2120	Grand Island
88A-4	4/3/88	1	1365	804	59	29	0.5	1.8	183	4	2260	Grand Island
89A-1	3/29/89	1	709	677	95	72	0.5	1+	191.1	5	1590	Grand Island
89A-1	4/13/89	1	528	-----	-----	-----	-----	-----	188.0	5	802	Grand Island
89A-13	4/16/89	1	678	589	87	46	0.25	0.5	211	8	808	Kearney
89B-5	10/13/89	4	910	824	91	67	1+	1+	189.9	5	920	Grand Island
89B-18(d)	11/4/89	2	700e	---	---	---	---	---	179.5	3	842	Grand Island
89B-18(d)	11/4/89	2	900e	---	---	---	---	---	184.2	4	842	Grand Island

Sighting Number[1]	Roost Night (Mo/Day/Year)	No. of Cranes	Active Channel Width[2] (feet)	Water Width[2] (feet)	Percent Wetted Width[2]	% of Water Width <0.7 ft	Approx. Visibility (Miles)		Location		River Information	
							Upstream	Downstream	River Mile	Bridge Segment	Flow[3] (cfs)	Nearest Gage
90A-4(d)	4/14/90	3	750	750	100	30	0.3	1+	207.5	7	2160	Kearney
90B-15	10/26/90	3	469	384	82	62	0.4		193.5	5	604	Grand Island
92A-3(d)	4/10/92	2	670e	---	---	---	---	---	201.6	6	1810	Kearney
92A-4	4/10/92	4	855	836	98	50	1+	1+	204.3	7	1810	Kearney
92A-5	4/10/92	6	673	524	78	24	0.25	0.5	239.0	11	1590	Overton
92A-10(d)	4/13/92	5	799	726	91	41	1+	1+	204.7	7	1990	Kearney
93A-2	4/9/93	5	1453	1158e	80e	46	0.5	0.2	206.5	7	1970	Kearney
93A-3	4/9/93	2	887	834	94	53	1+	1+	180.2	3	2170	Grand Island
93A-4	4/9/93	2	552	539	98	48	0.5	0.1	188.1	5	2170	Grand Island
94A-3(d)	4/4/94	2	660e	---	---	---	---	---	201.0	6	1170	Kearney
94A-4	4/4/94	2	899	691	77	60	---	---	205.6	7	1170	Kearney
94A-4	4/5/94	2	1008	585	58	50	---	---	206.6	7	996	Kearney
94A-14	4/13/94	1	1000e	---	---	---	---	---	171.5	2	1650	Grand Island
94A-15	4/13/94	1	1200e	---	---	---	---	---	203.8	7	1030	Kearney
95A-8(d)	4/14/95	2	800e	---	---	---	---	---	203.2	7	1340	Kearney
95A-21	5/8/95	1	1251	1149e	92e	30e	1+	1+	180.6	3	2240	Grand Island
95B-5	10/24/95	5	736	609	83	36	1+	1+	205.25	7	1930	Kearney
96A-10(d)	4/10/96	2	1000e	---	---	---	---	---	191.1	5	2230	Grand Island
96A-11	4/10/96	3	476	466	98	56	---	---	187.8	5	2230	Grand Island
96A-22	4/20/96	3	926	639	69	70	---	---	176.6	3	2130	Grand Island
96-A31	5/8/96	2	797	681	85	56	0.75	0.5	228.2	10	1020	Overton
97-A1	3/8/97	1	881	801	90	33	---	---	203.9	7	2360	Kearney
97-A2	3/13/97	1	1500	1177	78	53	0.5	0.1	183.1	3	2620	Grand Island
97-A2	3/20/97	1	1197	1196	100	49	---	---	180.7	3	2070	Grand Island
97-A2	3/26/97	1	707	644	91	42	---	---	178.4	3	2330	Grand Island
97-A3	3/19/97	1	843	693	82	33	---	---	205.7	7	2180	Kearney
97-A3	3/20/97	1	915	846	92	27	---	---	203	7	2070	Kearney
97-A3	3/25/97	1	833	833	100	44	---	---	204	7	2370	Kearney
97-A7	4/14/97	2	945	945	100	58	0.5	1+	203.4	7	2070	Kearney
97-A17	4/21/97	3	763	710	93	19	---	---	204.1	7	2230	Kearney
98-A1	3/4/98	1	950*	770	81*	46	1	1	178.2	3	2800	Grand Island
98-A3	3/28/98	1	656e	656e	100e	---	---	---	169.7	2	5020	Grand Island
98-A6	3/29/98	1	800e	800e	100e	---	---	---	177.1	3	5470	Grand Island
98-B8	10/23/98	3	970	769	82	26	---	---	207.7	7	2030	Kearney
98-B8	10/25+/98	3	847	846	100	40	---	---	204.0	7	2130	Kearney

Sighting Number[1]	Roost Night (Mo/Day/Year)	No. of Cranes	Active Channel Width[2] (feet)	Water Width[2] (feet)	Percent Wetted Width[2]	% of Water Width <0.7 ft	Approx. Visibility (Miles)		Location		River Information	
							Upstream	Downstream	River Mile	Bridge Segment	Flow[3] (cfs)	Nearest Gage
98-B8	10/25+/98	3	1238*	999	81*	36	---	---	203.7	7	2130	Kearney
99-A1	3/13/99	1	1005	1005	100	24	---	---	180.8	4	*2350	Grand Island
99-A1	3/14/99	1	890	861	97	55	---	---	169.0	2	*2300	Grand Island
99-A1	3/21/99	1	1021	1021	100	44	---	---	189.9	5	*2000	Grand Island
00-A2	3/7/00	1	729	---	---	---	---	---	178.7	3	---	Grand Island
00-A2	03/22,24,25/00	1	880	---	---	---	---	---	176.8	3	---	Grand Island
00-A4	03/8-16/00	1								3		Grand Island
00-B30	11/3/00	2							203.8	7		Kearney

Source: USFWS, Grand Island unpublished draft data

Notes:

1 (d) = day use; roosting not confirmed; --- = no data available

2 e = estimated; * = manipulated site; metrics not directly comparable to other natural sites

3 * = provisional data

Figure 1. Breeding and wintering areas, and migration pathway of the Aransas-Wood Buffalo population of whooping cranes (FWS 1994).

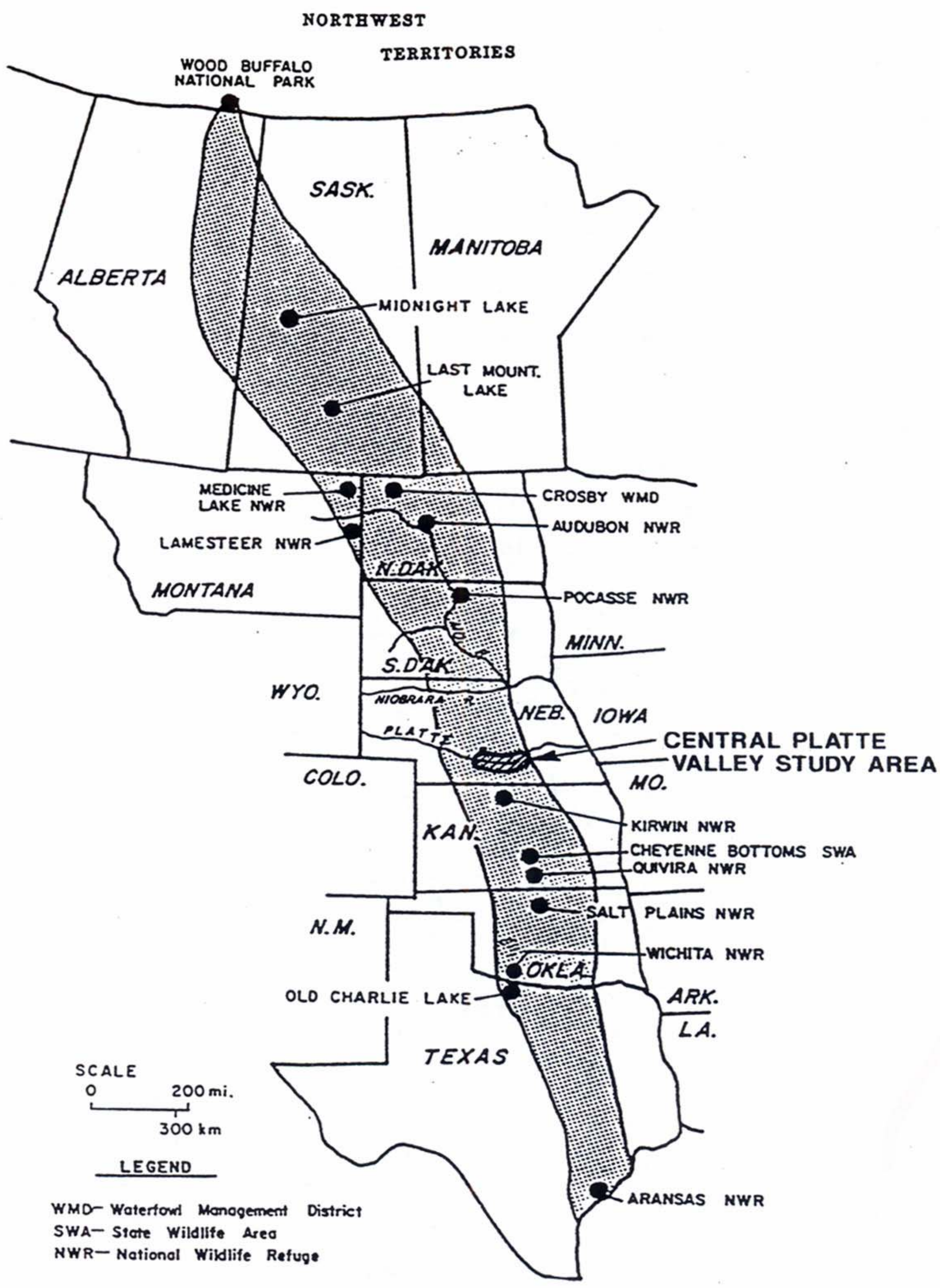


Figure 2. Location of the Central Platte River Study Area.

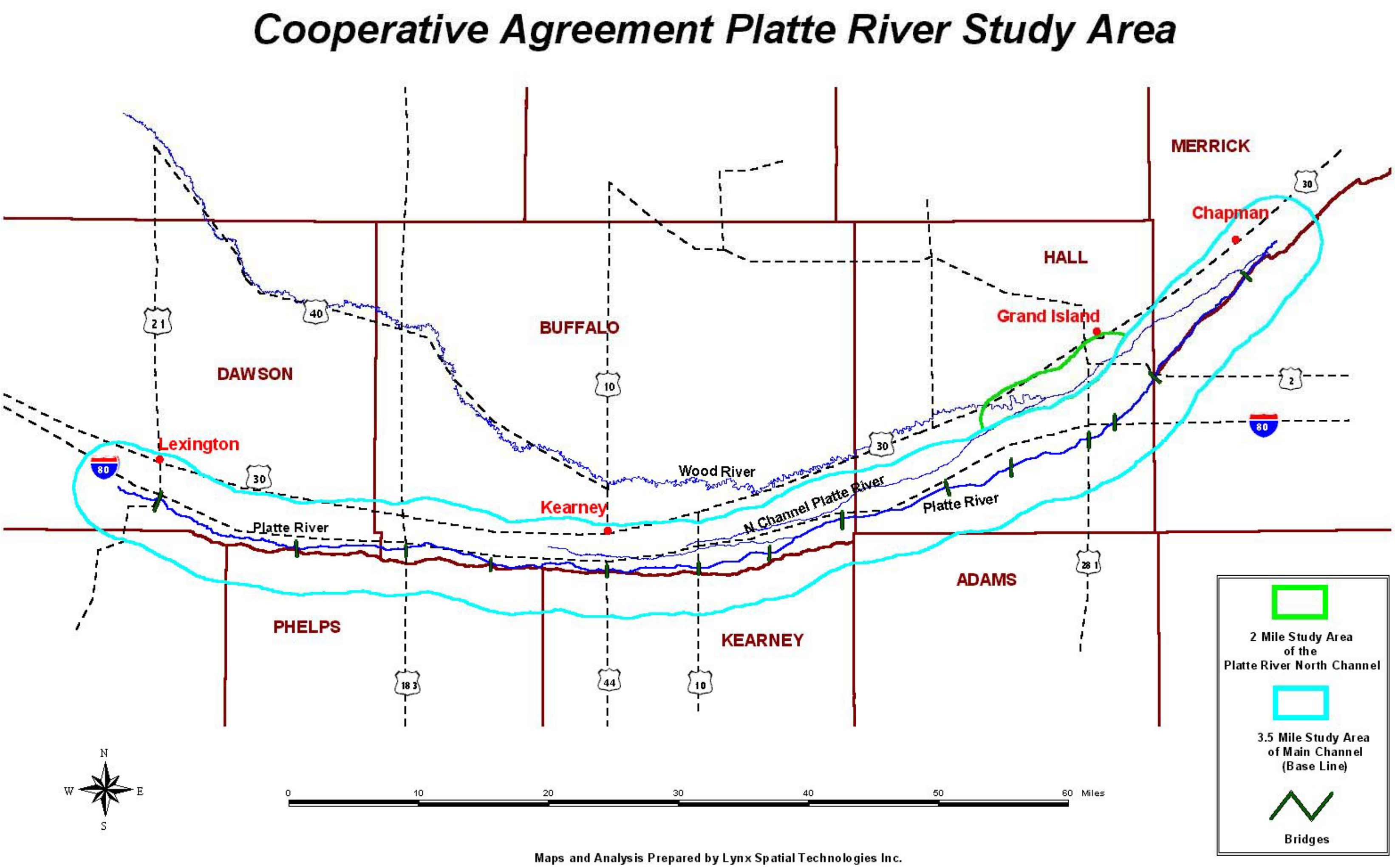


Figure 3. Whooping crane sightings in Nebraska, spring and fall, 1943-1999 (from Austin and Richert 2001).

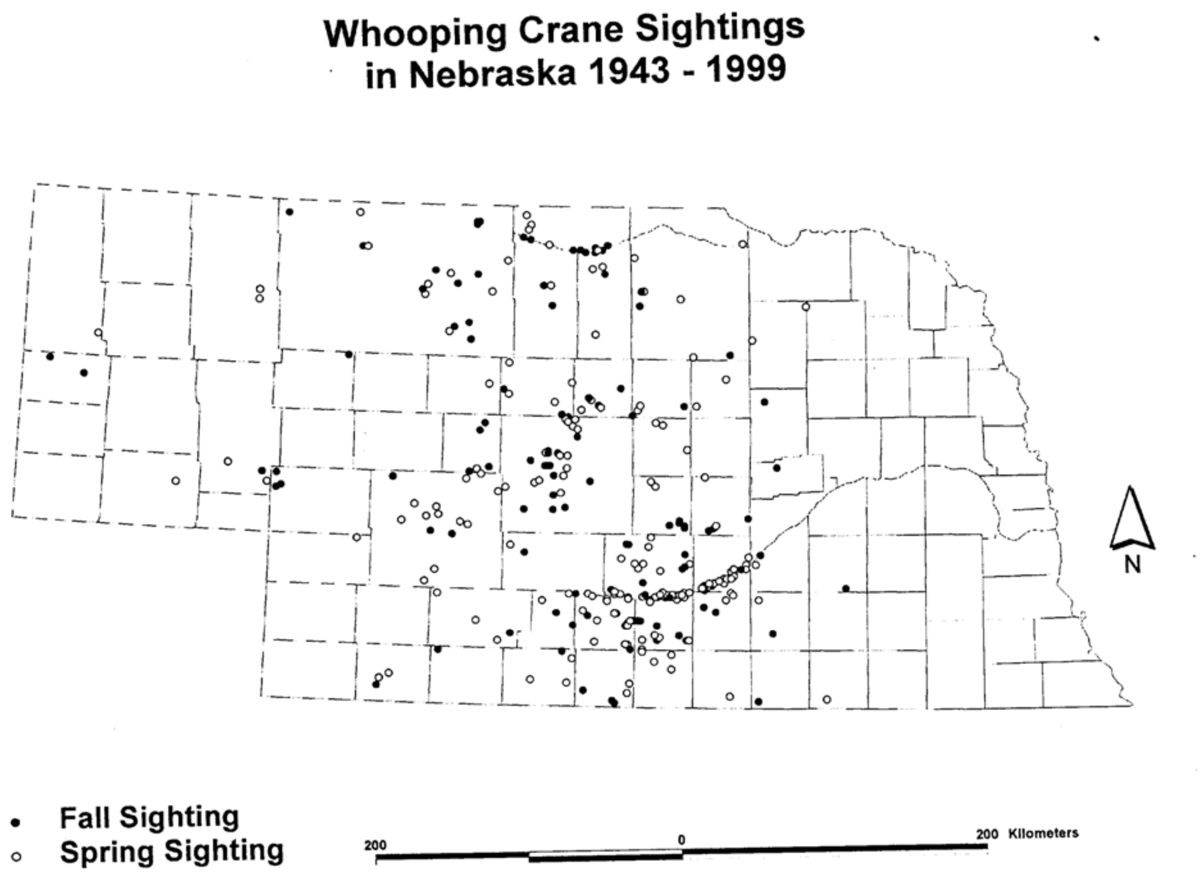
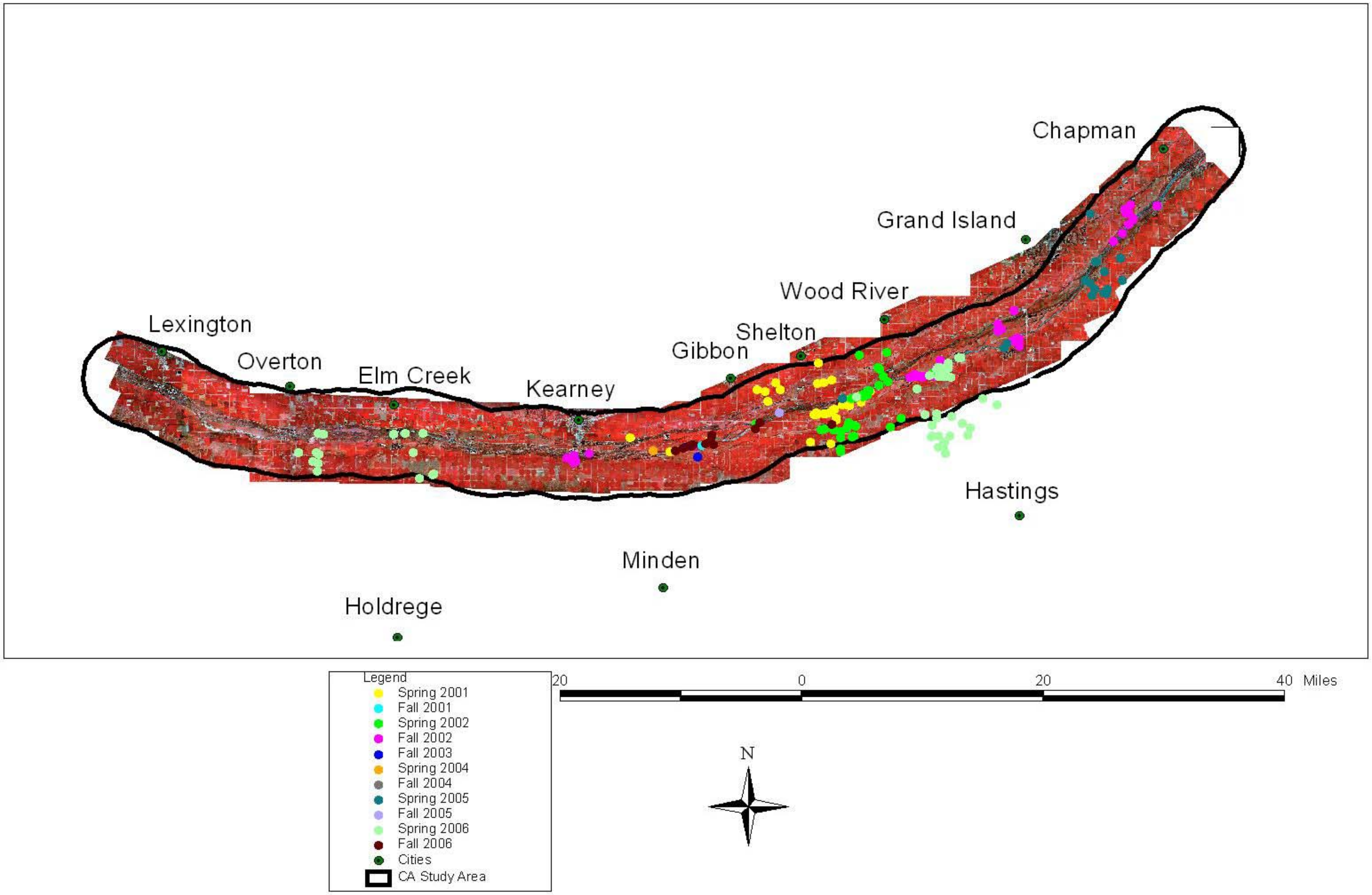


Figure 4. Whooping crane use sites along the central Platte River located during implementation of the Whooping Crane Monitoring Protocol, 2001 to 2006.



Appendix A. Whooping crane habitat studies throughout the Aransas-Wood Buffalo migration corridor.

Austin, J. E. and A. L. Richert. 2001. A comprehensive review of the observational and site evaluation data of migrant whooping cranes in the United States, 1943-99. U.S. Geological Survey, Northern Prairie Wildlife Research Center, Jamestown, North Dakota, and State Museum, University of Nebraska, Lincoln, Nebraska. 157pp.

This report summarizes whooping crane sighting and habitat use data from 1943-1999 throughout the Aransas-Wood Buffalo flyway. The data used for analysis was from the FWS records of whooping crane stopover sightings that have been documented since 1943. Standardized reporting began in 1977. From 1978-1999 site evaluations were compiled and described.

Howe, M. A. 1987. Habitat use by migrating whooping cranes in the Aransas-Wood Buffalo Corridor. Pages 303-311 in Proceedings from the 1985 Crane Workshop.

This report includes data collected on habitat use at nearly all stopovers in the United States and Canada through five migrations of individually radio-marked birds. Habitat characteristics of all feeding and roosting sites used at migratory stopovers in this study is evaluated.

Howe, M.A. 1989. Migration of radio-marked whooping cranes from the Aransas-Wood Buffalo population: Patterns of habitat use, behavior, and survival. U.S. Fish and Wildlife Service, Fish Wildl. Tech. Report 21. 33 pp.

This report includes data collected on habitat use, behavior, and survival in the prairies of the United States and southern Canada through five migrations of nine individually radio-marked birds from the Aransas-Wood Buffalo population. Habitat characteristics of all feeding and roosting sites used during migratory stopovers is evaluated.

Johnson, K. A. and S. A. Temple. 1980. The migratory ecology of the whooping crane (*Grus americana*). Unpublished report prepared under contract to U. S. Fish and Wildlife Service (Contract No. 14-16-0009-78-034). University of Wisconsin, Madison.

This report provides roost site characteristics based on incidental sightings of migrating whooping cranes. Habitat use at over 100 sites in the United States is described.

BASELINE DOCUMENT

LEAST TERN AND PIPING PLOVER SECTION

Table of Contents

List Of Tables And Figures

I. BACKGROUND

I.A. Population Status

I.A.1. Least Tern Population Status

The interior population of the least tern (*Sterna antillarum*) was listed as an endangered species on May 28, 1985 (50 FR 21792). The least tern in the interior of North America was historically distributed along the major rivers including the Arkansas, Colorado, Mississippi, Missouri, Platte, and Rio Grande (Boyd and Thompson 1985, Ducey 1985 in Wilson et al. 1993).

Past surveys have shown that over 50% of the interior least tern population occurs in the Mississippi River between Osceola, Arkansas, and Cairo, Illinois; the Salt Plains National Wildlife Refuge in Oklahoma; and the Platte River in Nebraska (Shoemaker 1988 in Wilson et al. 1993). Kirsch and Sidle (1999) documented between 6.2-13.6% of the interior least tern population nesting on the Platte River in Nebraska from 1984 to 1995. The historic distribution of least terns is shown in Figure 1 (USFWS 1990).

Kirsch and Sidle (1999) compiled data from 1984 to 1995 of breeding interior least tern populations, and estimated population trends at 31 local areas in the Great Plains that had been surveyed three or more years within the 12-year period. They found that five areas had significant positive population trends, two areas had significant negative trends, and 24 areas had no significant population trends. The central Platte River was one of the areas for which no trend was detected. Local breeding population estimates fluctuated substantially on an annual basis (Kirsch and Sidle 1999).

I.A.2. Piping Plover Population Status

The piping plover *(Charadrius melodus)* was listed as a threatened species on December 11, 1985 (50 FR 50733). The piping plover has been extirpated from Illinois, Indiana, Ohio, Pennsylvania, and New Hampshire (Russell 1983, Haig and Oring 1985 *in* Gaines 1988). The Great Plains population has declined from an estimated 1,500 pairs in 1985 to less than 1,100 pairs in 1990 (Great Lakes and Northern Great Plains Piping Plover Recovery Team, unpublished data in Root et al. 1992). Most Great Plains nesting areas that have been monitored for 10 years or more have experienced declines of piping plovers, with an overall decrease of 13% between 1987 and 1991 (Haig and Plissner 1992). The 1996 international piping plover census reported a total of 3,332 birds, including 1,398 pairs, found at 340 sites in the Canadian Prairie and U.S. Great Plains. This represented a 5.0% decline since the 1991 International Census over the same region (Plissner and Haig 1997). From 1991 to 2001, the International Census documented a 14.9% decline in the U.S. Northern Great Plains and Canadian Prairies (Ferland and Haig 2002).

The historic distribution of piping plovers is shown in Figure 1 (USFWS 1988). The current breeding range for the Great Plains piping plover population extends from alkali wetlands in southeastern Alberta east to Lake of the Woods in southwestern Ontario, and south along major river systems of the plains such as the Yellowstone, Missouri, and Platte. Reservoirs in southeastern Colorado, and alkali wetlands in northeastern Montana, North Dakota, and South Dakota are also used (Plissner and Haig 1997).

In non-Missouri River portion of Nebraska, the international piping plover census reported 398 piping plovers in 1991 and 366 piping plovers in 1996. This represented an 8% (32 adults) decline in the Nebraska population over this time period. A comparison of the 1996 Nebraska census total with the statewide ten year (1987-1996) mean population of 447 (excluding Missouri River totals) suggested a decrease of 18% (81 adults) in the Nebraska piping plover population (Dinan 1997). The international piping plover census reported 308 piping plovers in 2001 (Ferland and Haig 2002). This represented a decrease of 18% from 1996 and 23% from 1991 (Ferland and Haig 2002).

A population growth model developed by Ryan et al. (1993) projected that the Great Plains piping plover population was declining 7% annually. Unchecked, this decline would result in species extirpation in approximately 80 years. The model also demonstrated that with survival rates held constant, a 31% increase in fledging rates (from 0.86, presently, to 1.13 chicks per breeding pair) would be required to stabilize the population. Annual population increases of 1 percent and 2 percent required fledging rates of 1.16 and 1.19 chicks per pair, respectively.

I.B. Platte River Breeding Population Ecology

I.B.1. Platte River Breeding Population Status

Least terns and piping plovers nest on exposed riverine sandbars or sandpits along the Platte River system as far west as Ogallala, including the shore of Lake McConaughy (Sidle et al. 1991, Wilson 1991, Kirsch 1992, Lingle 1993a, Sidle and Kirsch 1993). Sandpits provide most of the nesting substrate for least terns and piping plovers between North Platte and Columbus (upper and central Platte) (Sidle et al. 1991, Kirsch and Lingle 1993, Sidle and Kirsch 1993, Kirsch 1996).

Kirsch (2001) reported that numbers of least terns and piping plovers (not nests or pairs) on the central Platte were declining significantly at sandpits, with an insignificant increase on sandbars based on census and productivity data provided by the Nebraska Game and Parks Commission (NGPC), Nebraska Public Power District (NPPD), Central Nebraska Public Power and Irrigation District (CNPPID), Platte River Trust, FWS Grand Island field office, and the U.S. Army Corps of Engineers Omaha office. From 1987 to 1998 the numbers of terns averaged 28 on sandbars and 119 on sandpits (Kirsch 2001). During the same time period the numbers of plovers averaged 14 on sandbars and 43 on sandpits (Kirsch 2001).

I.B.1.a. Platte River Least Tern Breeding Population Status

The 2001 annual breeding survey documented 765 least terns in Nebraska (excluding the Missouri River) which included 101 birds along the central Platte River (Loup River mouth to Lexington Bridge) and 75 in the area between the Wood River mouth (near Chapman) to Lexington Bridge (Dinan 2001).

The location of least tern adults and nests observed on the river and counts of least tern adults and nests observed at sandpits during every Nebraska state annual breeding survey is recorded by NGPC. Summaries of the data can be found in Sidle et al. (1991), Kirsch and Sidle (1999), Dinan (2001), Kirsch (2001), Jenniges (2005), and Lingle (2004). The counts reported in these sources do not agree and the exact river miles and sites included in these summaries are not always reported.

The Cooperative Agreement monitoring activity involved recording counts of adult least terns and locating nests to estimate reproductive parameters (see methods below). The protocol was implemented from 2001 to 2006 in the Cooperative Agreement study area of the central Platte River (Figure 2). Raw data are maintained in a database and summaries have been reported in annual reports (PRESP 2002b, PRESP 2003, PRESP 2004, PRESP 2006a, PRESP 2006b). Locations (i.e., each sandpit or island, not each individual nest) documented as containing least tern nests since 2001 are found in Figure 3.

I.B.1.b. Platte River Piping Plover Breeding Population Status

The 2001 annual breeding survey documented 308 piping plovers in Nebraska (excluding the Missouri river) which included 27 birds along the central Platte River (Loup River mouth to Lexington Bridge) and 26 in the Program study area (Chapman to Lexington Bridge; Ferland and Haig 2002).

The location of piping plover adults and nests observed on the river and counts of piping plover adults and nests observed at sandpits during every Nebraska state annual breeding survey is recorded by NGPC. Summaries of the data can be found in Sidle et. al. (1991), Dinan et al (1993), Sidle and Kirsch (1993), Plissner and Haig (1997), Dinan (2001), Kirsch (2001), Ferland and Haig (2002), Jenniges (2005), and Lingle (2004). The counts reported in these sources do not agree and the exact river miles and sites included in these summaries are not always reported.

The Cooperative Agreement monitoring activity involves recording counts of adult piping plovers and locating nests to estimate reproductive parameters (see methods below). The protocol has been implemented from 2001 to 2006 in the study area of the central Platte River. Raw data are maintained in a database and summaries have been reported in annual reports (PRESP 2002b, PRESP 2003, PRESP 2004, PRESP 2006a, PRESP 2006b). Locations (i.e., each sandpit or island, not each individual nest) documented as containing piping plover nests since 2001 are found in Figure 3.

I.B.2. Nesting Biology

I.B.2.a. Least Tern Nesting Biology

The least tern breeding population is composed of metapopulations (i.e. breeding subpopulations that occur within local areas and are indistinct components of the larger breeding population) (Wiens and Rothberry 1981, Pulliam 1988, Hanski and Gilpin 1991 *in* Kirsch and Sidle 1999). The bare sand areas used for nesting are ephemeral, and the quality and amount in any one area can vary from year to year depending on factors that maintain habitat (Sidle et al. 1992). Consequently, the tern breeding population and the reproduction rates on a particular portion of a system can fluctuate from year to year (Lingle 1993b)

Movements of individual breeding birds between nesting areas from year-to-year are common. Least terns banded at central Platte River nesting colonies were later observed nesting up to 170 miles (273 km) from their banding origin (based on 163 sightings of 109 individuals). Twenty-eight percent of the least terns returned to the colony where they were banded as chicks. Movements have been documented between the central Platte River nesting area and nesting areas at Quivira National Wildlife Refuge in Kansas, and the lower Platte River, near Fremont, Nebraska (Lingle 1993c *in* USFWS 1997).

Least terns usually arrive at breeding areas in Nebraska in late April to late-May (April 24-May 25 in Lexington according to Wycoff 1960 *in* Faanes 1983) and establish feeding areas and nesting territories. Least terns nest in colonies on bare sand/gravel areas near water (Sidle et al. 1991, Kirsch and Lingle 1993, Sidle and Kirsch 1993). Nesting colonies in Nebraska average 5 to 10 pairs of least terns (NGPC 1995). Nests are shallow bowls scraped in unconsolidated sand or gravel substrate.

