Programmatic Environmental Impact Statement
Technical Appendix

Piping Plovers and Interior Least Terns Appendix

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Platte River

Recovery Implementation Program
Technical Appendix

PIPING PLOVERS AND INTERIOR LEAST TERNS

INTRODUCTION 02-25-06

Technical appendix material has been previously developed for the Platte River Recovery Implementation Program—Final Programmatic Environmental Impact Statement (FPEIS) for piping plovers and least terns. That material (USDI 2004) contains valuable background information on piping plovers and interior least terns, and the resources that have been historically used by these species along the Platte River. However, action alternatives have changed somewhat from those described in the draft environmental impact statement (DEIS), and readers should review changes to alternatives in the FPEIS before reading this appendix. In addition, review comments received in response to the DEIS have resulted in extensive revisions to impact indicators and analyses originally used for the DEIS. Those revisions are the subjects of this technical appendix.

Background

Piping plovers (plovers) are migratory shorebirds that spend approximately 3-4 months utilizing northern breeding habitat before moving to wintering sites along beaches in the Gulf of Mexico or Atlantic Coast. The Northern Great Plains population of piping plovers utilizes suitable breeding habitat along prairie rivers and on alkali wetlands from Alberta to Manitoba, and south to Nebraska (Haig et al. 1988). Plovers generally arrive for the nesting season along the central Platte River between early April and early May, with nest initiation beginning in mid May to mid June (Bent 1929, Tout 1947, Faanes 1983).

Interior least terns (terns) are also migratory and historically used suitable nesting sites along the Missouri, Arkansas, Mississippi, Ohio, and Rio Grande river systems (Sidle and Harrison 1990). Terns also arrive for the nesting season along the Central Platte River between early April and early May, with nest initiation beginning in mid May to mid June (Bent 1929, Tout 1947, Faanes 1983).

Both species utilize sediment deposits—exposed sand and/or small gravel bars—and sites to which the birds respond as if they are sediment deposits (e.g., beaches, parking lots, roof tops, etc.), for nesting. Potential nest sites support no or sparse vegetation at nest initiation and are usually in close proximity to surface water. In Nebraska, plovers and terns have been reported nesting on sand/gravel spoil piles (generally waste material remaining from flood-plain aggregate mining operations—these sites are known as "sand pits") and on exposed sandbars in the Missouri, Niobrara, Elkhorn, and North, South, and Platte Rivers, on sediment deposits on the Loup River, and on beaches at Lake McConaughy (Haig et al. 1988, Sidle and Harrison 1990).

Selected recent (1992-2004) plover and tern nesting data are provided in Table PT-1 in order to provide examples of relative use of nesting sites within the area of the proposed action. Note that these data are presented for illustration only—they come from several sources and were collected with a variety of methods for a variety of purposes (Lingle 2004, Central Nebraska Public Power and Irrigation District and Nebraska Public Power District 2005). These data do indicate however that channel nest sites in the Platte River between Lexington and Chapman produce fewer fledged plovers and terns than do other sites within the study area.

Data in Table PT-1 in the column identified as "Central Platte Islands" were collected from managed islands within the channel between Lexington and Chapman. "Managed" refers to some type of anthropomorphic activity generally directed at vegetation—such as clearing, mowing, disking, spraying, or dredging of sediment—believed to improve nesting conditions for plovers and terns. The distinction between managed and naturally formed and maintained islands is important, and is the basic focus of some measures addressed in the FPEIS. Currently, the last recorded nesting on naturally formed and maintained sandbars in the central Platte River occurred in 1989 (least tern) and 1990 (piping plovers) (Lingle 2004). However, some survey records indicate that nesting attempts may have occurred on naturally formed sediment deposits as late as 1996, and the U.S. Fish and Wildlife Service (Service) is currently reviewing those records. The Service believes that successful nesting on naturally formed and maintained sandbars is essential to the long-term well being of plover and tern populations using the Platte River Basin.

Present Condition hydrology and sediment supply do not create sandbars that currently support successful nesting in the central Platte River channel. Sandbar elevation is generally either not high enough to prevent annual flooding, or too high to permit frequent overtopping of flows that would prevent the establishment of dense vegetation.

