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Sandhill Cranes Appendix

SPRING HABITAT USE IN NEBRASKA

Abstract

INTRODUCTION

The midcontinent population of sandhill cranes use the Central Platte Valley (North Platte and Platte Rivers, and adjacent lands) each spring to rest, feed, court, and ready themselves physiologically for the remainder of migration and subsequent nesting in their holartic breeding grounds. This use is traditional, lasts 4-6 weeks, and involves most if not the entire mid-continent population. Sandhill cranes are gregarious at this time and most utilization of resources occurs in flocks varying in size from a few birds to aggregations of several thousand individuals. This gregarious behavior─at a traditional use site─is the focus used to formulate our concept of habitat suitability for this species. Basically, that concept is the greater the abundance of resources, the larger the number of sandhill cranes that can be accommodated at any unit area of interest. This is a simplistic approach to evaluating the complex relationship that exists between sandhill cranes and their environment. For example, human disturbance and competition with geese and ducks for food likely also defines habitat suitability for sandhill cranes using the Central Platte Valley. However, disturbance and potential competition for food are not addressed in this assessment.

The pre-development North Platte and Platte Rivers were likely dynamic systems. Historically, sandhill cranes likely roosted in the broad active channels and fed on plants and animals in adjacent wetlands and suitable prairie sites between what is now present day Sutherland and Grand Island, Nebraska. Crane use was likely opportunistic and dispersed in order to efficiently exploit resources. Habitat resources and crane use of these resources have changed from historic conditions. The most obvious change has involved basin-wide channel narrowing resulting from occupation of much of the historic active river channel by woody vegetation. Cranes appear to prefer wide channels (> 500 feet on the Platte River) for roosting and have responded to channel narrowing by abandoning some sites in the western Central Platte Valley for remaining wide channel sites in the eastern valley. The concentration of sandhill cranes into remaining suitable roost sites has been facilitated by abundant waste corn in adjacent fields.

Resources traditionally used by sandhill cranes in the Central Platte Valley consists of three main components: (1) secure roost sites within the active river channel, (2) feeding sites where cranes obtain waste corn from harvested fields, and (3) feeding sites where cranes obtain invertebrate food (from wet meadows, alfalfa fields, grazed pastures, and hay fields). This evaluation of is focused on the abundance of suitable roost sites, and the abundance of waste corn and invertebrate food.

It is assumed in this assessment that the suitability of roost sites can be characterized and quantified by an evaluation of the depth of water available for roosting and the unobstructed width of the channel. The relationship between roosting depth and discharge is discussed in the assessment (via PHABSIM examples), and then used at the site (transect) scale to estimate roosting depth abundance at future alternative flows (via SEDVEG Gen-3 output). The relationship between roosting depth and discharge is then extrapolated to the North Platte River system scale to estimate the direction of change in roosting depth abundance when only future discharge data are available.

Unobstructed channel width is also a measure of roosting habitat suitability used in this assessment. The GIS database was used to estimate unobstructed channel width at the bridge segment scale, with the focus on channel area > 501 feet. Unobstructed channel width was also evaluated in terms of percent change from Present Conditions with SEDVEG Gen-3 output.

Food abundance is documented via the GIS database to define Present Conditions, and then evaluated based on projected alternative management options that may affect Present Condition acreages.

Roosting Suitability at the Site Scale—Roosting Depth Abundance

Optimum water depth for roosting sandhill cranes ranges from 4 to 8 inches, with depths greater than 14 inches unsuitable. A depth range of 3-9 inches was selected to represent suitable roosting depth. Two techniques and two sets of transect data were used to evaluate the relationship between discharge and roosting-depth abundance in the 3-9 inch range. PHABSIM was used with data from eight sites located between just downstream of the J-2 return and Chapman, and the SEDVEG Gen-3 model was used with 62 transects located between Lexington and Chapman, to document the relationship between discharge and roosting depth abundance.

The PHABSIM analysis indicated that roosting depth is maximized between 800 cfs and 1,600 cfs (mean of 1,175 cfs). In order to translate the above relationships into estimates of roosting depth abundance under Present Conditions, median March flows (1947-1994) were selected to represent discharge during the spring roosting period. Present Condition median March flows ranged from 1,935 cfs (Overton gauge) to 2,141 cfs (Grand Island gauge), and are greater than flows that would maximize roosting depth in the 3-9 inch depth range. Median March flows for the action alternatives would be numerically higher than Present Conditions, and significantly greater than Present Conditions for the Full Water Leasing and Water Emphasis Alternatives. Higher flows may result in reduced roosting depth abundance. What effect—if any—a reduction in roosting depth abundance would have on sandhill cranes is unknown.

The SEDVEG Gen-3 model was used at the site scale to evaluate future abundance of roosting depth in the 3-9 inch range at 62 transects. SEDVEG Gen-3 output was converted to mean transect length within the 3-9 inch depth category for comparative purposes. Mean length was evaluated for all transects, managed and non-managed transects, transects upstream and downstream of Kearney, and transects within bridge segments 7-2. The analysis for all channels greater than 170 feet predicts a small (≤ 10 percent) reduction in roosting depth abundance in the all transects categories for all alternatives except the Wet Meadow Alternative. Managed transects are predicted to experience a moderate (11-40 percent) to large (41-70 percent) increase in roosting depth as compared to Present Conditions, while non-managed transects may experience a small to moderate reduction. Transects upstream from Kearney may experience a small to moderate increase in roosting depth abundance, except under the Water Emphasis Alternative, which may experience a small reduction. Transects downstream from Kearney may experience a small to moderate reduction in roosting depth. Finally, transects within bridge segments 7-2 may experience small to moderate reductions or small increases in roosting depth abundance depending on the alternative implemented.

We also evaluated change in roosting depth abundance in channels greater than 500 feet. Roosting depth in channels greater than 500 feet are predicted to experience some small to moderate increases in roosting depth under the proposed action alternatives when all transects are considered. The exception would occur under the Water Emphasis Alternative which may experience a small reduction in roosting depth abundance. Managed transects may experience large to very large (71-100 percent) increases. Non-managed transects under three alternatives would all experience reductions in roosting depth (-5.5 to -11.4 percent) in channels greater than 500 feet. Non-managed transects under the Full Water Leasing Alternative may experience a small increase in roosting depth abundance.

Transects upstream of Kearney would experience small to moderate increases in roosting depth, while transects downstream from Kearney would experience small to moderate losses -except for a small increase under the Wet Meadow Alternative. Finally, those transects within bridge segments 7-2 may experience increases in roosting depth from moderate to large.

Roosting Depth Abundance at the Bridge Segment Scale—Unobstructed Channel Width

Unobstructed channel width—as estimated via a GIS analysis—would increase from Present Conditions under the Governance Committee, Wet Meadow, and Water Emphasis Alternatives. Increases would generally occur in channel width categories greater than 500 feet. Estimated increases in unobstructed channel width using a GIS approach, i.e., simulating some island leveling at various locations include:

- Governance Committee Alternative = 21.1 percent
- Full Water Leasing Alternative = 0.0 percent
- Wet Meadow Alternative = 21.1 percent
- Water Emphasis Alternative = 15.0 percent

Obviously, management actions could be initiated under any alternative to produce desired effects. The above values are presented to provide some examples of the types of increases in unobstructed channel width that may be possible

The SEDVEG Gen-3 (open view) analysis also predicts increases in unobstructed channel width in four reaches of the central Platte River. Estimated minimum increases in the four reaches range from 9.0 to 14.0 percent, and estimated maximum increases range from 27.0 to 60.0 percent depending on alternative. The largest predicted increase in open view would occur between Gibbon and Wood River (Reach 3) in all alternatives except Water Emphasis where the largest increase would occur between Jeffreys Island and Elm Creek (Reach 1). The smallest increases in open view for all alternatives are predicted between Wood River and Chapman (Reach 4). This reach currently contains some of the widest channel widths. In terms of current crane roost use, Reaches 4 and 2 receive the highest percentage use, and Reach 1 receives the lowest use.

Roosting Suitability at the System Scale—North Platte River Hydrology

Roosting suitability at the system scale was evaluated via discharge data from various stream gauges located on the North Platte River. Alternative data were compared to Present Conditions on an annual and seasonal basis (February-April and May-July). Spring flows directly affect conditions for roosting cranes, and early to mid summer (May 15-July 15) flows can affect the success of cottonwood establishment on exposed substrates. Occupation of channel sites by woody vegetation such as cottonwoods during periods of low flow has been linked to channel narrowing.

A reduction in the frequency of spills from Kingsley Dam, reduced average annual discharge passing North Platte, and reduced flows in June and July, indicate the possibility of additional establishment of woody vegetation within the Sutherland to North Platte reach of the North Platte River. Woody vegetation establishment would likely result in channel narrowing and perhaps deeper flows during the spring migration period, and an assumed reduction in roosting habitat suitability. Established survey sites exist in this reach but have not been re-surveyed since the early 1980's. Current survey information is needed for this reach. Both the Lewellen to Clear Creek WMA and this reach should be candidates for research and monitoring studies under the Adaptive Resource Management Process. Data are needed to assess whether management actions (changes in discharge) designed to benefit target species downstream may affect sandhill crane roosting habitat in the Lewellen to Clear Creek WMA and/or the Sutherland to North Platte reaches of the North Platte River.

Food Suitability at the Bridge Segment Scale—Food Abundance

A GIS analysis of food resources indicates that acres of corn and lowland grasses increased between 1982 and 1998 along the Platte River, while acres of upland grasses, alfalfa, and other crops were reduced. However, the increase in total acres of lowland grassland may reflect conversions of marginally productive farmland to the Conservation Reserve Program (CRP). CRP plantings generally consist of tall-grass prairie species that provide robust cover unsuitable for crane foraging. In addition, increases in acres of corn may not equate into an increase in food for cranes. For example, harvesting efficiency has increased, numbers of waterfowl using the

Central Platte Valley have increased, cranes are foraging further from the Platte River, and fat storage in larger sandhill cranes and white-fronted geese has been reduced when compared to earlier studies.

Acres of corn would be reduced somewhat on some managed sites. Acres of corn and invertebrate food would be unchanged by the action alternatives at non-managed sites. Acres of corn potentially restored to lowland grasses would be at most (Wet Meadow Alternative) less than 2.0 percent of the 1998 corn acreage within the Lexington to Chapman (3.5 miles on each side of the river channel) study area. Additional acres of irrigated corn would be lost under the action alternatives through water leasing agreements. Because of the uncertainties that surround waste corn abundance and availability for sandhill cranes, any reduction in waste corn abundance as measured by acres of corn, should be avoided.

As discussed above, median March flows at Overton, Odessa, and Grand Island —for all action alternatives—would be numerically higher than Present Condition flows. A similar situation would exist for February flows. Higher flows in February and March may make soil invertebrates more accessible to sandhill cranes.

CONCLUSIONS

Sandhill cranes are not the focus of proposed actions under evaluation within the Platte River Programmatic EIS process. The results of implementing any of the proposed four action alternatives on sandhill crane habitat would be mixed. Sandhill cranes using the Platte River would likely benefit from an increase in roosting depth abundance and unobstructed channel width at managed sites. However, when data from individual transects are inspected, it appears that while roosting depth at managed sites increases, many non-managed sites experience a reduction in roosting depth abundance. Reductions in habitat at non-managed sites may result in cranes becoming more concentrated at managed sites.

Some action alternatives would convert cropland (e.g., corn ground) to grassland along the Platte River. The abundance of waste corn as food for sandhill cranes and other wildfowl is becoming an issue of concern. The U.S. Geological Survey is currently attempting to replicate components of the Service's 1981 study (Krapu 2003). However, until these data are available, conclusions on the abundance of waste corn and its ability to provide adequate food for all ecosystem components can not be made. As discussed previously, harvesting efficiency has increased since the 1981 study, numbers of waterfowl using the Central Platte Valley have increased, cranes are foraging further from the Platte River, and fat storage in larger sandhill cranes and white-fronted geese has been reduced. The abundance and adequacy of waste corn to provide food for sandhill cranes and other wildfowl should be the focus of continuing studies.

Finally, February and March flows at Platte river sites would increase under all alternatives and should benefit sandhill cranes in their foraging for soil invertebrates in wet meadows. However, increased flows may reduce roosting depth abundance in non-managed sites (see above).

For the North Platte River, roosting suitability at the upper end of Lake McConaughy would be generally similar to Present Conditions for spring and summer flows under each proposed action alternative. Some reduction in monthly volume passing Lewellen may occur in July under each of the proposed alternatives, but these differences are not statistically significant. There would be an increase in median annual flow at Lewellen under each proposed action alternative, but again, theses increases are not statistically significant. Crane roosting habitat above Lake McConaughy in and west of the Clear Creek Wildlife Management Area would likely be least affected by the proposed action alternatives.

Spills from Kingsley Dam would be reduced for all action alternatives. Reductions in spill magnitude would be significant for the Governance Committee, Wet Meadow, and Water Emphasis Alternatives. The frequency of spills would be reduced, and the size of the largest spills would be reduced except under the Water Leasing Alternative.

The Sutherland to North Platte reach of the North Platte River would likely experience changes under the action alternatives. Spring and early summer flows (February-May) would be similar to Present Conditions, with June and July flows somewhat reduced. Median annual flows would also be reduced under the Governance Committee and Water Leasing Alternatives, remain similar to Present Conditions under the Wet Meadow Alternative, and increase somewhat under the Water Emphasis Alternative.

Reduced June and July flows, reduced average annual discharge passing North Platte, and a reduction in the frequency and magnitude of spills from Kingsly Dam, indicate the possibility of further establishment of woody vegetation. Woody vegetation establishment would result in channel narrowing and perhaps deeper flow during the spring roosting period. These factors are consequences of management actions under the proposed action alternatives and may result in reductions of roosting suitability within this reach. Reduced spills from Lake McConaughy may exacerbate the channel narrowing processes within this reach

In summary, sandhill cranes using the Lexington to Chapman reach of the Platte River may benefit from some management activities (increased roosting depth abundance at some sites, increased unobstructed channel width, and increased lowland grassland) performed at specific sites for target species. However, there are indications that roosting depth abundance may be reduced at sites represented as non-managed transects. Those transects that currently support most night roosting below Kearney (bridge segments 7-2) indicate that roosting depth abundance may increase under all action alternatives. The validity of these projections, and their implications to sandhill cranes, should be a priority for research and monitoring studies under the Adaptive Resource Management process.

Changes in flow regime within the Sutherland to North Platte reach may be problematic for sandhill cranes using these sites. Established survey sites exist within the Sutherland to North

Platte reach, but have not been surveyed since the early 1980s. Current survey information is needed for this reach. This reach should be a candidate for research and monitoring studies under the Adaptive Resource Management process.

SANDHILL CRANE SPRING HABITAT IN NEBRASKA, AND POTENTIAL EFFECTS TO RESOURCES FROM PROPOSED CHANGES IN RIVER CORRIDOR MANAGEMENT

(03-10-06)

INTRODUCTION

Technical appendix material has been previously developed for the Platte River Recovery Implementation Program—Final Programmatic Environmental Impact Statement (FPEIS) addressing sandhill cranes and associated habitat issues. That material (USDI 2004) contains valuable information describing sandhill cranes, the resources along the central Platte River that have been historically used by cranes, and projections of how resources and their use by cranes may change under various proposed action alternatives addressed in the Draft Environmental Impact Statement (DEIS) (USDI 2003). However, action alternatives have changed somewhat from those described and evaluated in the DEIS, and readers should review changes to alternatives in the FPEIS before reviewing this appendix. These changes have required modification to some parts of the original sandhill crane appendix (USDI 2004).

Modifications to the original sandhill crane appendix material occur in three main areas. The first area of modification deals with the alternatives themselves. There are now five alternatives—including Present Conditions—rather than the six evaluated in the DEIS. Next, the analysis has shifted emphasis somewhat. In the original sandhill crane appendix, much discussion and several graphic displays were devoted to establishing the relationships between discharge and roosting depth. That discussion relied heavily on historic Physical Habitat Simulation Model (PHABSIM) studies on the Platte River. Those discharge-roosting depth relationships remain valid, and are the basis of the analysis of roosting depth, but the background material for PHABSIM studies has been reduced in this appendix. Readers interested in PHABSIM, and its use in crane studies should review the original crane appendix (USDI 2004), and some recent work accomplished by the U.S. Geological Survey on whooping crane use of the Platte River (Farmer et al. 2005). SEDVEG Gen-3 analyses have expanded since the DEIS, and now are used to focus on potential future changes in resources that may affect sandhill cranes. The final modification to this appendix occurs in the area of additional information on resource use by cranes along the North Platte River, and additional information on the importance of food, i.e., corn and invertebrates.

This appendix follows the general format of the original by providing background information, identifying impact indicators, establishing indicator values for Present Conditions, and then presenting an assessment of proposed action alternative conditions compared to Present Conditions. Although some information presented in the original appendix is retained here, other information as discussed above is not, and both documents should provide information on the interactions between sandhill cranes and resources along the North Platte and Platte Rivers.