Three eggs per clutch are usually laid during the first nesting effort. If nesting fails, a breeding pair may re-nest up to two times at new locations, but reduced clutch size is common. For example, Lingle (1988) documented 15 cases of re-nesting by least terns, and in all cases, the clutch size of the second nest was 2 eggs. The incubation period is about 21 days, and all chicks of a nest usually hatch within 24 hours of one another (Kirsch 1990). Chicks are able to move around shortly after hatching, and fledge at approximately 21 days (CNPPID 2002).

1.B.2.b. Piping Plover Nesting Biology

Piping plovers are semi-colonial, and often nest with least terns. Nesting colonies in Nebraska contain an average of 1 to 3 pairs of piping plovers (NGPC 1995). Piping plovers frequently change territories following nest failure and between years. Piping plovers banded at central Platte River nesting colonies were later observed nesting up to 125 miles (200km) from their banding origin (based on 71 sightings of 57 individuals). Thirty-two percent of piping plovers returned to the colony where they were banded (Lingle 1993c *in* USFWS 1997).

Nine sightings of seven banded piping plovers confirm that mixing occurs among the nesting areas of the Platte River from year to year. These birds have been spotted occupying nest areas from the lower Platte River near Ashland, the central Platte River area, and Lake McConaughy beaches on the North Platte River (Wingfield 1993).

In Nebraska, piping plovers arrive on the breeding grounds from early April to early May (April 7 –May 4 according to Bent (1929) and Tout (1947) *in* Faanes 1983). Soon after arrival, males establish a territory that encompasses wet shoreline for feeding and a dry, sandy, relatively flat area for nesting. Nests are shallow scrapes, located on elevated areas with sparsely or unvegetated sand, gravel, or cobble substrate.

Mean clutch size among 25 piping plover nests was 4.0 eggs (Faanes 1983). Lingle (1988) reported an average clutch size of 3.7 for piping plovers based on 529 eggs from 143 nests. The incubation period for piping plovers is estimated at 24 days (Faanes 1983). Chicks are precocial; within a few hours after hatching they leave the nest and are capable of running and feeding. Chicks are capable of making short flights at about 20 to 25 days of age and are normally fledged by 28 days of age (CNPPID 2002). The life span of a piping plover is thought to average about 3.5 years with a maximum of 14 years (NGPC 1995).

I.B.3. Productivity

I.B.3.a. Least Tern Productivity

Lingle (1993a) examined factors contributing to nest failures and poor recruitment (high chick mortality) and compared success between riverine and sandpit colonies. Effects of river stage on tern and plover nests and/or chicks along the 80 mile reach of the Platte River from Lexington downstream to Grand Island were monitored from 1985 through 1990 (Lingle 1993b).

Riverine

From 1985 through 1990, least terns had a 39% hatching success rate (Lingle 1993a). Failures in 37% (17 nests) of the 46 unsuccessful tern nests were due to flooding, and 37% (17 nests) due to predation (Lingle 1993a, 1993b).

Sandpits

From 1985 through 1990, least terns had a 64% hatching success rate (Lingle 1993a). Predation (37% or 50 of the 135 failed nests) was the greatest cause of nest failure on sandpits, followed by human disturbance and weather. Only 3% (4 nests) of the sandpit nests were lost to flooding, compared to 37% of the river nests. Human disturbance and abandonment accounted for 27% of failed sandpit nests and only 17% of failed river nests. Dogs/coyotes (*Canis latrans*) were suspected in 38 (78%) cases; skunks (*Mephitis mephitis*) in 3 (6%), raccoon (*Procyon lotor*), great horned owl (*Bubo virginianus*) and American crow (*Corvus brachyrhynchos*) in two (4%) each; and great blue heron (*Ardea hereodias*) and snake in one (2%) each. Other potential predators included mink (*Mustela vison*), American kestrel (*Falco sparverius*), black-billed magpie (*Pica pica*), bullsnake (*Pituophis melanoleucus sayi*), and garter snake (*Thamnophis* spp.) (Lingle 1993a).

Recently, reproduction has improved at sandpits due to active management by fencing nesting areas and removing predators (NPPD 1998, Jenniges and Plettner 1999). From 1991 to 2001 a total of 302 least tern nests were monitored on managed pits. Nest success was 68%. Seventy-three percent of all hatched chicks survived to fledging (Jenniges and Plettner 1999) and the total number of chicks fledged was 329 (1.09 fledge ratio) (Jenniges 2001). From 1994 to 1997 a total of 125 least tern nests were monitored on unmanaged pits. Nest success was 38%. Fifty-three percent of all hatched chicks survived to fledging (Jenniges and Plettner 1999).

Blue Hole Sandpit near Elm Creek was not managed but was monitored in 1994 and 1995, and then managed in 1996 and 1997. During 1994 and 1995 there were 20 least tern nests with a success rate of 40%. A total of 18 chicks hatched and 4 survived to fledging (Jenniges and Plettner 1999). During 1996 and 1997 predator fences were installed and predator removal was implemented. During this time period there were 18 least tern nests with a success rate of 94%. A total of 44 chicks hatched, and 40 chicks survived to fledge (Jenniges and Plettner 1999).

Three factors influenced nesting success at sandpits during a study conducted in 1989 and 1990: 1) flooding, 2) predation, and 3) failure of the eggs to hatch (Wilson et al. 1993). Predation was observed in 1990 and several eggs failed to hatch for unknown reasons in both years (Wilson et al. 1993).

Predation accounted for 35% of nest losses from 1985 through 1990 (Lingle 1993a). Suspected predators were dog/coyote in eight (73%) cases and skunk, American crow, and snake in one case each (9% each) (Lingle 1993a).

Constructed Islands

From 1991 to 2001 three island sites constructed by NPPD were monitored for least terns. A total of 49 least tern nests were found at two of the island sites (Elm Creek, and Overton; no least tern nests were found at Lexington Island). Of these, 35 nests hatched at least one chick for a nest success of 71%. A total of 74 chicks hatched, of which 51 chicks fledged, for a fledge ratio of 1.04 chicks fledged per nest. Fifteen percent of nest loss for least terns was due to predation, 5% to unknown causes and 2% to weather (Jenniges 2001).

I.B.3.b. Piping Plover Productivity

Riverine

From 1985 through 1990, piping plovers had a 52% hatching success rate (Lingle 1993a). Failures in 61% of the unsuccessful piping plover nests were due to flooding, and 19% due to predation (Lingle 1993a, Lingle 1993b).

Sand pits

From 1985 through 1990, piping plovers had a 67% hatching success rate (Lingle 1993a). Piping plovers were also monitored on the managed sand pits from 1991 to 2001 (Jenniges 2001). Of 87 nests monitored, 74 hatched and produced 235 chicks. Nest success was 85% and 150 chicks fledged resulting in a fledge ratio of 1.72 fledglings per nest (Jenniges 2001).

Constructed Islands

From 1991 to 1997 18 piping plover nests were monitored on three islands. Eight of the 18 nests hatched resulting in nest success of 44%. Twenty-one chicks were hatched from the eight successful nests. Of these, 13 chicks fledged resulting in a fledge ratio of 0.72 fledglings per nest. Predation caused 22% of lost nests for piping plovers on the islands, 22% of the lost nests were by unknown causes, 6% from abandonment, and 6% from cattle damage (Plettner and Jenniges 1999).

I.C. Foraging Ecology

I.C.1. Least Tern Foraging Ecology

The least tern is piscivorous, preying almost exclusively upon small schooling fish within the 1 to 3-inch size range (Atwood and Kelly 1984, Wilson et al. 1993). Adult birds and chicks also consume terrestrial invertebrates (Wilson et al. 1993). Chicks fledge 21 days after hatching, but they are not competent at fishing until after fall migration from the breeding grounds (Whitman 1988, Wilson 1991). Until then, the parent birds share feeding the young.

Prey Species

The size of forage fish brought back to nests in 1989 were primarily <1.02 inches (2.6 cm) in length (83%), and in 1990, 88% of fish brought to nests were less than 1.52 inches (3.8 cm) in length (Wilson et al. 1993). Lingle (1988) reported the diet of least terns to be composed of 1- to 2-inch fish.

Wilson et al. (1993) observed the following species of fish brought to nests: red shiners (*Notropis lutrensis*), creek chubs (*Semotilus atromaculatus*), white suckers (*Catostomus commersoni*), plains killifish (*Fundulus zebrinus*), gizzard shad (*Dorosoma cepedianum*), largemouth bass (*Micropterus salmoides*), and other species of cyprinids. Lingle (1988) collected specimens of fish lying in the sand within the least tern colony, these species observed included sand shiner (*Notropis stramineus*), red shiner, and river carpsucker (*Carpiodes carpio*). In addition, terns were observed feeding on plains killifish (Lingle 1988).

Terrestrial invertebrates consumed by terns were described as flying and crawling insects in close proximity to the nest. For an example, an adult least tern was observed changing its flight direction to capture a dragonfly (Wilson et al. 1993).

Foraging Movements

Terns nesting at sandpits use the adjacent sandpit and the adjoining river, as well as other sandpits, for foraging and loafing. In 1988 and 1989, least terns nesting adjacent to sand pits did not forage solely at the nearest available sand pit, but traveled to other areas to forage (Wilson et al. 1993).

Lingle (1988) reported that least terns generally forage within one mile of their nest site. After the young fledge, terns become more mobile and use other locations for foraging and loafing, which may include other sandpits and the river. Following nesting, least terns congregate in areas to feed and prepare for migration (Lingle 1988). In Nebraska, fall migration usually takes place from mid- or late-July to early September (NGPC 1997). The congregation sites are used for up to 30 days and are typically used by more adult birds than can be accounted for in the local colonies (USFWS 1997).

I.C.2. Piping Plover Foraging Ecology

The piping plover is a visual forager, feeding by picking and gleaning for invertebrates at the substrate surface in open, wet, sandy shorelines along of rivers, alkali wetlands, and other water bodies (Lingle 1988).

Prey Species

Corn and Armbruster (1993) identified several patterns of invertebrate distribution and abundance related to piping plover foraging along the central Platte River between Lexington and Grand Island at 11 study sites (6 sandpits and 5 river channel reaches) in 1988, and at 12 sites (6 sandpits and 6 river channel reaches) in 1989. Of these sites, 4 of the 6 sandpit sites were used for nesting and foraging, all of the river reaches were used for foraging, and no river reaches were used for nesting. Diets of piping plovers were determined by describing the invertebrate fauna in areas where plovers were known to forage. Invertebrate distribution and abundance were determined by sampling strata that were used significantly more than other areas at each study site. The dominant invertebrate taxa were collected on sticky boards from both site types and consisted of shore-inhabiting and semi-aquatic species associated with moist, sandy environments. Observations of plover foraging activity indicated that the birds appeared to track soil moisture of the foraging substrate. Plovers using sandpits concentrated their foraging effort along the sandpit shoreline where soil moisture was highest. Plovers foraging on river channel sites where soil moisture did not vary with distances from water's edge tended to forage at all distances from the edge of the water.

Corn and Armbruster (1993) found that invertebrates are distributed more or less uniformly across the foraging habitat on river channel sites, but decline with increasing distance from water's edge in sandpits. Invertebrate abundance explained a significant amount of variation in piping plover foraging activity on sand pit sites, but not on river channel sites (Corn and Armbruster 1993). Piping plover foraging activity (% of samples with birds observed foraging) was lower on sandpits than on river sites, although the difference was not statistically significant (Corn and Armbruster 1993).

Lingle (1988) reported that piping plovers preyed on invertebrates of all sizes both on dry substrates and along the waterline. Fecal samples that were collected and examined contained body parts from beetles. Adult piping plovers have been observed feeding on grasshoppers and terrestrial beetles (Lingle 1988).

Foraging Movements

Piping plovers generally forage within one mile of their nest site until fall migration (Lingle 1988). Banded piping plovers nesting at sand pits have been observed foraging at the river approximately ½-mile from their nests (Lingle 1988).

I.D. Nest Habitat Characteristics

I.D.1. Vegetative Cover

Using ground transects and aerial videography, Ziewitz et al. (1992) surveyed and examined least tern and piping plover riverine habitat along the Platte River. Aerial videography of the central Platte River indicated that moderately vegetated sandbars and sandbars only slightly exposed above water were common in 1988. Areas with greater or less vegetation were rare (Ziewitz et al. 1992).

Vegetative characteristics of habitat surrounding least tern and piping plover nests along the Platte River between Lexington and Grand Island in 1979 were determined using 1-m^2 quadrats positioned over each nest to quantify percent cover and vegetative composition. Faanes (1983) found that the bare ground percentage for least terns (n=17) was 89.1%, and for piping plovers (n=37) was 79.4%. According to Faanes (1983) piping plovers tolerate sites with more vegetation surrounding them than do terns. Wilson (1991) reported that least terns nesting in a sandpit complex in central Nebraska nested in sites with less than 10% vegetation. Nests occurred from 0 to 56 m (mean = 19 m) from vegetation, objects such as logs, or surface contours that provided a visual barrier to nesting birds (Wilson et al. 1993). Least terns and piping plovers can nest in areas with greater than 25 percent vegetative cover if some open areas still occur, especially if the site has been used in previous years (Gochfeld 1983, Burger and Gochfeld 1990 *in* Sidle and Kirsch 1993). Sidle and Kirsch (1993) observed single nests in areas with greater than 25 percent vegetative cover late in the season on sandbars near existing colonies, and at one sandpit in 1990 when the site was covered with fill material and seeded that spring.

I.D.2. Elevation

On the central Platte River, mean elevation above the stage associated with a discharge of 400 cfs at 6 tern and plover nest sites ranged from 0.2 to 2.0 feet, with a mean of 1.0 foot (Ziewitz et al. 1992). Mean elevation at a systematic sample of 29 sites ranged from 0.1 to 1.8 feet, with a mean of 0.4 feet and were not significantly different from the use area means (Ziewitz et al. 1992). Maximum elevation above the stage associated with a discharge of 400 cfs at the 6 nest sites ranged from 0.4 to 4.4 feet, with a mean of 2.7 feet. Maximum elevation above the stage associated with a discharge of 400 cfs at a systematic sample of 29 sites ranged from 0.3 to 3.7 feet, with a mean of 1.4 feet and this mean was not significantly different from the use site mean (Ziewitz et al. 1992).

Comparisons of sandbar area, channel width, mean elevation, and maximum elevation of tern and plover nest sites versus a systematic sample of sites in the Platte River suggest that least terns use wider channels with a larger area of dry, sparsely vegetated sand. By these measures, habitat availability was greater on the lower Platte River than the central Platte River in 1988 (Ziewitz et al. 1992). Although nest sites had higher mean and maximum elevation than systematic sample sites, these differences were not statistically significant in either river reach (Ziewitz et al. 1992).

Low flows followed by sudden peak flows generally result in inundated nests (Faanes 1983). Natural riverine nesting areas on the central Platte are typically low in elevation above water level and occur in wide channels (Sidle and Kirsch 1993). If nests and/or chicks occur on these low sandbars, small flow increases can inundate them (Kirsch and Lingle 1993, Sidle and Kirsch 1993). An example of this occurred in 1988 when low flows followed by sudden high flows in early and late July resulted in the inundation of 8 of 13 nests surveyed at central Platte River sites (Ziewitz et al. 1992). The median elevation of these nests equates to a flow of about 2,895 cfs at the Grand Island gage. Flows higher than 2,895 cfs from June 16 to August 31, the latter half of the nesting season, occurred in 18 of the 30 years from 1959 to 1988 (Ziewitz et al. 1992).

I.D.3. Flow / Discharge, relative to sandbar area

River discharge at Grand Island ranged from 25 to 2,570 cfs on the eight sampling dates (range between April 25 and June 24, 1988) of aerial videography (Ziewitz et al. 1992). With one exception, sandbar areas greater than 2 acres were measured only on the two lowest flow dates (June 15 and 24). Mean sandbar area at the 6 active tern or plover nest sites was 1.2 acres for the eight dates examined. This was significantly greater than the mean of 0.6 acre for the 29 systematically sampled sites (Ziewitz et al. 1992).

I.D.4. Channel Width

Mean channel width measured at 6 nesting areas was 967 feet, significantly greater than the mean of 661 feet for 29 systematically sampled sites (Ziewitz et al. 1992).

I.D.5. Relative Use of Resources

Sidle and Kirsch (1993) analyzed the use of sandpits by least terns along the entire Platte River. In 1988, there were approximately 255 sand and gravel mining sites along the Platte, Loup, and North Loup rivers; the majority occurring along the central Platte River. Most (99 percent) were within 1 mile (1.5 km) of the river channels, and 78 were thought to provide suitable nesting substrate. Least terns and piping plovers nested at 53 of 78 (68%) sand pits with suitable substrate in at least one year during 1988-1991. On the central Platte River, least terns and plovers nested at a greater percentage of suitable sand pits (81%) than on the lower Platte (60%; Sidle and Kirsch 1993).

I.D.6. Habitat Models
A habitat characteristics model for least terns and piping plovers is described by Armbruster (1986).

II. DATA/METHODS

II.A. International Piping Plover Census
The international census is a coordinated effort throughout the range of the piping plover in Canada, United States and Mexico (Ferland and Haig 2002). The census is designed to monitor trends in population size and has been implemented in 1991, 1996, and 2001; with plans for implementation every 5 years (Ferland and Haig 2002). The number of paired birds, unpaired birds in the presence of nests or young, and other unpaired birds are recorded for each site (Ferland and Haig 2002). The breeding census has been conducted in Nebraska through the work of the state coordinator of NGPC. The international census directs coordinators to visit sites with the following order of priority: 1) sites with piping plovers detected in a previous international census, 2) sites with piping plover habitat in a previous international census, 3) sites without suitable habitat in previous census but have become suitable, 4) sites uncensused previously but likely to be suitable presently, and 5) sites uncensused previously but with historic documentation of plover presence (Ferland and Haig 2002). In addition, the following guidelines are provided to surveyors: 1) census each site in 1 day during a specified two-week survey window, 2) survey in the morning and avoid surveying during extreme weather conditions, 3) do not search for nests or young, 4) avoid double-counting individual birds, 5) limit time in nesting territories to under 5 minutes (Ferland and Haig 2002).

II.B. Nebraska State Annual Breeding Survey
In Nebraska, an annual breeding survey is conducted for least terns and piping plovers. The statewide effort is coordinated by the NGPC. The survey encompasses the efforts expended for the international piping plover census and is relatively thorough in geographic coverage across Nebraska; all sites used in recent years and new potential nest areas (i.e., newly excavated mining spoil piles) are visited (John Dinan, NGPC, pers. comm.).

Records from the annual breeding survey of adult plovers and terns are to be maintained in a computer database managed by the State Non-game Bird Biologist and by the Nebraska Natural Heritage Program, Wildlife Division, at Lincoln, Nebraska. Records of the breeding survey contain the following information: 1) site name; 2) site classification (riverine or sandpit); 3) location, by river mile, latitude/longitude, and/or legal description; 4) source of information (surveyor name or affiliation); 5) survey date; 6) number of observed adults; and 7) number of observed nests, eggs, and chicks. Review of these data show conflicts between archived data and published data during the same time periods. The NGPC is in the process of updating this database.

II.B.1. Abundance

The annual breeding survey usually consists of airboat surveys along the river through the length of the study area, and ground-based surveys of potential sandpit nesting sites. The timing of airboat surveys may be adjusted according to flow and nesting conditions. The survey involves one driver and two spotters checking sandbars and the river for the presence of adult least terns and piping plovers. If adult birds are seen, a thorough survey is made to determine whether the birds are associated with nearby nesting areas. The count of adults observed during the peak of the nesting season in mid-June is recorded.

II.B.2. Productivity

Procedures used to survey least tern and piping plover breeding areas have been generally consistent since 1987 (John Dinan, NGPC, pers. comm.). No written description of these methods has been documented. Survey participants describe the general procedure as follows: the number and distribution of breeding pairs and nests is determined by conducting site-visits to known or suspected nesting areas during the peak of the nesting season in mid-June. At each site, adult birds and nests are counted. A "nest" is defined to be a scrape with at least one egg. Only birds that are associated with a nesting area are included in site counts; birds seen in the survey region but which are not associated with a nesting area (referred to as 'floaters') are tallied and recorded for each surveyed area, such as bridge segment. One or more follow-up visits to nesting areas may be made to search for new nests, determine status of previously located nests, and assess causes of nest loss.

When productivity is monitored, field surveys of nesting areas are conducted every other day or every third day to document the outcome of each nesting attempt. If multiple surveys of river nesting areas are conducted, they are usually done by land access. Nesting surveys at sandpits are also done by land. Where multiple visits are made to a colony, the count from one visit in mid-nesting season is selected to represent the breeding survey count of that site. Young birds are considered fledged if the plumage and coloration indicate the young to be at least 21 days old, or if the young are observed flying.

Data from repeated nest site visits at individual colonies throughout the nesting season have not been compiled in a database.

II.C. Platte River Surveys

From 2001 to 2006, the Cooperative Agreement coordinated monitoring of reproductive success and reproductive habitat parameters of least terns and piping plovers in the central Platte River from Lexington to Chapman, Nebraska. A draft protocol has been developed and implemented to standardize definitions and survey methods for monitoring throughout the Cooperative Agreement study area (PRESP 2002a). The Cooperative Agreement protocol has been implemented by FWS Grand Island office, NPPD, and Central Platte Natural Resources District (CPNRD). These data have been maintained in a database and summarized in annual reports by the office of the executive director of the Cooperative Agreement (PRESP 2002b, PRESP 2003, PRESP 2004, PRESP 2006a, PRESP 2006b).

II.C.1. Abundance

Abundance information for breeding adults in the central Platte River was collected as part of the Nebraska annual breeding survey. Central Platte River abundance information has been pulled from the Nebraska survey information (Kirsch 2001).

The Cooperative Agreement protocol estimates the number of adult least terns and piping plovers with three airboat surveys on the river and three visits to each site per breeding season (mid May, mid June, and mid July). Sites are defined as more than 1 acre of bare sand (less than 20% vegetative cover) and include sandpit spoil piles or constructed riverine islands.

II.C.2. Productivity

Much of the productivity data for least terns and piping plovers in the central Platte River has been collected by cooperators or by individuals with special research projects (e.g., graduate students). The methods used by NPPD and CNPPID to monitor nests located at their sandpits and constructed river islands are described by Jenniges and Peyton (1999). Data from repeated nest site visits at individual colonies throughout the nesting season are provided to NGPC, Lincoln.

The Cooperative Agreement protocol describes methods to monitor the productivity of nests from outside the colony (PRESP 2002a). Nesting sites (riverine, sandpit, or constructed island) are visited every 3 days to check the status of previously located nests and search for new nests. The number of adults, nests, chicks, broods, and fledglings is recorded on each visit. Nests that appear to be inactive are approached to assess the reproductive outcome and causes of nest failure if necessary. Definitions of hatching success, nesting loss, nesting success, fledging success, and Mayfield estimators of mortality rate are described in the protocol.

Kirsch (1996) estimated fledglings per nest by defining the number of nesting pairs as the maximum number of active nests and broods present at a colony during a single visit. Kirsch (1996) recognized that this assumes re-nesting pairs remained at their original colony or that emigration and immigration of pairs is equivalent.

NPPD provides data for the NGPC annual survey for the central Platte River and expresses fledge ratios as fledglings per nest. It is defined as the number of chicks documented to fledge divided by the number of nests observed within a colony (Jenniges 2001). This calculation is considered a conservative estimate of the fledge ratio since it will come out lower than the number of fledglings per pair.

II.D. Off-Channel Nest Site (Sandpits) Management

Sandpits consist of fine-grained sand from the dredge spoil of commercial gravel mining operations (Jenniges and Plettner 1999). Without management, spoil piles at sandpits usually remain unvegetated for 6 to 8 years (Currier and Lingle 1993). However, sandpit areas have been maintained in an unvegetated state with management such as application of herbicides or mechanical clearing (Jenniges and Plettner 1999).

Other management strategies designed to improve productivity include electric predator fences, fencing for human control, erecting “do not enter” signs, placement of drain tiles and driftwood on nesting areas, and cleaning up potential predator hiding places in the general vicinity of the nesting area. Additional management techniques include strobe lights, snake fences, and predator removal by USDA Animal and Plant Health Inspections Services (Jenniges and Plettner 1999).

III. DATA GAPS AND PROPOSED PROTOCOLS

Much of the information on least terns and piping plovers was collected or compiled over various time frames using a variety of methodologies and is often ambiguous in the context of answering questions pertinent to the Program. Collecting species and habitat data concurrently using a consistent methodology over a period of time will provide a much more thorough dataset and description of the ecology of terns and plovers on the central Platte River.

The Cooperative Agreement and Program monitoring protocol will be used to evaluate the biological response (changes in status and trend) of least tern and piping plover reproduction during the time that habitat and water elements of the Program are being implemented. The Program document "Monitoring reproductive success and reproductive habitat parameters of least terns and piping plovers in the central Platte River valley" describes the conceptual design and study methods for monitoring the reproductive success and reproductive habitat parameters of least terns and piping plovers in the central Platte River valley, Nebraska.

IV. HISTORIC DATA NOT BEING COLLECTED DURING THE PROGRAM

During the Program, nest site habitat parameters will be qualitatively estimated or recorded from outside the colony using binoculars or a spotting scope. These measurements will include elevation, distance of the nest to nearest water, distance to obstruction, vegetation around the nest, and sediment size. Historically, some or all of these parameters have been quantitatively measured at selected nest sites.

V. DATA ADEQUACY

Baseline information was evaluated for quantitative descriptions of pre-Program or pre-treatment (baseline) conditions that could be combined with monitoring data initiated during the Program in before-after comparisons or trend estimations. The presence of quantitative baseline information will significantly enhance analysis of the Program's monitoring data. The Program's monitoring is designed to detect statistically significant changes in measured parameters over time and document correlations between those changes and management activities. It is anticipated that the trends in the least tern and piping plover breeding population size, reproductive parameters, relative use of resources, frequency of use, and spatial distribution of use will be analyzed with data collected during the Program.

For baseline data to be useful, data collection procedures should have followed detailed and scientific protocols. The methods of data collection should have been recorded and vigorously adhered to. The quality assurance procedures should have been conducted and any changes made to the data should have been documented. Finally, data should have been stored in an accessible medium along with the data collection protocols and other metadata. Even if data have the above characteristics, the data must be entered into an electronic format, (i.e. a data spreadsheet) before analysis can occur.

In addition, for baseline data to be useful for before-after comparisons or trend estimation, the study design should have incorporated statistical sampling procedures. The sampling frame should have been identified, and random sampling should have been employed to ensure the data would be unbiased for the region and/or time of interest.

The international piping plover census (methods section II.A.) provides appropriate methods for detecting long term trends in abundance and productivity of piping plovers in the Program study area. Errors associated with the estimates from this survey has not been recognized, but estimating trends with this data should result in accurate estimates since the data collection, data handling, and quality assurance procedures have been standardized. In addition, the survey effort is quantified. Before trend analyses are conducted using the data for the central Platte River, inconsistencies in the river miles surveyed in the 1996 and 2001 reports should be resolved, and a review of the sites included in the sample each year (and the effect of the definition of suitable habitat) should be reviewed.

The use of baseline data from the Nebraska annual breeding survey (methods section II.B.) to conduct before-after Program comparisons or estimate trends in breeding population abundance (number of adults) and reproductive parameters (number of nests, number of fledglings, etc.) will require a considerable effort to ensure the data are accurate and comparable. Many sources cited in this document report different numbers of adults, pairs, or nests for the annual breeding survey conducted in the central Platte River in the last 20 years. The raw data need to be archived in the most basic format (e.g., sightings by river mile and pit) from the primary data sources. Judgments to delete individual bird observations (because of suspected double counting or other reasons) should be documented while the data are archived, but actual deletions should only be implemented during analyses of the data. The database should be created as soon as possible to use the information in the memories of the original data collectors. Data from the annual breeding survey could be a valuable dataset upon which post-Program initiation analyses could be based if a comprehensive electronic database of pre-Program data is developed.

The unequal effort that has been expended to survey terns and plovers in the central Platte River will complicate before-after comparisons or trend estimations. Only data collected using a consistent (or measurable) effort are comparable in a valid statistical analysis of trend. The annual breeding survey in the central Platte River has involved relatively consistent (although undocumented) survey methods, but the survey effort has not been consistent. Airboat surveys on the river have covered the same length of the river and used the same basic survey techniques (although the amount of sand and water varied each year) since 1988 and data from this effort could be used in a before-after comparison with post-Program initiation data. Surveys of the river before 1988 involved methods that varied annually and are undocumented and should not be used in a trend analysis. Annual breeding surveys of sandpits in the Program study area have involved relatively consistent (although undocumented) survey methods, but the actual sites that have been visited are not consistent every year. To analyze trends in a combined sandpit estimate (abundance or productivity), only data from sites that have been consistently surveyed should be included. To analyze trends using data from all sites, the trend analyses should estimate trends for each site and then estimates can be combined across sites.

In summary, the annual breeding survey data described in this section of the baseline document are unarchived and unavailable for before-after comparisons with post-Program initiation data. Reports that include tables of these data are not consistent. The raw data have not been provided by NGPC and it is questionable if the dataset exists in electronic form. Summaries of the data can be found in Sidle et al. (1991), Dinan et al (1993), Sidle and Kirsch (1993), Kirsch and Sidle (1999), Dinan (2001), Kirsch (2001), Jenniges (2005), and Lingle (2004). However, the counts reported in these sources do not agree with each other (Lott 2006) and the exact river miles and sites included in these summaries is not always reported. If a comprehensive electronic database of pre-Program data is developed, the data should be used for before-after comparisons. Otherwise analyses will be restricted to portions of the study area for which adequate records have been maintained and which will not be unbiased for the Cooperative Agreement study area. All analyses will have to address the annual variability in the unequal effort expended and the sites included in the sample.

The observations that have resulted from the implementation of the Program's protocol for monitoring the reproductive success and reproductive habitat parameters of least terns and piping plovers in the central Platte River from 2001-2006 (methods section II.C.), represent an unbiased dataset from surveys within a defined study area with precise documentation of the survey effort. This data will be appropriate for quantitative analyses of trends in breeding population size, reproductive parameters, relative use of resources, frequency of use, and spatial distribution of use. Data collection procedures followed a detailed scientific protocol, the data were entered into an electronic format, the data were checked for quality assurance and changes made to the data were documented.

Estimating trends for reproductive parameters in the Program study area is complicated by the unknown probability of inclusion of nests in the observed sample of nests. Since the sampling techniques differ for locating nests on the river and the sandpit/constructed islands, there is little chance the inclusion probabilities are equal. Therefore, analyses should be conducted for the river and sandpit sites separately.

VI. LITERATURE CITED

Armbruster, M. J. 1986. A review of habitat criteria for least terns and piping plovers using the Platte River. Unpublished report. National Ecology Research Center, U.S. Fish and Wildlife Service, Fort Collins, CO.

Atwood, J. L., and P. R. Kelly. 1984. Fish dropped on breeding colonies as indicators of least tern food habits. Wilson Bull. 96(1): 34-47.

Bent, A. C. 1929. Life histories of North American shorebirds. Part II. U. S. National Museum Bulletin 146. 412 pp.

Boyd, R. L. and B. C. Thompson. 1985. Evidence for reproductive mixing of least tern populations. Journal of Field Ornithology 56:405-408.

Burger J. and M. Gochfeld. 1990. Nest site selection in least terns (*Sterna antillarum*) in New Jersey and New York. Colonial Waterbirds 13(1): 31-40.

CNPPID (Central Nebraska Public Power and Irrigation District). 2002. Least Terns, Piping Plovers. Brochure accessed 6-24-2002 at http://www.cnppid.com/tpbroch.html.

Corn, J.G., and M.J. Armbruster. 1993. Prey availability for foraging piping plovers along the Platte River in Nebraska. Pages 143-149 in Proceedings of the Missouri River and its Tributaries: Piping Plover and Least Tern Symposium-Workshop, K.F. Higgins, and M.R. Brashier, eds. Brookings, SD: South Dakota State University, Dept. of Wildlife and Fisheries Sciences.

Currier, P. J. and G. R. Lingle. 1993. Habitat restoration and management for least terns and piping plovers by the Platte River Trust. Pages 92 in Proceedings of the Missouri River and its Tributaries: Piping Plover and Least Tern Symposium-Workshop, K.F. Higgins, and M.R. Brashier, eds. Brookings, SD: South Dakota State University, Dept. of Wildlife and Fisheries Sciences.

Dinan, J. J. 1997. The 1996 International piping plover breeding census in Nebraska. Pages 205-210 in International Piping Plover Census. J. H. Plissner, and S. M. Haig, eds. U. S. Geological Survey, Biological Resources Division, Corvallis, Oregon.

Dinan, J. J. 2001. Piping plover and least tern census-Nebraska. Unpublished report. Nebraska Game and Parks Commission, Lincoln, NE.

Dinan, J. J., G. A. Wingfield, J. G. Sidle. 1993. Surveys of least terns and piping plovers in Nebraska. Pages 62-63 in Proceedings of the Missouri River and its Tributaries: Piping Plover and Least Tern Symposium-Workshop, K.F. Higgins, and M.R. Brashier, eds. Brookings, SD: South Dakota State University, Dept. of Wildlife and Fisheries Sciences.

Ducey J. 1985. The historic breeding distribution of the least tern in Nebraska. Nebraska Bird Review 53:26-36.

Faanes, C. A. 1983. Aspects of the nesting ecology of least terns and piping plovers in central Nebraska. Prairie Nat. 15:145-154.

Ferland, C. L., and S. M. Haig. 2002. 2001 International Piping Plover Census. U.S. Geological Survey, Forest and Rangeland Ecosystem Science Center, Corvallis, Oregon. 293 pp.

Gaines, E. P. 1988. Piping plover habitat use and reproductive success in North Dakota. Journal of Wildlife Management 52(2): 266-273.

Gochfeld, M. 1983. Colony site selection by least terns: physical attributes of sites. Colonial Waterbirds 6: 205-213.

Haig, S. M. and L. W. Oring. 1985. Distribution and status of piping plover throughout the annual cycle. Journal of Field Ornithology 56: 334-345.

Haig, S. M. and J. Plissner. 1992. 1991 International piping plover census. U.S. Fish and Wildlife Service, Fort Snelling, MN. 148 pp.

Hanski, I. and M. Gilpin. 1991. Metapopulation dynamics: brief history and conceptual domain. Biological Journal of the Linnean Society 42:17-38.

Jenniges, J. J. 2001. Least Tern and Piping Plover Nest Monitoring by Nebraska Public Power District along the Central Platte River. Report submitted in accordance with Federal Fish and Wildlife Permit TE039100-0, November 28, 2001.

Jenniges, J. J. 2005. Least tern and piping plover nesting at managed nesting sites on the central Platte River 1991 through 2003. Pages 39-50 in Higgins, K.F., M.R. Brashier and C. Fleming, eds. 2005. Proceedings, Third Missouri River and North American piping plover and least tern habitat workshop/symposium. WFS1-05, South Dakota State University, Brookings, SD.

Jenniges, J. J. and M. Peyton. 1999. Monitoring Plan for Federal Energy Regulatory Commission License 1835 Article 405 (Nebraska Public Power District) and Federal Energy Regulatory Commission License 1417 Article 423 (The Central Nebraska Public Power and Irrigation District). January 25, 1999.

Jenniges, J. J. and R. G. Plettner. 1999. Reproductive success of least terns on managed and unmanaged sand pits near the central Platte River, Nebraska, 1994-1997. Nebraska Public Power District.

Kirsch, E. M. 1990. Ecology of least terns and piping plovers on the lower Platte River, Nebraska. Final report submitted to Nebraska Game and Parks Commission, Lincoln. 81 pp.

Kirsch, E. M. 1992. Habitat selection and productivity of least terns on the lower Platte River, Nebraska Ph.D. Dissertation. University of Montana, Missoula.

Kirsch, E. M. 1996. Habitat selection and productivity of least terns on the lower Platte River, Nebraska. Wildlife Monograph No. 132. 48 pp.

Kirsch, E. M. 2001. Nebraska's least terns and piping plovers 1987-1999: final report. U. S. Geological Survey, Biological Research Division. 24 pp.

Kirsch, E.M., and G.R. Lingle. 1993. Habitat Use and Nesting Success of Least Terns Along the Lower Platte River, Nebraska. Pages 73-74 in Proceedings of the Missouri River and its Tributaries: Piping Plover and Least Tern Symposium-Workshop, K.F. Higgins, and M.R. Brashier, eds. Brookings, SD: South Dakota State University, Department of Wildlife and Fisheries Sciences.

Kirsch, E. M. and J.G. Sidle. 1999. Status of the interior population of least tern. Journal of Wildlife Management. 63(2): 470-483.

Lingle, G. R. 1988. Least tern and piping plover nesting ecology along the central Platte River valley, Nebraska. Submitted to the U.S. Fish and Wildlife Service, Grand Island, Nebraska. FEW/SE/Blanket Permit #PRT-704930.

Lingle, G.R. 1993a. Causes of nest failure and mortality of Least Terns and Piping Plovers along the central Platte River. Pages 130-136 in Proceedings of the Missouri River and its Tributaries: Piping Plover and Least Tern Symposium-Workshop, K.F. Higgins, and M.R. Brashier, eds. Brookings, SD: South Dakota State University, Department of Wildlife and Fisheries Sciences.

Lingle, G.R. 1993b. Nest success and flow relationships on the central Platte River. Pages 69-72 in Proceedings of the Missouri River and its Tributaries: Piping Plover and Least Tern Symposium-Workshop, K.F. Higgins, and M.R. Brashier, eds. Brookings, SD: South Dakota State University, Department of Wildlife and Fisheries Sciences.

Lingle, G.R. 1993c. Site fidelity and movements of Least Terns and Piping Plovers along the Platte River, Nebraska. Pages 189-191 in Proceedings of the Missouri River and its Tributaries: Piping Plover and Least Tern Symposium-Workshop, K.F. Higgins, and M.R. Brashier, eds. Brookings, SD: South Dakota State University, Department of Wildlife and Fisheries Sciences.

Lingle, G. R. 2004. Platte River Recovery Implementation Program DEIS Response. Final report submitted to Central Platte Natural Resources District. July 14, 2004.

Lott, C. A. 2006. Distribution and abundance of the interior population of the Least Tern (Sterna antillarum), 2005: a review of the first complete range-wide survey in the context of historic and ongoing monitoring efforts. Dredging Operations and Environmental Research Program Technical Notes Collection, U.S. Army Engineer Research and Development Center, Vicksburg, MS.

NGPC (Nebraska Game and Parks Commission). 1995. Nebraska's threatened and endangered species: Piping plover. Brochure.

NGPC (Nebraska Game and Parks Commission). 1997. Nebraska's threatened and endangered species: Interior least tern. Brochure.

NPPD (Nebraska Public Power District). 1998. Least Tern and Piping Plover Nest Monitoring by NPPD along the Central Platte River, NPPD Report.

PRESP (Platte River Endangered Species Partnership). 2002a. Protocol for Monitoring reproductive success and reproductive habitat parameters of least terns and piping plovers in the central Platte River, Technical Committee. May 1, 2002

PRESP (Platte River Endangered Species Partnership). 2002b. Tern and Plover Monitoring Protocol Implementation Report for 2001, Technical Committee. June 12, 2002

PRESP (Platte River Endangered Species Partnership). 2003. Least Tern and Piping Plover Monitoring Protocol Implementation Report for 2002, Technical Committee. May 31, 2003.

PRESP (Platte River Endangered Species Partnership). 2004. Least Tern and Piping Plover Monitoring Protocol Implementation Report for 2003, Technical Committee. June 7, 2004.

PRESP (Platte River Endangered Species Partnership). 2006a. Least Tern and Piping Plover Monitoring Protocol Implementation Report for 2004, Technical Committee. January 16, 2006.

PRESP (Platte River Endangered Species Partnership). 2006b. Least Tern and Piping Plover Monitoring Protocol Implementation Report for 2005, Technical Committee. July 18, 2006.

Plettner, R. G. and J. J. Jenniges. 1999. Reproductive success of least terns and piping plovers on three artificial islands on the central Platte River, Nebraska, 1991-1997. Nebraska Public Power District.

Plissner, J. H. and S. M. Haig. 1997. 1996 International piping plover census. U. S. Geological Survey, Biological Resources Division, Corvallis, Oregon.

Pulliam, H. R. 1988. Sources, sinks, and population regulation. American Naturalist 132:652-661.

Root, B. G., M. R. Ryan and P. M. Mayer. 1992. Piping plover survival in the Great Plains. Journal of Field Ornithology 63(1): 10-15.

Russell, R. P., Jr. 1983. The piping plover in the Great Lakes region. American Birds 37: 951-955.

Ryan, M. R., B. G. Root, and P. M. Mayer. 1993. Status of piping plovers in the Great Plains of North America a demographic simulation model. Conservation Biology 7: 581-585.

Shoemaker, T. G. 1988. Wildlife and water projects on the Platte River. Pages 284-331 *in* Audubon wildlife report 1988/1989. The National Audubon Society, New York.

Sidle, J. G., E. C. Wilson, J. J. Dinan, J. Lackey, G. Wingfield, B. K. Good, G. R. Lingle, and R. G. Plettner. 1991. The 1991 census of least terns and piping plovers in Nebraska. Nebraska Bird Rev. 59:133-149.

Sidle, J. G, D. E. Carlson, E. M. Kirsch, and J. S. Dinan. 1992. Flooding mortality and habitat renewal for least terns and piping plovers. Colon. Waterbirds 15: 132-136.

Sidle, J.G. and E.M. Kirsch. 1993. Least terns and piping plovers nesting at sandpits in Nebraska. Colon. Waterbirds 16: 139-148.

Tout, W. 1947. Lincoln County birds. Publ. by author, North Platte, Nebraska.

USFWS (U.S. Fish and Wildlife Service). 1988. Recovery Plan for Piping Plovers, Charadrius melodus, of the Great Lakes and Northern Great Plains, Great Lakes/Northern Great Plains Piping Plover Recovery Team. Twin Cities, MN: Department of the Interior, U.S. Fish and Wildlife Service.

USFWS (U.S. Fish and Wildlife Service). 1990. Recovery Plan for the Interior Population of the Least Tern (Sterna antillarum). Twin Cities, MN: Department of the Interior, U.S. Fish and Wildlife Service. 90 pp.

USFWS (U.S. Fish and Wildlife Service). 1997. Biological Opinion on the Federal Energy Regulatory Commission's Preferred Alternative for the Kingsley Dam Project (Project No. 1417) and North Platte/Keystone Dam Project (Project No. 1835). U.S. Fish and Wildlife Service, Grand Island, Nebraska.

Wiens, J. A. and J. T. Rothberry. 1981. Censusing and evaluation of avian habitat occupancy. Studies in Avian Biology 6: 522-532.

Whitman, P. L. 1988. Biology and conservation of the endangered least tern: a literature review. USFWS Biol. Rep. 88(3). 22 pp.

Wilson, E. C. 1991. Nesting and foraging ecology of interior least terns on sandpits in central Nebraska. M.S. Thesis, University of Wyoming, Laramie.

Wilson, E. C., W. A. Hubert, and S. H. Anderson. 1993. Nesting and foraging of least terns on sandpits in central Nebraska. Southwest Nat. 38(1): 9-14.

Wingfield, G.A. 1993. Least tern and piping plover use of Lake McConaughy, Nebraska. Pages 64-65 in Proceedings of the Missouri River and its Tributaries: Piping Plover and Least Tern Symposium-Workshop, K.F. Higgins, and M.R. Brashier, eds. Brookings, SD: South Dakota State University, Department of Wildlife and Fisheries Sciences.

Wycoff, R. S. 1960. The least tern. Nebraska Bird Review 28: 39-42.

Ziewitz, J. W., J. G. Sidle, and J. J. Dinan. 1992. Habitat conservation for nesting least terns and piping plovers on the Platte River, Nebraska. Prairie Nat. 24:1-20.

Figure 1. Distribution of the interior least tern and piping plover.

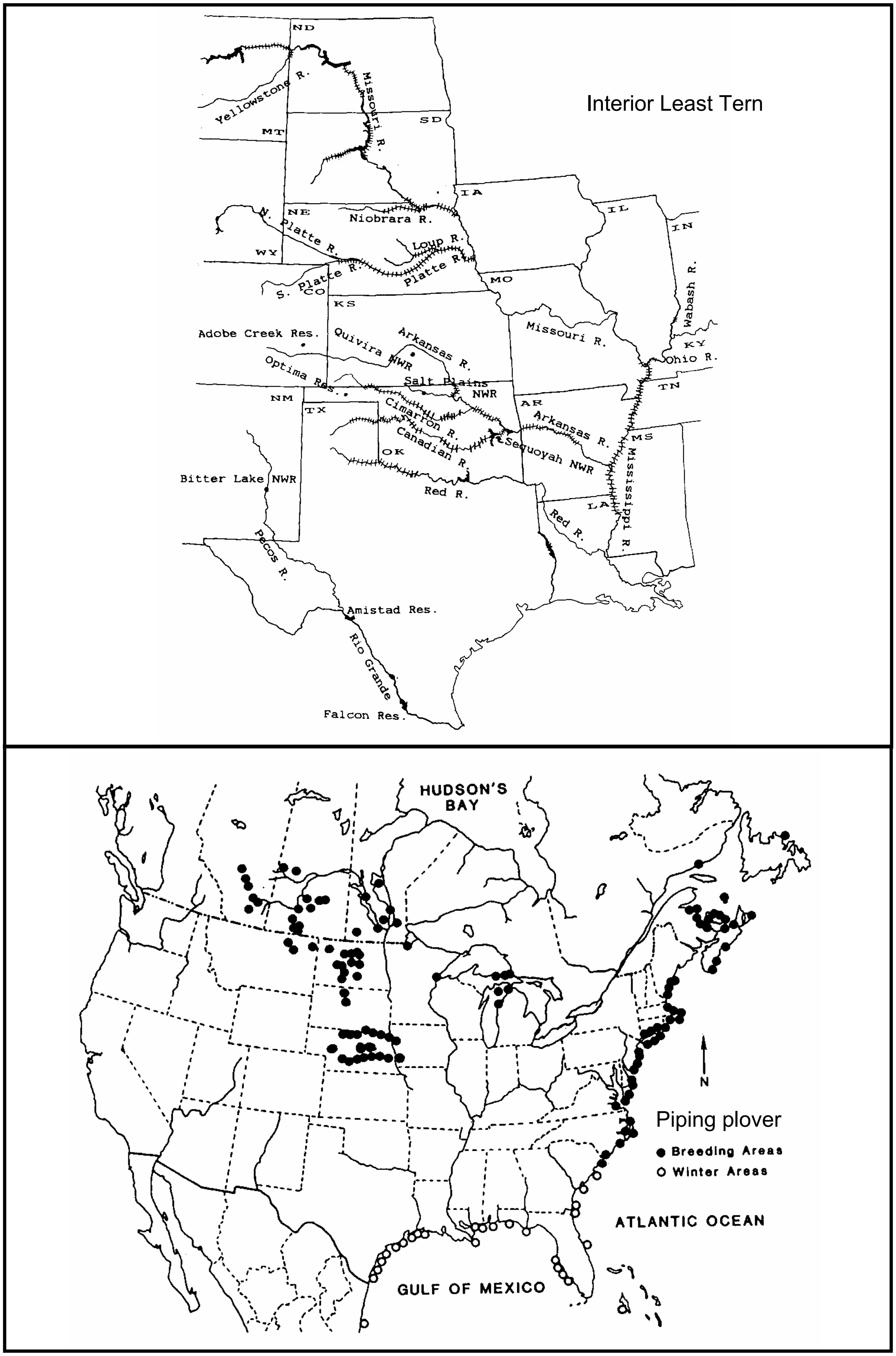


Figure 2. Location of the Central Platte River Study Area.

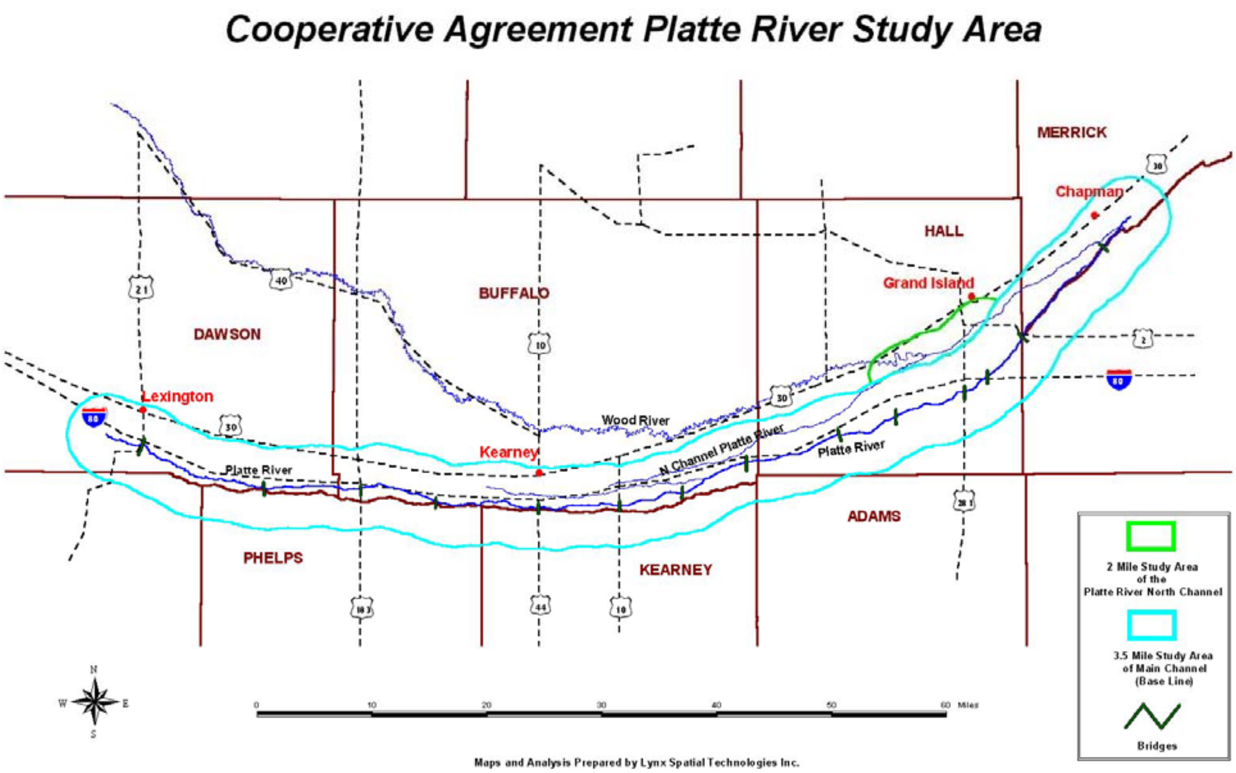
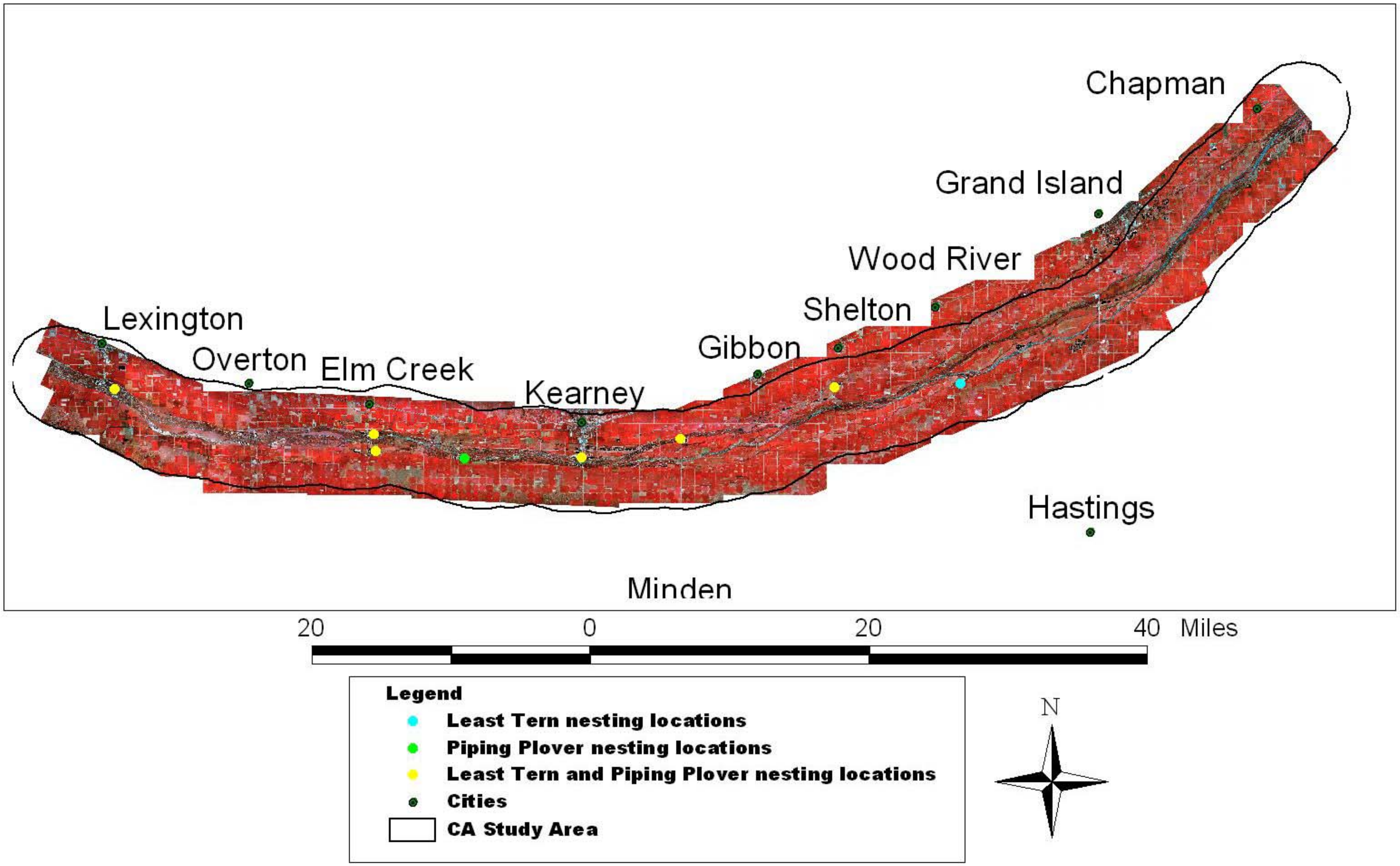


Figure 3. Locations with documented interior least tern and/or piping plover nesting locations, 2001-2005.



BASELINE REPORT

PALLID STURGEON SECTION

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I. BACKGROUND

The pallid sturgeon (*Scaphirhynchus albus*) was federally listed as an endangered species on September 6, 1990 (55 FR 36641) pursuant to the Endangered Species Act (ESA) of 1973 (16 USC 1531 *et seq.*) as amended (USFWS 1990). The pallid sturgeon was first recognized as a species by Forbes and Richardson (1905) based on nine specimens collected from the Mississippi River near Grafton, Illinois in 1904. The historical distribution of pallid sturgeon encompassed the Missouri River from Fort Benton-Great Falls, Montana downstream to the Mississippi River (Kallemeyn 1983) and was thought to include "the lower reaches of the Platte (21.1 mi, 34 km), Kansas (39.7 mi, 64 km), and Yellowstone (200 mi, 322 km) Rivers" (USFWS 1993) (Figure 1). The most upstream record of pallid sturgeon in the Mississippi River was near Keokuk, Iowa, where an immature sturgeon was taken and identified by Coker (1930) as a pallid sturgeon. No other pallid sturgeons have been reported from the Mississippi River in Iowa, northern Illinois, Minnesota, or Wisconsin. Therefore the principal range of pallid sturgeon in the Mississippi River is downstream of the Illinois River mouth (Kallemeyn 1983) to New Orleans, Louisiana (Bailey and Cross 1954) (Figure 1). In 1963, a pallid sturgeon was caught in the St. Francis River, a tributary to the Mississippi River, near Madison, Arkansas (Buchanan 1973 *in* Kallemeyn 1983). The most downstream capture of a pallid sturgeon on the Mississippi River was in the vicinity of New Orleans, Louisiana (Bailey and Cross 1954).

Although the species' range is large, catch records are rare and few wild sub-adults have been captured in recent years. Based on declines in observational data from an average of 50 per year in the 1960's (500 observations), to 21 per year in the 1970's (209 observations), to 6 per year in the 1980's (56 observations), pallid sturgeon have declined over their entire range (Keenlyne 1989). In the headwaters of Garrison Reservoir, North Dakota, Keenlyne (1989) compared hours to catch a pallid sturgeon (catch-per-unit effort) data from 1959 and 1984. In 1959 it took 181 hours of variegated (i.e., "experimental net") gill net fishing (250-foot length) for each pallid sturgeon caught (Van Wyhe 1960 *in* Keenlyne 1989). In 1984, using the same equipment as that used in 1959, 859 hours of sampling were required for each pallid sturgeon caught (Keenlyne 1989).

Forbes and Richardson (1905) reported that pallid sturgeon were not common, and represented about 1 in 500 sturgeon taken by fishermen in the central Mississippi River. Pallid sturgeon were reportedly more abundant in the lower Missouri River in 1905, and represented 1 in 5 of sturgeons caught in the river by fishermen (Forbes and Richardson 1905). In the late 1970's pallid sturgeon represented 1 in 398 of the sturgeons collected in the lower Missouri and middle Mississippi Rivers (Carlson et al. 1985). The ratio of wild pallid sturgeon to all river sturgeon collected dropped from 1 in 398 (0.25%) in the 1970's (Carlson et al. 1985) to 1 in 647 (0.15%) from 1997-2000 (Grady et al. 2001). Wild and hatchery pallids combined accounted for 1 in 247 (0.36%) of all river sturgeons captured in the lower Missouri and middle Mississippi rivers during the 1997-2000 study (Grady et al. 2001).

In its final decision to list pallid sturgeon as an endangered species, the USFWS stated that the pallid sturgeon has become threatened as a result of habitat modification, apparent lack of natural reproduction, commercial harvest, and hybridization in parts of its range (USFWS 1989). Fifty-one percent of the known historic range of pallid sturgeon has been channelized, 28 percent has been impounded, and the remaining 21 percent is located below dams, which influence water quality, temperature, flow regimes, and fish passage (Keenlyne 1989, USFWS 1989).

I.A. Pallid Sturgeon Occurrence

Pre-1980 catch records reported occurred primarily in the Mississippi River from its mouth upstream to its confluence with the Missouri River, and the Missouri River upstream to Fort Benton, Montana as well as the lower portions of a limited number of tributaries. These tributaries include the lower 56 km (35 mi) of the Big Sunflower and the St. Francis Rivers (Keenlyne 1989), the lower 64 km of the Kansas River (Cross 1967), the lower 34 km (21 mi) of the Platte River (Keenlyne 1989), and the lower 322 km (200 mi) of the Yellowstone River (Keenlyne 1989).

Post 1980, the most frequent reports of occurrence have been from the Missouri River between the Marias River and Fort Peck Reservoir in Montana; between Fort Peck Dam and Lake Sakakawea (near Williston, North Dakota); within the lower 113 km (70 mi) of the Yellowstone River to downstream of Fallon, Montana; in the headwaters of Lake Sharpe in South Dakota; near the mouth of the Platte River near Plattsmouth, Nebraska; and from the lower Missouri River below river mile 218 in the state of Missouri. Areas of most frequent occurrence on the Mississippi River have been near Chester, Illinois; Caruthersville, Missouri; and in both the Mississippi and Atchafalaya Rivers in Louisiana at the Old River Control where the Atchafalaya diverges from the Mississippi River (USFWS 1993).

Six Recovery Priority Management Areas (RPMA) have been designated on the Missouri and Mississippi Rivers, which include the confluence of the major tributaries to these rivers, one being the Platte River (USFWS 1993). The confluence of the Platte River with the Missouri River was designated as part of RPMA 4 (Figure 2).

II. DATA/METHODS

II.A. Morphology

Pallid sturgeon are usually light brown on the dorsal surface and white on the ventral side (Kallemeyn 1983). While lighter than the shovelnose sturgeon (*Scaphirhynchus platyrhynchus*), color alone cannot consistently be used to differentiate between the species (Kallemeyn 1983). Other principal morphological characteristics distinguish pallid from shovelnose sturgeon. These include head length, the height of the tenth lateral plate, inner barbel length, as well as the location of the bases of outer barbels (usually behind those of the inner barbels), the distance from the snout tip to the outer barbel, and the absence of bony plates on the belly. Pallid sturgeon also have a larger number of dorsal and anal fin rays: 37 or more dorsal fin rays, 24 or more anal fin rays (Pflieger 1975, Phelps and Allendorf 1983, Carlson et al. 1985).

Pallid sturgeon are difficult to identify morphologically from other river sturgeon of the genus Scaphirhynchus, and hybrids occur. The hierarchical pattern of phylogenetic relationships among this genus produced by analysis of mitochondrial DNA is not consistent with that produced by morphological data (Simons et al. 2001). Morphological descriptions of pallid and shovelnose sturgeon have found the two species are identical as larvae, with tentatively identifying characteristics emerging when total length reaches 10 mm and after the yolk is absorbed identification is reasonably certain for unhybridized specimens (Snyder 2002).

II.B. Occurrence of Pallid Sturgeon in the Platte River

Baseline information on pallid sturgeon occurrence in the Platte River is derived from records maintained by the Nebraska Game and Parks Commission (NGPC), and Ak-sar-ben aquarium near Gretna, Nebraska, since 1979. Unless otherwise noted, all information contained below is from raw data provided by the NGPC so no references are included. Ak-sar-ben aquarium staff receive reports of pallid sturgeon captures in Nebraska. In addition, records of verified captures are maintained in the Natural Heritage Program database by the NGPC, Lincoln.

Between 1979 and 2000, reports of pallid sturgeon captured in Nebraska by anglers and others were logged into a database that included information provided by the capturing party (e.g., approximate capture location, bait used, date, etc.). Beginning in 2001, NGPC applied ratings to each reported capture, defining observations as 1 ("confirmed"), 2 ("probable"), or 3 ("unconfirmed") according to the following criteria: 1) Actual observation of the fish by a fishery biologist, where identification can be made, 2) A catch reported by an individual that has either caught a fish (pallid sturgeon) in the past or one that correctly answers questions asked about identification, or a report that Aquarium staff feels is accurate, 3) A catch reported by an individual that leaves doubt as to what species it might have been. No specific set of questions is asked of each individual reporting a capture, rather questions are asked of each individual that are appropriate to that reported capture (D. Feit, NGPC, pers. comm.).

Between 1979 and September 2004, 17 pallid sturgeon captured in the lower Platte River have been examined by a biologist and reported (*i.e.*, confirmed) (Table 1). Between 1979 and September 2004 there were 13 probable/unconfirmed reports (16 fish) of pallid sturgeon captures in the lower Platte River (Table 2). All reports have been downstream of the Elkhorn River mouth. There have also been seven unconfirmed/probable captures of pallid sturgeon in the Elkhorn River between 1979 and June 2004, and one confirmed capture (based on photographs) from the Elkhorn River.

The area within the Missouri River 20 miles upstream and 20 miles downstream of the mouth of the Platte River is specifically identified as a portion of Recovery Priority Management 4. Within this area there have been 14 confirmed captures of pallid sturgeon between 1979 and June 2004. Within this same area and time frame there have been 19 probable/unconfirmed reported captures of pallid sturgeon.

II.C. Hybridization

Incidences of hybridization of pallid with shovelnose sturgeon have been found in the Missouri and Mississippi Rivers (Carlson et al. 1985, Keenlyne et al. 1993). Hybrid species have generally been identified by the intermediacy or inconsistency of morphological features (Keenlyne et al. 1994). Also, hybrids tend to use habitats more similar to those of shovelnose sturgeon, but have diets more similar to pallid sturgeon (Carlson et al. 1985). Electrophoretic analysis revealed that shovelnose and pallid sturgeon were indistinguishable at all 37 loci examined, which suggests a close genetic relationship between these two species (Phelps and Allendorf 1983, Carlson et al. 1985). Campton et al. (2000) conducted studies on mitochondrial

DNA which indicated significant reproductive isolation between pallid and shovelnose sturgeon, and led to the conclusion that mitochondrial DNA results provide the first molecular genetic evidence for distinguishing the *Scaphirhynchys* species (USFWS 2000).