Background

The North Platte and Platte Rivers, and adjacent lands in central Nebraska, provide important resources to sandhill cranes migrating from southern wintering sites (in Arizona, New Mexico, Texas, and Mexico) to northern nesting grounds. Most (> 95 percent) of the midcontinent population, and about 80 percent of all sandhill cranes in North America, spend from 4 to 6 weeks each spring along portions of the North Platte and Platte Rivers. Although members of all three subspecies likely pass through central Nebraska, Canadian and lesser sandhill cranes are the more common subspecies, with greater sandhill cranes uncommon (Tacha et al. 1984). Four subpopulations—identified by their nesting destination—stop in central Nebraska: Alaska/Siberia, Northern Canada/Nunavut, west-central Canada/Alaska, and east-central Canada/Minnesota (Krapu 2003). More than 500,000 cranes make use of the North Platte and Platte Rivers, and adjacent uplands, each spring.

Much of the popular literature addressing cranes and their spring stop in Nebraska loosely refer to the "half-million" sandhill cranes using the "Central Platte". Readers should note that crane numbers are difficult to estimate primarily because of the logistics involved and the staggered pattern of use. Although any particular crane may spend 3-4 weeks in Nebraska, the use period can extend from about mid-February to early April. Recent (2000-2003) use estimates for the Lexington to Grand Island reach range from 486,000 to 552,000 sandhill cranes (Kinzel et al. in press). Kinzel et al. (in press) used sophisticated thermal photography to obtain their estimates, while earlier studies have relied in various approaches to aerial and/or ground surveys. Such estimates within the same time frame at the same location often vary. For example in discussions below, crane-use estimates for the North Platte River in 1979 range from 100,000 (Krapu et al. 1984) to 131,000 (Iverson et al. 1987).

It appears that there may be roughly 500,000 sandhill cranes—on average—currently using the Platte River, and another 100,000 to 150,000 cranes—on average—currently using the North Platte River. These numbers currently exceed management goals (Kinzel et al. in press). However, actual numbers of cranes—while important—are secondary in this assessment to estimates of use over time and changes in such trends as they relate to trends in resource abundance and/or availability. These topics are addressed later in this appendix.

This appendix attempts to use the most current information available for sandhill cranes using the North Platte and Platte Rivers. However, "current" may be somewhat misleading in that most of the definitive studies on sandhill cranes and use of the North Platte and Platte Rivers were originally conducted between the late 1970s to late 1980s. Scientists (e.g., G. Krapu and others) from the U.S. Geological Survey research facilities in Jamestown, North Dakota, have recently revisited some sandhill crane resource issues along the central Platte River, and some of these findings are available for discussion in this appendix. However, no follow-up studies have been conducted for sandhill cranes and resource issues along the North Platte. This appendix provides background information, identifies assumptions and methods, and presents results from various analyses of sandhill crane spring resource use along the North Platte and Platte Rivers and adjacent lands. The material is provided in support of various analyses of sandhill crane habitat either conducted for, or associated with, the FPEIS.

Study Area

Although the central Platte River between Lexington and Chapman supports the majority of spring use by sandhill cranes, two other stream reaches also support cranes and are addressed in this assessment. The first of these areas is located along the North Platte River at the upper end of Lake McConaughy from the Clear Creek Wildlife Management Area (WMA) west approximately 2 miles. About 5,000 to 8,000 cranes use the river for roosting and adjacent grasslands and irrigated corn fields for feeding. The second area is also located on the North Platte River and historically occurred between Sutherland and North Platte, Nebraska, although most use now occurs between Hershey and North Platte. About 150,000 (131,000 to 165,000) cranes used the river—and some adjacent wetlands—for roosting, and fed in adjacent grasslands and grain fields in 1979-1980 (Iverson et al. 1987).

Some limited crane use does occur outside these primary areas, for example in portions of the Rain Water Basin south of the central Platte River. However, this appendix focuses on sandhill crane habitat resources and spring use along the North Platte and Platte Rivers. The Platte River between Overton and just east of Grand Island has received attention and study because of numerous whooping crane observations within the area (see U.S. Fish and Wildlife Service 1981, and U.S. Geological Survey 2005, for examples). The Clear Creek WMA site and the Sutherland to North Platte reach of the North Platte River have received less attention and study.

Importance of Migration Stopover Sites

Migration stop-over sites can be placed into three categories based on distance traveled, length of stay, and function (Melvin and Temple 1981). *Staging areas* are sites where cranes gather during the first segment (within the first 20 percent of the route) of their fall migration to physiologically ready themselves for the next stage of migration. Use of these sites may be traditional, but can vary depending on habitat variables. *Traditional stopover areas* occur further along the migration route (25 to 75 percent of the distance) and are used for extended periods during spring and fall migrations every year. Melvin and Temple (1981) believed such sites are actively sought by individual cranes each year, and at least in the spring, may be used to accumulate lipid reserves (Krapu et al. 1985, Tacha et al. 1987). *Nontraditional stopover sites* provide overnight (or a few days) resources, and are used opportunistically. Although the Central Platte Valley (the lower North Platte River, the central Platte River, and adjacent lands) is commonly referred to as a "staging area," it is traditionally used each year for the purpose of physiologically preparing sandhill cranes for the nesting season.

Sandhill cranes often arrive on their nesting grounds in early spring while snow still covers most of the ground surface (Krapu et al. 1985, Tacha et al. 1987, Krapu 2003). Nesting and egg laying are generally initiated before adequate local food resources become available. Lipid reserves necessary for these activities are in part acquired along the North Platte and Platte Rivers in central Nebraska (Krapu et al. 1985, Tacha et al. 1987). Krapu et al. (1985) found that cranes used about 46 percent of their lipid reserves during migration between the northern Great Plains and the Yukon-Kuskokwim (YK) Delta in western Alaska. Cranes were still carrying about one pound of fat—equivalent to what was stored along the Platte River in spring—upon arrival at the YK Delta. Krapu (2003:5) believes that "…the fact that cranes breeding in the arctic were able to draw on a large fat reserve acquired at the Platte to meet reproductive needs likely has been a key factor responsible not only for the strong tradition for staging at the Platte in spring but also the health of the MCP (mid-continent population)".

Sandhill cranes use resources along the North Platte and Platte Rivers to physiologically prepare themselves for continuing their migration and participating in the subsequent nesting season. Cranes build lipid reserves and obtain important proteins by feeding in harvested corn fields and lowland grasslands and alfalfa fields near river-channel roost sites (Krapu et al. 1985, Reinecke and Krapu 1986, Tacha et al. 1987). Harvested cropland and lowland grasslands also provide secure sites for courtship, pair-bond formation and maintenance.

The importance of these sites to cranes is likely related to several factors including the Platte River's strategic location within the Central Flyway, the river's wide braided channels that provide secure roost sites, and abundant food (Krapu 2003). However, Krapu (2003) believed that the ultimate factors that determined annual traditional use of the central Platte River by sandhill cranes were increased survival and reproductive success. Importance is exemplified by the findings that some cranes—tracked by satellite telemetry—traveled up to 1,000 miles out of their flight-line path to nesting grounds to spend time along the North Platte and Platte Rivers.

Sandhill crane use of the Central Platte Valley in the fall has not received the study generated by spring use. There appears to be no tradition associated with fall use, in contrast to spring use by sandhill cranes. Cranes appear to use the Central Platte Valley in fall as a nontraditional stopover site, i.e., opportunistically if inclement weather is encountered, or some other factor dictates an overnight or short multi-day stop.

Historic Resource Conditions and Use

In order to understand existing habitat resources and their use by migrating cranes, it is necessary to understand the historic distribution and abundance of resources, and their use by sandhill cranes. The lower North Platte River, central Platte River, and adjacent lands have historically provided resources for migrating sandhill cranes. Cranes used the Central Platte Valley from Sutherland to Grand Island, Nebraska (Krapu 1999). Although data are limited, there is documentation of extensive crane use in river reaches no longer used, such as the area between the confluence of the North and South Platte Rivers (near North Platte, Nebraska), downstream to Overton, Nebraska (Walkinshaw 1956, Krapu 1999).

It is informative to review historic changes in river channel parameters that currently function to provide resources used by migrating cranes. Historically—before major water development began in the late 1800's—high spring flows restructured the active channels of the North Platte and Platte Rivers and helped maintain a wide and sediment rich system (Simons & Associates, Inc. 2000). Estimated channel widths at selected sites on the Platte River in 1865 were: 3,746 feet at Cozad, 4,795 feet at Overton, 4,988 feet at Odessa, and 2,707 feet at Grand Island (Peak et al. 1985). Sediment was primarily provided to the Platte River by the North Platte River (estimated at 896,000 tons annually at North Platte) during the pre-development period (1895-1909) with a smaller contribution from the South Platte River (estimated at 212,000 tons annually at North Platte) (Randle and Samad 2003). Approximately 1,040,000 tons of sediment passed Grand Island annually. Sediment transport estimates (1895-1909) by Kircher (1983) and Simons & Associates, Inc. (2000) are somewhat higher than those presented above (see Randle and Samad 2003).

Riparian vegetation was a component of the pre-development river system (see review by Simons & Associates, Inc. 2000). The extent and abundance of riparian vegetation associated with the pre-development Platte River have been, and remain, the topics of much discussion (see Currier et al. 1985 and Johnson 1998 for differing views on the historic abundance of woody vegetation). Differing opinions may originate in the use of different data sets from different periods such as photographic comparisons (Williams 1978) and General Land Office surveys and notes (Johnson and Boettcher 1999). General Land Office data and historical accounts (reviewed by Eschner et al. 1983) indicate that the pre-development Platte River supported cottonwood, willow, and other trees and shrubs on islands of all sizes within the channel, and a band of riparian vegetation along both banks (Simons & Associates, Inc. 2000).

Based on our current understanding of rivers and the processes at work (see Standford et al. 1996, Poff et al. 1997, and Friedman et al. 1998 for process overview), we can assume that the pre-development North Platte and Platte Rivers were dynamic systems supporting diverse and abundant habitat resources. Cranes likely roosted in the broad active channels and fed on plants and animals in adjacent wetlands such as wet meadows (flood-plain grasslands hydrologically linked to river flows), and suitable prairie sites. Dynamic systems are often characterized by patchy resources. Local and/or regional weather cycles of abundant moisture followed by drought conditions would have favored diverse resource conditions. Some sites may have supported abundant food and suitable roosting conditions during some years, while other sites supported more favorable conditions at other times. Crane use was likely opportunistic and dispersed in order to efficiently exploit resources separated in space and time.

SANDHILL CRANE HABITAT RESOURCES

Habitat resources, and crane use of these resources, in the Central Platte Valley of today have changed from historic conditions. The most obvious change is channel narrowing resulting from occupation of much of the historic active channel by woody vegetation. Channel narrowing is a basin-wide characteristic occurring on the North, South, and Platte Rivers (reviewed by Simons & Associates, Inc. 2000). In general, sites from above Lake McConaughy on the North Platte River, to Chapman on the Platte River, have lost from 72 to 90 percent of their channel width when compared to estimates from the late 1800's (Simons and Simons 1994). Estimated channel widths at selected sites on the Platte River in 1983 (and the reduction in width when compared to 1865 data) were: 476 feet (-87 percent) at Cozad, 1,050 feet (-78 percent) at Overton, 893 feet (-82 percent) at Odessa, and 1,339 feet (-51 percent) at Grand Island (Peak et al. 1985).

Reductions in channel widths are linked to changes in annual discharge, sediment transport, bridge building, and other factors. Mean annual discharge measured at Overton declined from about 2.8 million acre feet (maf) before 1930, to 1.4 maf after 1970, and average peak discharge was reduced from 16,325 cubic feet /second (cfs) to 7,878 cfs (Simons & Associates, Inc. 2000). The sediment supply has also changed. Randle and Samad (2003) have estimated current (1970-1999) sediment transport at North Platte, Nebraska, of 71,900 tons/year from the North Platte River, and 245,000 tons/year from the South Platte River. Approximately 374,000 tons annually pass Grand Island, Nebraska. Finally, there are 20 bridge crossings, each affecting about 1 mile of channel, on the Platte River between North Platte and Chapman, Nebraska (Simons & Associates, Inc. 2000).

It is generally believed that changes in flow—primarily reduced annual discharge and lower peak flows—have substantially contributed to conditions that have permitted vegetation to become established within much of the historic active channel. Most channel narrowing occurred between 1930 and 1970 (reviewed by Simons & Associates, Inc. 2000), when major upstream reservoirs were constructed and filled, and two major regional droughts occurred (1930's and 1950's). Simons & Associates, Inc. (2000) argue that low flows exposed much of the active channel during this period and that the exposed substrate provided a seed bed for riparian vegetation. With reduced annual and peak flows, the river could not maintain historic channel widths.
Channel narrowing is believed to have stabilized since the late 1960's. However, the channel between Alda and Chapman, Nebraska, has experienced recent additional width reductions, possibly associated with vegetation management activities within this reach (Johnson 1996 in Simons & Associates, Inc. 2000).

The River Geomorphology section of the FPEIS provides a detailed discussion—based on new analyses—of the processes affecting the river channel and ultimately sandhill crane roosting habitat. Basically, that analysis characterizes the Platte River from the Johnson Power Plant #2 return to Chapman into four reaches based on process. These reaches include:

- Reach 1—Jeffreys Island (River Mile-RM 247) to Elm Creek (RM 231)
- Reach 2—Elm Creek to Gibbon (RM 202)
- Reach 3—Gibbon to Wood River (RM 187)
- Reach 4—Wood River to Chapman (RM 154)

Further analysis—based on location, plan form, and dominant process—identify 12 reaches within the central Platte River. Two areas of instability are identified in the FPEIS; a degrading section between river mile (RM) 247 (Jeffreys Island) and RM 230 (Elm Creek), and an aggrading section between RM 204 (about 3 miles upstream of Gibbon) and RM 189 (near Wood River). The reader is referred to Chapters 4 and 5—River Geomorphology of the FPEIS for more detailed information on historic and current changes in the river channel.

Resource Use by Sandhill Cranes

Krapu et al. (1984) compared three major crane-use areas in the late 1970s on the North Platte and Platte Rivers. These areas included "Area 1" on the Platte River between about Kearney and Grand Island, "Area 2" on the Platte River between about Lexington and Kearney, and "Area 3" on the North Platte River between Sutherland and North Platte. Gross comparisons among the three areas are provided in Table SC-1 below, with more detailed discussions of crane use on the North Platte and Platte Rivers addressed below. As discussed below, major use areas basically reflect sandhill crane adjustments to changes in the river channel based on the changing suitability of roost sites.

Table SC-1. Comparison of land features and crane estimates for three spring-use areas along the North Platte and Platte Rivers in Nebraska. Data modified from Krapu et al. (1984).

Land Features and Crane Estimates	Area 3 (Sutherland to North Platte)	Area 2 (Lexington to Kearney)	Area 1 (Kearney to Grand Island)
Approximate Area (acres)	45,465	63,500	142,825
Surface Cover (percent)			
Cropland	28	38	53
Grassland	40	20	23
Hay	11	19	7
Present Channel	2	3	3
Historic Channel (woody vegetation)	13	13	9
Other	6	8	5
Estimated Crane Use in 1979	100,000	50,000	350,000

North Platte River Resource Use

Cranes generally begin arriving along the North Platte in early March and depart during the first or second week of April (Iverson et al. 1987). Iverson et al.(1987) found that crane numbers peaked March 15-20, with the average stay of radio-tagged birds involving 25-30 (range = 15-40) days.

Much of our understanding of resource use by sandhill cranes along the North Platte River originates in studies from the late 1970s and early 1980s. No more recent studies of sandhill crane spring use of resources along the North Platte River were located. The historic importance of the North Platte River is exemplified by the designation by the U.S. Fish and Wildlife Service (Service) in 1987 of the reach between Sutherland and North Platte as Resource Category 1 for sandhill cranes (U.S. Department of the Interior 1987). Resource Category 1 areas are believed to be of unique and irreplaceable value, with a management goal of no habitat loss. As mentioned earlier, sandill cranes currently use a site at the upper end of Lake McConaughy and the another between Sutherland and North Platte. The majority of use occurs at the latter site, in an area bounded on the south by the South Platte River and on the north by sandhills upland just north of the North Platte River (Iverson et al. 1987). Most crane use in this reach has shifted east in recent years and now occurs between Hershey and North Platte. Folk and Tacha (1991) documented what they believed to be substantial reductions in sandhill crane use of the North Platte River Valley between 1980 and 1989. These researchers believed reductions in use were highly associated with declining habitat quality.

Platte River Resource Use

Historically (before water development began in the late 1800s), cranes have used the Central Platte Valley from Sutherland to Grand Island, Nebraska (Krapu, 1999). Sandhill cranes no longer use the North Platte and Platte Rivers between North Platte and Lexington, Nebraska. In the areas still occupied on the Platte River, crane use has shifted eastward during the past 45 years. Approximately 60 percent of crane use occurred between Lexington and Kearney in 1957, with about 9 percent of the use between Kearney and Chapman (Faanes and LeValley, 1993). By 1989, 5 percent of cranes occupied the Lexington to Kearney reach, and 81 percent of cranes used the Kearney to Chapman reach (see Table SC-2 for recent estimates of use).