The rate of hybridization between pallid sturgeon and shovelnose sturgeon, based on morphological measurements, has increased from 1 in 363 (0.28%) of river sturgeons in the late 1970's (Carlson et al. 1985) to 1 in 232 (0.42%) in the late 1990's (Grady et al. 2001). Carlson et al. (1985) captured 4,355 river sturgeons at 12 stations in the Missouri and Mississippi Rivers, in and adjoining the state of Missouri. Of these, 4332 (99.5%) were shovelnose sturgeon, 11 (0.2%) were pallid sturgeon, and 12 (0.3%) were hybrids of the two species. Hybrids were identified by morphological characteristics. Grady et al. (2001) captured 4,433 river sturgeons along 1000 river miles in the lower Missouri and middle Mississippi River. Of these, 4391 (99.1%) were shovelnose sturgeon, 21 (0.5%) were pallid sturgeon, and 21 (0.5%) were hybrids.

A suspected hybrid, based on measurements and characteristics that were intermediate between pallid and shovelnose sturgeons as documented by Carlson et al. (1985), was captured in the lower Platte River near the confluence of the Elkhorn River on April 20, 1996 (Hopfar 1997). This fish was age 9 (750mm), and the intermediate characteristics included barbel placement and length, pigmentation, and body size.

Bailey and Cross (1954) reported the distribution range of pallid sturgeon to fall within the range of shovelnose sturgeon, with shovelnose sturgeon considered more common and widely distributed.

II.D. Reproduction
Little is known about pallid sturgeon reproduction or spawning activities. Throughout its range, no spawning beds have been located (Kallemeyn 1983, Peters et al. 2001).

II.D.1. Maturity
Keenlyne and Jenkins (1993) examined 5 male and 9 female wild pallid sturgeons collected by state and federal fish and wildlife personnel and found that males reached sexual maturity at age 5-7 and that females began egg development at ages 9-12. Fogle (1961 *in* Peters 2000) reported that pallid sturgeon males mature at age 4, while females matured between ages 5 and 7.

Keenlyne and Jenkins (1993) found that females may spawn for the first time at ages 15-20, and then wait for several years before spawning again. Spawning bands on pectoral fin rays of only two (ages 25 and 41) of the nine females collected could be identified. The 41 year old 17-kg female taken from the Missouri River on May 14, 1983 was the only female in an advanced stage of egg development, containing an estimated 170,000 eggs, and is the oldest reported wild pallid sturgeon (Keenlyne et al. 1992, Keenlyne and Jenkins 1993).

Keenlyne and Jenkins (1993) reported that while all five of the male specimens studied were sexually mature and exceeded the minimum length at sexual maturity reported by Fogle (1961), the age 11 and age 37 fish would not have spawned during the year of capture, suggesting that some pallid sturgeon males may not spawn annually.

II.D.2. Timing

Forbes and Richardson (1905) reported that pallid sturgeon spawn between March and June, and continue spawning as late as August. Keenlyne and Jenkins (1993) estimated that spawning probably begins in March in the lower Mississippi and Atchafalaya Rivers, in late April or early May in the lower Missouri and middle Mississippi Rivers, and in late May or early June in the upper Missouri River. A 14.5-kg male netted from the Missouri River on May 31, 1991, near Williston, North Dakota, was running milt, and a 10.0-kg male netted near Pierre, South Dakota, on June 27, 1991 contained motile sperm (Keenlyne and Jenkins 1993).

The age 41 female collected from the Missouri River on May 14, 1983 contained mature ova, and a spawned age 14 female was collected from the Mississippi River near Cairo, Illinois on May 23, 1979 (Keenlyne and Jenkins 1993). Females collected in June and July in Lake Sharpe, a mainstem Missouri River reservoir, contained mature ova and presumably were ready to spawn (June 1987). However, sampling for young-of-the-year pallid sturgeon in the reservoir from 1964 to 1975 produced no evidence of successful reproduction (Kallemeyn 1983).

A gravid female was collected from the Platte River on May 3, 2001 (Peters et al. 2001, 2003). This fish was radio tagged and followed until it entered the Missouri River on June 9, 2001.

II.D.3. Larval Occurrence

Evidence of successful pallid sturgeon reproduction and recruitment is rare. However, in 1998, a young of the year pallid sturgeon was collected at approximate river mile 49.5, south of Cape Girardeau in the middle Mississippi River (Krentz 1999). In August 1998 and 1999, several pallid sturgeon larvae were collected from the lower Missouri River in Missouri (Burton 2000, USFWS 2000).

Other larval sturgeon occurrences have been documented; however, in the following cases the species was undeterminable. In 1994, four larval sturgeon were collected from the upper Missouri River, and in 1995, thirteen sturgeon larvae were collected from the Missouri River. Nine sturgeon larvae were collected from the lower Yellowstone River (Liebelt 1996). One larval sturgeon was collected from the Missouri River near Blair, Nebraska (Omaha Public Power District 1977). Hesse and Mestl (1993) collected two sturgeon larvae from the Missouri River adjacent to Nebraska between 1983 and 1991. These larvae were among 147,000 fish larvae collected during filtration of 18,340,014 ft^3 (519,400 m^3) of river water (Hesse and Mestl 1993).

The University of Nebraska-Lincoln, School of Natural Resource Sciences, has conducted larval drift netting on the lower Platte River. Larval drift was sampled at four sites (Highway 81 bridge-Columbus, Highway 79 bridge-North Bend, Highway 6 bridge, and the Schilling Wildlife Management Area-just above the confluence with the Missouri River) in 1998 and 1999. Sampling was conducted from the beginning of May to the first week in August, and was performed at each site at least once per month at randomly selected times, and every other week for a 24 hour period at the Hwy 6 site. Reade (2000) describes in detail the study objectives, methods, procedures, sampling intensity, and results. A continuation of the Reade (2000) study conducted sampling at four sites (Two Rivers State Recreation Area (RM 41), US Highway 6 bridge (RM 28), Nebraska Highway 50 Bridge (RM 16), and the Schilling Wildlife Management Area (RM 0) from 2000-2004 (Peters and Parham 2006). Sites were sampled monthly from May to August from 2000 to 2002, and the US highway 6 site continued to be sampled every three hours for a 24 hour period. In 2003 and 2004 biweekly sampling was conducted at the US highway 6 and Nebraska highway 50 sites. To date, no confirmed pallid sturgeon larvae have been collected from the lower Platte River and confirmation is not possible with the sampling methods used by Peters and Parham (2006). Four larval specimens of the *Scaphirhynchus* (sturgeon) genus were collected in the lower Platte River (Reade 2000) (Table 3). Eleven sturgeon (*Scaphirhynchus* spp.) larvae were collected from 2000 to 2004 between river mile 28 and the confluence with the Missouri River (Peters and Parham 2006).

II.E. Diet

The pallid sturgeon is primarily piscivorous (Coker 1930, Carlson et al. 1985), with large river cyprinid minnows serving as the primary forage species. Carlson et al. (1985) reported that both pallid sturgeon and shovelnose sturgeon have a high incidence of aquatic invertebrates in their diet. However, the pallid sturgeon had a greater proportion of fish (mostly cyprinids) than did the shovelnose sturgeon. Other investigators also reported a higher incidence of fish in the diet of pallid sturgeon compared to the diet of the shovelnose sturgeon (Held 1969, USFWS 1993).

Coker (1930) reported that the stomach contents of pallid sturgeon from the Mississippi River contained 90% fish remains. A pallid from the unchannelized Missouri River in southeastern South Dakota contained two sauger (*Stizostedion canadense*) (Kallemeyn 1983). Carlson and Pflieger (1981) found that fish were important in the diet of pallid sturgeon from Missouri, but substantial numbers of immature aquatic insects were also eaten. Aquatic insects and small fish were also the principal items in the stomachs of pallid sturgeon from the Kansas River (Cross 1967).

II.F. Habitat Use Characteristics of Captured Pallid Sturgeon

Pallid sturgeon primarily use the main channels of large, turbid rivers in strong currents over firm sand bottoms (Bailey and Cross 1954, Kallemeyn 1983). Forbes and Richardson (1905) reported that pallid sturgeon occur in swifter water than shovelnose sturgeon. Carlson et al. (1985) reported that both pallid and shovelnose sturgeons were found in the main channels of the river, along sand bars at the inside of river bends and behind wing dikes with deeply scoured trenches. However four of eleven pallid sturgeon were caught in areas with swift currents, where shovelnose sturgeons were less numerous (Carlson et al. 1985). Bramblett (1996) reported that shovelnose sturgeons are poor surrogates for pallid sturgeon due to substantial differences in habitat use between the adult pallid and adult shovelnose sturgeon.

Habitat use information presented below includes data from studies throughout the range of pallid sturgeon, as well as data collected from fish caught and followed in the lower Platte River by the University of Nebraska Lincoln research project (Peters et al. 2001, 2002, 2003, 2004, Peters and Parham 2006). After a fish was captured, Peters and Parham (2006) and Swigle (2003) measured habitat and water quality data at the trotline or drift net. During relocation efforts, substrate, water depth, mean column velocity, bottom velocity, and cover were measured at the focal point of the radio signal location and then two meters upstream, downstream, left, and right of the focal area (Peters and Parham 2006). Temperature, dissolved oxygen, conductivity and suspended solids were measured at the focal point. As of August 2004, efforts by the University of Nebraska Lincoln research project in the lower Platte River have resulted in 13 pallid sturgeon captures, of these 6 were wild fish, 6 were recaptures of hatchery fish, and 1 fish was lost before status was determined (see Table 1). This section includes habitat use characteristics for the capture locations of the 6 wild fish, and relocations of the 5 wild fish implanted with radio transmitters. In addition, habitat use characteristics for the capture location of one wild fish captured by the University of Nebraska Statewide stream fisheries inventory crew is included (Peters and Parham 2006).

The following section (Section II.G) reports habitat use characteristics for hatchery fish recaptured by the University of Nebraska Lincoln research project (Peters and Parham 2006) and hatchery fish that were followed immediately after their release (Snook 2001).

II.F.1. Substrate Type

Bramblett (1996) found that pallid sturgeon in the Yellowstone and lower Missouri rivers preferred fines and sand, avoided gravel and cobble, and used boulder and bedrock in proportion to their availability. Pallid sturgeons were most frequently caught over a sand bottom, which is the predominant bottom substrate within its range on the Missouri and Mississippi rivers (Bramblett 1996).

The average percentage of substrate at relocations of wild pallid sturgeon captured in the lower Platte by the University of Nebraska research project between May 2001 and May 2004 was 100% sand for four of the fish and 97.4% sand and 2.6% silt for one of the fish (Peters and Parham 2006). These numbers were averaged across the 5 data points around the relocation and across relocations of individual pallid sturgeon.

II.F.2. Water Depth

Bramblett (1996) reported that pallid sturgeon used water with a mean depth of 2.93 m in the Yellowstone River, 7.74 m in the upper Missouri River, and 3.11 m in the lower Missouri River. Clancey (1990) located pallid sturgeon in the Fort Peck tailrace in Montana at depths of 1.7 to 2.7 m while depths used in the tailrace downstream from Oahe Dam on the Missouri River were 4 to 6 m in Lake Sharpe, South Dakota (Erickson 1992). Hurley (1998) found that pallid sturgeon used even greater depths of between 6 and 12 m in the middle Mississippi River. One pallid sturgeon collected in the lower Platte River of Nebraska in May 1989 was captured at a depth of 1.5 m (4.9 ft) (USFWS 1993; Note: This fish is not in the NGPC database, see Tables 1 and 2, but is cited as a personal communication with M. Harberg, ACOE, in the Pallid Sturgeon Recovery Plan. This may be the same fish as the May 15, 1990 pallid sturgeon included in Table 1 since this fish was also reported by M. Harberg, ACOE.)

The average water depth at capture locations of wild pallid sturgeon captured in the lower Platte River by the University of Nebraska research project between May 2001 and May 2004 was 1.46, 1.52, 2.22, 1.79, 1.71, 0.39, and 0.36 meters (Peters and Parham 2006). These numbers were averaged across the 3 or 4 measurements made at the trotline or drift net, respectively. The average water depth at relocations was 1.74, 1.25, 1.08, 1.23, and 1.19 meters (Peters and Parham 2006). These numbers were averaged across the 5 data points around the relocation and across relocations of individual pallid sturgeon.

II.F.3. Flow Velocity

Preliminary findings from a study on the Missouri River in South Dakota indicate that pallid sturgeon most frequently occupy river bottoms where flow velocities range from 0.33 to 1.0 feet per second (fps) (0.10 to 0.30 m/s) (USFWS 1993). Other studies in Montana found pallid sturgeon were most frequently associated with water velocities ranging from 1.3 to 2.9 fps (0.40 to 0.90 m/s) (USFWS 1993). Bramblett (1996) reported pallid sturgeon were found where bottom velocities ranged from 0.43 to 4.4 fps (0.13 to 1.32 m/s) in the Yellowstone River, from 0 to 2.3 fps (0 to 1/37 m/s) on the upper Missouri River, and from 1.5 to 4.6 fps (0.40 to 0.82 m/s) in the lower Missouri River.

The average velocity at capture locations of wild pallid sturgeon in the lower Platte River by the University of Nebraska research project between May 2001 and May 2004 was 1.02, 0.63, 1.21, 0.71, 0.85, 0.50, and 0.52 meters per second (Peters and Parham 2006). These numbers were averaged across the 3 or 4 measurements made at the trotline or drift net, respectively. The average velocity at relocations was 0.73, 0.78, 0.76, 0.82, and 0.82 meters per second (Peters and Parham 2006). These numbers were averaged across the 5 data points around the relocation and across relocations of individual pallid sturgeon.

II.F.4. Turbidity

Pallid sturgeon historically occupied turbid river systems (Bailey and Cross 1954). Turbidity levels where pallid sturgeon have been found in South Dakota ranged from 31.3 to 137 nephelometric turbidity units (NTU) (USFWS 1993). In the Yellowstone and Missouri Rivers in Montana and North Dakota, the mean Secchi disc depth was 7.8 inches (20 cm) at 115 pallid sturgeon locations (Bramblett 1996). Turbidity levels ranged from 12 to greater than 100 Jackson turbidity units at pallid sturgeon relocation sites below Fort Peck dam on the Missouri River. Two pallid sturgeons were monitored for habitat use in the Missouri River near the confluence with the Milk River and both appeared to prefer turbid water; relocations in the vicinity of the confluence with the Milk River consistently were in the plume of turbidity along the north bank where the Milk River entered the Missouri River (Bramblett 1996).

The turbidity at capture locations of wild pallid sturgeon in the lower Platte River by the University of Nebraska research project between May 2001 and May 2004 was 92.8, 64.8, 50.4, 45.8, and 1040 NTU (Peters and Parham 2006).

II.F.5. Total Suspended Solids

The total suspended solids at capture locations of wild pallid sturgeon in the lower Platte River by the University of Nebraska research project between May 2001 and May 2004 was 336, 110.5, 129, 168.5, and 115.5 mg/L (Peters and Parham 2006). The average total suspended solids at relocations was 86, 108, 192, 640, and 1172 mg/L (Peters and Parham 2006). These numbers were averaged across relocations of individual pallid sturgeon.

II.F.6. Temperature

Water temperatures at pallid sturgeon locations in the Yellowstone and Missouri Rivers in Montana and North Dakota ranged from 3.0-26.0º C, with a mean water temperature of 15.8º C (Bramblett 1996).

The water temperature at capture locations of wild pallid sturgeon in the lower Platte River by the University of Nebraska research project between May 2001 and May 2004 was 17.2, 17.2, 15.8, 12.3, 14.4, 16.6, and 20.8 degrees C (Peters and Parham 2006). The average water temperature at relocations was 15.0, 11.3, 13.0, 18.7, and 22.0 degrees C (Peters and Parham 2006). These numbers were averaged across relocations of individual pallid sturgeon.

II.F.7. Dissolved Oxygen

Dissolved oxygen measured from locations of radio-tagged pallid sturgeon in the Yellowstone and Missouri Rivers in Montana and North Dakota ranged from 7.0 to 12.0 mg/L with a mean level of 8.7 mg/L (Bramblett 1996).

The dissolved oxygen at capture locations of wild pallid sturgeon in the lower Platte River by the University of Nebraska research project between May 2001 and May 2004 was 8.9, 11.1, 11.8, 12.5, 11.7, 11.9, and 10.0 mg/L (Peters and Parham 2006). The average dissolved oxygen at relocations was 12.47, 14.37, 11.57, 8.91, and 6.71 mg/L (Peters and Parham 2006). These numbers were averaged across relocations of individual pallid sturgeon.

II.F.8. Conductivity

Mean conductivity from locations of radio-tagged pallid sturgeon on the Yellowstone and Missouri Rivers in Montana and North Dakota was 526 µS/cm, with a minimum of 67 and a maximum of 880 µS/cm (Bramblett 1996).

The specific conductivity at capture locations of wild pallid sturgeon in the lower Platte by the University of Nebraska research project between May 2001 and May 2004 was 745.5, 542.5, 574.0, 626.5, 648.5, 617.0, and 678.0 µS/cm (Peters and Parham 2006). The average specific conductivity at relocations was 584, 628, 594, 560, and 523 µS/cm (Peters and Parham 2006). These numbers were averaged across relocations of individual pallid sturgeon.

II.F.9. Pallid Sturgeon Movements

In Lake Sharpe, South Dakota, Erickson (1992) used sonic telemetry and determined that pallid sturgeon movements were greater at night and were positively correlated with water temperatures and discharge, and larger fish moved more than smaller fish. Two pallid sturgeon were also captured and monitored using radio telemetry below Fort Peck dam on the Missouri River; one pallid sturgeon moved 272 km downstream and the other moved 72 km downstream from the Fort Peck tailrace from March to mid-June (Bramblett 1996).

Five wild pallid sturgeon were relocated in the lower Platte River by the University of Nebraska research project between May 2001 and May 2004 (Peters and Parham 2006). Fish #621 was captured at RM 16.2, near Louisville, on May 3, 2001. This fish was relocated within 0.25 km of the release site from May 6 to May 24, moving downstream at a rate of 150 meters per day from May 3 to May 29. From May 29 to June 9 this fish moved downstream at a rate of 1940 meters per day and entered the Missouri River on June 9.

Fish #721 was captured at RM 16.2, near Louisville, on May 23, 2002. This fish was relocated 14.8 km downstream of the release site after 5 days. This fish remained in the lower Platte River for at least 8 days and entered the Missouri River on May 30, moving at an average rate of 3250 meters per day (Peters and Parham 2006).

Fish # 542 was captured at RM 3.7 on April 3, 2003. This fish was relocated within 1 km of the release site from April 3 to April 23, and entered the Missouri River by April 27 (Peters and Parham 2006).

Fish # 291 was captured 0.6 RM upstream from the mouth of the Platte River on April 8, 20004. This fish was relocated in the area on April 12, 13 and 14 before it entered the Missouri River (Peters and Parham 2006).

Fish # 231 was captured 0.9 RM upstream from the mouth of the Platte River on April 15, 2004. This fish was tracked moving into the Missouri River on that date (Peters and Parham 2006).

II.G. Habitat Use Characteristics of Hatchery-Raised Pallid Sturgeon in the Lower Platte River

Habitat use information presented below includes data collected from fish caught and followed in the lower Platte River by the University of Nebraska Lincoln research project (Peters et al. 2001, 2002, 2003, 2004, Peters and Parham 2006). After a fish was captured, Peters and Parham (2006) and Swigle (2003) measured habitat and water quality data at the trotline or drift net. During relocation efforts, substrate, water depth, mean column velocity, bottom velocity, and cover were measured at the focal point of the radio signal location and then two meters upstream, downstream, left, and right of the focal area. Temperature, dissolved oxygen, conductivity and suspended solids were measured at the focal point. As of August 2004, efforts by the University of Nebraska Lincoln research project in the lower Platte River have resulted in 6 recaptures of hatchery pallid sturgeon, of these 4 were too small for radio transmitters, 1 fish was tracked to one relocation using radio telemetry, and 1 fish was implanted with a radio transmitter and never relocated. The portions of the subsections below referenced to Peters and Parham 2006 include habitat use characteristics for the 6 capture locations and the 1 relocation.

In April 1998, ten six-year-old pallid sturgeon that were hatchery spawned and reared were implanted with transmitters. Another 15 seven-year-old pallid sturgeon were implanted in April 1999 (Reade 2000). Each group of implanted sturgeon was separately released into the Platte River, above the Elkhorn River confluence. Each fish was tracked and habitat variables were measured at and around the fish locations. Measured variables included substrate, depth, mean column current velocity, bottom current velocity, and instream/outstream cover. Most hatchery-raised radio-tagged pallid sturgeon in the lower Platte River used areas characterized by sharp changes in depth, at the downstream edges of sandbars or islands, where currents converge. The amount of use of instream cover such as logs and other woody debris was negligible (Snook 2001).

II.G.1. Water Depth

Hatchery-reared pallid sturgeons in the lower Platte River used depths ranging from 0.15 to 1.68 m and averaged 0.76 m in 1998, and ranged from 0.34 to 1.89 m and averaged 0.98 m in 1999. Depth intervals used greater than 10% included those between 0.33 and 1.21 m in 1998 and 1999 (Snook 2001).

The average water depth at capture locations of hatchery pallid sturgeon in the lower Platte River by the University of Nebraska research project between May 2001 and May 2004 was 1.63, 1.68, 2.42, 1.71, 1.51, and 1.92 meters (Peters and Parham 2006). These numbers were averaged across the 3 or 4 measurements made at the trotline or drift net. The average water depth at the one relocation of the hatchery pallid sturgeon was 1.13 meters (Peters and Parham 2006). This number was averaged across the 5 data points around the relocation.

II.G.2. Substrate

Researchers tracking hatchery-reared pallid sturgeon in the lower Platte River observed use of predominantly sand substrates (Snook 2001).

The average percentage of substrate at the one relocation of the hatchery pallid sturgeon captured in the lower Platte by the University of Nebraska research project in April 2004 was 100% sand (Peters and Parham 2006). This number was averaged across the 5 data points around the relocation.

II.G.3. Flow Velocity

Snook (2001) reported hatchery-raised pallid sturgeon used habitats in areas where mean column velocities ranged from 1.35 to 3.28 fps (0.41 to 1.00 m/s); and bottom velocities were generally less than 2.30 fps (0.70 m/s).

The average velocity at capture locations of hatchery pallid sturgeon in the lower Platte River by the University of Nebraska research project between May 2001 and May 2004 was 0.99, 1.08, 0.37, 0.85, 0.74, and 0.76 meters per second (Peters and Parham 2006). These numbers were averaged across the 3 or 4 measurements made at the trotline or drift net. The average velocity at the one relocation of the hatchery pallid sturgeon was 0.52 meters per second (Peters and Parham 2006). This number was averaged across the 5 data points around the relocation.

II.G.4. Turbidity

The turbidity at capture locations of hatchery pallid sturgeon in the lower Platte River by the University of Nebraska research project between May 2001 and May 2004 was 75.1, 64.8, 45.8, 299, and 292 NTU (Peters and Parham 2006).

II.G.5. Total Suspended Solids

The total suspended solids at capture locations of hatchery pallid sturgeon in the lower Platte River by the University of Nebraska research project between May 2001 and May 2004 was 158.5, 129, 115.5, 164, and 307 mg/L (Peters and Parham 2006). The average total suspended solids at the one relocation of the hatchery pallid sturgeon was 114 mg/L (Peters and Parham 2006).

II.G.6. Temperature

Water temperatures were measured at locations for hatchery raised radio-tagged pallid sturgeons in the lower Platte River from May 18 to October 8, 1998 and from April 28 to October 5, 1999. Water temperature ranged from 13.1 to 33.7º C (mean 24.8º C, median 26.2º C) in 1998. In 1999 water temperature ranged from 11.4º C to 30.9º C (mean 20.6º C, median 19.8º C) (Snook 2001).

The water temperature at capture locations of hatchery pallid sturgeon in the lower Platte by the University of Nebraska research project between May 2001 and May 2004 was 15.5, 16.3, 9.95, 14.4, 13.3, and 13.4 degrees C (Peters and Parham 2006). The average water temperature at the one relocation of the hatchery pallid sturgeon was 14.3 degrees C (Peters and Parham 2006).

II.G.7. Dissolved Oxygen
The dissolved oxygen at capture locations of hatchery pallid sturgeon in the lower Platte River by the University of Nebraska research project between May 2001 and May 2004 was 12.1, 12.6, 15.8, 11.7, 9.5, and 12.0 mg/L (Peters and Parham 2006). The average dissolved oxygen at the one relocation of the hatchery pallid sturgeon was 12.48 mg/L (Peters and Parham 2006).

II.G.8. Conductivity
The specific conductivity at capture locations of hatchery pallid sturgeon in the lower Platte River by the University of Nebraska research project between May 2001 and May 2004 was 635.5, 634.0, 636.5, 648.5, 548.0, and 561.0 µS/cm (Peters and Parham 2006). The average specific conductivity at the one relocation of the hatchery pallid sturgeon was 655 µS/cm (Peters and Parham 2006).

II.G.5. Pallid Sturgeon Movements
Hatchery-raised pallid sturgeon implanted with transmitters were released in the Platte River just above the confluence with the Elkhorn River at Two Rivers State Recreation Area, Nebraska; 10 individuals were released in April 1998 and 15 individuals were released in April 1999. Immediately following release, 22 of the 25 pallid sturgeons moved downstream of the confluence. Three fish moved approximately 500 m upstream in 1998, and then moved downstream. Eight of the pallid sturgeons hesitated in their downstream movement at the mouth of the Elkhorn River (river mile 32.3). One fish (#055) used this area for several weeks in May, June and August. Two other fish (#155 and #164) used this area from September though December 1999. Throughout the year fish were often located in the area upstream of Louisville (river mile 16.2), and 8 individuals were found there in March and April (Snook 2001).

Fish #055 was last observed on November 22, 1999 at the mouth of the Platte River at river mile 1.1. By December 14, 1999 the signal was lost, and Snook (2001) concluded that the fish most likely entered the Missouri River. Fish #014 was upstream of Ashland at river mile 33.8 in September, and then moved upstream to river mile 37.5. In February 2000 fish #014 was located downstream at river mile 10.2, and then upstream again at river mile 44.3, where it was last located on April 28, 2000 (Snook 2001).

Two hatchery-raised pallid sturgeon appeared to leave the Platte River during the winter months and then returned in the spring. One individual (#095) was last located near the mouth at river mile 2.6 of the Platte River and left after October 11, 1999. Then on March 31, 2000, this fish (#095) was found at river mile 16.2, likely returning to the Platte River from the Missouri River. Fish #095 remained in this area until April 14, 2000, when it moved downstream and was found at the mouth of the Platte once again. Fish #095 was last located on May 12, 2000 at river mile 0.6; after this date the fish moved into the Missouri River or the transmitter expired (Snook 2001). Another fish (#184) used the area around river mile 21.6 until October 12, 1999 when it was found near the mouth of the Platte at river mile 7.2. Fish #184 remained in this vicinity until

November 8, 1999, when downstream movements suggested that it moved into the Missouri River. Then on March 31,2000 fish #184 was located once again in the Platte River at river mile 19.9, and was last located at river mile 21.7 on April 28, 2000 (Snook 2001).

Six hatchery pallid sturgeon were relocated in the lower Platte River by the University of Nebraska research project between May 2001 and May 2004 (Peters and Parham 2006). Fish #260 was captured at 0.72 RM upstream of the mouth of the Platte River on April 13, 2004. This fish had been stocked at Boonville, Missouri on April 15, 2002. Between the stocking release and this recapture, this fish had traveled a minimum of 400 miles over 719 days. This fish was tracked once on April 14 before entering the Missouri River.

Fish #910 was captured at 0.6 RM upstream from the mouth of the Platte River on April 8, 2004. This fish had been stocked at Boonville, Missouri on April 3, 2002. Between the stocking release and this recapture, this fish had traveled a minimum of 400 miles over 736 days. This fish was not relocated after release with a radio transmitter (Peters and Parham 2006).

Four hatchery pallid sturgeon were recaptured and too small to be implanted with a radio transmitter. All four were stocked at Bellevue, Nebraska (RM 601.4) on September 4, 2003. The fish caught at the mouth of the Platte River on April 7, 2004 had traveled a minimum of 7 miles over 216 days. The fish caught at RM 1.3 on April 15, 2004 had traveled a minimum of 8.2 miles over 224 days. Two fish caught at Cedar Creek (RM 12) on May 13, 2004 had traveled a minimum of 19.4 miles over 252 days.

II.H. Lower Platte River Geomorphology, Hydrology, and Water Chemistry

For this section, the lower Platte River is defined to begin at the confluence of the Loup and Platte Rivers near Columbus, Nebraska, approximately 160 km upstream from its confluence with the Missouri River. The Loup and Elkhorn rivers, which are both fed by groundwater from the sandhills, provide much of the flow for the lower Platte River (Bentall 1982).

II.H.1. Flow Information

Mean daily river discharge is recorded by the USGS at four gage locations in the lower Platte River from the mouth of the Loup River downstream to the mouth of the Elkhorn River, and from the mouth of the Elkhorn River (a few miles upstream of Ashland) downstream to the mouth of the Platte River. Gaging stations in these reaches are located at Duncan (just upstream of the Loup River), North Bend, Ashland, and Louisville. Records are published annually in the Surface Water Supply Report, and are also available at http://waterdata.usgs.gov. Periods of record for Ashland are 1928-1953 and 1988-present, and for Louisville are 1953-present.

Peters et al. (1989) found that over 40% of available mean column velocities in the lower Platte River were between 1.31 and 1.97 fps.

II.H.2. Substrate

Peters et al. (1989) reported that sand compromised over 80% of available substrates in the lower Platte River, and documented an increase in the availability of silt and gravel during the summer.

II.H.3. Sediment Transport

Erosion introduces organic matter and large woody debris from the floodplain, as well as sediment in the form of rock, gravel, sand, silt, and clay. Information on suspended sediment load is available from USGS sampling at gage sites. The USGS National Stream Water Quality Network (NASQAN) posts water chemistry information from the Platte River at Louisville, Nebraska at the following website: http://water.usgs.gov/nasqan/data/provdata/platte.html. Information provided includes the following:

- Flow = Mean daily streamflow, in cubic feet per second
- P00061 = Instantaneous discharge, in cubic feet per second
- P00010 = Temperature (C)
- P00095 = Specific conductance (uS/cm)
- P00300 = Dissolved oxygen, in milligrams per liter
- P00400 = pH, in standard units
- P39086 = Alkalinity (filtered, as $CaCO_3$), in milligrams per liter
- P80154 = Suspended sediment, in milligrams per liter
- P70331 = Suspended sediment, percent finer than 62 microns

II.H.4. Water Chemistry

Reade (2000) measured water temperature, dissolved oxygen, conductivity, and suspended solids in 1998 and 1999 from mid-May through early-August at four sites along the lower Platte River from the Loup River confluence to the Missouri River confluence during a larval fish drift study.

Peters et al. (2001, 2002, 2003, 2004) reported measurements of water temperature, dissolved oxygen, conductivity, salinity, and suspended solids at four sites in the lower Platte basin (Louisville and Leshara on Platte River; Greenwood on Salt Creek; and Waterloo on Elkhorn River).

II.H.5. Temperature

Beginning in September 2000, water temperature was measured at Leshara and Louisville on the Platte River. Sites were sampled weekly by the UNL research team except when ice conditions make water sampling dangerous. Five temperature recording units were placed at Louisville to continually monitor temperature (Peters et al. 2001, 2002, 2003, 2004).

Reade (2000) reported mean temperatures of four sites along the lower Platte River by date for 1998 and 1999 (Table 4).

II.H.6. Dissolved Oxygen

Beginning in September 2000, dissolved oxygen was measured at Leshara and Louisville on the Platte River by the UNL research team. Sites are sampled weekly except when ice conditions make water sampling dangerous (Peters et al. 2001, 2002, 2003, 2004).

Reade (2000) reported mean dissolved oxygen levels at four sites along the lower Platte River by date for 1998 and 1999 (Table 5).