Krapu et al. (1984) radio tagged 20 sandhill cranes and tracked their use of resources between Kearney and Shelton in 1978 and 1979. Some 97 percent of all diurnal locations of radio-tagged cranes occurred in three vegetation classes: cropland, native grassland, and hay fields. In 1978, cranes used cornfields exclusively, and in 1979, 99 percent of cropland locations occurred in cornfields. In both years, 28 percent of diurnal sandhill crane locations occurred in native grasslands, while 27 percent (1978) and 9 percent (1979) of locations occurred in hay fields.

Table SC-2. Sandhill cranes daylight and roosting use estimates by bridge segments for the Lexington to Chapman study area, averages of 2000-2003 data.

Bridge Segment (River Reach)	Segment Number	Diurnal Distribution	Roosting Distribution	
		Percent Cranes[1]	Percent Cranes[1]	Percent Roosting Area[2]

Lexington-Overton	12	1.6	0.0	1.2
Overton-Elm Creek	11	2.9	0.1	0.8
Elm Creek-Odessa	10	6.7	0.7	5.4
Odessa-Kearney	9	6.0	1.6	2.2
Kearney-Highway 10	8	7.9	6.0	6.0
Highway 10-Gibbon	7	12.9	22.5	22.5
Gibbon-Shelton	6	17.7	3.9	9.3
Shelton-Wood River	5	12.3	19.0	15.0
Wood River-Alda	4	9.6	15.4	13.9
Alda-Highway 281	3	14.8	18.0	12.9
Highway 281-US 34	2	5.9	11.8	10.9
US 34-Chapman	1	2.2	1.1	

[1]Whooping Crane Habitat Maintenance Trust estimates at www.whoopingcrane.org.

[2]Frinzel *et al*. (*in press*) estimates.

Sandhill cranes are active during day-light hours and spend the night roosting in secure wetland sites such as river channels and palustrine wetlands including wet meadows. Wet meadows are wetlands characterized by standing sheet water or saturated soils during some portion of the year, occurring on sites hydrologically linked to river flows, and generally supporting native grasses or remnant native grasses mixed with tame grasses. While cranes commonly use palustrine wetlands for roosting along the North Platte River (Iverson et al. 1897, Folk and Tacha 1990), such use along the Platte River is generally restricted to periods when the river channel is iced over (Krapu et al. (1984), or when flows are too high for channel roosting (Davis 2003). In the river channel, cranes roost standing on submerged sediment deposits (i.e., sandbars).

Habitat Components

Spring migration habitat traditionally used by sandhill cranes in the Central Platte Valley consists of three main components: (1) secure roost sites within the active river channel, (2) feeding sites where cranes obtain waste grain (primarily corn from harvested fields), and (3) feeding sites where cranes obtain invertebrate food (from wet meadows, alfalfa fields, grazed pastures, and hay fields) (Armbruster and Farmer 1981). Cranes generally roost in the channel, standing in shallow water, away from wooded banks and islands. They leave their roost sites at first light and move to nearby feeding sites. Mid-day activities include loafing, sleeping, and courtship. The afternoon feeding period ends at dusk when cranes move to roost sites for the night.

Roost Site Characteristics

Cranes use two types of roost sites associated with the North Platte River between Sutherland and

North Platte: river channel and a variety of palustrine wetland types. Wetlands used for roosting ranged from sheet water collecting in cropland and pasture, to wet meadows, to semi-permanent wetlands with emergent aquatic vegetation (Iverson et al. 1987). Iverson et al. (1987) defined wet meadow as an area with standing sheet water or saturated soils located within one-half mile of the North Platte River in a grassland (pasture) cover type. Cranes roosted in five principal areas within the river channel, and in 14 wetlands within 2.5 miles of the North Platte River (Iverson et al. 1987). Wetlands ranged in size from one-half acre to almost 25 acres. Numbers of cranes using each wetland averaged 5,500, with a maximum count of 67,500 cranes using eight wetlands in 1980.

Semi-permanent wetlands down to about 39 feet in width were used for roosting, but wetlands at least 75 feet wide were preferred (Folk and Tacha 1990). Within wetlands, cranes roosted in water from 2 to almost 10 inches in depth with no observed preference within the range. North Platte River channel width between Sutherland and North Platte ranged up to about 590 feet, but most channel widths were less than 330 feet (Folk and Tacha 1990). Cranes used channels down to 52 feet in width for roosting (18 percent of observations between 52 and 154 feet), but preferred channels wider than 158 feet for roosting (82 percent of observations). Within channels, cranes roosted in water up to 14 inches deep (14 percent of observations between 8.4 and 14.2 inches), but preferred depths ≤ 8.4 inches (86 percent of the observations). Radio-tagged cranes left river roosts an average of 8 minutes after sunrise, while cranes roosting in wetlands departed an average of 117 minutes after sunrise. Cranes returned to river roosts an average of 6.5 minutes after sunset, while cranes using wetlands as roosts arrived on average 17.5 minutes after sunset. Individual cranes used both types of roost sites (67 percent river channel and 33 percent wetland), and changed night roost locations an average of 5.9 (range 1-16) times each spring (Iverson et al. 1987).

The Platte River between Lexington and Chapman has a generally flat bed and vertical banks. The river at low flows is a mosaic of individual braided channels carrying water, the exposed bed and low elevation sediment deposits of different size and height, and higher elevation sediment deposits (islands) supporting herbaceous vegetation (cleared islands) and shrubs and trees (non-managed islands). As flows increase, individual channels carrying water increase in depth and width, and merge with others as low elevation sediment deposits become submerged. Submerged sediment deposits—at suitable depths—are used for roosting by sandhill cranes. Optimum water depth for roosting ranges from 4 to 8 inches, with depths greater than 14 inches unsuitable for sandhill cranes (Armbruster and Farmer 1981). Depth of submerged sediment deposits varies with discharge, and different stream flows provide different amounts (area) of channel roosting habitat.

Sandhill crane roost requirements in the Platte River have been variously defined and debated. A concept common to most discussions involves “unobstructed view,” which is generally translated into a measurable unit referred to as “unobstructed channel width” (Armbruster and Farmer 1981, Currier and Ziewitz 1987). *Unobstructed channel width* is an active channel measure—the bank-to-bank distance perpendicular to stream flow— that is devoid of obstructions that would interfere with roosting cranes' line of sight [generally estimated at 1 meter (39.4 inches) above the substrate]. It is assumed that cranes select roost sites that provide some measure (via an unobstructed channel width) of security from terrestrial predators. Security is generally believed associated with some minimum distance (i.e., width) from woody (concealing) cover (e.g., vegetated banks and islands), and wider channel reaches. The distance from defined roosts to woody vegetation varies, but sandhill cranes appear to use channel sites more frequently on the Platte River that exhibit greater unobstructed channel widths than sites with smaller width values. Krapu et al. (1984) found that 70 percent of roosting cranes were located at sites where the channel was greater than 150 meters (about 492 feet), and generally avoided channels less than 50 meters (164 feet) in width. However, Latka and Yahnke (1986) noted some cranes within 15 meters (49 feet) from banks.

Feeding and Feeding Site Characteristics

The accumulation of lipid reserves requires an abundant food source that can be efficiently utilized. Several stopover sites have received study and the principle food for migrating cranes has been determined from sites in west Texas, Nebraska, Saskatchewan, and Delta Junction, Alaska. Crane food resources differ at each site with milo (grain sorghum) important in Texas (97 percent of the diet), corn in Nebraska (98 percent), wheat in Saskatchewan (99 percent), and barley at Delta Junction, Alaska (99 percent) (Tacha et al. 1987). The value of stopover sites in Nebraska is enhanced by abundant waste corn. Corn has the highest metabolizable energy value of the above four grains which means less grain (by weight) is needed to provide cranes with their daily nutritional needs (Tacha et al. 1987).

Sandhill cranes obtain food from two sources in the Central Platte Valley—96 percent of the daily composite diet was obtained from cornfields, and the remaining 4 percent from grasslands and alfalfa fields (U.S. Fish and Wildlife Service 1981). Researchers believe that the invertebrate component of the diet (3 percent reported by Reinecke and Krapu 1986), increases the protein intake of cranes by 10-20 percent and calcium intake by more than 500 percent. Cranes obtain invertebrates from wet meadows, alfalfa fields, and grasslands (pastures and hayfields).
Studies of sandhill crane spring use of the North Platte and Platte Rivers have concentrated—as this analysis does—on the roost site as the focal point of crane home ranges (for example see Sparling and Krapu 1994). However, food—or more precisely—nutrient storage is believed to be the reason sandhill cranes traditionally use the Platte River Valley (Reinecke and Krapu 1986, Krapu 2003). The importance of the North and Platte Rivers to sandhill cranes for feeding and storing nutrients is exemplified by the fact that some cranes fly up to 1,000 miles out of their flight path to breeding grounds in order to spend 4-6 weeks here each spring (Krapu 2003). Indeed, Krapu (2003:9) believes… "A thorough examination of the role of the CPRV (Central Platte River Valley) in the life cycle of the MCP (mid-continent population) of sandhill cranes indicates the MCP exhibits a remarkable level of fidelity to this site apparently because survival and reproductive success are enhanced as a result of the extended stopover".

Table SC-3 identifies cover types potentially providing food for sandhill cranes, their percent

availability, and crane use for the North Platte River, and the Platte River during two time periods.
Note that Iverson et al. included all grasslands (brome grass, fescue, and native grass) within a "pasture" category. Davis (2003) included all grasslands as "lowland grassland".

Waste Corn. Perhaps the second most important habitat change affecting sandhill cranes (the first being channel narrowing) can be associated with the advent of the mechanical corn picker in the early 1940's (Krapu et al. 1985). Corn has likely been a common crop in the Central Platte Valley since the first irrigation attempts in the 1800's. However, hand-harvested corn was basically waste free and thus provided no waste grain food resources for spring migrating cranes. The first mechanical corn pickers were, however, somewhat inefficient and left a portion of the crop in the field as waste grain. The availability of an abundant and highly nutritious food (waste corn) permitted cranes to respond to narrowing channels by concentrating roosting activity into remaining vegetation-free areas. Thus it appears that abundant waste corn has facilitated the shift in use patterns to the eastern Central Platte Valley.

The abundance, availability, and use of waste corn near the central Platte River was evaluated in the late 1970's. At that time, corn yields averaged 101 bushels/acre, with a 6 to 7 percent loss at harvest (U.S. Fish and Wildlife Service1981). Depending upon weather conditions, between 0 and 25 percent of the fields were fall tilled, leaving the remaining cornfields as stubble with waste grain. Foraging by livestock removed about half the waste corn before cranes arrived in the spring. Cranes removed between 0.2 to 0.3 pounds of corn per bird/day, and an estimated crane population of 350,000 to 450,000 birds removed between 1,130 and 1,450 tons of waste corn during their spring stopover in the central Platte River (U.S. Fish and Wildlife Service1981).

Waste corn accounted for about 97 percent of sandhill cranes diets during the late 1970s (Reinecke and Krapu 1986), and recent studies indicate that waste corn continues to provide significant food resources for cranes using the Platte River Valley (Krapu 2003). Waste corn permits cranes to acquire and store large nutrient reserves as fat for subsequent use during migration and reproduction on the breeding grounds.

There are indications that the relationships between food abundance and cranes' ability to efficiently store nutrients as fat may be changing. For example, in the late 1970's, radio-tagged
Table SC-3. Land cover types, percent availability, and percent use by sandhill cranes along the North Platte River (1979-1980), and the Central Platte River during two time periods.

	North Platte River (1979-1980)[1]		Central Platte River (1978-1979)[2]		Central Platte River (1998-2001)[3]	
Cover types	Available	Use	Available	Use	Available	Use
Corn stubble	27.1	45.6	54.1	52.8	60.4	49.7

Soybeans					5.0	3.6
Winter wheat					0.4	0.4
Alfalfa	8.8	20.2	6.5	15.8	4.7	10.6
Hay fields			10.7	18.0		
Pasture	43.7	27.1				
Native grassland			17.3	28.1		
Lowland grassland					26.5	32.0
Upland grassland					1.5	2.8
Shrubland					1.3	0.5
Wetland	1.3	7.1				
Other			6.4	0.6	0.2	0.4

[1] Iverson et al. (1987). Percent use is presented here as an average of the original 1979 and 1980 data.

[2] Krapu et al. (1984). Percent use is presented here as an average of the original 1978 and 1979 data.
[3] Davis (2003). Percent use is presented here as an average of the original 1998 and 2001data.

cranes moved an average 1.7 miles from their roost sites to feeding areas, and exhibited a total daily movement of about 6 miles (U.S. Fish and Wildlife Service 1981). More recently, VerCauteren (1998) observed cranes using corn fields 5 miles north and 8 miles south of the river, while Krapu and Brandt (U.S. Geological Survey, Jamestown, ND, unpublished data) observed
cranes foraging up to12 miles south of the river in 1999 and 2000. In addition to an increase in movement patterns, larger cranes are now storing less fat then in the 1970's (Krapu *et al*. in press).

Results from *The Platte River Ecology Study* (Fish and Wildlife Service 1981) in the late 1970's indicated abundant waste corn available to meet the needs of wintering livestock, waterfowl, and spring-migrating sandhill cranes using the Central Platte study area. In the 25 plus years since that study, increased harvesting efficiencies and large increases in numbers of waterfowl using the area, indicate a reduction in waste corn and warrant further study of food availability for migrating sandhill cranes and other wildfowl. It is unclear whether there is currently enough waste corn to meet all needs, but it is likely that further reductions in waste corn abundance will occur. For example, Krapu et al. (2004) reported a loose kernel loss of about 88 pounds/acre (average of 1997-98 data), which is an above average (about 78 pounds/acre) loss according to the *Corn Production Handbook* (available from the Agricultural Experiment Station and Cooperative Extension Service at Kansas State University). The Handbook indicates that an experienced operator ("expert") using a well adjusted machine in a field with at least 90 percent of the stalks standing and a moisture content below 25 percent should be able to reduce the loose kernel loss to 28 pounds/acre.

The abundance and availability of waste corn is also influenced by post-harvest management practices and use by migrating waterfowl (Davis 2003). Davis (2003) reported high sandhill crane use of ungrazed and grazed stubble (64-88 percent) compared to use of tilled and shredded stubble (12-36 percent). This investigator believed that fall tillage—which buries waste grain—was increasing along the Platte River during his study (1998-2001). Table SC-4 compares corn stubble use by sandhill cranes based on post-harvest management for two time periods along the central Platte River.

Increases in foraging by expanding populations of Canada and lesser snow geese—that often arrive along the Platte River before migrating cranes—may further affect the abundance and availability of waste corn (Davis 2003). Another indicator of changing food abundance is provided by white-fronted geese—which stored abundant fat in the 1070's—but are now unable to store fat while feeding along the Platte River (Krapu *et al.* 1995).

Lowland Grassland and Alfalfa. The remaining 3 percent of diets from sandhill cranes using the Central Platte Valley in the 1970's consisted of soil invertebrates gleaned from lowland grasslands (wet meadows), alfalfa fields, and upland grasslands (Reinecke and Krapu 1986). Cranes appeared to prefer native grasslands and planted hayland over other sites that could potentially provide invertebrates (Sparling and Krapu 1994, Davis 2003).

The importance of invertebrates in the diet is exemplified by the fact that cranes spend as much time foraging for invertebrates as they do for waste corn (Krapu 2003). Invertebrates provide protein—including essential amino acids—and calcium that can not be acquired from a totally waste corn diet (Reinecke and Krapu 1986). Recent studies indicate that cranes store 1 to 1.5 grams of protein per day during their spring stop in Nebraska (Krapu 2003). Protein storage is likely important in subsequent egg production.

Table SC-4. Corn stubble use by sandhill cranes along the Central Platte River by post-harvest management activity.

	Central Platte River (1978-1979)[2]		Central Platte River (1998-2001)[3]	
Corn Stubble Post-Harvest Condition[1]	Available	Use	Available[4]	Use

Grazed	25.0	29.6	76.0	48.5
Ungrazed	6.7	3.4	76.0	27.5
Shredded			24.0	13.5
Tilled			24.0	10.5
Disced	12.3	9.4		
Cultivated	5.9	8.6		
Plowed	2.0	1.3		
Other	2.2	0.9		

[1] Corn is harvested in the fall or winter leaving stubble and waste corn. Some stubble may receive post-harvest treatment such as grazing or tillage.

[2] Krapu et al. (1984). Percent use is presented here as an average of the original 1978 and 1979 data.

[3] Davis (2003). Percent use is presented here as an average of the high and low values for the original 1998 and 2001data.

[4] Davis (2003) presented corn availability as stubble (grazed and ungrazed) and treated stubble (shedded and tilled), thus availability values in the Table are not as refined as earlier data.

Wet meadows are hydrologicaly linked to river channel flows (Wesche et al. 1994, Sanders et al. 2001, Henszey et al. in press). The importance of this hydrologic link in the maintenance and biological functioning of wet meadows is discussed in the section of this FPEIS addressing whooping cranes, and will not be repeated here. Wet meadows are important to sandhill cranes as the principle source of invertebrate food. High river surface elevations in spring are believed to facilitate the movement of soil invertebrates into surface layers where they become accessible to foraging sandhill cranes.