II.H.7. Conductivity

Beginning in September 2000, conductivity was measured at Leshara and Louisville on the Platte River. Sites are sampled weekly except when ice conditions make water sampling dangerous (Peters et al. 2001, 2002, 2003, 2004).

Peters et al. (1989) described a persistent difference in conductivity between north and south banks of the lower Platte River for up to 72 km below the confluence of the Platte and the Loup River Power Canal near Columbus.

II.H.8. Salinity

Beginning in September 2000, salinity was measured at Leshara and Louisville on the Platte River. Sites are sampled weekly except when ice conditions made water sampling dangerous (Peters et al. 2001, 2002, 2003, 2004).

II.H.9. Suspended Solids and Turbidity

Beginning in September 2000, total suspended solids and turbidity were measured at Leshara and Louisville on the Platte River. Sites are sampled weekly except when ice conditions made water sampling dangerous (Peters et al. 2001, 2002, 2003, 2004).

Reade (2000) reported mean suspended solid levels at four sites along the lower Platte River by date for 1998 and 1999 (Table 5).

II.H.10. Hydraulic Modeling

Hydraulic data from two studies from the mouth of the Platte to the Elkhorn River are available. The study sites near Louisville and Cedar Creek, Nebraska, were selected by an interagency team of NGPC and U.S. Bureau of Reclamation biologists and hydrologists according to the guidelines of the Instream Flow Incremental Method (Bovee 1982). Further information on site selection and site maps are contained in NGPC (1993).

Hydraulic data were collected in 1985, 1987, and 1988 in the lower Platte River and consisted of: 1) bed profile data and bed elevations from headpin to headpin across transects, 2) distances across the channels with corresponding depths and velocities, and 3) substrate fish cover distributions. Hydraulic data have been processed using Physical Habitat Simulation (PHABSIM) procedures, and calibrated hydraulic data files have been produced to represent hydraulic relationships at a range of simulated river discharges.

III. HISTORIC DATA/PROJECTS NOT BEING REPLICATED DURING THE PROGRAM

III.A. Pallid Sturgeon Stocking

The Program does not currently plan to stock the lower Platte River (other groups may stock this area in the future). In October 1997, 401 ten-inch hatchery-raised pallid sturgeons were stocked in the lower Platte River approximately 5 river miles above the mouth of the Platte River (Krentz et al. 2005). The stocked pallid sturgeons were the progeny of a brood stock population maintained by the Missouri Department of Conservation at the Blind Pony State Fish Hatchery.

In the Missouri River, pallid sturgeons were stocked upstream of the confluence of the Platte River. The closest stocking was near Bellevue, NE at river mile 601.4 where there were 2513 stocked in 2002, 4936 stocked in 2003, and 7868 stocked in 2004 (Krentz et al. 2005).

III.B. Contaminant Load

Ruelle and Keenlyne (1993) analyzed contaminant concentrations in three Missouri River pallid sturgeon. Two of these fish were captured in the upper Missouri River in North Dakota, an area isolated from the lower river by mainstem dams. The third was captured in the lower Missouri River in Nebraska, approximately 60 miles below the confluence with the Platte River. The Nebraska fish was a 10-year-old female that was not sexually mature. Samples were taken of gonad, liver, kidney and muscle tissue. The Nebraska fish contained concentrations of DDT, chlordane, dieldrin, cadmium, mercury, selenium, and particularly PCB's (which have been found to reduce reproductive success in fish) high enough to suggest that these individual contaminants or the combination thereof may be affecting pallid sturgeon health and reproduction (Ruelle and Keenlyne 1993).

III.C. Habitat Suitability Criteria for Potential Pallid Sturgeon Prey Species

A two-year study by the University of Nebraska, from 1986-1988, developed microhabitat suitability index criteria for dominant species of fish and macroinvertebrate taxa which may be used as food by pallid sturgeon of the lower Platte River. Methods and results are described by Peters et al. (1989). The study reach extended from the confluence of the Platte and Loup River (RM 101) downstream to the mouth of Salt Creek (RM 25). Most sampling was conducted between RM 59 and 78, which included instream flow incremental methodology (IFIM) transects established by the NGPC at RM 69. Forage fish were sampled weekly, using pre-positioned electrofishing grids placed along 100-meter transects. Quantitative measurements of depth, current velocity, cover and substrate were collected for 10 species of fish and 18 invertebrate taxa. Using similar methods, Holland and Peters (1994) expanded the information to about 20 species and life stages using sites from river mile 18 to 230.

Hopfar (1997) conducted larval fish survey in May and June of 1996 and reported that Cyprinidae was the most abundant family found in the lower Platte River. Reade (2000) also found Cyprinidae to be the predominant family of larval fish in a survey conducted in 1998 and 1999 on the lower Platte River.

IV. DATA GAPS/PROTOCOLS

Protocols for conducting pallid sturgeon monitoring and research will be developed for the Program, and will be on file with the Program's Executive Director's office.

Basic parameters relating to spawning, such as locations, substrate preference, water temperature, and time of year have not been documented.

Information regarding life history of the pallid sturgeon and the role of the lower Platte River was not found in the literature.

Habitat use data for wild pallid sturgeon in the lower Platte River are remain limited.

Information regarding predators of pallid sturgeon, other than commercial fishery was not found in the literature.

Information regarding diseases of pallid sturgeon in the lower Platte River was not found in the literature.

V. DATA ADEQUACY

Baseline information was evaluated for quantitative descriptions of pre-Program (baseline) conditions that could be used in the monitoring and research items identified for the pallid sturgeon. For baseline data to be as useful as possible, the data collection procedure should have 1) followed detailed and scientific protocols, 2) been recorded and vigorously adhered to, and 3) entered into an electronic format (i.e. a data spreadsheet). The quality assurance procedures should have been conducted and any changes made to the data should have been documented. Finally, data should have been stored in an accessible medium along with the data collection protocols and other metadata.

In addition, for baseline data to be as useful as possible, the study design should have incorporated statistical sampling procedures. The sampling frame should have been identified, and random sampling should have been employed to ensure the data would be unbiased for the region and/or time of interest.

The data collected by Peters' UNL research team from 2001 to 2004 constitutes the best information about pallid sturgeon location and habitat use for the lower Platte River. These data have been provided in an electronic format. These data should be used to define the macro-habitat used by the pallid sturgeon in the lower Platte. Since the sampling procedures (specifically, the sampling locations) were not implemented in accordance with a sampling design, the captured fish represent a non-probability based sample and are subject to sampling biases. For example, since the research team only directed their sampling efforts on the deepest and swiftest waters (Peters and Parham 2006), the observations resulting from this method will contain a depth and velocity bias. Analyses conducted with this sample of fish must acknowledge the sampling biases associated with this data.

In addition, analyses of habitat use involving the hatchery reared individuals will need to address the assumption that hatchery reared fish are behaving like wild reared fish. Analyses of habitat use conducted with this data will need to be conducted separately for the wild caught and the hatchery reared individuals. Post-stratification of the data based on fish origins will enable an evaluation of the habitat used by each strata to determine if analyses based on the combination of the strata are valid.

The historical observations of pallid sturgeon that were not a part of the UNL research and which were confirmed (Table 1) and unconfirmed or probable (Table 2) represent a non-probability based sample containing biases inherent in data collected in this manner. In addition, the location information is not precise. This sample of points should not be used in a quantitative analysis of the spatial distribution or habitat used by pallid sturgeon for these reasons.

VI. LITERATURE CITED

Bailey R. M. and F. B. Cross. 1954. River sturgeons of the American genus *Scaphirhynchus*: characters, distribution, and synonymy. Papers of the Michigan Academy of Science, Arts, and Letters, Vol. XXXIX, 1954. Pages 169-208.

Bentall, R. 1982. Nebraska's Platte River – a graphic analysis of flows. Conservation and Survey Division, Nebraska Water Survey Paper 53. University of Nebraska, Lincoln. 47pp.

Bovee, K. D. 1982. A guide to stream habitat analysis using the Instream Flow Incremental Methodology. Instream Flow Information Paper 12. U. S. Fish and Wildlife Service Biology Report 82(26). 248pp.

Bramblett, R. G. 1996. Habitats and movements of pallid and shovelnose sturgeon in the Yellowstone and Missouri rivers, Montana and North Dakota. Ph.D. thesis. Montana State University. Bozeman.

Buchanan, T. M. 1973. Key to the fishes of Arkansas. Arkansas Game and Fish Commission, Little Rock. 68pp. 198 maps.

Burton, K. 2000. First reproduction of Pallid Sturgeon in lower Missouri River in decades is confirmed by Fish and Wildlife Service. February 9, 2000, Office of Public Affairs, News Release, available at http://news.fws.gov.

Campton, D. E., A. L. Bass, F. A. Chapman, and B. W. Bowen. 2000. Genetic distinction of pallid, shovelnose, and Alabama sturgeon: emerging species and the U.S. Endangered Species Act. Conservation Genetics 1: 17-32.

Carlson, D. M. and W. L. Pflieger. 1981. Abundance and life history of lake pallid and shovelnose sturgeons in Missouri. Missouri Department of conservation, sturgeon studies in Missouri Job No. 1, Endangered Species Project SE-1-6.

Carlson, D. M., W. L. Pflieger, L. Trial, and P. S. Haverland. 1985. Distribution, biology, and hybridization of *Scaphirhynchus albus* and *S. platorynchus* in the Missouri and Mississippi Rivers. Environmental Biology of Fishes 14(1): 51-59.

Clancey, P. 1990. Fort Peck pallid sturgeon study. Annual Report. Montana Fish, Wildlife and Parks, Helena.

Coker, R. E. 1930. Studies of common fishes of the Mississippi River to Keokuk. Bull. U. S. 6. 63pp.

Cross, F. B. 1967. Handbook of fishes in Kansas. University of Kansas Museum of Natural History Miscellaneous Publication Number 45, Lawrence.

Erickson, J. D. 1992. Habitat selection and movement of pallid sturgeon in Lake Sharpe, South Dakota. M.S. Thesis. South Dakota State University, Brookings.

Feit, D. 2002. Personal communication with Clayton Derby, November 2002.

Fogle, N. E. 1961. Report of the fisheries investigations during the second year of impoundment of Oahe Reservoir, South Dakota, 1961. South Dakota Department of Game, Fish and Parks, Federal Aid in Fish Restoration Project F-1-R-12, Pierre, South Dakota.

Forbes, S. A., and R. E. Richardson. 1905. On a new shovelnose sturgeon from the Mississippi River. Bulletin of the Illinois State Laboratory of Natural History 7: 37-44.

Grady, J., Milligan, J., C. Gemming, D. Herzog, G. Mestl, L. Miller, D. Hernig, K. Hurley, P. Wills, and R. Sheehan. 2001. Pallid and shovelnose sturgeon in the lower Missouri and Middle Mississippi Rivers. Final Report prepared for MICRA, June 2001. 45pp.

Held, J. W. 1969. Some early summer foods of the shovelnose sturgeon in the Missouri River. Transactions of American Fisheries Society 98: 514-517.

Hesse, L. W., and G. E. Mestl. 1993. The status of paddlefish in the Missouri, Nebraska. Progress Report, D.J. Project F-75-R, Nebraska Game and Parks Commission, Norfolk, Nebraska. 31 pp.

Holland, L. E. and E. J. Peters. 1994. Biological and economic analyses of fish communities in the Platte River: Creel survey of fishing pressure along the lower Platte River. Final Report. Federal Aid in Fish Restoration Project No. F-78-R. Study III: JobIII-1. University of Nebraska, Lincoln. March 1994.

Hopfar, R. L. 1997. Biology of shovelnose sturgeon, *Scaphirhynchus platorynchus*, in the lower Platte River, Nebraska. M.S. Thesis, University of Nebraska, Lincoln. 83pp.

Hurley, K. L. 1998. Habitat use, selection, and movements of Middle Mississippi River pallid sturgeon and validity of pallid sturgeon age estimates from pectoral fin rays. M.S. Thesis. Southern Illinois University, Carbondale.

June, F. C. 1987. Limnological and fishery studies on Lake Sharpe, a main-stem Missouri River reservoir, 1964-1975. U. S. Dept. of the Interior, Fish and Wildlife Service, Technical Report No. 8.

Kallemeyn, L. 1983. Status of the Pallid Sturgeon (*Scaphirhynchus albus*). Fisheries 8(1): 3-9.

Keenlyne, K. D. 1989. A report on the Pallid Sturgeon. U. S. Fish and Wildlife Service, Pierre, South Dakota. MRC-89-1. 20pp.

Keenlyne, K. D., L. K. Graham, and B. C. Reed. 1993. Natural hybrids between two species of *Scaphirhynchinae* sturgeon. U. S. Fish and Wildlife Service, Pierre, South Dakota. Unpublished report.

Keenlyne, K. D., E. M. Grossman, and L. G. Jenkins. 1992. Fecundity of the pallid sturgeon. Transactions of the American Fisheries Society 121: 139-140.

Keenlyne, K. D., C. J. Henry, A. Tews, and P. Clancey. 1994. Morphometric comparisons of upper Missouri River sturgeons. Transactions of the American Fisheries Society 123: 779-785.

Keenlyne, K. D. and L. G. Jenkins. 1993. Age at sexual maturity of the pallid sturgeon. Transactions of the American Fisheries Society 122: 393-396.

Krentz, S. 1999. Pallid sturgeon recovery update. Issue No. 10.

Krentz, S., R. Holm, H. Bollig, J. Dean, M. Rhodes, D. Hendrix, G. Heidrich, and B. Krise. 2005. Pallid sturgeon spawning and stocking summary report, 1992-2004.

Liebelt, J. E. 1996. Lower Missouri River and Yellowstone River pallid sturgeon study. Submitted to U.S. Bureau Of Reclamation and Western Area Power Administration. Montana Fish, Wildlife, and Parks.

NGPC (Nebraska Game and Parks Commission). 1993. Platte River instream flow report – fish community, Elkhorn River to Missouri River. Application for a permit to appropriate water for instream flows, November 30, 1993. Lincoln, Nebraska. 29pp.+app.

Omaha Public Power District. 1977. Fort Calhoun Station Unit No. 1 Five Year Report. Omaha Public Power District, Omaha.

Peters, E. J. 2000. Ecology and management of the pallid sturgeon and sturgeon chub in the lower Platte River. Study proposal, School of Natural Resource Sciences, University of Nebraska, Lincoln. 25pp.

Peters, E. J. 2002. Personal communication; Oct. 31, Governance Committee Workshop.

Peters, E. J., R. S. Holland, M. A. Callam, and D. L. Bunnell. 1989. Platte River habitat suitability criteria: Habitat utilization, preference and suitability index criteria for fish and aquatic invertebrates in the lower Platte River. Nebraska Technical Series No. 17. Nebraska Game and Parks Commission, Lincoln.

Peters, E.J., M.T. Kaminski, J. Olnes, J. Parham, C.N. Reade, R. Ruskamp, D. Shuman, B. Swigle, S.M. Sedlacek, L.A. Vrtiska. 2002. Ecology and management of the pallid sturgeon and sturgeon chub in the lower Platte River. Perfomance report May 1, 2001/April 30, 2002 to The Pallid Sturgeon, Sturgeon Chub Task Force.

Peters, E.J., M.T. Kaminski, J. Olnes, J. Parham, C.N. Reade, R. Ruskamp, D. Shuman, B. Swigle, S.M. Sedlacek, L.A. Vrtiska. 2003. Ecology and management of the pallid sturgeon and sturgeon chub in the lower Platte River. Perfomance report May 1, 2002/April 30, 2003 to The Pallid Sturgeon, Sturgeon Chub Task Force.

Peters, E.J., J. Olnes, J. Parham, C.N. Reade, R. Ruskamp, D. Shuman, V.A. Snook, B. Swigle. 2001. Ecology and management of the pallid sturgeon and sturgeon chub in the lower Platte River. Progress report May 2000/May 2001 to The Pallid Sturgeon, Sturgeon Chub Task Force.

Peters, E.J., and J.E. Parham. 2006. Pallid sturgeon and sturgeon chub in the lower Platte River 2000 to 2004: Final report to The Pallid Sturgeon, Sturgeon Chub Task Force.

Peters, E.J., M, J. Parham, C.N. Reade, M.T. Kaminski, J.J. Olnes, R. Ruskamp. 2004. Ecology and management of the pallid sturgeon and sturgeon chub in the lower Platte River. Perfomance report May 1, 2003/April 30, 2004 to The Pallid Sturgeon, Sturgeon Chub Task Force.

Pflieger, W. L. 1975. The fishes of Missouri. Missouri Department of Conservation, Jefferson City. 343pp.

Phelps, S. R. and F. W. Allendorf. 1983 Genetic identity of pallid and shovelnose sturgeon (*Scaphirhynchus albus* and *S. platorynchus*). Copeia 1983(3):696-700.

Reade, C. N. 2000. Larval fish drift in the lower Platte River, Nebraska. M.S. thesis, University of Nebraska, Lincoln.

Ruelle, R., and K. D. Keenlyne. 1993. Contaminants in Missouri River pallid sturgeon. Bulletin Environmental Contaminants and Toxicology 50: 898-906.

Simons, A.M., R.M. Wood, L.S. Heath, B.R. Kuhajda, and R.L. Mayden. 2001. Phylogenetics of Scaphirhynchus based on mitochondrial DNA sequences. Transactions of the American Fisheries Society 130 (3): 359-366.

Snook, V. A. 2001. Movements and habitat use by hatchery-reared pallid sturgeon in the lower Platte River, Nebraska. M.S. thesis, University of Nebraska, Lincoln. 153pp.

Snyder, D. E. 2002. Pallid and shovelnose sturgeon larvae – morphological description and identification. Journal of Applied Ichthyology 18 (4-6): 240-265.

Swigle, B. 2003. Movements and habitat use by shovelnose and pallid sturgeon in the lower Platte River, Nebraska. MS Thesis, Univ. of Nebraska, Lincoln.

USFWS (U. S. Fish and Wildlife Service). 1989. Proposed rule to determine the pallid sturgeon to be an endangered species. Federal Register 54: 35901-35904.

USFWS (U. S. Fish and Wildlife Service). 1990. Endangered and threatened wildlife and plants; determination of endangered status for the pallid sturgeon. Final rule. Department of the Interior, Fish and Wildlife Service, 50 CFR part 17, RIN 1018-AB 31.

USFWS (U. S. Fish and Wildlife Service). 1993. Pallid sturgeon recovery plan. U.S. Fish and Wildlife Service. Bismarck, ND. 55pp.

USFWS (U. S. Fish and Wildlife Service). 2000. Biological Opinion on the Missouri River. November 2000.

Van Wyhe, G. L. 1960. Test netting survey of the Garrison Reservoir. North Dakota Game and Fish Department. Dingell-Johnson Project F-3-R-7, Work Plans I, II, and III.

Table 1. Confirmed observations of pallid sturgeon in the Platte River, 1979-2004. Confirmed observations constitute fish that were observed by a fish biologist.

Date	Location	Size	Comments
May 15, 1990	0.25 mile above confluence with Missouri River	Weight – 7.4 pounds Length – 42.5 inches	Fish captured by USACOE biologists conducting a pallid sturgeon study. Fish was tagged.
May 25, 1993	One mile downstream of Elkhorn River	Weight – 6.5 pounds Length – 35 inches	Fish was captured by angler, reported to NGPC staff, and personnel from the USACOE measured and weighed the fish. Fish was not tagged or marked.
May 3, 2001	0.50 mile downstream of Hwy 50 bridge	Weight – 5.40 pounds Length – 34.65 inches	Wild fish captured by UNL research crew.
May 23, 2002	0.50 mile upstream of Hwy 50 bridge	Weight – 9. 04 pounds Length – 40.6 inches	Wild fish captured by UNL research crew.
April 3, 2003	1.0 mile upstream of Hwy 75 Bridge, approximately river mile 5.	Weight – 3.97 pounds Fork Length – 31.0 inches	Wild fish captured by UNL research crew.
April 2, 2004	4 miles upstream of Hwy 75 bridge		Fish captured by UNL research crew. Lost at boat.
April 7, 2004	Near Schilling WMA	Weight – 0.25 pounds Fork Length – 13.11 inches	Fish captured by UNL research crew. Recapture of hatchery fish as identified by PIT tag.
April 8, 2004	Near Schilling WMA	Weight – 5.95 pounds Fork Length – 35.08 inches	Wild fish captured by UNL research crew.
April 8, 2004	Near Schilling WMA	Weight – 0.90 pounds Fork Length – 19.45 inches	Fish captured by UNL research crew. Recapture of hatchery fish as identified by PIT tag.
April 13, 2004	Near Schilling WMA	Weight – 2.20 pounds Fork Length – 27.36 inches	Fish captured by UNL research crew. Recapture of hatchery fish as identified by PIT tag.
April 14, 2004	Near Schilling WMA	Weight – 0.88 pounds Fork Length – 19.57 inches	Wild fish captured by UNL research crew.
April 15, 2004	1.25 miles downstream of Hwy 175 Bridge.	Weight – 6.17 pounds Fork Length – 35.94 inches	Wild fish captured by UNL research crew.
April 15, 2004	1.25 miles downstream of Hwy 175 Bridge	Weight – 0.22 pounds Fork Length – 11.18 inches	Fish captured by UNL research crew. Recapture of hatchery fish as identified by PIT tag and colored elastomer marks.
May 13, 2004	Near Cedar Creek, approximately 12.5 miles upstream of Missouri River	Weight – 0.26 pounds Fork Length – 12.95 inches	Fish captured by UNL research crew. Recapture of hatchery fish as identified by PIT tag.
May 13, 2004	Near Cedar Creek, approximately 12.4 miles upstream of Missouri River	Weight – 0.26 pounds Fork Length – 13.15 inches	Fish captured by UNL research crew. Recapture of hatchery fish as identified by PIT tag.
July 23, 2004	2.0 miles upstream of Hwy 50 Bridge		Fish captured by Nebraska stream fisheries inventory.
September 25, 2004	4.0 miles upstream of Hwy 75 Bridge		Wild fish captured by Nebraska stream fisheries inventory.

Table 2. "Probable" and "unconfirmed" observations of pallid sturgeon in the Platte River 1979-2004.

Date	Location	Size	Comments
May 10, 1979	Interstate 80 bridge between Lincoln and Omaha	Weight – 6.25 pounds Length – 37 inches Girth – 10 inches	First observation in Natural Heritage database maintained by NGPC.
April 15, 1995	Just upstream of Hwy 50 bridge	Weight – 8-10 pounds Length – about 36 inches	Fish was immediately released to the river so no positive identification was made.
May 10, 1997	Approximately 150 yards downstream of Elkhorn River	Weight – 6.25 pounds Length – 41 inches	Fish was caught by same person that caught/reported the "confirmed" observation on May 25, 1993. Photos were taken but unclear from notes if they were ever delivered to NGPC.
May 25, 1997	0.5 mile downstream of Elkhorn River	Weight – 6.5 pounds Length – none given	Angler capture and report.
June 9, 1997	Just below the Hwy 6 bridge.	Weight – none given Length – about 36 inches	Fish was not observed by biologist but through interview was decided was "probably a pallid sturgeon".
May 25, 1998	Near the mouth of the Elkhorn River	Weight – none given Length – about 18 inches	Reported by the angler's friend, to Omaha Metro NGPC office, then to Aquarium staff from NGPC office. May have been "one of the sub adult fish that were stocked in the Platte river in the fall of 1997 or 1998."
May 8, 1999 **2 Fish**	Louisville State Rec. Area camping area	Weight – none given Length – about 15 inches	Only two fish caught that day, 10 minutes apart.
May 22, 1999	One mile east of Ak-Sar-Ben Aquarium	Weight – none given Length – 42.5 inches	Angler capture and report.
May 18, 2000 **2 Fish**	About one mile downstream (east) of Ak-Sar-Ben Aquarium	Weight – none given Length – about 24 inches	Angler capture and report. Comments noted that angler "knew the answers", but biologist was not convinced these were pallids.
June 2, 2000	2.5 miles upstream of Hwy 50 bridge	Weight – none given Length – 26 inches	Angler capture and report. Biologist was not convinced this was a pallid.
July 21, 2000 **2 Fish**	One mile east of Ak-Sar-Ben Aquarium	Weight – 5 pounds and 6.5 pounds (weight on fish scale) Length – none given	Fish caught within 5 minutes of each other, both immediately released.
April 18, 2002	Schramm Park (near Ak-Sar-Ben Aquarium)	Weight – none given Length – 25.5 inches	Angler capture and report. Biologist rated as a "2" (report that biologist feels is accurate)
May 16, 2003 **2 Fish**	Schramm Park	Weight – none given Length – both about 24 inches	Angler capture and rated as a "3".

Table 3. Date and location of the collection of larvae of the genus Scaphirhynchus in the lower Platte River (Reade 2000).

Date	Location
June 1996	Confluence with the Elkhorn River, near Fremont
June 24, 1998	U.S. Highway 6 sampling site near Ashland
May 25, 1998	U.S. Highway 6 sampling site near Ashland
June 24, 1999	U.S. Highway 6 sampling site near Ashland

Table 4. Mean water temperatures (C^o) in 1998 and 1999 at four sites on the lower Platte River.

Date	Mean
14 May 1998	22.0
28 May 1998	21.6
11 June 1998	21.8
23 June 1998	25.9
7 July 1998	28.4
22 July1998	27.3
3 August 1998	25.5
11 May 1999	16.9
8 June 1999	26.4
23 June 1999	24.9
20 July 1999	29.7
3 August 1999	23.8

Table 5. Mean dissolved oxygen concentration levels (mg/l) at four sites on the lower Platte River.

Date	Mean
14 May 1998	9.4
11 June 1998	7.3
23 June 1998	7.4
7 July 1998	6.9
3 August 1998	9.5
11 May 1999	9.1
8 June 1999	7.2
23 June 1999	9.0
20 July 1999	6.8
3 August 1999	7.9

Table 6. Mean suspended solids levels (mg/L) for four sites on the lower Platte River.

Date	Mean
14 May 1998	157
11 June 1998	767
23 June 1998	439
7 July 1998	783
3 August 1998	250
11 May 1999	304
25 May 1999	676
7 July 1999	228
20 July 1999	687
3 August 1999	146

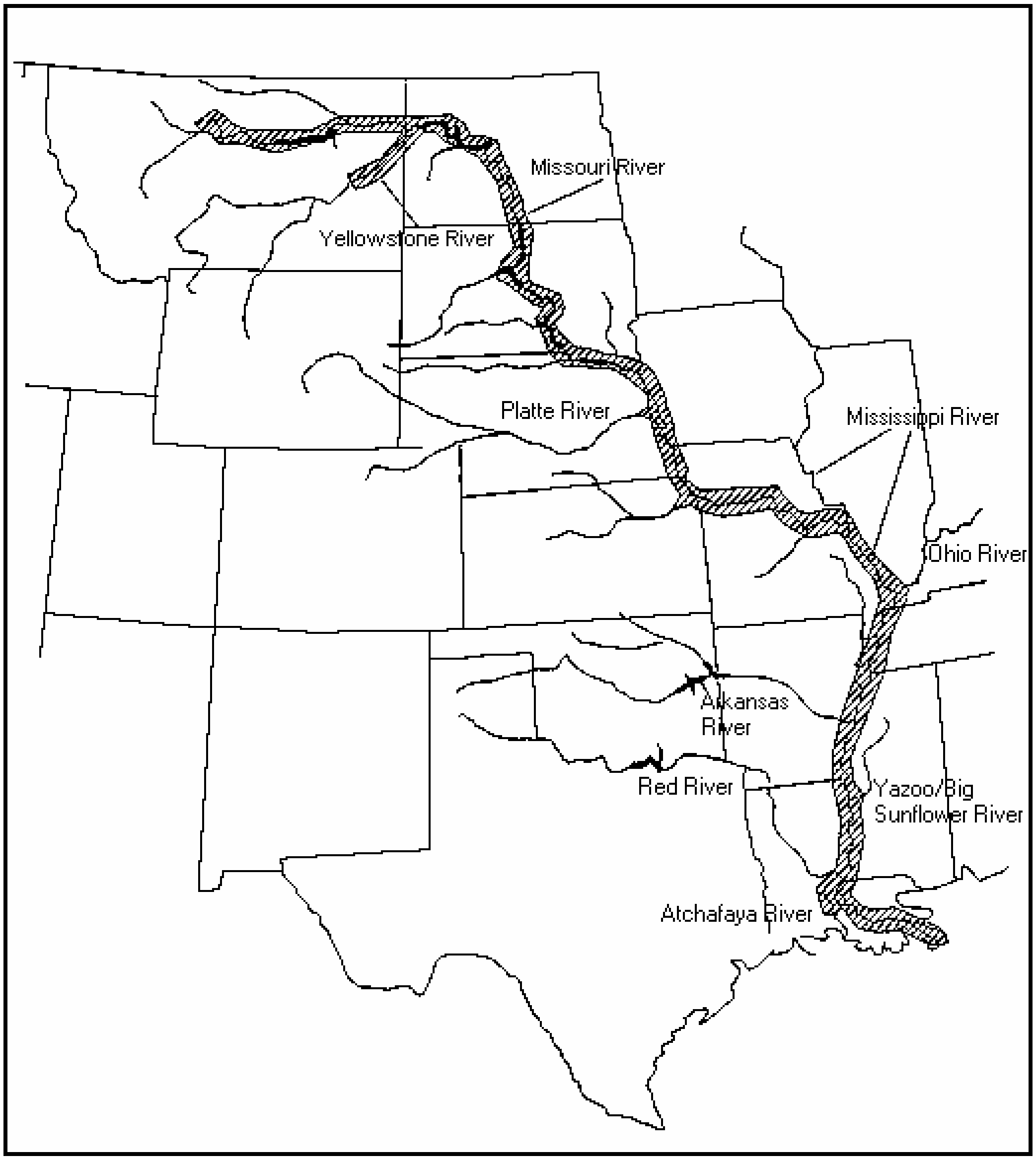

Figure 1. Pallid Sturgeon Historical Range (USFWS 1993).

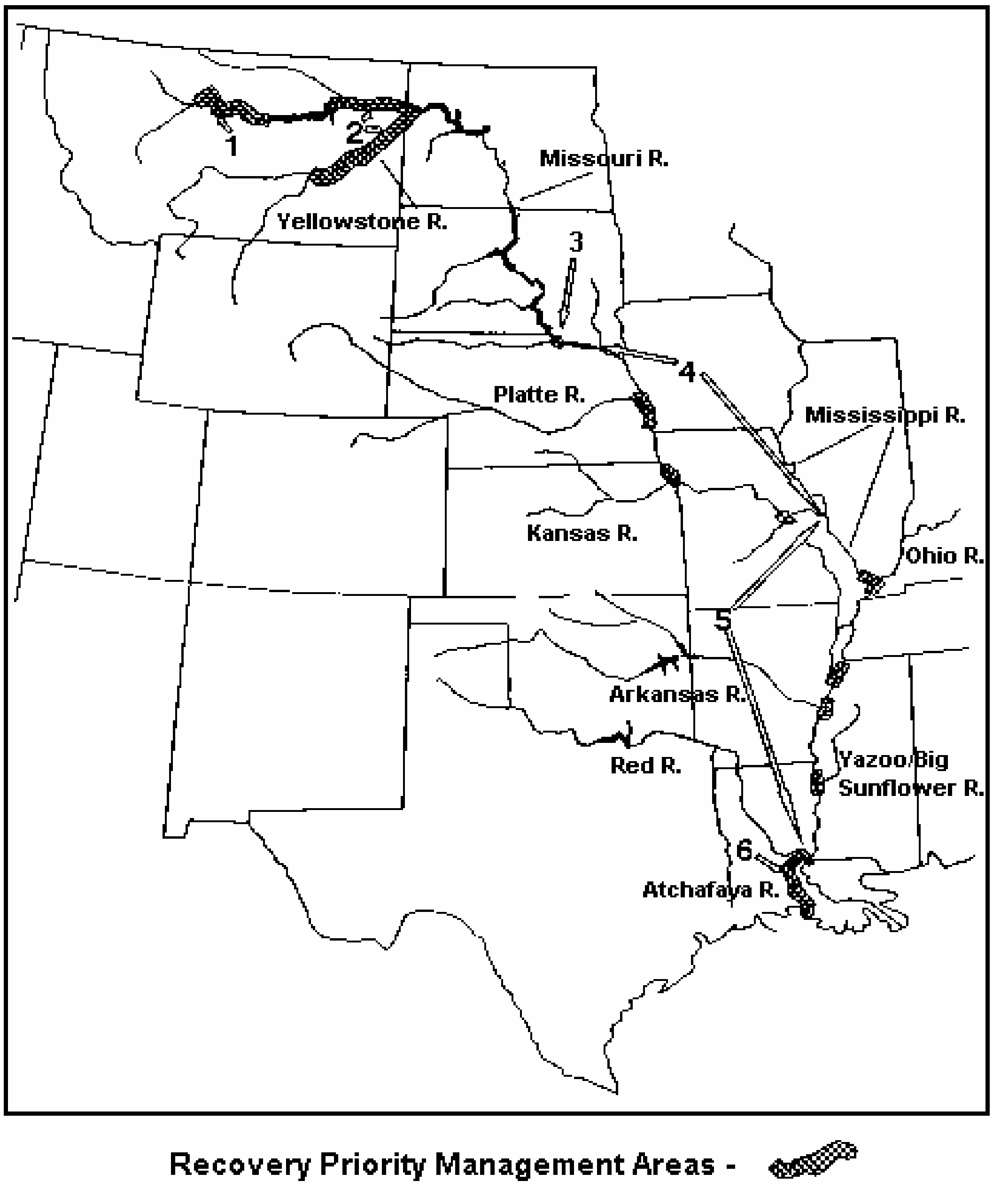

Figure 2. Pallid Sturgeon Recovery Priority Management Areas (USFWS 1993).

BASELINE REPORT

LANDSCAPE FEATURES SECTION

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I. BACKGROUND

I.A. Study Area

Participants in the Cooperative Agreement agreed to implement certain activities relating to the four target species and their associated habitats. For purposes of the Cooperative Agreement, the term "associated habitats" means, with respect to the interior least tern, whooping crane, and piping plover, the Platte River Valley beginning at the junction of U.S. Highway 283 and the Platte River near Lexington, Nebraska, and extending eastward to Chapman, Nebraska, including designated critical habitats defined by the FWS. With respect to the pallid sturgeon, "associated habitat" means the lower Platte River between its confluence with the Elkhorn River and its confluence with the Missouri River. Refer to the Pallid Sturgeon Section of this document for information on landscape features in the lower Platte River.

The area of interest in designing and implementing monitoring protocols for the piping plover, interior least tern, and whooping crane consists of an area 3.5 miles on either side of the Platte River centerline, beginning at the junction of U.S. Highway 283 and the Platte River near Lexington, and extending eastward to Chapman, Nebraska. When side channels of the Platte River extend beyond the 3.5-mile width, a 2-mile width is included around these channels (Figure 1). This study area covers approximately 678 square miles (434,199 acres) and includes portions of nine counties in central Nebraska: Dawson, Gosper, Phelps, Buffalo, Kearney, Hall, Adams, Hamilton, and Merrick. In past analyses, the study area was divided into 13 river segments defined primarily by bridge crossings of the Platte River (Figure 1). The 13 river segments are used as reference points to describe the geographical distribution of species and their habitats.

I.B. Background Studies and Models

Numerous published and unpublished articles discuss the natural history of the Platte River. These documents review historic photos, journal articles, research projects, and other evidence to describe what the Platte River may have looked like at certain points in its history compared to more contemporary views. The Technical Committee directed that this Baseline Document identify and summarize sources of data, methods used, and conclusions drawn from projects based on data collected by those projects; therefore, extensive reference to descriptive and qualitative documents is not contained in this baseline.

I.B.1. Background studies analyzing the history and chronology of Platte River development and consequent impacts to land cover

Review articles as they related to vegetation, woodland development, and wet meadow impacts include Currier (1995), Johnson (1994), Johnson (1997), and Sidle et al. (1989). A comprehensive review and analysis of historical documents was conducted by Johnson and Boettcher (2000) and by Currier and Davis (2000) in a dialogue emphasizing differing interpretations of available historical data.

I.B.2. Sediment Transport Model

Murphy et al. (2006) developed a one-dimensional numeric sediment transport model to use in comparing alternatives for the Platte River Environmental Impact Statement. The SedVeg Gen3 Platte River model estimates changes in channel geomorphology and flood plain vegetation associated with river flow, sediment supply and mechanical actions (Murphy et al. 2006).

II. DATA/METHODS - AVAILABLE DATA

II.A. Land Cover and Land Use - GIS
II.A.1. Western Energy and Land Use Team
The Western Energy and Land Use Team (WELUT; USFWS 1983) mapped land-cover types between Chapman and Overton (bridge segments 1-11) of the central Platte River study area in 1983. The coverage extended 3.5 miles from either side of the centerline of the Platte River. This database, referred to as the WELUT database, was developed from 1:24,000-scale, color infrared aerial photographs taken on September 2 and 3, 1982. The WELUT database identified 26 land-cover types, including three agricultural classes, nine natural or semi-natural vegetation classes, four hydrology classes, and ten land-use classes. All data were interpreted and digitized in accordance with the minimum mapping unit (MMU) of 0.5 acres except for the agricultural classes, which required an MMU of 10 acres (Appendix H of USBOR 2000). This database was not assessed for accuracy.

II.A.2. Center for Advanced Land Management Information Technologies
Land cover types identified in the WELUT database were updated in 1995 by the University of Nebraska at Lincoln and subsequently referred to as the Center for Advanced Land Management Information Technologies (CALMIT) database (University of Nebraska 1998). The CALMIT database was developed from 1:24,000-scale, color infrared aerial photographs taken on May 13, 1993 and October 25, 1995. Similar to the WELUT database, the CALMIT covered the area between Chapman and Overton (bridge segments 1-11). No metadata were produced and the database was not assessed for accuracy.

II.A.3. Nebraska Public Power District and Central Nebraska Power and Irrigation District
Central Nebraska Power and Irrigation District (CNPPID) and Nebraska Public Power District (NPPD) prepared GIS databases as part of their joint deficiency response report (CNPPID & NPPD 1984).

Johnson (1990b) conducted a GIS analysis to quantify the amount of roosting habitat available to sandhill cranes along the central Platte River. The coverage extended up to 3 miles on either side of the centerline of the Platte River, between Grand Island and Lexington. The database was developed using 1:12,000 black and white aerial photographs taken on October 7, 1986. Mean river flow on this date was 4,320 cfs at Overton, 4,260 cfs at Kearney, and 4,020 cfs at Grand Island. The database identified 24 land-cover types and the designation “agriculture” included cropland, grassland/hayland, and wet meadows. Grid cell size was 12.5 m by 12.5 m (0.0385 acres). Ground-truthing showed a classification accuracy among parcels between 87-95%, with an average of 93% correct.

Johnson (1990a) conducted another GIS analysis to quantify the amount and distribution of land and water cover types that are associated with projects owned and operated by the NPPD and CNPPID. The geographic scope encompassed the J-2 Return below Lexington, Nebraska, on the Platte River, to the Lewellen Bridge above Lake McConaughy on the North Platte River and to the Korty diversion Dam on the South Platte River (Johnson 1990a). Black and white photographs at 1:8,000 taken on June 5, 1987 were used for the reach between the Lewellen Bridge and Keystone Diversion (i.e., including Lake McConaughy and Lake Ogalalla), while black and white photographs at a scale of 1:12,000 taken May 23 and 24, 1989 were used for all other reaches.

Johnson's (1990a) classification system included 52 land-cover types and emphasized quantification of wetland habitat as defined by Cowardin et al. (1979), including lacustrine, riverine, and palustrine categories. Non-wetland cover types were inventoried as well using more general classifications. GIS maps produced for the District's projects were ground-truthed in fall, 1989. Ground-truthing for the Platte and North Platte rivers near the projects was conducted in March 1990. Ground-truthing indicated that overall accuracy for riverine features ranged between 79.8-100% and (Johnson 1990a). For features beyond the high banks accuracy averaged 91.7%.

In an addendum to Johnson (1990b), a further breakdown of the land-cover categories was described that used the 1989 photographs. New information also was provided for the Big Bend Reach on wet meadow and other land- and water-cover categories that mostly occurred outside the high banks of the Platte River and were used by cranes.

II.A.4. Bureau of Reclamation

Land-cover types for the entire central Platte River study area most recently were mapped by the Bureau of Reclamation's (BOR) Remote Sensing and Geographic Information Group (USBOR 2000). This database was developed from 1:24,000-scale, color infrared aerial photographs taken on August 19, 21 and 24, 1998. All data were interpreted and digitized in accordance with a minimum mapping unit (MMU) of 0.5 acres, except for the agricultural classes, which required an MMU of 10 acres. Refer to USBOR (2000) for a detailed description of photo-interpretation methodology and photo-signature characteristics used to delineate land-cover and land-use types.

USBOR (2000) identified 35 land-cover and land-use types (Table 1), including seven agricultural map units, nine natural or semi-natural vegetation map units, five hydrology map units, four bare-ground map units, and ten land-use map units. Additionally, the floodplain boundary was delineated. The USBOR (2000) database summarizes land-cover and land-use data for each of the 13 river segments in the central Platte River study area. Polygon-attribute data included area, perimeter, map unit code, and map unit description. Line-attribute data included length, map unit code, and map unit description. Refer to Appendix B for the complete metadata of the USBOR (2000) database.

USBOR (2000) describes the map units as:

<u>Emergents (Map Unit 1):</u> Occurs on saturated and inundated soils, where water depths do not exceed one meter. Wetland vegetation is found on/near seeps, springs, drainages, pond margins,

swales, closed basins, riverbanks, and in ditches. Only emergent wetlands that meet the MMU for this study are delineated; linear wetlands are represented by line coverage.

Channel (Map Unit 2): Occupies the center of the floodplain boundaries as a single entity in some areas, but may be braided in several places. This is the active, inundated river from bank-to-bank.

Open Water Canal (Map Unit 3): Constructed water conveyance channel located outside the river channel.

Open Water Slough (Map Unit 4): Occupies the first terrace within the floodplain boundaries, and may consist of water-filled channel scars, cut-off oxbow bends, or abandoned channel segments. Water remains in sloughs because it is exposed ground water or trapped surface run-in.

Open Water Pit, Pond, or Lake (Map Unit 5): Includes excavated or dammed water storage structures to provide livestock water, fisheries habitat, and recreation. Many structures are old gravel pits.

Barren Beach/Bar (Map Unit 6): Occupies the active channel (Map Unit 2) area as islands and point bars. Colonizing vegetation on these sites attains <30% cover.

Open Water (Map Unit 7): Occurs outside the river channel (Map Unit 2) and includes any open water not represented by Map Units 2, 3, 4, and 5.

Shrubs inside Floodplain (Map Unit 10): Occurs within floodplain (Map Unit 50) boundaries, including on the large permanent islands or more permanent depositions/accumulations in the Platte River, and the sites tend to be sub-irrigated. The vegetation is predominantly shrubs or sapling trees from 1–4 meters tall.

Upland Grasses (Map Unit 11): Occurs on drier, often elevated soils that are not sub-irrigated, including sand hills and ridges, eolian flats, and tops of abandoned alluvial deposits. Topographic features are present which include drainages, sand hills with blowouts, and sandy bluffs, in addition to check dams in drainages to capture water for livestock.

Lowland Grasses (Map Unit 12): Occupies sub-irrigated soils within the floodplain boundaries that include shallow drainages and depressions. Mown sites of this habitat type are placed under Map Unit 17. Exposed groundwater and saturated soils have emergent vegetation clusters that are placed in Map Unit 1 if they meet the MMU or are included in this class if smaller. The vegetation is predominantly herbaceous with many tall grasses, but some introduced grass species are dominant on many acres and included in the mapping unit.

Shrubs outside Floodplain (Map Unit 13): Occurs outside floodplain (Map Unit 50) boundaries on upland soils of drainages, swales, and hills. The vegetation is predominantly shrubs or sapling trees from 1–4 meters tall.

Wooded within Floodplain (Map Unit 15): Occupies river terraces and large and small islands within the floodplain that have sufficient substrate over groundwater to allow root development and sufficient aeration. Trees are over 4 meters in height, but range from 4–50 meters tall depending on age and species.

Wooded outside Floodplain (Map Unit 16): Occupies hills, draws, farm fields and houses (windbreaks), as well as minor drainages outside the floodplain boundaries. Trees are over 4 meters in height, but range from 4–15 meters tall depending on age and species.

Mown Lowland Grasses (Map Unit 17): Occupies sub-irrigated soils within the floodplain boundaries that include shallow drainages and depressions. Non-mown sites of this habitat type are placed under Map Unit 12. Exposed groundwater and saturated soils have emergent vegetation that is placed in Map Unit 1 if it meets the MMU or is included in this class if smaller.

Herbaceous Riparian (Map Unit 18): Occupies terraces within floodplain boundaries, typically with sub-irrigated soils. This type may have dense cover for grass species, but is overtopped by weedy, broad-leaved species and some short shrubs and/or tree seedlings.

Agriculture Alfalfa (Map Unit 20): Typically occupies soils above the channel (Map Unit 2) and low valley terraces, although this crop may occupy some sub-irrigated soils. May include both alfalfa and clover crops and attendant irrigation ditches, access lanes, and haystacks.

Agriculture Corn (Map Unit 21): Occupies soils above the channel (Map Unit 2) and low valley terraces. May include both corn and seed sorghum crops and attendant irrigation ditches, drainage ditches, and access lanes.

Agriculture Other Crops (Map Unit 22): Occupies soils above the channel (Map Unit 2) and low valley terraces. May include milo, millet, annual weeds, and some introduced grasses.

Agriculture Bare Ground/Fallow (Map Unit 23): Occupies soils above the channel (Map Unit 2) and low valley terraces. Includes land that is fallow prior to planting winter wheat, feed lots, and could include some land where corn silage was cut prior to aerial overflight.

Agriculture Soy Bean (Map Unit 24): Occupies soils above the channel (Map Unit 2) and low valley terraces. Usually consists of small fields interspersed with corn and alfalfa.

Agriculture Mown Field (Map Unit 25): May occur almost anywhere in the corridor, even large openings among floodplain trees. This map unit will typically relate to Map Unit 20 Agriculture Alfalfa and Map Unit 22 Agriculture Other Crop (grass hay from introduced species). The unit may include irrigation ditches, access lanes, and haystacks.

Agriculture Winter Wheat (Map Unit 26): Occupies higher, drier soils, usually non-irrigated and hilly areas, as this crop is often grown dry-land. Appears as fallow land on aerial photos, because the crop is not planted until September/October, and may be included with Map Unit 23 Agriculture Bare Ground.

Bridge (Map Unit 30): Includes any structure providing passage for vehicles over the Platte River, its tributaries, or canals within the floodplain.

Development Commercial (Map Unit 31): Occupies areas that are built over and predominantly used for business or commercial activities. Examples include downtown areas of cities, truck stops along the interstate highway, and large utilities.

Development Residential (Map Unit 32): Occupies areas that are built-over and predominantly used for living quarters (e.g., parks and housing tracts). These sites include incorporated towns and cities and clusters of rural housing.

Development Residential (Map Unit 33): Includes any single residence within the study corridor and its attended yard and out-buildings.

Powerline (Map Unit 34): Large powerlines cross the study corridor perpendicular to the Platte River and are placed in separate line coverage. Only tower sites, substations, and maintenance areas are included in this unit.

Road Gravel (Map Unit 35): Maintained gravel roads are located on nearly every section boundary above the riparian area of the Platte River.

Road Interstate (Map Unit 36): Interstate Highway 80 parallels the north side of the Platte River through the study corridor and crosses the river south of Grand Island.

Road Paved (Map Unit 37): Paved highways are two-lane and accept traffic from gravel roads or directly from private roads. Almost all bridge crossings of the Platte River are for paved, two-lane highways.

Railroad (Map Unit 38): The railroad line parallels U.S. Highway 30 north of the Platte River through the entire study corridor. Spur lines are in place to serve some utilities.

Other Road (Map Unit 39): Small, private roads and lanes leading to residences and farm buildings. This map unit does not include travel lanes in agricultural fields and river floodplain.

Sand/Gravel Areas (Map Unit 40): Occupies sand and gravel mines, usually within the floodplain boundary. This map unit contains the active area for equipment operation and piled material.

Barren Surface (Map Unit 42): Primarily associated with developed sites; includes berms, disturbed sites, rest stops, way stations, and pull-outs.

Sand/Gravel Operations (Map Unit 41): Gravel pits are located mostly within the floodplain, on large islands and first terraces. They are usually represented by newly disturbed areas and areas undergoing recovery following sand and gravel extraction. This unit includes the operations area; associated with sand and gravel operations are barren lands placed in Map Unit 40.

Floodplain (Map Unit 50): Includes the approximate edge of floodplain as determined by GIS analysts with assistance from project hydrologists. Floodplain boundaries may be obvious where cliffs occur at the edge of the Platte River or the raised elevation of Interstate Highway 80. Floodplain boundaries are not obvious in predominantly tilled farmland.

Field inventories conducted in October 1998 and summer (June–August) 1999 focused on descriptions of non-agricultural vegetation classes sufficient to meet the National Vegetation Classification Standard (NVCS; The Nature Conservancy and Environmental Research Systems Institute 1994). Map Units 12 (Lowland Grasses) and 13 (Shrubs outside Floodplain) were not sampled because access could not be obtained. A total of 250 accuracy-assessment points were evaluated for the other land-cover map units; 175 for natural or semi-natural vegetation and 74 for agricultural crop map units. These data had an overall accuracy of 88.8%. USBOR (2000) reported that the only vegetation class that was difficult to interpret was Map Unit 18 (Riparian Herbaceous). Because most of the incorrectly classified points of Map Unit 18 fell into the Map Unit 12 (Lowland Grasses), the authors suggested that researchers using this database should either consider combining Map Units 12 and 18, or, if Map Unit 18 is critical for study protocols, developing a more reliable photo-signature for the vegetation class. Vegetation classification surveys of non-agricultural vegetation classes described species composition, percent ground cover of dominant species, general soil characteristics, and distribution and abundance of each vegetation class within the central Platte River study area. Refer to USBOR (2000) for a detailed description of vegetation classification surveys. Table 2 lists NVCS plant associations corresponding with natural/semi-natural land cover types.

A supplemental description and analysis of the vegetation classifications used for the central Platte River land-cover/land-use mapping project was provided by Butler (2001). The Butler (2001) assessment followed the procedures outlined by the NVCS, and provided one means of summarizing the compositional and structural characteristics of the vegetative communities, and assessing possible spatial patterns related to environmental gradients at the study area scale.

While the USBOR (2000) database provides the most appropriate measure of baseline land-cover and land-use data for the central Platte River study area, several web sites maintain other geospatial data sources that may be useful for mapping, describing, or evaluating landscape features in the region. Refer to Appendix A for a list of web sites and available data.

II.B. Land Cover and Land Use – Physical Measurements

II.B.1. Bureau of Reclamation

Physical measurements were conducted to ground-truth GIS layers created as part of the USBOR (2000) database described in the previous section. Physical measurements of land-cover and land-use were collected for many areas within the study area; although much of the work was conducted on small specific parcels, or focused on habitat analyses for individual species. Land cover within the channel is described in the Channel Morphology Section.

II.B.2. Jeffrey Island and Cottonwood Ranch Vegetation Survey

A vegetation survey was conducted along the central Platte River at Jeffrey Island and Cottonwood Ranch in 2001 to document the quantity of land cover types (Lack et al. 2002). The Jeffrey Island property is an 11.3-km long, 1.6-km wide strip of land along the Platte River between Lexington and Overton, Nebraska. The Cottonwood Ranch property is located approximately 8 km down river from Jeffrey Island and is approximately 5 km long and 1.6 to 3.2 km wide. Both areas consist of open grassland, river channels, vegetated islands, exposed sand bars, and riparian and upland forest. The Cottonwood Ranch Property also contains some cropland and former cropland being reclaimed to a wetland/grassland area.

The Lack et al. (2002) survey was conducted along 48 evenly spaced transects (35 at Jeffrey Island and 13 at Cottonwood Ranch), crossing the properties from north to south through system-wide anchor points previously established in the main channel of the Platte River. A description of the system-wide anchor points is presented in the Adaptive Management Plan (AMP).

Eight land-cover types were defined at Jeffrey Island and Cottonwood Ranch (Table 3). Three were non-vegetated, including open water, open-water canal, and wetted channel. Other land-cover types included agricultural fields, exposed sand beach/bar, emergent wetland, forest, and grassland.

Vegetative species and transect information was presented in the report (Lack et al. 2002), which is available at from the Executive Director's, CNPPID, or NPPD.

Johnson (2000) conducted a study from 1985-1998 on tree reproduction and survival in the Platte River, Nebraska. Two main study areas included a 2-3-km reach near the town of Shelton, and a reach at Odessa, Nebraska. A total of 296 permanently located sites, constituting approximately 600 plots with cottonwood and willow seedlings were selected and sampled. The overall approach was to sample and monitor each annual cohort of tree seedlings at various landform types representing different sets of environmental conditions. Johnson continued these studies to 2005 and has included sites at Cottonwood Ranch and Jeffrey Island (see Johnson 2001).

Johnson (2001) provided a progress report on monitoring the influence of streamflow, sediment, and other environmental factors on riparian vegetation at Cottonwood Ranch and Jeffrey Island. A total of about 100 sample plots were located at these two sites in July 2000. Both sites included a reference and treatment (the reaches to be cleared) plot. Plot elevations were measured, seedlings counted, plant cover estimates recorded, and photographs were taken of each site/plot for later comparison. Plots were then relocated and tree seedlings recounted in late September-early October 2000.

II.B.3. Tree Recruitment

Johnson (2000) found that tree recruitment is largely controlled by streamflow in June, and that, on average, streamflow in June was high enough to preclude cottonwood and willow recruitment in only one of seven years. Johnson also found that low streamflows facilitated the recruitment of cottonwood and willow seedlings in the active channel. Seedling mortality was dominated by summer streamflow pulses from thunderstorms (which erode or bury new germinants) and riverbed restructuring by shifting ice in winter. Seedling mortality by desiccation during summer droughts did occur at a low frequency. Nearly 90 percent of the plots lost all tree seedlings by the end of the first year: 42% by the first re-measurement (July to September), 36% by the second re-measurement (May) and 10 percent by the third re-measurement (July; Johnson 2000).

Currier (1997) used aerial videography in 1988 and 1994 to compare the same selected segments of the central Platte River. Expansion of woody vegetation was documented from 1990-1992 during a time that included a relatively low flow period. Dominant woody species occurring along the Platte River included cottonwood and willow species (Johnson 1994, Currier 1997). Flows during the summer germination and establishment period (mid-May through August for these species) were less than 600 cfs, 64% of the time from 1990-1992, allowing for extensive exposure of the riverbed where cottonwood and willow could germinate (Currier 1997).

II.B.4. Wet Meadows

Numerous site-specific studies of wet meadows have been conducted within the project area, including several at Mormon Island Crane Meadows, which is the largest contiguous grassland tract remaining on the Platte River within the study area (Currier 1989). Examples of these studies include the following:

Currier (1989) conducted a study to evaluate the interrelationships between hydrology and plants in wet meadows. Species composition and percent cover of each plant species were recorded from 1982 through 1987 in six permanent 1-m^2 plots located inside seven permanently fenced grassland areas where cattle and haying were excluded. River discharge and groundwater levels were monitored as well as precipitation and average monthly temperature data. Prescribed burns were also conducted throughout the study.

Nagel (1981) conducted a vegetation ecology study of Crane Meadows in 1980. Nagel provided list of soil types and plant species with the percent composition found.

Pfeiffer (1999) conducted a study from June 1997 to June 1998 to evaluate wet meadow restorations in the Platte River Valley. Fourteen native wet meadow sites were compared with 7 low-diversity plantings, 11 high diversity plantings, and 4 reclaimed riparian sites. Pfeiffer (1999) concluded that the high diversity planting technique was preferred for restoring native wet meadows, while the low diversity grass planting offered the least value for wet meadow restorations in the Platte Valley.

A demonstration project sponsored by the NGPC, CPNRD, NPPD, and CNPPID studied the feasibility of enhancing the ecological integrity and hydrology of Platte River wet meadows at three south-central Nebraska sites using means other than stream flow. The three demonstration sites examined were the Cottonwood Ranch Property near Overton, the Grand Island wellfield site located south of the city of Grand Island, and the Wyoming property located southeast of Kearney. Hydrologic monitoring included the collection of surface and groundwater levels, on-site precipitation, Platte River stage and discharge near each site, and project-water applications. Biological monitoring entailed the methods described in Nagel (1998) and Nagel (1999), and included surveys for birds, invertebrates, vegetation, mammals, amphibians, and reptiles (Nebraska Environmental Trust Fund 2001). Baseline and post-treatment hydrologic and biological monitoring results from 1997-2000 are included in the report (Nebraska Environmental Trust Fund 2001).

II.C. Channel Morphology – Physical Measurements

II.C.1. Transect Information

The BOR collected information on 90 cross sections of the central Platte River between North Platte and Chapman, Nebraska. Permanently marked transects were repeatedly surveyed two to three times between 1989 and 2005 (Holburn et al. 2006).

River cross-section data was recorded at whooping crane use sites and at decoy sites during whooping crane surveys (see Whooping Crane Section), and for monitoring channel habitat conditions on the Platte River for re-licensing FERC projects 1835 and 1417 (Currier 1996).

Central and NPPD established three channel morphology cross-section transects on Cottonwood Ranch and provided data for July 2000 (CNPPID & NPPD 2001). River cross-section data includes bed elevation measurements at 10-foot intervals across the channel between permanent bank pins using a transit and survey rod.

The Technical Committee contracted with the USGS to implement the Cottonwood Ranch Monitoring and Research Protocol (Technical Committee 2000). Cross-section data were collected on 57 transects to evaluate the effect of implementing Phase I of the Cottonwood Ranch Management Plan (Kinzel 2006a). Four monitoring cross-sections were measured between the east side of Cottonwood Ranch and the Kearney Canal Diversion (Kinzel 2006a). Data can be obtained at http://mcmcweb.er.usgs.gov/platte/cottonwood_ranch/. Comparisons of the characteristics of channel morphology before and after riparian vegetation clearing were summarized in Kinzel (2006a).

II.C.2. Sediment

Sediment data were collected during the 1979 and 1980 runoff seasons (May through September) at 21 stations along the Platte River, North Platte River and South Platte River, including 3 stations within the project area located on the Platte River near Overton, Odessa, and Grand Island (Kircher 1983). Bed material samples were collected at all locations, whereas water-discharge, suspended sediment and bedload measurements were collected only at some stations, including stations at Overton and Grand Island (Kircher 1983). The median bed material decreased in a downstream direction except near Overton, where it increased as a result of an increase in local slope at the same location (Kircher 1983). From Overton, the median diameter then continued to decrease in the downstream direction. The median bed material at two locations in the Platte River was found to vary little with increasing water discharge (Kircher 1983). The size of bed material in the Platte River ranged from less than 0.062 mm to greater than 16 mm (Karlinger et al. 1983). Mean sediment discharge, computed by combining the relations between water discharge and measured total sediment discharge with the stations' respective flow-duration curve, was found to be 1,100 metric tons per day for the Platte river near Overton, and 1,130 metric tons per day for the Platte River near Grand Island (Kircher 1983).

The Technical Committee contracted with the USGS to implement the Cottonwood Ranch Monitoring and Research Protocol (Technical Committee 2000). Sediment samples were collected along 25 of the 57 cross section transects to evaluate the effect of implementing Phase I of the Cottonwood Ranch Management Plan (Kinzel 2006a). Sediment samples were collected along four monitoring cross-sections between the east side of Cottonwood Ranch and the Kearney Canal Diversion (Kinzel 2006a). Data can be obtained at http://mcmcweb.er.usgs.gov/platte/cottonwood_ranch/. Comparisons of the characteristics of bed-sediment before and after riparian vegetation clearing were summarized in Kinzel (2006a).

The BOR collected sediment information at numerous locations in the central Platte River in the 1980's and 2000's. The 1989 sediment sample collection was implemented at representative cross sections to numerically model sediment transport (Holburn et al. 2006). The grain size analyses of these data were archived in appendix F of Holburn et al. (2006).

II.C.3. Light Detection and Ranging

National Aeronautics and Space Administration (NASA) has tested Experimental Advanced Airborne Research LiDAR (EAARL), a hybrid topographic and bathymetric airborne laser scanner or light detection and ranging (LiDAR) platform specifically designed to survey shallow water environments, on the central Platter River in 2002 and 2005 (Kinzel et al. 2006b, 2006c). Concurrent topological surveys made with survey grade GPS technology were used to evaluate the vertical accuracy of the EAARL laser returns (Kinzel et al. 2006b, 2006c).

II.D. Hydrology

The USGS and NDNR maintain gaging stations that measure flow and/or stage at several points along the Platte River in Nebraska. USGS stations measuring both flow and stage within the study area are located at the bridges near Overton, Kearney, and Grand Island. The USGS also maintains a gage measuring stage in the main channel at NPPD's Cottonwood Ranch Property. USGS gages are available on many of the tributaries to the Platte River, such as the North and South Platte Rivers, Plum Creek, Elkhorn River, etc., as well as further downstream on the Platte River. Provisional real-time data and corrected information are available for several of these stations at the USGS web site http://water.usgs.gov/.

Daily flow information is available for gaging stations between Sinclair, Wyoming and Grand Island, Nebraska at the link labeled "Platte River and Canal Bulletin" at the NDNR web site http://www.nrc.state.ne.us/docs/apportionments.html, including stations maintained by organizations other than USGS (e.g., NDNR). These data are not in real-time. NDNR also maintains a gage at Odessa, Nebraska that is not included in the above referenced web sites. Information related to this gage must be obtained directly from the NDNR.

II.E. Water Temperature

Five continuous-reading thermometers were placed in the Platte River at five locations in Platte River channels adjacent to Cottonwood Ranch and Jeffrey Island Property from June 26 to September 30, 2000 (CNPPID & NPPD 2001). Thermometers were placed a minimum of 30 cm off the channel bottom and programmed to record data every seven minutes. CNPPID & NPPD (2001) provided information including daily maximums and averages for water temperature, air temperature, and discharge during this period.

II.F. Aerial photography during the Cooperative Agreement

Aerial photography was taken several times during the Cooperative Agreement period, generally following the aerial photography protocol (PRESP 2001). Deviations from the protocol were done to take advantage of cost sharing opportunities. Aerial photographs were taken at these times during the Cooperative Agreement:

- 1:12,000 black and white aerial were taken on April 17, 2001 by Horizons, Inc., hard-copies available from Executive Director's office
- 1:24,000 CIR aerials taken on June 21-22, 2001 by Horizons, Inc., hard-copies available from Executive Director's office
- 1:12,000 black and white aerials taken on November 4, 2002 by Sanborn Map Company, hard-copies available from the Executive Director's office
- 1-meter resolution digital color infrared aerials taken on from September 6-15, 2003 by a joint venture of the USFWS, Central Platte NRG, and others, available in digital format from Executive Director's office.
- 1:12,000 black and white aerials taken on December 14, 2004 by Kucera International, Inc., hard-copies available from the Executive Director's office
- 1-meter resolution digital color infrared aerials taken on August 15-30, 2005 by a joint venture of the USFWS, Central Platte NRG, and others, available in digital format from Executive Director's office.
- 1-meter resolution digital color infrared aerials taken on August 15-September 1, 2006 by a joint venture of the USFWS, Central Platte NRG, and others, available in digital format from Executive Director's office.

III. HISTORIC DATA NOT BEING COLLECTED DURING PROGRAM

III.A. Soils

Soil data will be used (soils data provided at the Nebraska DNR web site is listed in Appendix A) in project planning and implementation, but the Program will not monitor soils. Available soils data include the Soils Survey Geographic (SSURGO) database, the State Soil Geographic (STATSGO) database, P-Factor data, C-Factor data, and soil mapping-unit interpretive records (MUIR). The P-Factor is the erosion control practice factor expressed as the ratio of soil loss from contouring, strip cropping, or terracing to soil loss with normal row up-and-down farming. The C-factor is the cropping and management factor expressed as the ratio of soil loss under a specific cropping and management system to the soil loss under a clean-till, continuous fallow system.

III.B. Water Quality and Contaminants

A plethora of information exists on water quality and contaminants for ground and surface water in the Platte River watershed. Monitoring of these parameters will not be included in the overall Program area, but will likely be done at site specific locations (e.g., Program lands). However, a summary and list of historic and current data resources are provided in Appendix C.