Crane use of grasslands and alfalfa fields is also influenced by management actions that affect the height of vegetation. As exemplified in Table SC-5, cranes generally avoid ungrazed, idle, or other types of robust (tall and dense) vegetation (Krapu et al 1984, Davis 2003).

Resource Complex

Habitat components discussed above can be evaluated individually, but such an approach fails to recognize the importance of spatial relationships among the components. Sandhill crane habitat should be viewed in terms of a complex of landscape features providing resources. The complex is best envisioned as an activity range—or definable areas that are not defended and change in size and location through time (Sparling and Krapu (1994). Activity ranges differ from home ranges in that the former are transient and only include roosting and feeding activities.

Table SC-5. Grassland and alfalfa use by sandhill cranes along the Central Platte River by management activity.

Grassland and Alfalfa Condition[1]	Central Platte River (1978-1979)[2]		Central Platte River (1998-2001)[3]	
	Available	Use	Available	Use

Native Grassland	17.3	28.1		
Grazed	14.2	26.3		
Mowed	1.1	1.3		
Idle	1.2	0.4		
Other	0.8	0.4		
Lowland Grassland			26.5	
Grazed				69.3
Hayed				21.5
Idle				6.3
Hay				
Mowed Alfalfa			4.7	10.6
Inter-seeded and Mowed Alfalfa				
Mowed Grass				
Grazed Grass	10.7	18.0		
Other	5.3	13.5		
	1.2	2.3		
	1.0	1.0		
	2.3	0.5		
	0.9	0.7		

[1] The two studies use to develop this Table used somewhat different classifications. Both native grassland and lowland grasslands may represent wet meadows, but are separated here to reduce uncertainty.

[2] Krapu et al. (1984). Percent use is presented here as an average of the original 1978 and 1979 data.

[3] Davis (2003). Percent use is presented here as an average of the original 1998 through 2001data.

Sparling and Krapu (1994) found significant differences between use of potential resources by sandhill cranes and resource availability along the Platte River between Kearney and Shelton. Twenty activity ranges consisted of an average 44.4 percent corn fields (stubble under various management regimes) (range 35.7-51.0), 19.7 percent native grassland (range 12.6-25.8), 9.6 percent hay fields (7.1-14.2), 17.9 percent riverine (7.6-29.2), and 8.5 percent other (3.4-20.3). Riverine sites, native grasslands, and hay fields were used more than expected.

The above 20 cranes used activity ranges that averaged 14 square miles (mi^2) (range 4.5 to 26 mi^2) in size (U.S. Fish and Wildlife Service 1981, Sparling and Krapu 1994). Cranes traveled a mean daily distance of 6 miles, and moved on average 1.7 miles from the roost site to the area where they spent the day. The average distance moved decreased as the spring stopover progressed. Suitable roost sites should be the focal point of habitat component evaluations (see Sparling and Krapu 1994). Researchers believe cranes exhibit a high degree of roost site fidelity (U.S. Fish and Wildlife Service 1981). The average river reach used by marked cranes was 7.3 miles long. Only 2 of 20 cranes moved out of the Kearney to Shelton reach─1 bird moved 11 miles and the other 14 miles.

Three principal upland cover types were available to cranes Along the North Platte river during the Iverson et al. (1987) study. Corn stubble occupied 25 percent of the study area, pasture occupied 44 percent, and alfalfa occupied 9 percent. Fall-tilled fields occupied less than 1 percent of available cover types. Crane use of cover types varied: corn stubble = 41 percent, alfalfa = 20 percent, and pasture = 28 percent (Iverson et al. 1987). Wetlands occupied 1.3 percent of the study area but received 7 percent of the use. Average daily home range (n = 17) was about 1,580 acres (2.47 square miles), with the maximum distance traveled from the North Platte River averaging 2.0 miles. Pasture use peaked just after sunrise and just before sunset as cranes moved from or to river channel roost sites. Corn stubble was used throughout the day with use peaking in mid afternoon. Use of wetlands and alfalfa was highest during mid-day.

Iverson et al. (1987) found that over 90 percent of the variation in sandhill crane distribution along the North Platte River could be explained by the composition and juxtaposition of habitat components. "Optimal habitat composition/section of land" was described as "…an interspersion of 35-70% Corn Stubble, 5-40% Pasture, ≥ 13% Alfalfa, and ≥ shallow wetland" (Iverson et Al. (1987):456). These researchers added that the above components should be within 2.5 miles of a major roost site and include wet meadow areas within ½ mile of the river.

The Platte River Whooping Crane Maintenance Trust, Inc. (Trust), a non-profit conservation organization based out of Wood River, Nebraska, incorporates the concept of resource complex into their management plan (Platte River Whooping Crane Maintenance Trust, Inc. 1998). One of the Trust's goals involves creation of resource complexes in each of the river segments (separated by bridge crossings) between Overton and Chapman. Each complex would consist of approximately two miles of cleared channel at least 1,000 feet wide (about 240 acres) and about 2,400 acres of adjacent grassland and wet meadow. Although not explicitly stated, it is assumed that cropland would be abundant nearby to provide the energetic needs of sandhill cranes.

These discussions have identified percent composition of resources that have sustained cranes in past studies. Using the above data, it would be a simple task to develop a basic habitat model that could be used to "rate" the value or suitability of existing sites, or the same site before and after theoretical management actions were applied. Such a tool would be valuable in this assessment. That approach has not been taken here because of the uncertainties resulting from potential changes in resource abundance since the late 1970s to mid-1980s, and perhaps beyond. For example, historic studies assumed corn stubble provided a non-limiting supply of waste corn for food. This assumption is questionable based on recent studies (for example, Krapu et al. 2004). In addition, original GIS studies assumed that if channels were wide enough then somewhere within that suitable width there existed optimum roosting depth. Recent data (Kinzel et al. in press) indicates that cranes use a small portion of the channel assumed suitable, but continue to shift distribution eastward. This indicates that perceptions of habitat suitability developed in the early 1980s (Armbruster and Farmer 1981) likely need additional review and evaluation.

Resource Factors Not Addressed

The effects of human disturbance should also be considered when addressing the concept of resource complex. Cranes avoid areas of high human use such as roads, bridges, and sand and gravel mining (sand/gravel pits) operations. For example, residential development—particularly those on former sand/gravel pits near the river—potentially increase human disturbances near roosting areas. Crane avoidance behavior basically reduces the amount of potential habitat that would otherwise be available for use.

Human disturbance and the avoidance response it presumably elicits from sandhill cranes are not treated in this analysis. Avoidance and the disturbance buffers or zones of influence around various features used to portray the response have been debated for some time (Table SC-6). At present, there is no consensus on the influence of human disturbances to potential crane habitat, or even how the concept of disturbance should be evaluated.   While developing material for this appendix, various disturbance buffers, similar to those described by Armbruster and Farmer (1981), were applied to potential roost sites via a GIS-based analysis. In several cases, sites well within described zones of influence from disturbance features—and therefore supposedly avoided by cranes—are known to be used by sandhill cranes. The issue of human disturbance and its role in habitat assessments for cranes clearly requires additional research. Until the issue of human disturbance can be adequately addressed, information presented in this appendix should be viewed as an over-simplification of how sandhill cranes respond to habitat resources.

Potential competition for food is another area that is not addressed in this appendix. The U.S. Fish and Wildlife Service conducted the “Platte River Ecology Study” in the late 1970’s to document the relationships between cranes, waterfowl, and other species, and the habitat resources provided by the central Platte River (U.S. Fish and Wildlife Service1981). The study evaluated both riverine habitat and food resources in grasslands and cropland. The quantity of waste corn remaining for cranes after fall tillage, winter foraging by livestock, and use by waterfowl was a particular interest of the study. For example, field-feeding waterfowl—primarily mallard and pintail ducks, and Canada, white-fronted, and snow geese—also utilize waste corn while over-wintering or during spring migration through the Central Platte Valley. In the late 1970’s, several thousand mallards and Canada geese wintered along the Platte River and in adjacent ice-free canals (U.S. Fish and Wildlife Service 1981). Highest concentrations of wintering waterfowl occurred between Lexington and Grand Island. Corn accounted for 94 to 97 percent of the diet of wintering mallards. Use by migrants was weather dependent. Upon arrival, migrant waterfowl roosted on the Platte River and fed in adjacent fields until wetlands in the Rainwater Basin became ice-free. The study concluded that waste corn was abundant and could meet the needs of foraging livestock, wintering and migrant waterfowl, and cranes. For example,
Table SC-6.   Disturbance buffers/zones of influences for various man-made features affecting sandhill crane habitat.

Man-Made Features	Armbruster and Farmer 1981			Norling et al. 1990		
	Roost Buffer (m)	Grassland Buffer (m)	Cropland Buffer (m)	Roost Buffer (m)		Zone of Influence (m)
				Screen	No Screen	

Paved Road	400	200	100	301-400	>900	500
Gravel Road	200	100	50	301-400	301-400	400
Private Road	40	20	10	100	100	100
Urban Dwelling	800	400	200	limited data	limited data	800
Single Dwelling	200	100	50	101-200	>400	100
Railroad	400	200	100	limited data	limited data	600
Commercial	800	400	200	limited data	limited data	700
Recreation Area	200	100	50	no data	no data	no data
Power Lines	40	20	10	limited data	limited data	200
Bridges	400	200	100	400	400	400
Sand/Gravel Operations				100	100	

cranes used only 10-20 percent of the waste corn present upon arrival, and left behind an amount equal to 3-5 times the population's requirements (U.S. Fish and Wildlife Service1981).

Spring use of the Central Platte Valley by migrating waterfowl has increased substantially since the above referenced ecology study's findings were published. For example, the Rainwater Basin, located to the south and east of the central Platte River, has become the first principal stop for lesser snow geese migrating north each spring from the Gulf Coast (Farrar 1998). Numbers of geese can be impressive. For example, snow geese using Funk Lagoon─one basin complex about 15 miles south of Odessa─ can exceed one million birds. Geese generally arrive in mid-to-late-winter before sandhill cranes, but timing varies and periods of use may overlap with sandhill cranes. For example in 1998, snow geese, Canada geese, and sandhill crane numbers all peaked in late March, while in 1999, geese were declining in numbers as cranes began arriving [The Trust unpublished data 1999, 2000 (http://www.whoopingcrane.org)]. The Trust speculates that high snow geese numbers in 1999 may indicate a response to increased spring hunting pressure in the eastern Rainwater Basin. Regardless of the reasons for an increase in waterfowl numbers, geese now commonly exceed cranes in abundance in the Central Platte Valley during the spring migration period.

IMPACT INDICATORS AND ASSESSMENT METHODS

Sandhill cranes use the Central Platte Valley for specific purposes. The primary purpose is likely the accumulation of lipids and other physiological requisites used to continue migration, and ultimately reproduction on the nesting grounds. The fact that cranes interrupt their northern migration to spend 4-6 weeks each spring along the North Platte and Platte Rivers indicates the importance of this period in their annual cycle. This traditional use of the Central Platte Valley also indicates the ability of the area to provide resources and therefore its value during this period of the annual cycle. The Central Platte Valley also provides secure sites for roosting, resting, and courtship.

Sandhill cranes migrate as family groups, sub-adults, and other non-breeders that congregate to form flocks. It is assumed that this gregarious behavior facilitates the efficient exploitation of resources. However, large numbers of birds—flocks can range in size from a few individuals to thousands of cranes—require abundant resources in close juxtaposition in order to efficiently acquire food and deposit lipid reserves. The concept of resource complexes—suitable roost sites near abundant food sources—fits our perceptions of how large flocks of cranes would efficiently exploit their environment. Unfortunately, no current, comprehensive, and ready-to-use assessment model for sandhill crane resource complexes exists for the Central Platte Valley. An alternative to evaluating the value of resource complexes is the evaluation of the individual components of spring sandhill crane habitat. Although the approach is expedient for planning purposes such as those addressed in this FPEIS, the approach fails to adequately address the value of the spatial relationships inherent within the concept of resource complexes. The fact that cranes are moving longer distances to feed and storing less fat indicates a need for further research.

As previously stated, the analysis does not address the influences of human disturbances or potential competition for food and roost sites by field-feeding ducks and geese. The analysis is therefore a simplistic approach that is further complicated by treating resource complex components individually. However, until additional information and more creative approaches become available, the analysis can serve to represent our current understanding of sandhill crane use of the Central Platte Valley, and can readily be updated through the Adaptive Resource Management Process.

Changes in Analysis Focus

Although sandhill cranes do not regularly use the South Platte River for extended periods, the river remains important as the only current source of large amounts of sediment for the central Platte River. (The reader is referred to the Chapters 4 and 5—River Geomorphology section of the FPEIS for a detailed discussion of sediment dynamics within this system.) Discharge estimates at various gauges between Julesburg, CO, and North Platte, NE, were inspected and data presented in the original sandhill crane appendix to determine the magnitude of change in flows that would be expected from the action alternatives. The same type of approach was conducted for the North Platte and Platte Rivers. While some information on North Platte hydrology is presented in this appendix, hydrology information for the South Platte and Platte Rivers has been largely eliminated from this appendix.

This modification was incorporated for two reasons. First, the proposed action alternatives would result in small changes ($\leq$6.5 percent) in discharge at various locations along the South Platte

River. Because of the relatively small size of these changes and the co-mingling of South Platte River flows with North Platte River flows that occurs downstream in the Platte River, it is difficult to identify effects associated with these changes. Any effects to sandhill crane habitat will be credited to North Platte River and/or Platte River flows. Second, the SEDVEG Gen-3 analysis has been expanded since the original appendix was developed and the model now provides extensive coverage of hydrology and sediment changes along the central Platte River. Hydrology data for the North Platte River remains important in this appendix, and hydrology data presented earlier for the Platte River has been replaced with specific output from the SEDVEG Gen-3 model.

Assumptions

The analysis presented in this appendix relies on some basic concepts, relationships, and assumptions. One of the primary assumptions deals with data interpretation. In order to interpret data from our analysis, we have assumed that an increase in resources—such as suitable roost sites or food—is a positive situation while a reduction in resources is a negative situation. The assumption may seem obvious, but is necessary because we do not currently know the resource quantities required by the Mid-Continent Population of sandhill cranes during their spring stay in the Central Platte Valley. For example, estimates have been made of the quantities of waste corn available and consumed by cranes in the late 1970's (U.S. Fish and Wildlife Service 1981). Since those studies were completed, harvesting efficiency has increased, acres of corn have increased, and the use of waste grain by other species of wildfowl has increased. Studies are currently underway that address the question of how much corn is enough, but the data are not yet available. A similar situation exists for lowland grasslands. As presented below, data appear to indicate an increase in acres of lowland grasslands (1981 vs. 1998 GIS coverage). However, this comparison may reflect an increase in lands enrolled in the Conservation Reserve Program (CRP). These CRP lands are generally planted to and managed for robust grass species that are not generally used by sandhill cranes.

A potential problem with the assumption of more is better in an analysis that compares proposed alternatives to Present Conditions is that it implies that Present Conditions are adequate and acceptable. Without knowledge of what resource quantities are needed we do not know if Present Conditions provide adequate supplies of waste corn, invertebrate food, and/or resource conditions compatible with roosting needs. Present resource conditions may be inadequate or provide surpluses, and adding more to a surplus or removing some quantity from an already inadequate supply would have very different consequences. Because of this uncertainty, we have elected to take a conservative approach, and until additional data become available, will view an increase in resource abundance and/or condition as a positive situation, and a reduction as a negative effect. The analysis of roosting depth attempts to go beyond acceptance of present conditions and identify the amount of roosting habitat that would be present at various flows. Sandhill cranes roost in flocks on submerged sediment deposits in the active channel. Flows that maximize the area of submerged sediment deposits within a suitable depth range are of interest in defining sandhill crane roosting habitat because these are the flows that would accommodate the largest numbers of cranes (i.e., more is better). This appendix first treats the relationships between discharge and roosting depth at a limited number of sites between Lexington and Chapman. It is assumed that relationships between discharge and habitat defined at the site scale illustrates a concept that can then be extrapolated to the system scale where only hydrology data are available.

This evaluation of sandhill crane spring habitat and its use in the central Platte Valley is focused on the abundance of suitable roost sites, and the abundance of waste corn and invertebrate food. It is assumed that cranes prefer roosting sites that provide suitable water depth and an unobstructed view (measured as unobstructed channel width). Water depth and width are also characteristics of the channel, and thus the channel becomes the focus of this analysis. Food is evaluated indirectly as the relative abundance of lowland grasslands and alfalfa (invertebrate food), and corn fields.
Finally, this evaluation of sandhill crane spring habitat in the Central Platte Valley is focused on the abundance of suitable conditions (i.e., depth and width) for roosting within the channel, and the abundance of waste corn and invertebrate food—specifically, roosting suitability at the site, bridge segment, and system scale, and potential food abundance at the bridge segment scale.