III.C. Climate and Weather

Climate data for the central Platte River study area was included in the USBOR (2000) technical report. Monitoring climate and weather data will not be included in the Program. However, data is provided at the Nebraska DNR web site listed in Appendix A. Available data from hourly and daily stations include evaporation rates, precipitation, temperature, solar radiation, relative humidity, and wind speed. Data may also be obtained from the National Oceanic and Atmospheric Administration (NOAA) (http://www.noaa.gov/index.html). The central Platte River study area falls into NOAA divisions 5 and 8.

IV. DATA ADEQUACY

Landscape baseline information was evaluated for quantitative descriptions of pre-Program or pre-treatment (baseline) conditions that could be combined with post-Program monitoring data in before-after comparisons or trend estimations for the entire study area. The presence of quantitative baseline information would enhance the analysis of Program monitoring data. The Program's monitoring is designed to detect statistically significant changes in measured parameters over time and document correlations between management activities, other random variables, and those changes

For baseline data to be useful for before-after comparisons, the data collection procedure should have followed detailed and scientific protocols. The methods of data collection should have been recorded and vigorously adhered to. Measures should have been taken to document the quality assurance procedures and any changes made to the data should have been documented. Finally, data should have been stored in an accessible medium along with the data collection protocols and other metadata. Even if data have the above characteristics the data must be entered into an electronic format (i.e. a data spreadsheet) before analysis can occur.

In addition, for baseline data to be useful for before-after comparisons or trend estimation, the study design should have incorporated statistical sampling procedures. The sampling frame should have been identified, and random sampling should have been employed to ensure the data would be unbiased for the region of interest.

In general, the data described in *Section II.A. Land cover and land use – GIS* has high utility for before-after type comparisons with Program data. Landcover databases based on aerial photographs cover large geographic areas and generally cover the entire study area. Since the aerial photographs were stored with proper metadata (i.e. georeference, flow data), they are an ideal data source for trend analyses. For the databases with well-documented photointerpretation methods, the same methods can be repeated with a set of photos collected during Program monitoring. If new photointerpretation methods are developed which offer considerable improvement in the analysis (e.g., better accuracy on map units of interest, such as wet meadows) the old photographs are available and the analysis can be conducted on the old and new photographs. In either case, repeatable measurements of quantitative characteristics can be acquired and used in before-after comparisons or trend estimation.

In general, the data described in *Section II.B. Land cover and land use- Physical measurements* has little utility for comparisons with Program data over the entire study area. These studies were designed to investigate process questions (i.e. influence of streamflow on vegetation, influence of streamflow on germination, restoration techniques) and were conducted within small portions of the study area. Most of these studies could be repeated to document the current status of the variables measured, but a before-after comparison with these data would provide little insight into the changes that occurred throughout the study area. For example, Lack (2002) provides data for monitoring vegetation cover, but the data are not applicable to the entire Program study area, just to the Cottonwood Ranch Property and Jeffrey Island.

In general, the data described in *Section II.C. Channel morphology – Physical measurements* has utility for the post-Program comparisons for the Program study area. The BOR cross section data and sediment grain size data could be used to monitor trends in parameters at the locations surveyed. The USGS work at Cottonwood Ranch has good documentation of data collection methods and has random placement of transects within the area studied. Inferences from analyses of these data are not applicable to the entire Program study area, just to the Cottonwood Ranch Property.

Data described in *Section II.D. Hydrology* and *Section II.E. Water Temperature* will continue to be collected by the USGS and NDNR at the same locations and therefore will be useful for before and after comparisons.

V. LITERATURE CITED

Butler, J. 2001. Vegetation classification of the central Platte River, 1998 land cover/use mapping project. Technical report prepared for Jan McKee, USFWS, Platte River EIS Office. 39pp.

CNPPID & NPPD (Central Nebraska Public Power and Irrigation District and Nebraska Public Power District). 2001. 2000 Wildlife Monitoring Report Submitted for Federal Energy Projects #1417 and #1835. Submitted to Federal Energy Regulatory Commission, U. S. Fish and Wildlife Service, Nebraska Game and Parks Commission and Governance Committee of the Cooperative Agreement for the Platte River Research and Other Efforts Relating to Endangered Species Habitats along the Central Platte River, Nebraska. 126pp.

CNPPID & NPPD (Central Nebraska Public Power and Irrigation District and Nebraska Public Power District). 1984. Joint Response Of The Central Nebraska Public Power And Irrigation District And The Nebraska Public Power District To The Federal Energy Regulatory Commission's December 7, 1984 Deficiency Notice.

Cowardin, L. M., V. Carter, F. C. Golet, E. T. LaRoe. 1979. Classification of wetlands and deepwater habitats of the United States. U. S. Department of the Interior, Fish and Wildlife Service, Washington, D.C. 131pp.

Currier, P. J. 1989. Plant species composition and groundwater levels in a Platte River wet meadow. Pages 19-24 in T. Bragg and J. Stubbendieck, editors. Proceedings of the Eleventh North American Prairie Conference. University of Nebraska Printing, Lincoln, Nebraska.

Currier, P. J. 1995. Woody vegetation expansion and continuing declines in open channel habitat on the Platte River in Nebraska. Platte River Whooping Crane Maintenance Trust, Inc., Grand Island, Nebraska.

Currier, P. J. 1996. Channel changes in the Platte River Whooping Crane Critical Habitat Area 1984-1995. Platte River Whooping Crane Maintenance Trust, Inc., Grand Island, Nebraska.

Currier, P. J. 1997. Woody vegetation expansion and continuing declines in open channel habitat on the Platte River in Nebraska. Proceedings of the North American Crane Workshop 7:141-152.

Currier, P. J. and C. A. Davis. 2000. The Platte as a prairie river: a response to Johnson and Boettcher. Great Plains Research 10 (Spring): 69-84.

Holburn, E.R., L.M. Fotherby, T.J. Randle, D.E. Carlson. 2006. Trends of aggradation and degradation along the central Platte River: 1985-2005. U.S. Department of the Interior, Bureau of Reclamation, Denver, Colorado, 180 pp.

Johnson, W. C. 1990a. Appendix VI: Quantification of land/water cover associated with FERC projects 1835 and 1417 and the adjacent Platte River using GIS. Unpublished Report.

Johnson, W. C. 1990b. Appendix IX: Quantification of roosting habitat area for cranes in the Platte River, Nebraska, using a geographic information system. Unpublished Report.

Johnson, W. C. 1994. Woodland expansion in the Platte River, Nebraska: patterns and causes. Ecological Monographs 64:45-84.

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

Johnson, W. C. 2000. Tree recruitment and survival in rivers: influence of hydrological processes. In Hydrological Processes, Special Issue, John Wiley Press. 59pp.

Johnson, W. C. 2001. Progress report for project "Monitoring the influence of streamflow, sediment, and other environmental factors on riparian vegetation at Cottonwood Ranch and Jeffrey Island". Pages 40-42 in Central Nebraska Public Power and Irrigation District and Nebraska Public Power District. 2000 Wildlife Monitoring Report Submitted for Federal Energy Projects #1417 and #1835. Submitted to Federal Energy Regulatory Commission, U. S. Fish and Wildlife Service, Nebraska Game and Parks Commission and Governance Committee of the Cooperative Agreement for the Platte River Research and Other Efforts Relating to Endangered Species Habitats along the Central Platte River, Nebraska. 126pp.

Johnson, W. C. and S. E. Boettcher. 2000. The presettlement Platte: wooded or prairie river? Great Plains Research 10 (Spring):39-68.

Karlinger, M. R., T. R. Eschner, R. F. Hadley and J. E. Kircher. 1983. Relation of channel-width maintenance to sediment transport and river morphology: Platte River, south-central Nebraska. Pages E1 to E19 in Hydrologic and Geomorphic Studies of the Platte River Basin. Geological Survey Professional Paper 1277.

Kinzel, P.J., J.M. Nelson, and A.K. Heckman. 2006a. Channel morphology and bed-sediment characteristics before and after riparian vegetation clearing in the Cottonwood Ranch, Platte River, Nebraska, water years 2001-2004: U.S. Geological Survey Scientific Investigations Report 2005-5285, 25 p.

Kinzel, P.J., J.M. Nelson, and C. W. Wright. 2006b. Monitoring changes in the Platte River Riparian Corridor with Serial LiDAR Surveys. U.S. Geological Survey Fact Sheet 2006-3063, 4p.

Kinzel, P.J., C.W. Wright, and J.M. Nelson. 2006c. Application of an experimental airborne laser scanner for surveying a braided river channel, in Proceedings of the 8th Federal Interagency Sedimentation Conference, April 2-6, 2006, Reno, Nev. Subcommittee on Sedimentation, 8p.

Kircher, J. E. 1983. Interpretation of sediment data for the South Platte River in Colorado and Nebraska, and the North Platte and Platte Rivers in Nebraska. Pages D1 to D17 in Hydrologic and Geomorphic Studies of the Platte River Basin. Geological Survey Professional Paper 1277.

Lack, E., S. Howlin and K. Sernka. 2002. Baseline vegetation survey: Jeffrey Island and Cottonwood Ranch, Central Platte River, Nebraska. Prepared for Central Nebraska Public Power and Irrigation District, Gothenburg, Nebraska. 219pp.

Murphy, P.J., L.M. Fotherby, T.J. Randle, R. Simons. 2006. Platte River sediment transport and riparian vegetation model. U.S. Department of the Interior, Bureau of Reclamation, Denver, Colorado, 137 pp.

Nagel, H. G. 1981. Vegetation ecology of Crane Meadows. Prepared for The Nature Conservancy and Platte River Whooping Crane Critical Habitat Maintenance Trust. 34pp.

Nagel, H. G. 1998. Methods for monitoring changes in biology, soils and hydrology in restored or created wetlands on the Platte Valley, Nebraska. Report submitted to Central Platte Natural Resources District, Central Nebraska Public Power and Irrigation district, Nebraska Game and Parks Commission, and Nebraska Public Power District.

Nagel, H. G. 1999. Alternative methods to maintain and/or enhance wet meadow habitat in and along the Platte River, Nebraska – A report on baseline monitoring at three sites in central Nebraska 1997-1998. Submitted to Central Platte Natural Resources District, Central Nebraska Public Power and Irrigation District, Nebraska Game and Parks Commission and Nebraska Public Power District.

Nebraska Environmental Trust Fund. 2001. Alternative methods to maintain and enhance wet meadow habitat along the Platte River, Nebraska. Final monitoring report 1997-2000. Sponsored by Central Platte Natural Resources District, Nebraska Public Power District, The Central Nebraska Public Power and Irrigation District, and Nebraska Game and Parks Commission.

Pfeiffer, K. 1999. Evaluation of wet meadow restorations in the Platte River Valley. Platte River Whooping Crane Maintenance Trust, Wood River, Nebraska. 8pp.

Platte River Endangered Species Partnership (PRESP). 2001. Protocol for aerial photography in the central Platte River valley.

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

Technical Committee of the Platte River Cooperative Agreement (Technical Committee). 2000. Research Protocol for Nebraska Public Power District's Cottonwood Ranch Property. Protocol developed during the 1997 Cooperative Agreement period.

The Nature Conservancy and Environmental Research Systems Institute. 1994. National Biological Survey/National Park Service Vegetation Mapping Program: Accuracy Assessment Procedures. Arlington, Virginia.

University of Nebraska. 1998. CALMIT Database for the Central Platte River. Lincoln, Nebraska.

USBOR (U.S. Bureau of Reclamation). 2000. Central Platte River 1998 Land Cover/Land Use Mapping Project, Nebraska. Remote Sensing and Geographic Information Group (RSGIG) of the Bureau of Reclamation's Technical Service Center. Technical Memorandum No. 8260-00-08.

USFWS (U. S. Fish and Wildlife Service). 1983. Platte River, NE Database for the Whooping Crane Habitat Maintenance Trust. Western Energy and Land Use Team. Rapid Assessment Methods Group. Fort Collins, Colorado.

Table 1. Summary of the 35 land-cover and land-use classes identified by USBOR (2000) database for the central Platte River Study Area in 1998.

Map Code	Land Cover and Land Use Map Units	Number of Polygons	Acreage	Proportion (%)
Hydrology Map Units				
2	Wetted Channel	82	9,968	2.30%
3	Open Water Canal	75	242	0.06%
4	Open Water Slough	216	179	0.04%
5	Open Water Pit, Pond, or Lake	1,681	3,763	0.87%
7	Open Water (e.g., creek)	231	341	0.08%
Bare-Ground Map Units				
6	Barren Beach/Bar	2,128	1,408	0.32%
40	Sand/Gravel Areas	641	1,526	0.35%
41	Sand/Gravel Operation	30	146	0.03%
42	Barren Surface	162	238	0.05%
Agricultural Map Units				
20	Agriculture Alfalfa	843	22,171	5.11%
21	Agriculture Corn	1,493	204,729	47.15%
22	Agriculture Other Crops	412	8,413	1.94%
23	Agriculture Bare Ground/Fallow	736	4,406	1.01%
24	Agriculture Soy Bean	593	19,631	4.52%
25	Agriculture Mown Field	347	5,259	1.21%
26	Agriculture Winter Wheat	2	42	0.01%
Natural or Semi-Natural Vegetation Map Units				
1	Emergents	1,593	1,405	0.32%
10	Shrubs inside Floodplain	3,331	5,402	1.24%
11	Upland Grasses	2,955	35,637	8.21%
12	Lowland Grasses	615	38,914	8.96%
13	Shrubs outside Floodplain	310	308	0.07%
15	Woody within Floodplain	6,337	29,315	6.75%
16	Woody outside Floodplain	5,659	5,648	1.30%
17	Mown Lowland Grasses	147	4,121	0.95%
18	Herbaceous Riparian	3,009	4,202	0.97%
Land Use Map Units				
30	Bridge	59	20	0.00%
31	Development Commercial	350	3,246	0.75%
32	Development Residential	313	5,281	1.22%
33	Development Single Dwelling	1,812	3,320	0.76%
34	Powerline	8	36	0.01%
35	Road Gravel	324	7,153	1.65%
36	Road Interstate	30	3,440	0.79%
37	Road Paved	126	2,926	0.67%
38	Railroad	39	1,173	0.27%
39	Other Road	151	192	0.04%
TOTAL		**36,840**	**434,201**	**100.00%**

Table 2. Natural and semi-natural land-cover map units and corresponding National Vegetation Classification Standard (NVCS) plant associations for USBOR (2000) database.

Map Unit (#)	Provisional NVCS Association (Common Name)
Emergents (1)	*Typha* spp. - *Scirpus* spp. Great Plains Herbaceous Vegetation (Cattail - Bulrush Great Plains Herbaceous Vegetation)
	Spartina pectinata - Scirpus americanus Herbaceous Vegetation (Prairie Cordgrass - Three-square Bulrush Herbaceous Vegetation)
Shrub – Floodplain (10)	*Salix exigua - Cornus drummondii* Temporarily Flooded Shrubland (Sandbar Willow - Rough- leaved Dogwood Temporarily Flooded Shrubland)
	Weedy Grass / Forb / Short Shrub Great Plains Herbaceous Vegetation (shrubs on islands)
Grassland – Upland (11)	Not sampled for this study due to lack of access
Lowland Grasses (12)	*Andropogon gerardii - Panicum virgatum* Mesic Tallgrass Prairie (Big Bluestem - Switchgrass Mesic Tallgrass Prairie)
	Poa pratensis - Andropogon gerardii Semi-natural Herbaceous Vegetation (Kentucky Bluegrass - Big Bluestem Semi-natural Herbaceous Vegetation)
	Bromus inermis - (Andropogon gerardii) Semi-natural Herbaceous Vegetation (Smooth Brome - Big Bluestem Semi-natural Herbaceous Vegetation)
	Agropyron intermedium - *Andropogon gerardi*i Semi-natural Herbaceous Vegetation (Intermediate Wheatgrass - Big Bluestem Semi-natural Herbaceous Vegetation)
Shrub – Upland (13)	Not sampled for this study due to lack of access
Wooded - Floodplain (15)	*Populus deltoides - Fraxinus pennsylvanica / Cornus drummondii* Temporarily Flooded Woodland (Plains Cottonwood - Green Ash / Rough- leaved Dogwood Temporarily Flooded Woodland)
	*Fraxinus pennsylvanica - Ulmus rubra,- U. american*a) / *Cornus drummondii* Temporarily Flooded Woodland (Green Ash - Slippery Elm - American Elm / Rough- leaved Dogwood Temporarily Flooded Woodland)
	Fraxinus pennsylvanica - Acer negundo / Cornus drummondii Temporarily Flooded Woodland (Green Ash - Boxelder / Rough-leaved Dogwood Temporarily Flooded Woodland)
	Juniperus virginiana - *Morus rubr*a Floodplain Woodland (Eastern Red Cedar - Red Mulberry Floodplain Woodland)

Wooded – Upland (16)

Fraxinus pennsylvanica - Ulmus americana Woodland Alliance
(Green Ash - American Elm Woodland Alliance [Draws])

Juniperus virginiana Woodland Alliance (Eastern Red Cedar Woodland Alliance)

Mown Lowland Grasses (17)

See Map Unit 12: Lowland Grasses

Herbaceous Riparian (18)

Weedy Grass / Forb / Short Shrub Great Plains Herbaceous Vegetation

Table 3. Land cover-types occurring at Jeffrey Island and Cottonwood Ranch properties in summer 2001.

Land Cover Type	% Cover Jeffrey Island	% Cover Cottonwood Ranch
Grassland	46	27
Forest	37	48
Exposed sand beach/bar	7	0.04
Wetted channel	6	9
Emergent wetland	4	4
Open water	0.2	0
Open water canal	0	0.08
Agricultural field	0	11

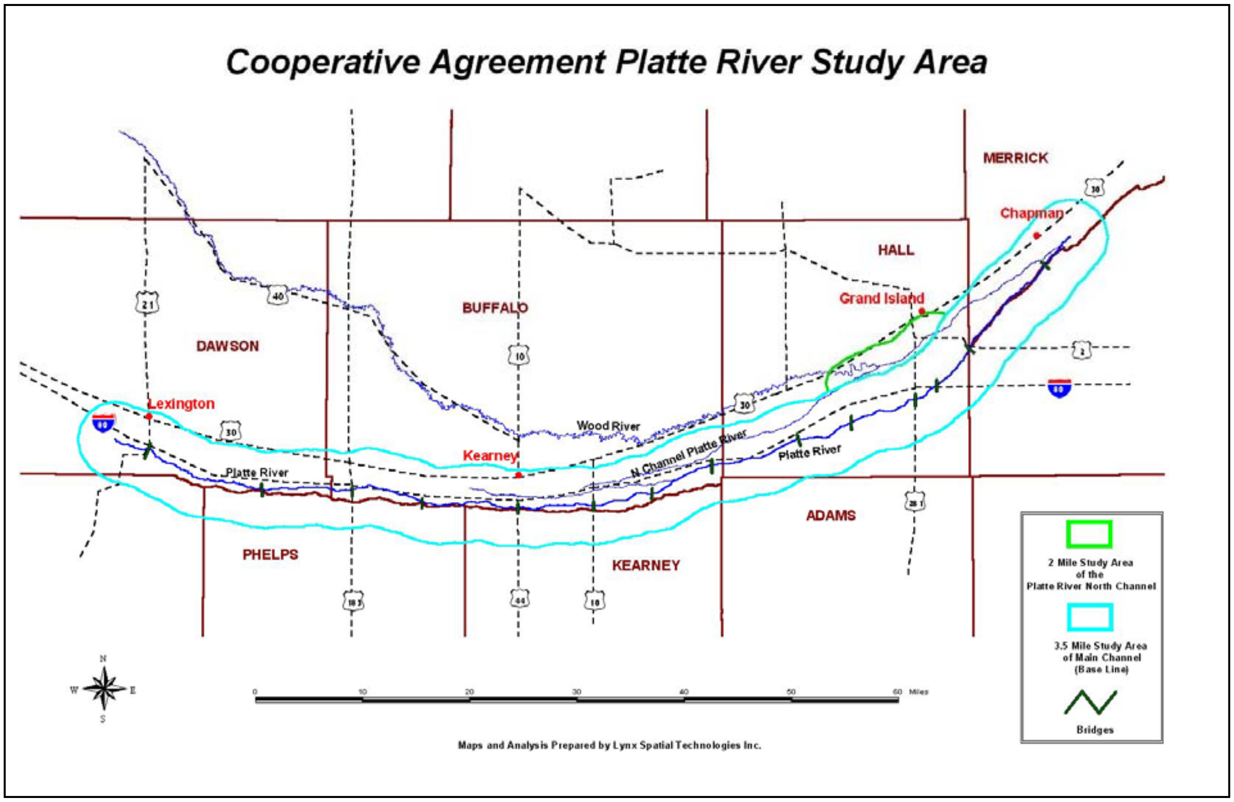

Figure 1. Location of the Central Platte River Study Area.

APPENDIX A

Sources for geospatial data and scientific references in the Central Platte River Study Area

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USGS The Platte River Program
http://ne.water.usgs.gov/platte/index.html

Available data include:

Color infrared (CIR) digital orthophotos

Digital orthophotos were made from color-infrared (CIR) aerial photography (1:24,000-scale) obtained on August 19, 21, and 24, 1998 and produced to USGS 3.75' DOQQ accuracy standards. The CIR digital orthophotos were produced to meet national map accuracy standards for USGS 3.75' (1:12,000-scale) digital orthophoto quarter-quadrangles (DOQQ). These standards specify a 1-meter pixel resolution, horizontal accuracy of 10.1 meters (1/30th of 1-inch or 33.3 feet) and a vertical accuracy of 7-meters. These images were visually inspected for completeness; they cover 3 1/2 miles on either side of the Platte River in central Nebraska, from Lexington to Chapman.

Digital orthophoto quadrangles (DOQQ)

A digital ortho-photo is a digital image of an aerial photograph with image distortion removed, and corrected for aircraft pitch, yaw and altitude, landscape relief, and camera lens (optic correction) orientation. These DOQs were developed from 1993 flight coverage flown under the National Aerial Photography Program. The finished product is a spatially accurate image with identifiable features represented in their true planimetric positions. This digital image is a GIS product that can be overlaid and manipulated like any other coverage or layer, and offers significant flexibility. The National Mapping Standards for primary DOQ require a 1-meter ground resolution for quarter-quadrangle (3.75-minutes of latitude by 3.75-minutes of longitude) image cast on the Universal Transverse Mercator (UTM) projection on the North American Datum of 1983 (NAD83) and mapped to 1:12,000 scale.

Digital elevation models (DEM)

A Digital Elevation Model (DEM) consists of a sampled array of elevations for ground positions referenced at regularly spaced (30 meter) horizontal intervals. The DEMs are produced in 7.5 minute units which correspond to USGS 7.5 topographic quadrangle maps.

Digital raster graphics (DRG)

A digital raster graphic (DRG) is a scanned image of a USGS standard series topographic map, including all map collar information. The image inside the map neatline is georeferenced to the surface of the earth and fit to the Universal Transverse Mercator (UTM) projection. The horizontal positional accuracy and datum of the DRG matches the accuracy and datum of the source map. The map is scanned at a minimum resolution of 250 dots per inch.

Digital line graphs (DLG)

The DLG data files derived from 1:24,000-scale maps contain selected base categories of cartographic data in digital form. These categories include: (1) political boundaries (e.g., State, county, city, and other municipal boundaries) and administrative boundaries (e.g., National and State forest boundaries); (2) hydrography, including all flowing water, standing water, and wetlands; (3) Public Land Survey System (PLSS) data describing the rectangular system of land surveys administered by the BLM, representing or referencing property boundaries (e.g., township, range, and park information); (4) transportation data, including major transportation systems collected in three separate overlays (roads and trails; railroads; and pipelines, transmission lines, and miscellaneous transportation features); (5) other significant manmade structures, including miscellaneous cultural features not in the other major data categories (e.g., schools, churches, hospitals); (6) hypsography; (7) surface cover, including information about vegetative surface cover (e.g., woods, scrub, orchards, and vineyards); (8) non-vegetative surface features, including information about the natural surface of the Earth (e.g., lava and sand); and (9) survey control and markers (i.e., information about the points of established position and third-order or better elevations that are used as fixed references in positioning and correlating map features).

Historic 1938 photos

Photographs were scanned at 600 dpi. Photo coverage extends from Gothenburg to Grand Island.

Nebraska Department of Natural Resource (NDNR)

http://www.dnr.ne.gov/

Available geospatial databases from NDNR databank include:

- Census Data
- Dams Inventory
- Digital Elevation Models (DEM)
- Digital Orthophoto Quadrangles (DOQ)
- Compresssed Digital Orthophoto Quadrangles (COQ)
- Other COQs
- DRASTIC Database - Groundwater Vulnerability to Contamination
- Groundwater Levels
- Hydrologic Units
- Landsat TM Data
- Land Use (8 acre cell)
- National Wetlands Inventory
- Political Boundary Databases
- Public Land Survey System (PLSS)-Township Section Points
- Registered Groundwater Wells

- Soils Data (SSURGO, STATSGO, P Factor, C Factor, MUIR)
- TIGER Files - 2000

National Wetland Inventory (NWI)
http://www.nwi.fws.gov/index.html

Available data included maps and wetland delineations produced by NWI.

Nebraska Geospatial Data Clearinghouse
http://www.dnr.ne.gov/databank/geospatial.html

The Nebraska Geospatial Data Clearinghouse is a searchable catalog of information about available, spatially-referenced data covering geographic areas of Nebraska. It provides users of Geographic Information Systems (GIS) with a means to identify sources of Nebraska-related geospatial data.

The Clearinghouse does not house geospatial databases itself, but rather the metadata (information about the data) related to the databases. This metadata provides information about what geospatial data is currently available, the quality of the data, and how the data may me accessed.

Nebraska Gap Analysis Project
http://www.calmit.unl.edu/gap/

Nebraska GAP objectives are to: map existing statewide vegetation and other land cover; predict the present distributions of native animal species; determine the extent and importance of places of native species richness; compare the distributions of vegetation communities with existing land management goals; compare places of species richness with existing land management goals; provide an objective basis for a statewide biodiversity management strategy.

The Nebraska GAP will involve analysis of the distribution of actual natural vegetation, mapped from satellite imagery and other records, and the distributions of native animal species, mapped by using museum and agency records in conjunction with known habitat ranges. These data will be manipulated and displayed with a computerized geographic information system (GIS). Maps of species-rich areas, individual species of concern, and vegetation types will be overlaid on maps of public land ownership and management, to provide land stewards with the information to make well-informed decisions regarding biodiversity management.

USGS Northern Prairie Wildlife Research Center
http://www.npwrc.usgs.gov/

The mission of the Northern Prairie Wildlife Research Center is to: 1) develop research information on the quantitative ecological requirements for sustainable wildlife populations; 2) design and conduct studies of numbers and distribution of flora and fauna including identification of change resulting from habitat loss and modification, and; 3) disseminate the latest in technical information and research findings such that interested audiences benefit to the maximum extent possible.

Platte River Cooperative Hydrology Study (COHYST)
http://cohyst.dnr.ne.gov/

Scientifically supportable hydrologic databases, analyses, and modeling maintained at FWS Grand Island and CPNRD Grand Island.

APPENDIX B
Metadata for USBOR (2000) Database

Metadata:

Identification_Information:
Citation:
Citation_Information:
Originator:
Platte River EIS Office, Bureau of Reclamation, in conjunction with the Fish and Wildlife Service, PL-100, PO 25007, Denver CO 80225
Publication_Date: 1998
Title: Central Platte River 1998 Land Cover/Use Database
Geospatial_Data_Presentation_Form: map
Publication_Information:
Publication_Place: Denver, CO
Publisher: Bureau of Reclamation
Description:
Abstract:
These metadata are for all bridge segments associated with the 1998 land cover/use geospatial database for the Central Platte River. This project was authorized by the Platte River EIS Office, formed to write the environmental impact statement for the Cooperative Agreement for Platte River research and other efforts relating to endangered species habitats along the Central Platte River, Nebraska. The mapping effort was performed by the Remote Sensing and Geographic Information Group (RSGIG) of the Bureau of Reclamation's Technical Service Center.
Purpose:
The land cover/use information will be used to evaluate alternatives for the Platte River EIS.
Supplemental_Information:
The following vegetation and land use classes were mapped for this project: LAND USE: 1 emergents; 2 wetted channel; 3 open water canal; 4 open water; slough; 5 open water pit, pond or lake; 6 barren beach/bar; 7 open water; 10 shrubs inside floodplain; 11 upland grasses; 12 lowland grasses; 13 shrubs outside floodplain; 15 wooded river within flood; 16 woody outside floodplain; 17 mown lowland grasses; 18 herbaceous riparian; 20 agriculture alfalfa; 21 agriculture corn; 22 agriculture other crops; 23 agriculture bare ground; 24 agriculture soy bean; 25 agriculture mown field; 26 agriculture winter wheat; 30 bridge; 31 development commercial; 32 development residential; 33 development single swelling; 34

powerline; 35 road interstate; 37 road paved 38 railroad; 39 other road; 40 sand/gravel operation; and 42 barren surface. Classification was in accordance with the Federal Geographic Data Committee's National Vegetation Classification Standard.
Time_Period_of_Content:
Time_Period_Information:
Single_Date/Time:
Calendar_Date: 199808
Currentness_Reference: Dates of aerial photography
Status:
Progress: Complete
Maintenance_and_Update_Frequency: None planned
Spatial_Domain:
Bounding_Coordinates:
West_Bounding_Coordinate: -99.8102
East_Bounding_Coordinate: -98.0766
North_Bounding_Coordinate: 41.0354
South_Bounding_Coordinate: 40.6077
Keywords:
Theme:
Theme_Keyword_Thesaurus: None
Theme_Keyword: land cover
Theme_Keyword: land use
Theme_Keyword: land cover/use
Theme_Keyword: vegetation
Theme_Keyword: wetted channel
Theme_Keyword: development
Theme_Keyword: road
Theme_Keyword: bridge segment
Theme_Keyword: unvegetated
Theme_Keyword: herbaceous
Theme_Keyword: water
Theme_Keyword: floodplain
Theme_Keyword: meadow
Theme_Keyword: agriculture
Theme_Keyword: wooded
Theme_Keyword: shrubs
Theme_Keyword: upland grasses
Place:
Place_Keyword_Thesaurus: None
Place_Keyword: Nebraska
Place_Keyword: Central Platte River
Place_Keyword: Platte River
Place_Keyword:
Big Bend Taxonomy: Taxonomic_Keywords: vegetation Taxonomic_Keywords: plants Taxonomic_Keywords: National Vegetation Classification System Taxonomic_Coverage:

Specific_Taxonomic_Information: General_Taxonomic_Coverage:
Complete list of mapped classes under Supplemental Information above

Access_Constraints: None

Use_Constraints:
Acknowledgment of U.S. Bureau of Reclamation and Fish and Wildlife Service would be appreciated in products derived from these data. Any person using the information presented here should fully understand the data collection and compilation before beginning analysis. The burden for determining fitness for use lies entirely with the user.

Point_of_Contact:
Contact_Information:
Contact_Organization_Primary:
Contact_Organization: Bureau of Reclamation
Contact_Person: Platte River GIS Analyst
Contact_Address:
Address_Type: mailing address
Address: PO 25007, PL-100
City: Denver
State_or_Province: CO
Postal_Code: 80225-0007
Country: USA
Contact_Voice_Telephone: 303-445-2096
Contact_Facsimile_Telephone: 303-445-6331
Contact_Electronic_Mail_Address: platte@www.usbr.gov
Hours_of_Service: Monday through Friday, 7:00 a.m. to 4:30 p.m. Mountain Time
Native_Data_Set_Environment: UNIX Arc/Info

Data_Quality_Information:
Attribute_Accuracy:
Attribute_Accuracy_Report:
These data have an overall accuracy of 88.8% (85.3% Kappa index) within a 90% confidence interval of 85.0 to 91.9%).

Logical_Consistency_Report:
All polygon features are checked for topology and existence of label points using the Arc/Info software. Each polygon begins and ends at the same point with the node feature. All nodes are checked for error so that there are no unintentional dangling features. There are no duplicate lines or polygons. All nodes will snap together and close polygons based on a specified tolerance. If the node is not within the tolerance it is adjusted manually. Logical consistency is performed in Arc/Info.

Completeness_Report:
All data that can be interpreted are digitized in accordance with the minimum mapping unit (MMU) of 1/2 acre for all but the agricultural classes which have an MMU of 10 acres. This includes selected features that fall into the NVCS vegetation classification and the Anderson Level II land use classification. Some classes below the MMU are included such as wetlands and beach bar areas and polygons cut off by other features and borders. Roads (to visible right-of-way or fence line) and streams/drainages wider than 10 meters were

digitized as polygons and attributed accordingly. Roads and wet drainages visible on the orthophotos but thinner than 10 meters were digitized as lines. Dry drainages thinner than 10 meters were not digitized.

Positional_Accuracy:
Horizontal_Positional_Accuracy:
Horizontal_Positional_Accuracy_Report:

Vegetation and land cover/use units were identified through stereoscopic examination of 1:24,000-scale color infrared (CIR) aerial photographs taken in August 1998. Every other photograph was enlarged to a scale of 1:12,000 to provide a larger-scale image for the interpretation. The vegetation boundaries were transferred to the GIS database using digital orthophoto quadrangles as the basemap. The mapped vegetation and land cover/use reflect conditions that existed during the time of photography. The attribute accuracy stated above may also reflect horizontal positional accuracy.

Vertical_Positional_Accuracy:
Vertical_Positional_Accuracy_Report: This database contains no elevation or vertical data.
Lineage:
Source_Information:
Source_Citation:
Citation_Information:
Originator: USGS
Publication_Date: 1993
Title:

Digital Orthophoto Quarter Quadrangle. See Other_Citations_Details for list.

Geospatial_Data_Presentation_Form: Remote-sensing image
Publication_Information:
Publication_Place: Rolla, Missouri
Publisher: USGS
Other_Citation_Details:

List of DOQQs used as basemaps: Abbott, Alda, Alfalfa Center, Bertrand NW, Central City West, Chapman, Cozad, Denman, Doniphan, Elm Creek East, Elm Creek SW, Elm Creek West, Elwood NW, Gibbon North, Gibbon South, Giltner, Grand Island, Hastings NW, Heartwell, Johnson Lake, Kearney, Kearney SW, Kearney SE, Lexington East, Lexington West, Minden North, Murphy, Newark, Overton, Phillips, Prosser, Shelton, and Wood River.

Online_Linkage: <http://www.nrc.state.ne.us/docs/frame3.html>
Source_Scale_Denominator: 12000
Type_of_Source_Media: CD-ROM
Source_Time_Period_of_Content:
Time_Period_Information:
Single_Date/Time:
Calendar_Date: 1993
Source_Currentness_Reference: Ground condition
Source_Citation_Abbreviation: DOQQ
Source_Contribution:

Interpreted data on Mylars were marked with control points from features located on the DOQQs for bridge segments 3, 4, 5, 6, and 7; the DOQQs were also used for making geometric corrections to land cover/use lines and polygons.

Source_Information:
Source_Citation:
Citation_Information:
Originator: Bureau of Reclamation
Publication_Date: 19990603
Title: Platte River Color-Infrared (CIR) Digital Orthophotos
Geospatial_Data_Presentation_Form: Remote-sensing image
Publication_Information:
Publication_Place: Denver, Colorado
Publisher: Bureau of Reclamation
Other_Citation_Details:
See metadata for Color-Infrared Digital Orthophotos at
<http://mcmcweb.er.usgs.gov/platte/cir_doq/metadata.html.>
Online_Linkage:
<http://mcmcweb.er.usgs.gov/platte/cir_doq/cir.html>
Source_Scale_Denominator: 24000
Type_of_Source_Media: Color-infrared aerial photographs
Source_Time_Period_of_Content:
Time_Period_Information:
Single_Date/Time:
Calendar_Date: 199808
Source_Currentness_Reference:

Ground condition determined by aerial photos taken August 19, 21, and 24, 1998

Source_Citation_Abbreviation: none
Source_Contribution:

Interpreted data on Mylars were marked with control points from features located on the DOQQs for bridge segments 1,2, 8 18; the DOQQs were also used for making geometric corrections to land cover/use lines and polygons.

Process_Step:
Process_Description:

Color-infrared digital and hardcopy orthophotos were specially produced for this project from aerial photography acquired by Horizons, Incorporated of Rapid City, South Dakota. (Platte River Color-Infrared Digital Orthophotos discussed in source citation above.) A planimetric basemap image was prepared by Horizons, Incorporated by registering the August 1998 aerial photographs. Orthophotos were produced at a scale of 1:12,000 and were used for photo-interpretation. The original poster-sized sheets were cut into more manageable sizes for the photo-interpreters (~16- (20-inches).

Each orthophoto portion had an identification number corresponding to the bridge segment number, the photo sheet number, and the photo sheet portion (e.g., Bridge Segment 08, Sheet 6, Portion 2 or 08062). The procedure for classifying vegetation followed guidelines set forth in the Vegetation Classification Standard (FGDC 1997) which was developed from the Standardized National Vegetation Classification System (NVCS). The Platte River

Color-Infrared Digital Orthophotos discussed in the source citation above were used for photo-interpretation of the map classes.
Each orthophoto portion was covered with drafting film (Mylar) overlays and registration points corresponding to the tic marks on the orthophotos (points representing known surface coordinates) were traced onto each overlay. Aerial photo portions with the overlays were backlit on a light table and visually scanned for photographic signatures using magnification. The entire photograph portion was systematically interpreted, delineated, and each polygon labeled with the appropriate map unit number. A stereoscope was used to investigate vegetation, land use, and topographic position on the related 9- (9-inch (1:24,000-scale) aerial photographs, as an interpretive aid for the smaller-scale (1:12,000) base photographs. The actual interpretation of aerial photography for the Central Platte River involved three basic steps. First, all of the photos were interpreted into broad land-cover and land-use classes based solely on standard photo-interpretation signature characteristics. These included tone, texture, color, pattern, topographic position, size, and shadow. Second, field note overlays and observation point locations were used, if available, to refine the preliminary delineation into the appropriate map units. Using the broad interpretation and site-specific data points, the final interpretation into map units was performed. Finally, in order to ensure completeness and accuracy, digital transfer specialists reviewed all of the interpreted photos for consistency and recommended further review and/or changes where necessary.

Interpreted linework marked on the overlays was then transferred into the GIS database to create land cover/use polygons. Transfer of information from the interpreted aerial photographs to a digital, geo-referenced database involved scanning the Mylar overlays using two scanners and software systems. ANATech Scansmith Scan-C software (version 4.1) was used to run an Eagle 3640C scanner; each resulting raster image was converted to a vector (line) coverage using the Arc/Info GRIDLINE command in the GRID module for bridge segments 3, 4, 5, 6, and 7. The remaining bridge segments (1, 2, 8-13) were scanned using another vectorizing software, PROVEC (version 3.0), to run a black-and-white Eagle 4080ET scanner. The resulting raster images were vectorized within the PROVEC environment. Each registration point on the interpreted photo was matched electronically to the corresponding registration point on the digital orthophoto for both transfer methods. The line/vector coverage of each photo was then edited to correct scanning flaws using the ARCEDIT module in Arc/Info. Each polygon was attributed according to the features identified during photo-interpretation, along with other pertinent data. The entire transfer and editing sequence was automated via in-house Arc/Info AML programs. Linear features that were not part of an existing polygon were put into a separate coverage.
Process_Date: 1998
Process_Contact:
Contact_Information:
Contact_Organization_Primary:
Contact_Organization: Platte River EIS Office,
Reclamation
Contact_Person: Platte River GIS Analyst
Contact_Address:
Address_Type: mailing address

Address: PO 25007, PL-100
City: Denver
State_or_Province: Colorado
Postal_Code: 80225-0007
Country: USA
Contact_Voice_Telephone: 303-445-2096
Contact_Facsimile_Telephone: 303-445-6331
Contact_Electronic_Mail_Address: platte@www.usbr.gov
Hours_of_Service: Monday through Friday, 7:00 a.m. to 4:30 p.m. Mountain Time
Cloud_Cover: 0

Spatial_Data_Organization_Information:
Indirect_Spatial_Reference: USGS 7.5-minute quadrangles for Central Platte River area
Direct_Spatial_Reference_Method: Vector
Point_and_Vector_Object_Information:
SDTS_Terms_Description:
SDTS_Point_and_Vector_Object_Type: GT-polygon composed of chains
Point_and_Vector_Object_Count: 36840

Spatial_Reference_Information:
Horizontal_Coordinate_System_Definition:
Geodetic_Model:
Horizontal_Datum_Name: North American Datum 1983
Ellipsoid_Name: Geodetic Reference System 1980
Semi-major_Axis: 6378137
Denominator_of_Flattening_Ratio: 298.257

Entity_and_Attribute_Information:
Overview_Description:
Entity_and_Attribute_Overview:

Polygon coverages include labels with unique items, (e.g., veg_code - 3 3 i, coded with vegetation classification number). See Supplemental Information above for complete listing of attribute codes and their descriptions. Arc attributed classes 1, 2, 4, 7, 30, 35, 37, and 39 were extracted and put into separate (line) coverages named lca98_x (where x equals the bridge segment number). Some of these arcs remained in the lcu98_x coverages if they also delineated a unique polygon.

Entity_and_Attribute_Detail_Citation:

Platte River EIS Office, PO Box 25007, PL-100, Denver CO 80225

Detailed_Description:
Entity_Type:
Entity_Type_Label: lcu98.dbf
Entity_Type_Definition: Shapefile Attribute Table
Entity_Type_Definition_Source: None

Attribute:
Attribute_Label: Area
Attribute_Definition: Area of polygon
Attribute_Definition_Source: Software computed
Attribute_Domain_Values:
Range_Domain:
Range_Domain_Minimum: 15.49079
Range_Domain_Maximum: 8187761.77432
Attribute:
Attribute_Label: Perimeter
Attribute_Definition: Perimeter of polygon
Attribute_Definition_Source: Software computed
Attribute_Domain_Values:
Range_Domain:
Range_Domain_Minimum: 24.92747
Range_Domain_Maximum: 91263.31391
Attribute:
Attribute_Label: Lcu98_
Attribute_Definition: Internal feature number
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:
Range_Domain:
Range_Domain_Minimum: 2
Range_Domain_Maximum: 1670
Attribute:
Attribute_Label: Lcu98_id
Attribute_Definition: Feature identification number
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:
Range_Domain:
Range_Domain_Minimum: 1
Range_Domain_Maximum: 2756
Attribute:
Attribute_Label: Veg_code
Attribute_Definition:
Code for vegetation classification (See Supplemental_Information for complete listing of vegetation codes)
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:
Range_Domain:
Range_Domain_Minimum: 1
Range_Domain_Maximum: 42
Attribute:
Attribute_Label: Photo
Attribute_Definition:

Corresponding CIR photo from 9- x 9-inch photos (3-digit number) or cut portions of hardcopy orthophotos (4-digit number)
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:
Range_Domain:
Range_Domain_Minimum: 0
Range_Domain_Maximum: 5095
Attribute:
Attribute_Label: Veg_desc
Attribute_Definition: Description of veg_code numbers
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:
Unrepresentable_Domain: Character field
Attribute:
Attribute_Label: Fp_code
Attribute_Definition: 1998 floodplain code (1 = inside fp, 0 = outside fp)
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:
Range_Domain:
Range_Domain_Minimum: 0
Range_Domain_Maximum: 1
Attribute:
Attribute_Label: Welut_code
Attribute_Definition: Code for comparing the 1982 WELUT land cover/use database
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:
Range_Domain:
Range_Domain_Minimum: 1
Range_Domain_Maximum: 40
Attribute:
Attribute_Label: Welut_desc
Attribute_Definition: Description of the Welut_code numbers
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:
Unrepresentable_Domain: Character field
Attribute:
Attribute_Label: Fp82_code
Attribute_Definition: 1982 floodplain code (1=inside fp, 0=outside fp)
Attribute_Definition_Source: User Defined
Attribute_Domain_Values:
Range_Domain:
Range_Domain_Minimum: 0
Range_Domain_Maximum: 1
Attribute:
Attribute_Label: Tcode
Attribute_Definition: Trend analysis code for comparing 1982 and 1998 datasets

Attribute_Definition_Source: User Defined
Attribute_Domain_Values:
Range_Domain:
Range_Domain_Minimum: 1
Range_Domain_Maximum: 40

Distribution_Information:
Distributor:
Contact_Information:
Contact_Organization_Primary:
Contact_Organization: Bureau of Reclamation
Contact_Person: Platte River GIS Analyst
Contact_Address:
Address_Type: mailing address
Address: PO 25007, PL-100
City: Denver
State_or_Province: CO
Postal_Code: 80225-0007
Country: USA
Contact_Voice_Telephone: 303-445-2096
Contact_Facsimile_Telephone: 303-445-6331
Contact_Electronic_Mail_Address: platte@www.usbr.gov
Hours_of_Service: Monday through Friday, 7:00 a.m. to 4:30 p.m. Mountain Time
Distribution_Liability:

Although these data have been processed successfully on a computer system at the Bureau of Reclamation, no warranty expressed or implied is made regarding the accuracy or utility of the data on any other system or for general or scientific purposes, nor shall the act of distribution constitute any such warranty. This disclaimer applies both to individual use of the data and aggregate use with other data. The Bureau of Reclamation shall not be held liable for improper or incorrect use of the data described and/or contained herein.

Standard_Order_Process:
Digital_Form:
Digital_Transfer_Information:
Format_Name: ArcView shapefiles or Arc/Info Interchange
Digital_Transfer_Option:
Offline_Option:
Offline_Media: CD-ROM
Recording_Format: ISO 9660
Fees: Media, Shipping, and Handling

Metadata_Reference_Information:
Metadata_Date: 20000501
Metadata_Review_Date: 20000714
Metadata_Contact:

Contact_Information:
Contact_Organization_Primary:
Contact_Organization: Bureau of Reclamation
Contact_Person: Platte River GIS Analyst
Contact_Address:
Address_Type: Mailing address
Address: PO 25007, PL-100
City: Denver
State_or_Province: CO
Postal_Code: 80225-0007
Country: USA
Contact_Voice_Telephone: 303-445-2096
Contact_Facsimile_Telephone: 303-445-6331
Contact_Electronic_Mail_Address: platte@www.usbr.gov
Hours_of_Service: Monday through Friday, 7:00 a.m. to 4:30 p.m. Mountain Time
Metadata_Standard_Name:
NBII Content Standard for National Biological Information Infrastructure Metadata
Metadata_Standard_Version: FGDC-STD-001-1998
Metadata_Access_Constraints: None
Metadata_Use_Constraints:
None SMMS Metadata report generated 5/31/2000
Generated by mp version 2.5.6 on Mon Nov 20 11:19:54 2000

APPENDIX C

Sources for water quality and contaminant data in the Central Platte River Study Area

Two technical reports were written discussing water quality issues for the Platte River Programmatic EIS. These are:

USDI Bureau of Reclamation. 2000. Existing water quality conditions in the Platte River. Prepared by J. Yahnke, Technical Report of the Platte River EIS Team for USDI-BOR, Technical Service Center, Denver, CO.

USDI Bureau of Reclamation. 2000. Water quality in the ground water mound in the middle Platte Basin, Nebraska. Prepared by J. Yahnke, Technical Report of the Platte River EIS Team for USDI-BOR, Technical Service Center, Denver, CO.

Other programs or efforts that have collected water quality information include:

National Water-Quality Assessment (NAWQA) Program
Surface-water information for the central Platte River is available from the National Water Quality Assessment (NAWQA) Program operated by the USGS. The NAWQA program assesses water quality status and trends of more than 50 of the Nation's largest river basins and aquifers.
Refer to: (http://water.usgs.gov/nawqa/index.html)

Environmental Protection Agency (EPA) STORET Database
STORET (short for STOrage and RETrieval) is a repository for water quality, biological, and physical data.
Refer to: (http://www.epa.gov/STORET/)

Department of Interior National Irrigation Water Quality Program (NIWQP)

The purpose of NIWQP is to identify and address irrigation-induced water quality and contamination problems related to water projects in the west. The program focuses on irrigation delivery water that originates from DOI developed irrigation and drainage projects. Impacts from irrigation return flows were focused on the following groups of fish and wildlife resources; 1) National Wildlife Refuges receiving drainwater from DOI irrigation and drainage facilities, 2) areas important to migratory bird and endangered species receiving drainwater from DOI irrigation and drainage facilities, and 3) public water supplies that may be affected by drainwater from DOI irrigation and drainage facilities.
Refer to: (http://www.usbr.gov/niwqp/)

Nebraska Department of Environmental Quality (NDEQ)
The NDEQ implements and maintains data for a variety of monitoring programs targeted for both ground and surface water.
Refer to: (http://www.deq.state.ne.us)

The National Contaminant Biomonitoring Program (NCBP) Database
The NCBP was designed to monitor temporal and geographic trends in the concentrations of accumulative contaminants in fish and wildlife through chemical analyses of freshwater fish, starlings, and duck wings collected periodically from national networks.
Refer to: (http://www.cerc.usgs.gov/data/ncbp/ncbp.html)

Biomonitoring of Environmental Status and Trends (BEST)
Development of the BEST program was initiated by the U.S. Fish and Wildlife Service as an expansion of the NCBP. The BEST program was designed to monitor and assess many classes of chemicals in a wide variety of habitats using a multiple-lines-of-evidence approach.
Refer to: (http://www.best.usgs.gov/)

USGS National Water Information System (NWIS)

The USGS investigates the occurrence, quantity, quality, distribution, and movement of surface and underground waters. This database provides access to water-resources data collected at approximately 1.5 million sites in all 50 states.
Refer to: (http://water.usgs.gov)

Natural Resources Districts
Natural Resources Districts in Nebraska have been collecting ground water quality information from 1000's of wells since the early 1970's. This monitoring has primarily focused on nitrate/nitrite for purposes of protecting drinking water quality but other limited quality data have been collected. These data are not published but are archived with the University of Nebraska Water Center (http://watercenter.unl.edu).

BASELINE REPORT

OTHER SPECIES AND COMMUNITIES OF CONCERN FOR BIOLOGICAL MONITORING SECTION

Table of Contents

List of Tables and Appendix

I. INTRODUCTION

This section lists species and communities of concern for biological monitoring and research. This section does not go into detailed discussion related to each species' habitat requirements, habitat use in the study area, or relative numbers in the study area. Species of concern for biological monitoring and research, other than the Program's four target species, include: other federally listed threatened or endangered species, Nebraska State listed threatened or endangered species, rare or declining species identified by the Nebraska Natural Heritage Program, noxious weeds, or other species as identified by the Program (Table 1). The Program does not envision conducting unique monitoring and research for all of these species. The Program will collect information from studies conducted on these species by other parties in the Platte River basin and regionally and may conduct monitoring efforts for some species on Program lands. Information about the occurrence and habitats of these species is available from a variety of sources in published and non-published literature. This list does not contain species of economic or social importance (e.g., white-tailed deer) unless they are also included in the above categories.

Communities of concern are those community types identified by the Nebraska Game and Parks Commission Heritage Database, and are provided as one means to determine if other species of concern may occur on Program lands when developing restoration and management plans.

II. FEDERAL OR STATE LISTED SPECIES

In addition to the four target species, four other federally-listed endangered or threatened species and one state listed endangered species are documented to occur or potentially occur in the central Platte River valley: bald eagle (*Haliaeetus leucocephalus*), Eskimo curlew (*Numenius borealis*), American burying beetle (*Nicrophorus americanus*), and western prairie fringed orchid (*Platanthera praeclara*). The northern river otter (*Lutra canadensis*) is listed as endangered by the State of Nebraska (Table 1).

III. OTHER RARE OR DECLINING SPECIES

The Nebraska Natural Heritage Program was used as one means to identify other rare or declining species potentially occurring in the central Platte valley study area. A heritage status rating is applied to each listed species for identifying the status of the population either globally or locally. Other species were included on the list as being species of concern by parties of the Program. Specific ratings and their definitions are listed below Table 1. Information regarding species occurrence in the study area could be investigated through literature review, including Faanes and Lingle (1995), local species lists (e.g., NPPD, CNPPID, FWS), and local North American Breeding Bird Surveys and Christmas Bird Counts (Appendix A).

IV. NOXIOUS AND INVASIVE WEEDS

Noxious weeds listed by the Nebraska Department of Agriculture, Nebraska Bureau of Plant Industry, and noxious/invasive species identified by the Platte Valley Weed Management Area are also included as other species of concern (Table 2). The list was obtained from the Nebraska

Noxious Weed Program and Platte Valley Weed Management Area websites: (http://www.agr.state.ne.us/division/bpi/nwp/nwp1.htm and http://www.plattewma.org/).

V. COMMUNITIES OF CONCERN

The Nebraska Game and Parks Commission's Heritage Database identified five communities of concern as occurring or potentially occurring in the central Platte River valley. These communities and heritage ranking include:

Loess Mixed-grass Prairie (G4-S3)
Northern Cordgrass Wet Prairie (G2G3-S2)
Sandhills Wet-mesic Tallgrass Prairie (G3?-S3)
Western Streamside Wet Meadow (G4-S2)
Wet-mesic Tallgrass Prairie (G2-S2)

VI. LITERTURE CITED

Faanes, C.A., and G.R. Lingle. 1995. Breeding birds of the Platte River Valley of Nebraska. Jamestown, ND: Northern Prairie Wildlife Research Center Online. http://www.npwrc.usgs.govindex.htm (Version 02SEP99).

Table 1. Special status species potentially occurring in the central Platte River valley.

Common Name	Scientific Name	Reason for Inclusion/Status
BIRDS		
Waterfowl		
Trumpeter Swan	*Cygnus buccinator*	G4, S2
Canvasback	*Aythya valisineria*	G5, S3
Raptors		
Bald Eagle	*Haliaeetus leucocephalus*	FT
Golden Eagle	*Aquila chrysaetos*	G4, S3
Ferruginous Hawk	*Buteo regalis*	G4, S2
Swainson's Hawk	*Buteo swainsoni*	G4, S3
Northern Harrier	*Circus cyaneus*	G5, S3
Cooper's Hawk	*Accipiter cooperii*	G4, S1
Sharp-shinned Hawk	*Accipiter striatus*	G5, S1
Peregrine Falcon	*Falco peregrinus*	G4, S3
Merlin	*Falco columbarius*	G4, S1
Short-eared Owl	*Asio flammeus*	G5, S2
Other Water Birds		
American Bittern	*Botaurus lentiginousus*	G4, S3
Least Bittern	*Ixobrychus exilis*	G5, S2
Great Blue Heron	*Ardea herodias*	G5, S4
Black-crowned Night-heron	*Nycticorax nycticorax*	G5, S2
White-faced Ibis	*Plegadis chihi*	G5, S1
Black Tern	*Chlidonias niger*	G4, S3
Forster's Tern	*Sterna forsteri*	G5, S3
Sandhill Crane	*Grus canadensis*	Program listed
Shorebirds		
Black Rail	*Laterallus jamaicensis*	G4, S1
Common Snipe	*Gallinago gallinago*	G5, S2
Long-billed Curlew	*Numenius americanus*	G5, S3
Black-necked Stilt	*Himantopus mexicanus*	G5, S1
Eskimo Curlew	*Numenius borealis*	FE
Passerines		
Western Wood Pewee	*Contopus sordidulus*	G5, S4
Yellow-throated Vireo	*Vireo flavifrons*	G5, S2
Bell’s Vireo	*Vireo bellii*	G5, S4
Solitary Vireo	*Vireo solitarius*	G5, S2
Brown Creeper	*Certhia americana*	G5, S3
Townsend’s Solitaire	*Myadestes Tounsendii*	G5, S2
Lazuli Bunting	*Passerina amoena*	G5, S4
McCown's Longspur	*Calcarius Mccownii*	G5, S3
Savannah Sparrow	*Passerculus sandwichensis*	G5, S3
Swamp Sparrow	*Melospiza georgiana*	G5, S3
Brewer’s Blackbird	*Euphagus cyanocephalus*	G5, S4
MAMMALS		
Northern River Otter	*Lutra canadensis*	SE
Eastern Spotted Skunk	*Spilogale putorius*	G5, S3

Common Name	Scientific Name	Reason for Inclusion/Status
FISH		
Sturgeon Chub	*Macrhybopsis gelida*	SE
Brook Stickleback	*Culaea inconstans*	G5, S3
Plains Topminnow	*Fundulus sciadicus*	G4, S4
Johnny Darter	*Etheostoma nigrum*	G5, S3
Iowa Darter	*Etheostoma exile*	G5, S4
Brassy Minnow	*Hybognathus hankinsoni*	SC
Common Shiner	*Luxilus cornutus*	SC
Flathead Chub	*Platygobio gracilis*	SC
Plains Minnow	*Hybognathus placitus*	SC
Stonecat	*Noturus flavus*	SC
Suckermouth Minnow	*Phenacobius mirabilis*	SC
INVERTEBRATES Mussels	Species known to be in the central Platte River: *Anodota imbecilis* (paper floater), *Anodota g. grandis* (giant floater), *Lasmigona c. complanata* (white heel-splitter), *Potamilus ohiensis* (pink paper shell), *Quadrula quadrula* (maple leaf), *Quadrula pustules* (pimple back), *Strophitus u. undulates* (squaw foot), *Leptodea fragilis* (fragile paper shell), *Anodontoides ferussacianus* (cylindrical paper shell), *Uniomerus tetralasmus* (pond horn), *Corbicula fluminea* (Asiatic clam), *Toxolasma parvus* (lilliput), *Lampsilis ventricosa* (pocketbook)	Program listed, SC
American Burying Beetle	Nicrophorus americanus	FE
PLANTS		
Western Prairie Fringed Orchid	*Platanthera praeclara*	FT
Purple False Foxglove	*Agalinis purpurea*	G5, S1
Meadow Garlic	*Allium canadense*	G5, S3
Eared redstem	*Ammannia auriculata*	G5, S1
Rush Aster	*Aster junciformis*	G5, S2
Marsh Water-Starwort	*Callitriche verna*	G5, S2
Spring Cress	*Cardamine bulbosa*	G5, S2
Water Sedge	*Carex aquatilis*	G5, S2
Bebb's Sedge	*Carex bebbii*	G5, S3
Uptight Sedge	*Carex stricta*	G5, S1
Nodding Chickweed	*Cerastium nutans*	G5, S1
Pale Goosefoot	*Chenopodium dessicatum*	G5, SH
Sessile Dodder	*Cuscuta compacta*	G5, S1
Small White Lady's-Slipper	*Cypripedium candidum*	G4, S1, S2
Tiny Love-Grass	*Eragrostis capillaris*	G5, S1
Spreading Fleabane	*Erigeron divergens*	G5, S1
Clammy Hedge-Hyssop	*Gratiola neglecta*	G5, S2

Common Name	Scientific Name	Reason for Inclusion/Status
American Pennyroyal	*Hedeoma pulgeoides*	G5, S1
Plains Frostweed	*Helianthemum bicknellii*	G5, S2
Blackfoot Quillwort	*Isoetes melanopoda*	G5, S1
Hairy Pinweed	*Lechea mucronata*	G5, S2
Narrowleaf Pinweed	*Lechea tenuifolia*	G5, S1
Narrowleaf Paleseed	*Leucospora multifida*	G5, S2
Smooth Four-O'clock	*Mirabilis glabra*	G5, S3
Prairie Ground-Cherry	*Physalis pumila*	G5, S2
Hooked Crowfoot	*Ranunculus recurvatus*	G5, S1
Toothcup	*Rotala ramosior*	G5, S2
Arrowhead sp.	*Sagittaria graminea*	G5, S2
Long-Barb Arrow-Head	*Sagittaria longiloba*	G5, S1
Hall's Bulrush	*Scirpus hallii*	G2, S1
Twisted Ladies'-tresses	*Spiranthes vernalis*	G5, S2, S3
Large-Flower Fame-Flower	*Talinum calycinum*	G5, S2
Lesser Bladderpod	*Utricularia minor*	G5, S2

FE Federal Endangered
FT Federal Threatened
SE State Endangered
ST State Threatened
SC Special Concern

Heritage Status:

G4 Apparently secure globally, though it might be quite rare in parts of its range, especially at the periphery.
G5 Demonstrably secure globally, though it may be quite rare in parts of its range, especially at the periphery.
S1 Critically imperiled in state because of extremely rarity (5 or fewer occurrences, or very few remaining individuals), or because of some factor of its biology making it especially vulnerable to extirpation from the state. (Critically endangered in state.)
S2 Imperiled in state because of rarity (6 to 20 occurrences), or because of other factors demonstrably making it very vulnerable to extirpation from the state. (Endangered or threatened in state.)
S3 Rare in state (21 to 100 occurrences).
S4 Apparently secure in state, although the species may be quite rare in points of its range.

Table 2. Noxious weeds of concern within the Platte River valley.

Common Name	Scientific Name
Canada Thistle	*Cirsium arvense (L.) Scop.*
Leafy Spurge	*Euphorbia esula L.*
Musk Thistle	*Carduus nutans L*
Purple Loosestrife	*Lythrum salicaria*
Plumeless thistle	*Carduus acanthoides L.*
Diffuse Knapweed	*Centaurea diffusa* Lam.
Spotted Knapweed	*Centaurea maculosa* Lam.
Saltceder (Tamarisk)	*Tamarix ramosissima* Ledeb *T. parviflora* DC
Phragmites	*Phragmites australis* (Cav.) Trin. Ex. Steudel
Johnsongrass	*Sorghum halepense*
Russian-olive	*Elaeagnus angustifolia* L.

APPENDIX A

Potential sources of quantitative information on bird populations within and in the vicinity of the study area include Christmas Bird Counts, Breeding Bird Surveys, Audubon Watchlist, and the Partners in Flight databases.

Christmas Bird Counts

The National Audubon Society Christmas Bird Count is conducted annually throughout the U.S.A. and Canada and at a few other locations in the New World. Participants conduct the bird census within a designated 15-mile diameter circle on a given count day. The Christmas bird counts provide a source of historic data and of current data not being collected by the Program for occurrence and relative numbers of bird species. Christmas Bird Count information and data is available at http://audubon.birdsource.org/cbcdata/ Count circles and years of data collection in the vicinity of the Program area include the following:

Circle Name	CBC Count Range	Circle ID	Location of Count Circle	
			Latitude	Longitude
Grand Island	**1948-1987**	**405109822**	**40.85**	**98.3667**
Kearney	**1940-1965**	**404209905**	**40.7**	**-99.0833**
Lake McConaughy	**1992-2000**	**NELM**	**41.2167**	**-101.7167**
Calamus-Loup	**1989-2000**	**NECL**	**41.35**	**-99.2667**
Loup City	**1989-1999**	**NELC**	**41.2833**	**-98.9833**

Breeding Bird Survey

The North American Breeding Bird Survey is conducted at approximately 3,700 active BBS routes across the continental U.S. and Canada, of which nearly 2,900 are surveyed annually in June. Each route is 24.5 miles long with 3-minute point counts conducted at 0.5-mile intervals for a total of 50 point counts. Birds seen or heard within a one-quarter mile radius are recorded. The data collected can be used to determine abundance, distribution, and population trends, as well as to identify local and continental trends or distributional shifts. Three routes are adjacent to or pass through the project area (Kenesaw (Route 6), Kearney (Route 7), and Sumner (Route 8)). Data for the three routes close to the Program area are available at http://www.mp2-pwrc.usgs.gov/bbs/results/index.html. These data would only be useful for breeding species and not for wintering or migrant birds.

Audubon Watchlist

The National Audubon Society has created a WatchList based on information collected through breeding bird surveys. The WatchList is a tool to identify birds whose population and/or habitats are decreasing. The WatchList bases relative abundance on scores derived from the BBS, which is a measure of the abundance of a bird, in appropriate habitat within its range, relative to other bird species (National Audubon Society 1998). This information is also included in the Partners in Flight Program.

Partners in Flight

Partners in Flight was launched in 1990 in response to growing concerns about declines in the populations of many land bird species and in order to emphasize the conservation of birds not covered by existing conservation initiatives. The initial focus was on species that breed in the Nearctic (North America) and winter in the Neotropics (Central and South America), but the focus has spread to include most land birds and other species requiring terrestrial habitats (Partners in Flight 1998). Partners in Flight is a comprehensive and cooperative effort among state, federal, and local agencies and private organizations, and its goal is to collect and assemble resources of all concerned organizations. Dissemination of information is continuous between all agencies involved in bird conservation. In most states, this information is compiled and distributed by Natural Heritage Programs that then rank birds as to population sensitivity.