Analysis

Channel transect data were manipulated within the PHABSIM and the SEDVEG Gen-3 model, and in supplementary spreadsheet and subroutine analyses, to yield estimates of roosting depth (discussed below). Because proposed action alternatives include mechanical restructuring of the channel at some sites, basic assumptions of channel equilibrium would likely invalidate the use of PHABSIM for comparisons between Present Conditions and action alternative conditions. For this reason, the analysis uses the SEDVEG Gen-3 model to determine how proposed island leveling and alternative hydrology would affect roosting depth.

This analysis relied heavily on output from the SEDVEG Gen-3 model and the Platte River Hydrology Operations model (Ops Model). These tools are addressed elsewhere within the FPEIS and appendices. SEDVEG Gen-3 output was manipulated post-processing with subroutines developed by Reclamation scientists. Because SEDVEG Gen-3 often collapsed large amounts of data into single output values, no statistical analyses were preformed.
Hydrology data distributions from the Ops Model were evaluated and determined to be non-normal. Statistical analyses were therefore preformed on Ops Model output using the Mann-Whitney (Wilcoxon) W test with an alpha = 0.10. This approach compares medians and can identify statistically significant differences between medians at the 90 percent confidence level.

Roosting Suitability at the Site Scale—Roosting Depth Abundance

Cranes use roosting sites that provide suitable water depth. The site-scale analysis of roosting suitability focuses on the interaction of discharge with channel morphology to produce various amounts of roosting depth. For example, the channel bottom consists of numerous subchannels of various depths separated by sediment deposits of various heights. Low flows are confined to deeper subchannels within the bottom of the main channel. As discharge increases, water overflows these deeper subchannels into progressively shallower subchannels until it spreads out over the bottom of the channel and covers low elevation sediment deposits. During this initial increase in flow, wetted channel width increases rapidly until the channel bottom is filled. Once the bottom is filled, wetted width increases by water moving up the channel banks. The rate of wetted width increase is reduced after the banks are encountered, but water depth continues to increase (Figure SC-1A).

Sandhill crane researchers have speculated that optimal water depth for roosting ranges from 4 to 8 inches, with depths greater than 14 inches believed unsuitable for sandhill cranes (Armbruster and Farmer 1981). Research indicates that depths up to about 8 inches are commonly used for roosting, with use decreasing rapidly at deeper sites (Latka and Yahnke 1986, Folk and Tacha 1990, and Norling et al. 1990). Latka and Yahnke (1986) speculated that—because velocities are closely correlated with depth in the Platte River—flow velocity greater than 1.3 feet/second, or channel bed instability at deeper sites with higher velocities may influence use of sites for roosting.

A depth range of 3 to 9 inches was selected to represent suitable roosting depth at the site scale of analysis. Flows and channel morphology have been the subject of numerous studies in the Central Platte Valley (reviewed by Simons and Associates, Inc. 2000). Permanent channel transects have been established for various purposes and used to collect data over the years. Subsets of these data, plus additional data are used to document transect length in the 3-to 9-inch depth range. The indicator for roosting suitability at the site scale is *roosting depth abundance* as measured by transect length (in feet) within the 3- to 9-inch depth range. Both PHABSIM and SEDVEG Gen-3 modeling methodologies were used to evaluate roosting depth abundance.

Note that this indicator seeks to identify roosting depth abundance in the 3 to 9 inch depth range. Because this analysis does not address disturbance, no buffering of bank or island vegetation, or bridges, or other human disturbance features (Table SC-6) has been performed. Abundance is a useful measure or indicator of suitable roosting depths. The area available for crane use would be abundance minus the area affected by individual crane's, or flocks', disturbance avoidance

PAGE RESERVED FOR FIGURE SC-1

(This is Figure 4-SC-1 from the FPEIS)

response. In addition, because this analysis does not address spatial issues (e.g., distance to food) of resource complex components, or the issues of potential competition with other wildfowl, the actual area used by sandhill cranes may be less then that which is available (which is likely less than the predicted abundance).

Cranes likely use a subset of depths suitable and available for roosting (Latka and Yahnke 1986, Folk and Tacha 1990, Norling et al. 1990). For example, Finzel *et al*. (in press) recently estimated roosting area using aerial infrared videography to map crane flocks at roost sites. The estimated area used for roosting by sandhill cranes between Lexington and Grand Island—during spring migration in 2000-2003—ranged from about 182 to 217 acres. To help put this value in perspective, Figure SC-1 uses data from a site within Bridge Segment 3, a segment that contains about 969 acres of channel of which 355 acres are associated with a channel width greater than

501 feet (estimated from Platte River 1998 GIS database). Roosting area actually used by sandhill cranes within Bridge Segment 3 ranged from 22 to 34 acres (Finzel *et al*. in press).

We have no area estimates of roosting depth within the 3- to 9-inch depth range within Bridge Segment 3, but an example may improve understanding of the potential differences between estimated roosting depth abundance and roosting area. If we select 400 feet (Figure SC-1-B) as an example transect length within the 3- to 9-inch depth range, then a square 400 feet on each side would contain about 3.7 acres. Within a mile of channel represented by the example site, 13 squares 400 feet on a side could be placed end-to-end enclosing about 49 acres. This particular sample site, and its companion site 9BE, are believed to represent about 16 miles of channel (Bureau of Reclamation 1989). Clearly, at flows represented in Figure SC-1-B, there is more area in the 3- to 9-inch depth range than is being used by sandhill cranes.

Another argument for viewing transect length within the 3- to 9-inch depth range as an indicator to roosting depth abundance at specific sites is depicted in Figure SC-1. Roosting depth abundance in this analysis assumes that all depths between 3 and 9 inches have equal value. Cranes may treat depths within the range of suitability differently (Latka and Yahnke 1986, Folk and Tacha 1990, Norling et al. 1990). For example, the 400 feet in the 3- to 9- inch depth range at 600 cfs (left arrow) in Figure SC-1-B may have different depth, velocity, distribution, and other characteristics than the 400 feet that occurs at 1,100 cfs (right arrow). Most studies of sandhill crane roosting depth have not explored potential preferences within a range of what are currently perceived to be suitable depths.

Finally, transect length within the 3- to 9-inch depth range does not address the issue of disturbance. Sandhill cranes respond to features within the landscape—such as channel banks, wooded islands, bridges, active sandpits, etc.—by avoiding them. Different "disturbance" features illicit differing responses that have been translated into avoidance "buffers" of varying widths (Armbruster and Farmer 1981, Norling et al. 1990). If a length of transect within the 3- to 9-inch depth range falls within a disturbance buffer, it would be functionally unavailable to sandhill cranes. This situation, like the two situations discussed above, would result in an over estimate of roosting depth abundance.

Given the issues discussed above, we believe roosting depth abundance as measured by transect length within the 3- to 9-inch depth range likely encompasses channel depth characteristics cranes value in a roosting site. For the purposes of analysis, the indicator can be used to make relative comparisons of roosting depth abundance among sites at the same flow and to compare changes in roosting depth abundance at the same site at different flows.

PHABSIM Analysis

Components of the Physical Habitat Simulation System (PHABSIM) (Bovee and Milhous 1978, Bovee 1982, Milhous et al. 1984) were used as one of two approaches to estimating the amount of channel available for roosting. Channel profile information such as wetted width, depth, velocity, etc., and mean monthly flow data are input into PHABSIM to predict user-defined parameter values. In this study, the values of interest were estimates of transect lengths within the 3- to 9-inch depth range.

In the original sandhill crane appendix (USDI 2004a), historic transect data were used to illustrate the relationship between various flows and roosting depth. For example, survey data from the eight habitat sites were selected (measured flow range between 1,068 cfs and 2,062 cfs) and compared to determine the discharge that provided the maximum transect length containing depths between 3 and 9 inches (Table SC-7). For these eight sites between Lexington and Chapman, roosting depth abundance is maximized between 800 cfs and 1,600 cfs (mean of 1,175 cfs). Within these flows, maximum length of transect occupied by depths between 3 and 9 inches ranged from 148 feet to 885 feet. These concepts became the basis of the site scale analysis for roosting depth abundance.

The discussion of PHABSIM was used in the original Sandhill Cane Apendix to familiarize the reader with the concept of how roosting depth abundance within the 3- to 9-inch depth range changes with flow. This concept is then represented by median March flows as an analysis tool. We selected median values over mean values because evaluation of the hydrology data indicated a non-normal distribution. Median values are a more appropriate estimate of central tendency in non-normal distributions. Actual estimates of transect length within the 3- to 9-inch depth range are derived from SEDVEG Gen-3 methodology discussed below.

SEDVEG Gen-3 Analysis

Some action alternatives contain provisions for island leveling for the purpose of increasing roosting area and unobstructed view. Island leveling would radically alter channel morphology at some sites in some bridge segments. The PHABSIM approach identified above assumes a reasonably stable channel―a channel in dynamic equilibrium―throughout the period of analysis. Island leveling, as proposed in some alternatives, would likely nullify the assumption of channel

Table SC-7. Mean wetted width (3- to 9-inch depth range) at eight habitat transect sites at various flows (cubic feet per second).

Flow	Mean Wetted Width (Feet) in the 3- to 9-Inch Depth Range at Eight Habitat Transect Sites							
	2-1 (2,062)	4A-2 (1,861)	6-1 (1,422)	8C-2 (1,373)	8B-4 (1,802)	9BW -2 (1,568)	9BE-1 (1,098)	12A-4 (1,068)
400							89	395
550				248				
600			238			115	103	592
700								666

800	142		288	**279**		145	126	765
900	**148**	190						803
1,000		**192**	299		322	182	153	842
1,100			313	228				
1,200	135	191	**320**		324	196	**192**	**885**
1,300			304	200				
1,400	122	183				236	188	831
1,430			291					
1,500			285	172	**351**			
1,600	121	147	275			**256**	169	746
1,700					346			
1,800	120	130	236	150		241	164	657
1,900					331			
2,000	112	103	213		320	208	140	556
2,100				137				
2,200	109		189		266		126	427
2,300				139				
2,400	99		182			145		351
2,500		77		132	197			
2,600	88		178			104		297
2,700		71			144			
2,800	79		182	140		90		254
3,000	72	43	190	133	110	74		
3,200	62			130		69		
3,400	60	27				65		
3,430				121				
3,500					104			
3,600	59	24				53		
3,800						49		
4,000					95			

Note: Multiple transect (three to nine transects per site) measurements were obtained at most sites. The number after the dash identifies a particular site data set. The measured flow for each respective data set is in parentheses. Data are not available at all flows for all sites. Maximum mean wetted widths (3- to 9-inch) for each site are bolded and occur within the range of shaded flows.

stability and limit the usefulness of the PHABSIM approach for future impact assessment. To address this uncertainty, a second technique, employing the SEDVEG Gen-3 model (Murphy and Randle (2003), was also used at the site scale to evaluate future abundance of roosting depth in the 3-9 inch depth range. This model uses island leveling scenarios and future hydrology to simulate channel morphology and stage/discharge relationships under the various action alternatives (see Chapters 4 and 5—River Geomorhpology in the FPEIS for more information).

For this analysis of roosting suitability at the site scale, data from 62 SEDVEG Gen-3 transects (see *Application of the Sediment and Vegetation Model to EIS Alternatives Appendix*) located between Lexington and Chapman, Nebraska, were evaluated to assess roosting depth abundance during the spring migration period. Two approaches—based on channel width—were taken. In the first approach, only channels greater than 170 feet (52 meters) wide were evaluated. This value was selected based on the work of Krapu et al. (1984) that indicated sandhill cranes generally avoid channels less than 50 meters in width (but see Folk and Tacha 1990 for channel widths used on the North Platte River). Transect length within the 3- to 9-inch depth range from estimated daily flows between February 15 and April 15 (60 days) for each year of the 48-year period of hydrology record, were collapsed into mean width estimated for each transect for each alternative. Although the exact timing of island leveling activities is unknown, it was assumed that management activities—both flow and mechanical channel restructuring would occur throughout the 13-year first increment period. Therefore, mean values for indicators during this period would not accurately capture conditions in place at the end of the first increment. For these reasons, SEDVEG Gen3 outputs from the 48-year post alternative implementation period were used in all analyses. We believe this period better represents conditions at the end of the first increment with alternatives in place.

The analysis focused on transect groupings derived from crane use as depicted in Table SC-2. Transect groupings included all transects, managed transects, non-managed transects, transects located upstream of Kearney, NE, transects located downstream of Kearney, and transects located within bridge segments 7-2. Management basically addresses the leveling of islands and the subsequent increase in channel width and release of trapped sediment, plus alternative hydrology. The locations of future island leveling and other channel clearing activities are currently nknown. For purposes of analysis, nine were selected to simulate leveling activities. The reader is referred to the *Application of the Sediment and Vegetation Model to EIS Alternatives Appendix* for additional information.

We also evaluated roosting depth abundance in channels greater than 500 feet. The same data set and transect groupings were used as in the above analysis of all channels greater than 170 feet. All transects with usable data, for each day of use, were summed to create a total "transect length" in the 3- to 9-inch depth range for all transects. Action alternative total transect lengths were then compared to the Present Condition value to obtain a percent change from Present Conditions.

The above analyses approaches will provide insight into the relationships between discharge and depth (PHABSIM), and to how island leveling (changes in channel morphology) may affect abundance of roosting habitat (SEDVEG Gen3). However, their output should not be viewed as absolute values, but rather the outputs are of value in providing relative comparisons among alternatives.

Roosting Suitability at the Bridge Segment Scale—Unobstructed Channel Width

The second level of analysis detail—the bridge segment scale—focuses on roost conditions in the Platte River between Lexington and Chapman. The indicator for roosting suitability at the bridge-segment scale is *unobstructed channel width* as measured in feet (distance) or acres (area) by two techniques. The first technique uses a digital database—supported within a geographic information system (GIS)—in an analysis of channel width. Two coverages (1982 and 1998) depicting an area from near Lexington to Chapman, and including the river channel and a band of adjacent lands approximately 3.5 miles in width on each side of the channel (see GIS Appendix for details) were compared. Resource managers and researchers working on the central Platte River have adopted a naming convention for describing locations of sample sites and resources. The naming convention is based on individual river reaches generally defined by bridge crossings, with the bridges named for the nearest town or highway number. The GIS coverage developed for the Platte River PEIS project in 1998 follows this convention (see the *GIS and Land Analysis Appendix* for details). For example, Bridge Segment1 begins near Chapman, Nebraska, and numbering progresses westward to near Lexington, Nebraska (Bridge Segment 13). Note that the 1998 coverage is larger (1 through 13 bridge segments) than the 1982 coverage (1 through12 bridge segments). Segment 12 in the 1998 coverage is larger than Segment 12 in the 1982 coverage. However, comparisons between the two years utilize an adjusted ("clipped") 1998 Segment 12 to represent areas equivalent to the 1982 Segment 12, and are valid.

The majority of sandhill cranes roost in channels greater than 500 feet in width (Krapu *et al.*1984, Davis 2003). Davis (2003) reported significantly greater channel widths (752 feet versus 271 feet) at occupied roost sites than those measured at unoccupied channel sites. It is believed that wide channels provide security to roosting cranes, and researchers use the measure of unobstructed channel width to express this relationship. The original sandhill crane appendix (USDI 2004a) presented GIS data for various comparisons of change in channel width and various combinations of unobstructed channel width. In this appendix, Table SC-8 is presented to illustrate that change does occur in channel area over time within various bridge segments.

Data from 1982 and 1998 were collapsed into three width categories and compared employing the assumption that herbaceous islands were part of the 1982 channel. The categories—501 to 750 feet, 751 to 1,000 feet, and greater than 1,000—were arbitrarily selected to focus on widths greater than 500 feet, because sandhill cranes most commonly roost in channels greater than 500 feet wide on the Platte River (Krapu et al. 1984).

Table SC-8. Acres (1998 compared to1982) of channel and riparian woodland within a band 3.5 miles north and south of the Platte River. The study area extends from about 3.5 miles west of Overton to near Chapman, NE. Channel consists of open water, sandbars, and herbaceous islands in 1982, and open water and sandbars in 1998.

Bridge Segment[1]	'82 Channel	'98 Channel	Change	Percent Change	'82 Riparian Woodland	'98 Riparian Woodland	Change	Percent Change
12a	316	420	104	32.9	1106	988	-118	-10.7

11	1029	838	-191	-18.6	3581	3230	-351	-9.8
10	620	644	24	3.9	2766	2147	-619	-22.4
9	862	889	27	3.1	2960	3002	42	1.4
8	684	780	96	14.0	1853	2061	208	11.2
7	727	723	-4	-0.6	1726	1529	-197	-11.4
6	739	703	-36	-4.9	1313	1489	176	13.4
5	932	946	14	1.5	1930	2331	401	20.8
4	666	718	52	7.8	966	1272	306	31.7
3	966	969	3	0.3	1092	1455	363	33.2
2	851	847	-4	-0.5	1188	1771	583	49.1
1	1875	1865	-9	-0.5	2909	4760	1851	63.6
Totals	10,267	10,342	75	0.7	23,390	26,035	2,645	11.3

[1]Segment 12a -3.5 miles west of Overton to Overton
Segment 11 - Overton to Elm Creek (State Highway 183)
Segment 10 - Elm Creek (State Highway 183) to Odessa
Segment 9 - Odessa to Kearney
Segment 8 - Kearney to State Highway 10
Segment 7 - State Highway 10 to Gibbon
Segment 6 - Gibbon to Shelton
Segment 5 - Shelton to Wood River
Segment 4 - Wood River to Alda
Segment 3 - Alda to State Highway 281
Segment 2 - State Highway 281 to Grand Island (State Highway 2)
Segment 1 - Grand Island (State Highway 2) to Chapman

The second technique for estimating unobstructed channel width uses output from SEDVEG Gen-3. The output is known as “open view”, and is described in depth in Chapters 4 and 5—River Geomorphology sections of the FPEIS. The open view analysis treats four reaches of the central Platte River:

- Reach 1—Jeffreys Island (River Mile-RM 247) to Elm Creek (RM 231)
- Reach 2—Elm Creek to Gibbon (RM 202)
- Reach 3—Gibbon to Wood River (RM 187)
- Reach 4—Wood River to Chapman (RM 154)

Roosting Suitability at the System Scale—North Platte River Hydrology

The final analysis approach for roosting suitability occurs at the system scale and evaluates existing and simulated flow data (see the *Hydrology Appendix* for details) at selected sites within the North Platte Basin and their assumed effects on water depth. Present Conditions (hydrology period of record 1947 to 1994) are used as the standard of comparison. The system-scale analysis assumes that the previously described relationships at the site scale between discharge and roosting depth abundance can be used to gain insight into future roosting conditions when only hydrology data are available.

The North Platte River is important to cranes because it provides water to the Central Platte, and its flows also currently support about 5,000-8,000 sandhill cranes that use the channel for roosting at the upper end of Lake McConaughy (Clear Creek Wildlife Management Area and the channel west for about 2 miles). Approximately 100,000 to 150,000 sandhill cranes also use the river between Sutherland and North Platte, Nebraska. It is assumed that currently existing channel width and depth characteristics provide these cranes with suitable roosting sites. Although some historic transects were established between Sutherland and North Platte, these sites have not been surveyed since the 1980s, and were not revisited for this study. Thus, this analysis relies on discharge, as represented by current and simulated hydrology conditions, to provide insight into future roosting conditions at sites along the North Platte River.

Basically, it is assumed that Present Condition North Platte River hydrology provides suitable—but presently unknown in quantity or quality—conditions for roosting sandhill cranes. Deviations from Present Condition flows may affect current roosting conditions because changes in flow would likely result in changes in channel width and water depth. In other words, changes in flow would be reflected as changes in roosting depths available to sandhill cranes. The interpretation of the effect is based on the assumptions that wider and shallower channels would be a positive development for roosting sandhill cranes, while narrower and deeper channels would be a negative development.

The indicator for this analysis at the system scale is *North PlatteRiver hydrology* (measured in thousand acre-feet [kaf] and/or cfs) at selected stream gauges within the North Platte River Basin. Gauges and parameters include:

- Median monthly flow at Lewellen during February, March, and April—believed important in providing roosting depth abundance
- Median monthly flow at Lewellen during May, June, and July—believed important in maintaining channel width by preventing cottonwood establishment
- Kingsley Dam total annual spill—believed important in maintaining channel configuration in the Sutherland to North Platte reach.
- Frequency of spills from Kingsley Dam—important for the reasons identified above
- Annual flow at North Platte, Nebraska—believed important in maintaining channel configuration

- o Median monthly flow at North Platte during February, March, and April—believed important in providing roosting depth abundance
- o Median monthly flow at North Platte during May, June, and July—believed important in maintaining channel width by preventing cottonwood establishment

Food Suitability at the Bridge Segment Scale—Food Abundance

Studies of sandhill crane spring use of the North and Platte Rivers have concentrated—as this analysis does—on the roost site as the focal point of crane home ranges (for example see Sparling and Krapu 1994). However, food—or more precisely—nutrient storage is believed to be the reason sandhill cranes traditionally use the Platte River Valley (Reinecke and Krapu 1986, Krapu 2003). The food component of spring sandhill crane habitat is evaluated at the bridge-segment scale via use of the GIS database mentioned above. The approach compares existing acres in various cropland types to projected acreage under future alternative management scenarios. The focus of the food analysis is waste corn, as measured in acres of corn, and invertebrate food, as measured by acres of lowland grassland. The analysis of *food abundance* is restricted to the central Platte River between Lexington and Chapman, Nebraska.

The abundance of invertebrate food in wet meadows is also evaluated via an analysis of river flows during the February-March period when sandhill cranes are using the Platte River between Lexington and Chapman. The detailed analysis of the value of wet meadows to whooping cranes occurs in the whooping crane section of the FPEIS. The reader is referred to that section for a detailed discussion of wet meadows.

Note that an analysis of food abundance is a simplistic approach that does not address the issue of food availability identified above. Food availability is a complex issue that would require the analysis of competition, disturbance, harvesting efficiency for corn, and other factors beyond the scope of this appendix or the FPEIS. We believe food abundance encompasses the issue of availability and any reduction in food abundance for sandhill cranes should be viewed with concern. Wet meadow invertebrates and waste corn abundance and availability are appropriate topics for further study and monitoring under the adaptive management process.

PRESENT CONDITIONS

Potential effects to sandhill crane habitat (both positive and negative) from the proposed alternatives were evaluated at three levels or scales. For roosting suitability, the analysis first treats specific sites within the Platte River during specific time periods to determine the relationships between water depth within the channel and flow, and to determine how these relationships affect the abundance of roosting depth. The relationships identified at the site scale are then extrapolated to the system scale for the North Platte River. Roosting suitability, in terms of channel width, is evaluated at the bridge-segment scale along the Platte River. Finally, food suitability is evaluated at the bridge-segment scale and only for that area between Lexington and Chapman.

Roosting Suitability at the Site Scale—Roosting Depth Abundance

As discussed previously, two techniques were used to evaluate roosting depth abundance:

- o Median March flows (based on PHABSIM concepts)
- o Transect length within the 3- to 9-inch depth range (SEDVEG Gen-3)

Median March Flows

Median March flows (1947 to 1994) were selected to represent discharge in the discharge-roosting depth abundance relationship described above (PHABSIM analysis) during the spring roosting period under the Present Condition. Median March flows ranged from 1,935.2 cfs (Overton gauge) to 2,141.4 cfs (Grand Island gauge). Note that these estimated flows would exceed the estimated 800 to 1,600 cfs that may maximize roosting depth abundance under the discharge-roosting depth abundance relationship described under PHABSIM.

Mean Transect Length—3 to 9 Inch Depth Range

Managed and non-managed transects under the action alternatives were compared to Present Conditions to determine potential differences. Although no management would occur under Present Conditions, these values are presented here as reference. Present Condition "managed" transects—for channels greater than 170 feet wide—would support a mean transect length of 81.0 feet within the 3- to 9-inch depth range, while non-managed transects would support 55.0 feet within the roosting depth range.

Fewer sandhill cranes now use the river upstream of Kearney than downstream. Because of this crane-use pattern, we also looked at SEDVEG Gen-3 output for transects 2-26 (near Lexington to Kearney) and transects 27-62 (just downstream of Kearney to Chapman). Transects above Kearney would support a mean transect length of 43.5 feet within the roosting depth range, while transects below Kearney would support 69.5 feet.

Finally, we looked at bridge segments 7-2 where over 85 percent of sandhill cranes make their nocturnal roosts (Table SC-2). The average transect length in the 3- to 9-inch depth range is 47.0 feet within this reach.

The above analysis focuses on all channels greater than 170 feet and can contain the main river channel and any other smaller channels greater than 170 feet. The second approach to this analysis focused on channels greater than 500 feet, and used the same categories as discussed above. As described earlier, the summation of all transect data produced rather large numbers. For example, the estimated total transect length within the 3- to 9-inch depth range for all transects was 7,398, 938 feet. Other transect group lengths (in feet) included managed transects = 1,692,187; non-managed transects = 5,706,751; upstream of Kearney = 3,060,730; downstream of Kearney = 4,338,209; and bridge segments 7-2 = 1,976,712. These values serve as the comparison standards for Present Conditions in the following alternative analyses.

Roosting Suitability at the Bridge Segment Scale—Unobstructed Channel Width

The area occupied at various unobstructed widths was determined from comparisons between 1982 and 1998 GIS data. Data were collapsed into three width categories and compared, employing the assumption that herbaceous islands were part of the 1982 channel. The categories—501 to 750 feet, 751 to 1,000 feet, and greater than 1,000 feet—were arbitrarily selected to focus on widths greater than 500 feet. Area in unobstructed channel width decreased (-0.2 percent) in the 501- to 750-foot category, decreased in the 751- to 1,000-foot category (-9.0 percent), and decreased in the greater than 1,000-foot category (-50.9 percent) between 1982 and 1998 (Table SC-9). Overall, this analysis indicates that the channel area represented by widths greater than 501 feet is decreasing (-462 acres or -13.3 percent in16 years) under the Present Condition.

Unobstructed channel width was also estimated using SEDVEG Gen-3 output known as "open view". The mean all transect unobstructed channel width using this approach under Present Conditions is 504 feet.

Roosting Suitability at the System Scale—North Platte River Hydrology

The system-scale analysis assumes that the previously described relationships at the site scale between discharge and roosting depth abundance can be used to gain insight into future roosting conditions when only hydrology data are available.

Discharge data from gauges located at Lewellen, Kingsley Dam, and North Platte, Nebraska were evaluated, and provide the following Present Condition information:

- Median monthly flow at Lewellen during February, March, and April—believed important in providing roosting depth abundance: February = 68.7 kaf, March = 72.1 kaf, April = 73.3 kaf.

Table SC-9. Three categories (acres) of unobstructed width compared (1982 and 1998) by bridge segment.

*Bridge Segment	Unobstructed Width 501-750 Feet				Unobstructed Width 751-1,000 Feet				Unobstructed Width > 1,000 Feet			
	1982	1998	Change	Percent	1982	1998	Change	Percent	1982	1998	Change	Percent
12a	83	47	-36	-43.4	0	0	0	-------	0	0	0	-------
11	100	24	-76	-76.0	12	45	33	275.0	0	0	0	-------
10	150	239	89	59.3	45	110	65	144.4	0	0	0	-------
9	99	81	-18	-18.2	0	11	11	-------	0	0	0	-------
8	108	92	-16	-14.8	7	0	-7	-------	25	0	-25	-------
7	112	203	91	81.3	132	85	-47	-35.6	51	0	-51	-------
6	109	119	10	9.2	77	53	-24	-31.2	0	0	0	-------

5	194	135	-59	-30.4	52	103	51	98.1	0	0	0	-------
4	146	199	53	36.3	99	109	10	10.1	67	0	-67	-------
3	253	224	-29	-11.5	236	81	-155	-65.7	25	50	25	100.0
2	221	86	-135	-61.1	177	57	-120	-67.8	0	0	0	-------
1	116	239	123	106.0	241	327	86	35.7	543	299	-244	-44.9
Totals	1,691	1,688	-3	-0.2	1,078	981	-97	-9.0	711	349	-362	-50.9

Note: GIS analysis evaluates unobstructed width in all directions for each category. Wooded islands were considered obstructions in 1982, and herbaceous and wooded islands were considered obstructions for analysis of 1998 data.

*Segment 12 - Lexington to Overton
Segment 11 - Overton to Elm Creek (State Highway 183)
Segment 10 - Elm Creek (State Highway 183) to Odessa
Segment 9 - Odessa to Kearney
Segment 8 - Kearney to State Highway 10
Segment 7 - State Highway 10 to Gibbon
Segment 6 - Gibbon to Shelton
Segment 5 - Shelton to Wood River
Segment 4 - Wood River to Alda
Segment 3 - Alda to State Highway 281
Segment 2 - State Highway 281 to Grand Island (State Highway 2)
Segment 1 - Grand Island (State Highway 2) to Chapman

- Median monthly flow at Lewellen during May, June, and July—believed important in maintaining channel width by preventing cottonwood establishment: May = 59.9 kaf, June = 64.4 kaf, July = 51.7 kaf.
- Kingsley Dam total annual spill—believed important in maintaining channel configuration in the Sutherland to North Platte reach. The Present Condition average annual spill is 169,100 acre feet.
- Frequency of spills from Kingsley Dam—important for the reasons identified above. Frequency of spills is currently 0.60.
- Annual flow at North Platte, Nebraska—believed important in maintaining channel configuration. The median annual discharge of the North Platte River is 391.9.0 kaf.
- Median monthly flow at North Platte during February, March, and April—believed important in providing roosting depth abundance: February = 21.5 kaf, March = 24.9 kaf, April = 23.4 kaf.
- Median monthly flow at North Platte during May, June, and July—believed important in maintaining channel width by preventing cottonwood establishment: May = 24.7 kaf, June = 33.5 kaf, July = 91.1 kaf.

Food Suitability at the Bridge Segment Scale—Food Abundance

The GIS database produced acreage estimates of the applicable cover types that can provide caorn and invertebrate food for sandhill cranes. Corn field acreage increased between 1982 and 1998 by 5.1 percent, while other crop acreage declined 3.1 percent (Table SC-10). These comparisons also indicate an increase in lowland grasses (31.7 percent), and a reduction in acres of alfalfa (-39.9 percent) and upland grasses (-3.9 percent) (Table SC-11). Some lowland grasslands are wet meadow sites that provide important resources for cranes. However, the increase in total acres of lowland grassland may reflect conversions of marginally productive farmland to the Conservation Reserve Program (CRP). Sandhill cranes commonly feed in short-stature grasslands, either grazed or hayed wet meadows or alfalfa (Davis 2003). CRP plantings generally consist of tallgrass prairie species that provide robust cover unsuitable for crane foraging.

Median February and March flows were evaluated for their effect on wet meadow foraging conditions. It is assumed that higher flows would have a higher potential for making soil invertebrates accessible to foraging sandhill cranes. Under Present Conditions, the median February flows for Overton and Grand Island are 2,177 cfs and 2,089 cfs respectively. For March, the flows are 1,935 cfs (Overton) and 2,141 cfs (Grand Island). Readers should also review the whooping crane section of the FPEIS for an expanded evaluation of flow effects to wet meadows.

Table SC-10.—Acreages (1998 compared to 1982) for corn and other crops within 3.5 miles of the Platte River, between 3.5 miles west of Lexington to Chapman.

Bridge Segment*	1982 Corn	1998 Corn	Change	Percent Change	1982 Other Crops	1998 Other Crops	Change	Percent Change
12a	5,387	5,323	-64	-1.2	566	866	300	53.0
11	15,872	15,907	35	0.2	3,701	4,746	1,045	28.2
10	11,230	11,004	-226	-2.0	1,389	3,160	1,771	127.5
9	12,522	13,492	970	7.7	3,227	2,841	-386	-12.0
8	15,904	16,336	432	2.7	1,443	2,015	572	39.6
7	12,470	14,399	1,929	15.5	2,076	1,010	-1,066	-51.3
6	15,864	16,811	947	6.0	2,547	2,247	-300	-11.8
5	24,276	24,105	-171	-0.7	3,336	3,578	242	7.3
4	10,732	12,489	1,757	16.4	3,626	2,108	-1,518	-41.9
3	14,167	15,263	1,096	7.7	3,307	2,266	-1,041	-31.5

2	15,255	15,426	171	1.1	2,577	2,944	367	14.2
1	23,384	25,567	2,183	9.3	6,532	5,475	-1,057	-16.2
Totals	177,063	186,122	9,059	5.1	34,327	33,256	-1,071	-3.1

*Segment 12a - 3.5 miles west of Overton to Overton
Segment 11 - Overton to Elm Creek (State Highway 183)
Segment 10 - Elm Creek (State Highway 183) to Odessa
Segment 9 - Odessa to Kearney
Segment 8 - Kearney to State Highway 10
Segment 7 - State Highway 10 to Gibbon
Segment 6 - Gibbon to Shelton
Segment 5 - Shelton to Wood River
Segment 4 - Wood River to Alda
Segment 3 - Alda to State Highway 281
Segment 2 - State Highway 281 to Grand Island (State Highway 2)
Segment 1 - Grand Island (State Highway 2) to Chapman

Table SC-11. Acreages (1998 compared to 1982) for lowland grasses, alfalfa, and upland grasslands within 3.5 miles of the Platte River from Overton to Chapman.

*Bridge Segment	1982 Lowland Grasses	1998 Lowland Grasses	Change	Percent Change	1982 Alfalfa	1998 Alfalfa	Change	Percent Change	1982 Upland Grasses	1998 Upland Grasses	Change	Percent Change
12a	755	639	-116	-15.4	1,524	1,338	-186	-12.2	1,349	1,678	329	24.4
11	1,569	2,372	803	51.2	5,513	4,118	-1,395	-25.3	3,415	3,260	-155	-4.5
10	481	1,554	1,073	223.1	4,853	2,821	-2,032	-41.9	3,849	3,862	13	0.3
9	580	460	-120	-20.7	3,494	3,289	-205	-5.9	10,791	10,280	-511	-4.7
8	1,382	1,483	101	7.3	2,181	978	-1,203	-55.2	2,458	2,368	-90	-3.7
7	2,103	2,085	-18	-0.9	2,108	1,554	-554	-26.3	3,394	3,232	-162	-4.8
6	594	890	296	49.8	1,723	884	-839	-48.7	2,550	2,840	290	11.4
5	735	712	-23	-3.1	792	514	-278	-35.1	6,316	6,713	397	6.3
4	2,333	2,801	468	20.1	1,054	591	-463	-43.9	3,558	3,250	-308	-8.7
3	4,473	5,940	1,467	32.8	2,108	510	-1,598	-75.8	3,186	2,915	-271	-8.5
2	3,226	4,063	837	25.9	1,726	344	-1,382	-80.1	1,714	1,872	158	9.2
1	3,288	5,351	2,063	62.7	2,772	1,007	-1,765	-63.7	6,476	4,861	-1,615	-24.9
Totals	21,519	28,350	6,831	31.7	29,848	17,948	-11,900	-39.9	49,056	47,131	-1,925	-3.9

*Segment 12a -3.5 miles west of Overton to Overton
Segment 11 - Overton to Elm Creek (State Highway 183)
Segment 10 - Elm Creek (State Highway 183) to Odessa
Segment 9 - Odessa to Kearney
Segment 8 - Kearney to State Highway 10
Segment 7 - State Highway 10 to Gibbon
Segment 6 - Gibbon to Shelton
Segment 5 - Shelton to Wood River
Segment 4 - Wood River to Alda
Segment 3 - Alda to State Highway 281
Segment 2 - State Highway 281 to Grand Island (State Highway 2)
Segment 1 - Grand Island (State Highway 2) to Chapman

COMPARISON OF ALTERNATIVES VIA RESOURCE INDICATORS

The following sections compare values for each action alternative to Present Conditions via impact indicators. Readers familiar with the original sandhill crane appendix (USDI 2004a) will note that the analysis has been shortened and focused. Much of the hydrology comparisons for the South Platte and Platte Rivers that occurred in the original sandhill crane appendix are not addressed in this appendix. Basically, the original comparisons fail to identify any meaningful differences between Present Conditions and the action alternatives—especially for the South Platte River. In addition, the SEDVEG Gen-3 analysis has been expanded since the original appendix material, and now provides an expanded assessment of the interaction of flows and sediments in the Platte River. As with Present Conditions, the following assessment addresses roosting suitability at three scales with an impact indicator for each scale, and food suitability at the bridge segment scale only.

Roosting Suitability at the Site Scale—Roosting Depth abundance

Median March flows at Overton, Odessa, and Grand Island —for all action alternatives—would be numerically higher than Present Condition flows (Table-SC-12). Median March flows under the Full Water Leasing and Water Emphasis Alternatives would be significantly higher than Present Conditions at all three gauges. Concepts developed under the PHABSIM analysis indicate a reduction in roosting depth abundance would likely occur under higher projected March flows if the current channel configuration within the Lexington to Chapman reach remains unchanged.

The SEDVEG Gen-3 analysis also indicates some reduction in future roosting depth abundance. Roosting depth abundance as represented by the mean transect length within the 3- to 9-inch depth range—for all channels greater than 170 feet—would be numerically increased for some transect categories under some alternatives, and would be reduced in others (Table-SC-13. The analysis predicts a small (≤ 10 percent) reduction in roosting depth abundance in the all transects categories for all alternatives except the Wet Meadow Alternative. Managed transects are predicted to experience a moderate (11-40 percent) to large (41-70 percent) increase in roosting

Location and Month	Present Conditions	Governance Committee	Full Water Leasing	Wet Meadow	Water Emphasis
Overton					
February	2177.3	2704.1	**2739.7**	2733.5	**2747.6**
March	1935.2	2100.7	**2282.6**	2217.7	**2537.4**
Odessa					
February	2192.9	2703.5	**2833.1**	2858.5	**2862.2**
March	1918.9	2344.6	**2433.1**	2399.2	**2587.9**
Grand Island					
February	2089.1	2806.7	**2816.5**	2807.4	**2808.5**
March	2141.4	2769.4	2757.3[1]	2781.5	**2785.6**

depth as compared to Present Conditions, while non-managed transects may experience a small to moderate reduction. Transects upstream from Kearney may experience a small to moderate increase in roosting depth abundance, except under the Water Emphasis Alternative, which may experience a small reduction. Transects downstream from Kearney may experience a small to moderate reduction in roosting depth. Finally, transects within bridge segments 7-2 may experience small to moderate reductions or small increases in roosting depth abundance depending on the alternative implemented.

We also evaluated change in roosting depth abundance in channels greater than 500 feet. As indicated in Table SC-14, roosting depth in channels greater than 500 feet are predicted to experience some small to moderate increases in roosting depth under the proposed action alternatives when all transects are considered.

The exception would occur under the Water Emphasis Alternative which may experience a small reduction in roosting depth abundance. Managed transects may experience large to very large (71-100 percent) increases. Non-managed transects under three alternatives would all experience reductions in roosting depth (-5.5 to -11.4 percent) in channels greater than 500 feet. Non-managed transects under the Full Water Leasing Alternative may experience a small increase in roosting depth abundance.

Table-SC-12. Median February and March flows at Overton, Odessa, and Grand Island for Present Conditions and the four proposed action alternatives. Bolded values indicate statistically significant differences from Present Conditions (Mann-Whitney (Wilcoxon) W test α.= 0.10).

[1]P value equals 0.11.

Transects upstream of Kearney would experience small to moderate increases in roosting depth, while transects downstream from Kearney would experience small to moderate losses -except for a small increase under the Wet Meadow Alternative. Finally, those transects within bridge segments 7-2 may experience increases in roosting depth from moderate to large.

Table-SC-13. Estimated percent change from Present Conditions in the 3- to 9-inch depth range for each transect category and each alternative for SEDVEG Gen-3 simulations of all channels greater than 170 feet.

	Present Conditions	Governance Committee	Water Leasing	Wet Meadow	Water Emphasis
All transects	58.9 feet	-4.4	-2.2	2.6	-10.4
Managed Transects	81.0 feet	38.3	25.7	53.6	17.7
Non-managed Transects	55.0 feet	-14.9	-9.0	-10.1	-17.4
Above Kearney	43.5 feet	5.9	5.3	16.6	-3.3

Below Kearney	69.5 feet	-10.6	-6.7	-6.0	-14.8
Bridge Segments 7-2	47.0 feet	-3.4	3.8	1.2	-11.1

Obviously these values are estimates of change and the reader is encouraged to focus on relative changes (e.g., minor, moderate, large, etc.) between action alternatives and Present Conditions.

Roosting Suitability at the Bridge Segment Scale—Unobstructed Channel Width

Unobstructed channel width could increase from Present Conditions under the Governance Committee, Wet Meadow, and Water Emphasis Alternatives. Increases would generally occur in channel width categories greater than 500 feet. Estimated increases in unobstructed channel width using a GIS approach, i.e., simulating some island leveling at various locations include:

- Governance Committee Alternative = 21.1 percent
- Full Water Leasing Alternative = 0.0 percent
- Wet Meadow Alternative = 21.1 percent
- Water Emphasis Alternative = 15.0 percent

Table SC-14. Estimated percent change from Present Conditions in the 3- to 9-inch depth range for each transect category and each alternative for SEDVEG Gen-3 simulation years 2019-2066 in channels greater than 500 feet in width.

	Present Conditions	Governance Committee	Water Leasing	Wet Meadow	Water Emphasis
All transects	7,398,938	3.7	10.5	12.9	-3.6
Managed Transects	1,692,187	54.3	41.1	75.1	19.2
Non-managed Transects	5,706,751	-11.4	1.4	-5.5	-10.4
Above Kearney	3,060,730	11.3	7.0	22.5	4.0

Below Kearney	4,338,209	-1.7	-12.9	6.2	-9.0
Bridge Segments 7-2	1,976,712	30.6	61.5	40.0	15.1

Obviously, management actions could be initiated under any alternative to produce desired effects. The above values are presented to provide some examples of the types of increases in unobstructed channel width that may be possible.

The SEDVEG Gen-3 analysis also predicts increases in unobstructed channel width in four reaches of the central Platte River. Estimated minimum increases in the four reaches range from 9.0 to 14.0 percent, and estimated maximum increases range from 27.0 to 60.0 percent depending on alternative (Table SC-15). The largest predicted increase in open view would occur between Gibbon and Wood River (Reach 3) in all alternatives except Water Emphasis where the largest increase would occur between Jeffreys Island and Elm Creek (Reach 1). The smallest increases in open view for all alternatives are predicted between Wood River and Chapman (Reach 4). This reach currently contains some of the widest channel widths. In terms of current crane roost use, Reaches 4 and 2 receive the highest percentage use, and Reach 1 receives the lowest use (Table SC-2, Frinzel et al. in press). The reader is referred to Chapter 5—River Geomorphology of the FPEIS for a detailed treatment of this indicator (widest water and open view of the channel).

Table SC-15. Estimated percent change from Present Conditions for the "open view" parameter of the SEDVEG Gen-3 model. Data from Chapter 5—River Geomorphology of the FPEIS.

	Present Conditions	Governance Committee	Water Leasing	Wet Meadow	Water Emphasis
Reach 1 (RM 249-231)		25	22	25	27
Reach 2 (RM 231-202)		21	24	22	23
Reach 3 (RM 202-187)		41	60	44	15
Reach 4 (RM 187-154)		13	14	9	12

Roosting Suitability at the System Scale—North Platte River Hydrology

Roosting suitability at the upper end of Lake McConaughy would be generally similar to Present Conditions for spring and summer flows under each proposed action alternative (Table SC-16). Some reduction in monthly volume passing Lewellen may occur in July under each of the proposed alternatives, but these differences are not statistically significant. There would be an increase in median annual flow at Lewellen under each proposed action alternative, but again, theses increases are not statistically significant.

Spills from Kingsley Dam would be reduced for all action alternatives. Reductions in spill magnitude would be significant for the Governance Committee, Wet Meadow, and Water Emphasis Alternatives (Table SC-16). The frequency of spills would be reduced, and the size of the largest spills would be reduced except under the Water leasing Alternative. Changes in monthly discharge on the North Platte River between Sutherland and North Platte would be similar to Present Conditions, with July experiencing some reduction in flows under some alternatives. Median annual flows at North Platte would be reduced except under the Water Emphasis Alternative.

Table SC-16. North Platte River hydrology system scale indicators for Present Conditions and all proposed action alternatives. Measures are median values in thousand acre feet (kaf) unless specified differently. Bolded values indicate statistical significance ($P < 0.10$).

North Platte Hydrology System-Scale Indicators	Present Conditions	Governance Committee	Water Leasing	Wet Meadow	Water Emphasis
Flows at Lewellen (kaf)					
February	68.7	68.4	68.7	68.7	68.7
March	72.1	71.7	73.9	72.1	72.1
April	73.3	70.4	73.5	70.1	70.1
May	59.9	59.3	59.6	59.4	59.1
June	64.4	62.2	66.8	63.2	62.0
July	51.7	50.6	44.4	50.2	47.2
Median Annual	879.4	908.4	902.0	946.3	950.6
Lake McConaughy Spills (kaf)	169.1	**95.3**	165.6	**82.3**	**102.2**

Average Annual Frequency Largest June Spill Largest Single Spill	0.60 600.9 600.9	0.29 449.0 535.5	0.50 622.0 622.0	0.31 419.9 536.1	0.35 441.7 539.4
Flows at North Platte (kaf)					
February	21.5	22.0	22.0	21.9	22.7
March	24.9	24.6	24.9	25.2	25.2
April	23.4	23.1	23.5	23.6	23.4
May	24.7	24.5	24.7	24.2	25.1
June	33.5	30.9	30.0	32.6	30.2
July	91.1	87.3	78.8	89.9	83.2
Median Annual	391.9	388.9	376.2	391.5	393.7

Food Suitability at the Bridge Segment Scale—Food Abundance

Acres of corn would be reduced somewhat on some managed sites. Acres of corn and invertebrate food would be unchanged by the action alternatives at non-managed sites. Acres of corn potentially restored to lowland grasses would be at most (Wet Meadow Alternative) less than 2.0 percent of the 1998 corn acreage within the Lexington to Chapman (3.5 miles on each side of the river channel) study area. Additional acres of irrigated corn would be lost under the action alternatives through water leasing agreements. The reader is referred to Chapter 5—Agricultural Economics of the FPEIS for a detailed treatment of these losses. Because of the uncertainties that surround waste corn abundance and availability for sandhill cranes, any reduction in waste corn abundance as measured by acres of corn, should be avoided.

As discussed above, median March flows at Overton, Odessa, and Grand Island —for all action alternatives—would be numerically higher than Present Condition flows, and in some cases, significantly higher. A similar situation would exist for February flows (Table SC-12). Higher flows in February and March may make soil invertebrates more accessible to sandhill cranes. The reader is referred to the section on whooping cranes in the FPEIS for a detailed analysis of flows and their effects on wet meadows.

SUMMARY AND DISCUSSION OF POTENTIAL EFFECTS

This assessment addresses sandhill cranes and their spring use of resources along the North Platte and Platte Rivers in central Nebraska, and the potential effects of five alternatives evaluated in the Platte River Programmatic FEIS process. That process evaluates the effects of changing stream flows and managing additional lands along the Platte River for the benefit of whooping cranes, interior least terns, piping plovers, and pallid sturgeon. Sandhill crane use of the Platte River differs from that of the four target species, and thus the effects to sandhill cranes from implementation of any of these alternatives would also differ from predicted effects to the target species. In addition, use of the North Platte River by whooping cranes, interior least terns, and piping plovers is limited, but changes in flow to facilitate habitat benefits for these target species downstream may affect North Platte River reaches used by sandhill cranes.

Roosting Depth Abundance

This assessment predicts a mixed future for resources used by sandhill cranes for roosting and feeding in the Central Platte River Valley. For example, PHABSIM analysis indicates that the Present Condition median flows in March currently exceed the discharge that would maximize the channel area in a depth range suitable for roosting. Roosting-depth abundance is maximized (i.e., that value that would accommodate the greatest number of sandhill cranes) at eight sites between Lexington and Chapman, Nebraska, at flows $\leq$1,600 cfs with a mean of 1,175 cfs (1984-1986). All proposed action alternatives would increase median March flows when compared to Present Conditions. This indicates that transect length within the 3- to 9-inch depth range would be reduced, and if this is a good indicator of roosting suitability, then this resource may be reduced under a channel structure similar to Present Conditions.

The SEDVEG Gen-3 analysis of all channels greater than 170 feet indicates that about one-third of comparisons within six transect groupings also would experience small to moderate reductions in roosting depth abundance. Comparisons between the four action alternatives and Present Conditions indicate reduced roosting depth abundance for all transects (except for the Wet Meadow Alternative), non-managed transects, and transects downstream from Kearney, and for transect in bridge segments 7-2 under the Governance Committee and Water Emphasis Alternatives.   Managed transects would experience increases in roosting depth under all action alternatives. Other increases may occur for all four alternatives in transects upstream of Kearney, and the Full Water Leasing and Wet Meadow Alternatives may increase roosting depth abundance in the bridge segments 7-2 grouping.

A similar analysis of channels greater than 500 feet indicates in general that the all transect category (except under the Water Emphasis Alternative), managed transects, transects upstream from Kearney, and transects in bridge segments 7-2 would benefit most from the proposed action alternatives. Bridge segments 7-2 are currently heavily used by roosting cranes. Sites upstream from Kearney have historically been used by cranes, but that use has shifted to sites downstream from Kearney. If roosting suitability can be improved in bridge segments west of Kearney, and cranes make use of these sites, this would be an important development for crane management within the Lexington to Chapman reach.

Unobstructed Channel Width

Mechanical clearing of islands within the channel would increase unobstructed channel width for sandhill cranes. This should benefit cranes roosting on remaining sites with suitable depth. Implementation of any habitat management plan—such as island leveling—would have site-specific effects, i.e., no two sites are identical and any clearing and leveling would result in different acreage values for unobstructed channel width depending upon features at the implementation site. The actual locations at which management would occur will not be selected until after the preferred alternative is implemented. These circumstances make detailed assessments of the effects of management actions academic at this time.

Channel management activities within the Central Platte Valley have focused on clearing of woody vegetation from islands within the river. Clearing is currently viewed by the Service as an initial step in the process of increasing unobstructed channel width that would occur with complete island removal. Crane use data from the Platte River Whooping Crane Maintenance Trust, Inc. (www.whoopingcrane.org) indicate high crane usage in bridge segment 7 (State Highway 10 to Gibbon) and in bridge segments 5-2 (Shelton to US Highway 34). These five bridge segments have likely received the majority of channel management efforts, and in 2000-2003, accounted for over 85 percent of sandhill crane roost-site usage. These same five bridge segments also accounted for over 85 percent of crane roosting use in 1998-1999. However, such usage cannot be explained by abundant "wide channels" (other segments have as much or more unobstructed width) when cleared islands are treated as obstructions (Table SC-17). These five bridge segments support 40.0 percent of the total channel area, 44.1 percent of unobstructed channel width greater than 501 feet, 65.6 percent of lowland grasses, and 36.4 percent of the corn within 3.5 miles of the river channel. It appears that we do not completely understand the mechanisms of crane habitat selection along the Platte River.

Table SC-17. Channel area, channel width greater than 501 feet, channel area cleared, lowland grasses, corn (1998 acres), and percent nocturnal and diurnal crane use (1998-1999, www.whoopingcrane.org) of bridge segments. Bridge segments are located from about 3.5 miles west of Overton to Chapman, NE, and cover a band 3.5 miles both north and south of the Platte River.

Bridge Segment[1]	Total Channel Area	Channel Width >501 ft	Channel Cleared 1982-1997	Lowland Grasses	Corn	% Cranes Surveyed (nocturnal)	% Cranes Surveyed (diurnal)
12a	644	47	27	639	5323	0.0	1.2
11	838	69	5	2372	15907	0.2	2.1
10	644	350	540	1554	11004	1.0	5.7
9	889	92	39	460	13492	0.3	3.8
8	780	92	441	1483	16336	6.1	9.8
7	723	288	467	2085	14399	26.2	15.9
6	703	172	13	890	16811	3.3	17.0

5	946	238	130	712	24105	16.7	7.8
4	718	308	200	2801	12489	15.0	8.9
3	969	355	277	5940	15263	19.1	19.7
2	847	143	16	4063	1,426	11.6	6.6
1	1865	865	0	5351	25567	0.5	1.1
Totals	10,566	3,019	2154	28,350	186,122	100.00	99.6

[1]Segment 12a - ________ to Overton
Segment 11 - Overton to Elm Creek (State Highway 183)
Segment 10 - Elm Creek (State Highway 183) to Odessa
Segment 9 - Odessa to Kearney
Segment 8 - Kearney to State Highway 10
Segment 7 - State Highway 10 to Gibbon
Segment 6 - Gibbon to Shelton
Segment 5 - Shelton to Wood River
Segment 4 - Wood River to Alda
Segment 3 - Alda to State Highway 281
Segment 2 - State Highway 281 to Grand Island (State Highway 2)
Segment 1 - Grand Island (State Highway 2) to Chapman

There is no "official" management objectives for spring sandhill crane habitat. However, dispersing use throughout the river from Lexington to Chapman is one option. If dispersal is a management goal, then alternatives containing plans for island clearing and leveling dispersed throughout the crane-use area would likely prove most informative and perhaps beneficial. Since five bridge segments currently support over 85 percent of crane usage, it would be interesting to disperse management activities around and through these five segments—for example in segments 11-9, 6, and 2— and observe crane response.

North Platte River Hydrology

No island clearing or leveling would occur on the North Platte River, but flows would change to benefit target species downstream in the Platte River. Roosting suitability at the system scale was evaluated via discharge data from various stream gauges located on the North Platte River. Alternative data were compared to Present Conditions on an annual and seasonal basis (February-April and May-July). Spring flows directly affect conditions for roosting cranes, and early to mid summer (May 15-July 15) flows can affect the success of cottonwood establishment on exposed substrates. Occupation of channel sites by woody vegetation such as cottonwoods during periods of low flow has been linked to channel narrowing. It is assumed that future changes in stream flow would be reflected as changes in sandhill crane roosting habitat through the same relationships between discharge and roosting depth abundance previously described for site-scale evaluations. Unfortunately, few cross-sectional transects are available outside the Lexington to Chapman reach of the Platte River. We are however, assuming that the relationships described for the central Platte River also exist in the North Platte River channel, and changes in future measures of discharge would represent future changes in roosting depth abundance when compared to Present Conditions.

At the system scale, conditions would remain similar to Present Conditions above Lake McConaughy during spring migration. In the Lewellen to Clear Creek WMA reach, spring flows would be very similar to Present Conditions in February and most of March and April. Exceptions involve predicted slightly lower March flows under the Governance Committee Alternative, slightly higher March flows under the Full Water Leasing Alternative, and lower April flows under the Governance Committee, Wet Meadow, and Water Emphasis Alternatives. Although no transect data are available for this reach, lower flows during this period are more likely to benefit roosting depth, than are higher flows.

Summer and median annual flows would be somewhat more varied than spring flows, but all predicted differences would represent a change from Present Conditions of less than 8 percent. Lower flows may expose sediment deposits and these substrates may be colonized by woody vegetation, and additional woody vegetation in the active channel would likely result in reduced channel width and deeper water. However, given the relative magnitude of predicted change in flows, it is unlikely that such changes would produce a measurable response in roosting depth abundance at the Clear Creek Wildlife Management Area and the channel immediately west. However, because the median annual discharge is predicted to increase under all action alternatives, permanent transects should be established in this reach, and channel parameters monitored for changes that may affect roosting suitability.

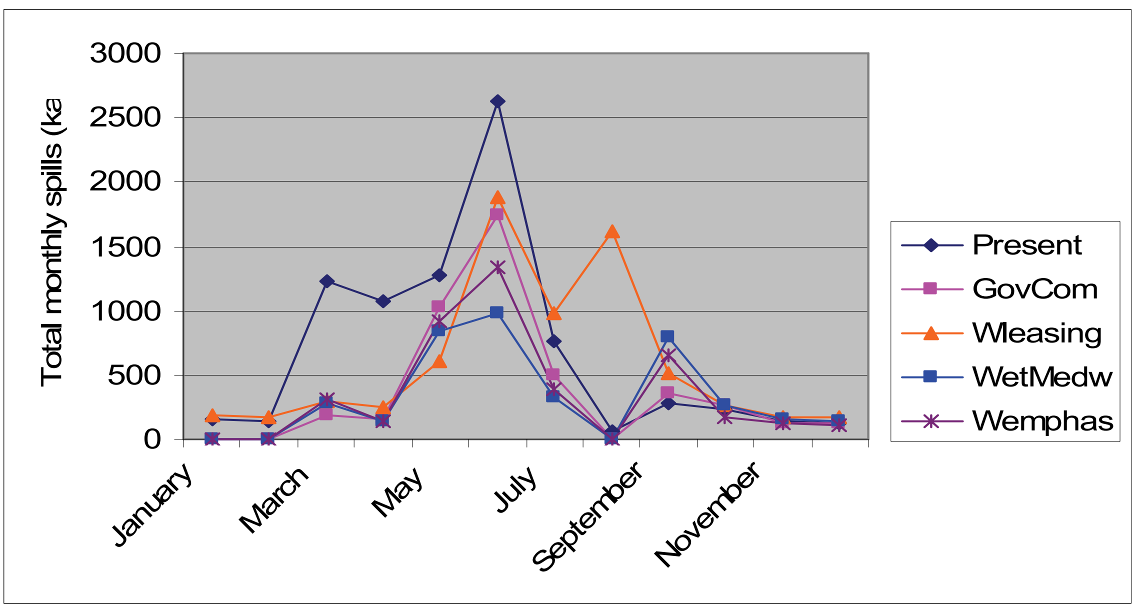
The most influential change in North Platte River hydrology—and its potential effects to sandhill crane roosting suitability—involves proposed reductions in frequency and magnitude of spills from Kingsley Dam (Figure SC-2). Lake McConaughy spills are important in maintaining the current character of the central Platte River channel and any habitat value the channel provides. The closer any particular site is to Kingsley Dam the greater the potential influence from spills. River regulation, such as the construction of dams and reservoirs, generally alters the pattern of seasonal streamflow by flattening periods of high flows and increasing flows during periods (e.g., summer) that historically experienced low or no flows. Reservoirs also trap sediments. The loss of high flows reduces the dynamic process that would otherwise periodically restructure the channel and create sediment deposits (sandbars) of various elevations and longevity. Dam spills, or the unscheduled release of water, provide a reduced-scale function similar to historic high flows, in that they serve to restructure the regulated channel with its remaining sediments.

The Sutherland to North Platte reach of the North Platte River would likely experience measurable changes under some action alternatives. Spring (February-April) and May flows are predicted to be very similar to Present Conditions. June and July flows would experience reduced flows—when compared to Present Conditions—during the cottonwood seeding period. Differences range from < 3 percent under the Wet meadow Alternative, to be > 13 percent under the Full water Leasing Alternative. Median annual flows would be reduced up to about 4 percent.

Although these changes may appear small when considered in isolation, their effects combined with reduced spills from Lake McConaughy may result in measurable channel responses.

A reduction in the frequency and magnitude of spills from Kingsley Dam, reduced median annual discharge passing North Platte, and reduced flows in June and July, indicate the possibility of additional establishment of woody vegetation within the Sutherland to North Platte reach of the North Platte River. Woody vegetation establishment would likely result in channel narrowing and perhaps deeper flows during the spring migration period, and an assumed reduction in roosting depth abundance. Established survey sites exist in this reach but have not been re-surveyed since the early 1980's. Current survey information is needed for this reach. Both the Lewellen to Clear Creek WMA and this reach should be candidates for research and monitoring studies under the Adaptive Resource Management Process. Data are needed to assess whether management actions (changes in discharge) designed to benefit target species downstream may affect sandhill crane roosting habitat in the Lewellen to Clear Creek WMA and/or the Sutherland to North Platte reaches of the North Platte River.

Magnitude of Spills (total spill volume in kaf by month 1947-1994)



Frequency of Spills (total number of spills by month, 1947-1994)

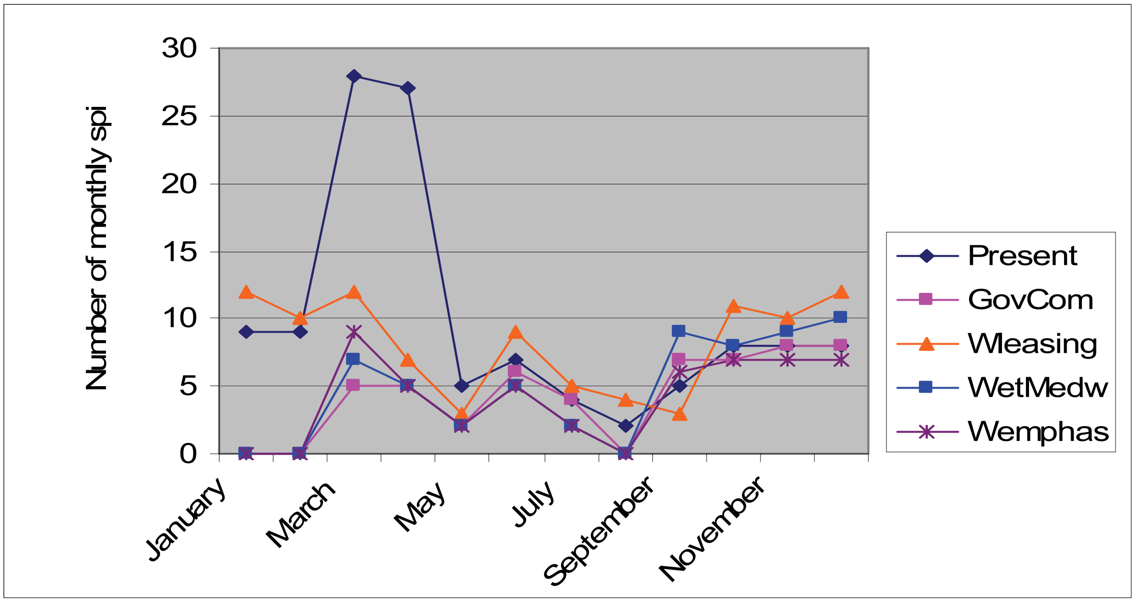


Figure SC-2. The magnitude and frequency of spills from Lake McConaughy under Present Conditions compared to simulated hydrology for the proposed action alternatives over the 48-year period of record.

Food Abundance

While this analysis has focused on roosting habitat and the river channel, the issue of food abundance and its adequacy to meet the needs of sandhill cranes and other wildfowl can not be addressed at this time. However, there are indications that food may be becoming an issue of concern for future management. For example, harvesting efficiency has increased since the last comprehensive studies in the late 1970's, numbers of waterfowl using the Central Platte Valley have increased, cranes are foraging further from the Platte River, and fat storage in larger sandhill cranes and white-fronted geese has been reduced. The abundance and adequacy of waste corn to provide food for sandhill cranes and other wildfowl should be the focus of continuing studies.

CONCLUSIONS

Sandhill cranes are not the focus of proposed actions under evaluation within the Platte River Programmatic EIS process. The results of implementing any of the proposed four action alternatives on sandhill crane habitat would be mixed. Sandhill cranes using the Platte River would likely benefit from an increase in roosting depth abundance and unobstructed channel width at managed sites. However, when data from individual transects are inspected, it appears that while roosting depth at managed sites increases, many non-managed sites experience a reduction in roosting depth abundance. Reductions in habitat at non-managed sites may result in cranes becoming more concentrated at managed sites.

Some action alternatives would convert cropland (e.g., corn ground) to grassland along the Platte River. The abundance of waste corn as food for sandhill cranes and other wildfowl is becoming an issue of concern. The U.S. Geological Survey is currently attempting to replicate components of the Service's 1981 study (Krapu 2003). However, until these data are available, conclusions on the abundance of waste corn and its ability to provide adequate food for all ecosystem components can not be made. As discussed previously, harvesting efficiency has increased since the 1981 study, numbers of waterfowl using the Central Platte Valley have increased, cranes are foraging further from the Platte River, and fat storage in larger sandhill cranes and white-fronted geese has been reduced. The abundance and adequacy of waste corn to provide food for sandhill cranes and other wildfowl should be the focus of continuing studies.

Finally, February and March flows at Platte river sites would increase under all alternatives and should benefit sandhill cranes in their foraging for soil invertebrates in wet meadows. However, increased flows may reduce roosting depth abundance in non-managed sites (see above).

For the North Platte River, roosting suitability at the upper end of Lake McConaughy would be generally similar to Present Conditions for spring and summer flows under each proposed action alternative. Some reduction in monthly volume passing Lewellen may occur in July under each of the proposed alternatives, but these differences are not statistically significant. There would be an increase in median annual flow at Lewellen under each proposed action alternative, but again, theses increases are not statistically significant. Crane roosting habitat above Lake McConaughy in and west of the Clear Creek Wildlife Management Area would likely be least affected by the proposed action alternatives.

Spills from Kingsley Dam would be reduced for all action alternatives. Reductions in spill magnitude would be significant for the Governance Committee, Wet Meadow, and Water Emphasis Alternatives. The frequency of spills would be reduced, and the size of the largest spills would be reduced except under the Water Leasing Alternative.

The Sutherland to North Platte reach of the North Platte River would likely experience changes under the action alternatives. Spring and early summer flows (February-May) would be similar to Present Conditions, with June and July flows somewhat reduced. Median annual flows would also be reduced under the Governance Committee and Water Leasing Alternatives, remain similar to Present Conditions under the Wet Meadow Alternative, and increase somewhat under the Water Emphasis Alternative.

Reduced June and July flows, reduced average annual discharge passing North Platte, and a reduction in the frequency and magnitude of spills from Kingsly Dam, indicate the possibility of further establishment of woody vegetation. Woody vegetation establishment would result in channel narrowing and perhaps deeper flow during the spring roosting period. These factors are consequences of management actions under the proposed action alternatives and may result in reductions of roosting suitability within this reach. Reduced spills from Lake McConaughy may exacerbate the channel narrowing processes within this reach

In summary, sandhill cranes using the Lexington to Chapman reach of the Platte River may benefit from some management activities (increased roosting depth abundance at some sites, increased unobstructed channel width, and increased lowland grassland) performed at specific sites for target species. However, there are indications that roosting depth abundance may be reduced at sites represented as non-managed transects. Those transects that currently support most night roosting below Kearney (bridge segments 7-2) indicate that roosting depth abundance may increase under all action alternatives. The validity of these projections, and their implications to sandhill cranes, should be a priority for research and monitoring studies under the Adaptive Resource Management process.

Changes in flow regime within the Sutherland to North Platte reach may be problematic for sandhill cranes using these sites. Established survey sites exist within the Sutherland to North Platte reach, but have not been surveyed since the early 1980s. Current survey information is needed for this reach. This reach should be a candidate for research and monitoring studies under the Adaptive Resource Management process.

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Sandhill Cranes Appendix

SPRING HABITAT USE IN NEBRASKA

Biological Attachment A

This attachment contains discharge-roosting depth abundance relationship information for eight habitat transect sites on the Platte River in central Nebraska. Sites were originally surveyed between 1983 and 1986, and were re-surveyed between 1998 and 2001. Data for each site includes a graphic comparison of total wetted width and wetted width supporting 3-9 inch depths, and supporting tabular data, for each survey period.

Sandhill Cranes Appendix

SPRING HABITAT USE IN NEBRASKA

Biological Attachment B

This attachment contains discharge-roosting depth abundance relationship information for eight habitat transect sites on the Platte River in central Nebraska. Sites were originally surveyed between 1983 and 1986. Data for each site includes a graphic depiction of total wetted width, wetted widths supporting 3-9 inch depths and depths greater than 12 inches, and supporting tabular data.