Data in Table PT-1 could be interpreted as indicating that other sites—for example, Lake McConaughy and sandpits—provide adequate nest resources for plovers and terns. While important, non-channel sites do not produce enough young birds to meet population recruitment needs. For example, piping plovers in the Northern Great Plains declined 15 percent from 1991 to 2001, while Nebraska plovers declined 25 percent during the same period (National Research Council 2004).

Table PT-1 Summary of Indicator Values for Piping Plovers and Interior Least Terns by Alternative

Table PT-1. Piping plover and least tern nesting information from selected sites within the Platte River Valley 1992-2004.

PIPING PLOVERS --- = no data

	Lake McConaughy		South Cozad Pit		Central Platte Islands		Central Platte Pits		Lower Platte Channel		Lower Platte Pits	
YEAR	# Nests	# Fledged	# Nests	# Fledged	# Nests	# Fledged	# Nests	# Fledged	# Nests	# Fledged	# Nests	# Fledged
1992	66	71	2	4	0	0	7	5	---	---	---	---
1993	83	110	4	1	8	0	6	13	---	---	---	---
1994	50	65	4	8	7	1	21	8	27	28	9	8
1995	37	6	3	6	7	3	17	14	0	2	22	24
1996	60	37	6	6	13	3	10	16	6	0	20	0
1997	40	17	3	8	3	6	12	20	20	0	32	35
1998	25	13	4	4	5	1	8	17	1	2	29	8
1999	34	24	4	0	3	2	9	10	---	---	15	8
2000	33	74	3	5	2	3	10	23	9	5	45	22
2001	51	112	2	1	0	0	10	23	9	13	22	25
2002	69	132	3	0	0	0	20	28	---	---	---	---
2003	118	205	1	3	0	0	18	24	19	17	23	20
2004	183	371	0	0	---	---	---	---	---	---	---	---
Totals	849	1237	39	46	48	19	148	201	91	67	217	150
Total Fledged/Total Nests		1.5		1.2		0.4		1.4		0.7		0.7

LEAST TERNS --- = no data

	Lake McConaughy		South Cozad Pit		Central Platte Islands		Central Platte Pits		Lower Platte Channel		Lower Platte Pits	
YEAR	# Nests	# Fledged	# Nests	# Fledged	# Nests	# Fledged	# Nests	# Fledged	# Nests	# Fledged	# Nests	# Fledged

1992	14	13	13	7	0	0	31	4	---	---	---	---
1993	10	6	12	4	4	5	29	49	---	---	---	---
1994	5	1	13	15	0	0	73	49	216	130	59	19
1995	4	4	12	4	14	16	55	41	5	23	109	16
1996	5	8	3	7	13	16	32	46	48	0	59	0
1997	7	11	8	10	10	13	35	49	120	0	116	81
1998	7	5	10	4	4	1	31	18	19	0	85	8
1999	3	5	6	5	3	0	24	23	---	---	---	---
2000	2	4	4	4	0	0	21	30	52	11	178	79
2001	8	13	4	6	0	0	27	45	64	52	95	26
2002	12	20	4	3	0	0	53	59	---	---	---	---
2003	14	19	2	1	0	0	67	49	109	109	84	87
2004	19	26	5	5	---	---	---	---	---	---	---	---
Totals	110	135	96	75	48	51	478	462	633	325	785	316
Total Fledged/Total Nests		1.2		0.8		1.1		1.0		0.5		0.4

The National Research Council (2004:203) reviewed existing information on plover and tern populations in the Northern Great Plains and Nebraska, and commented on the importance of channel nesting in the central Platte River:

> "The committee also concluded that suitable habitat characteristics along the central Platte River are essential to the survival and recovery of the piping plover and interior least tern. No alternative habitat exists in the central Platte that provides the same values essential to the survival and recovery of piping plovers and least terns. Although both species use artificial habitat (such as shoreline areas of Lake McConaughy and sandpits), the quality and availability of sites are unpredictable from year to year."

The Platte River channel between Lexington and Chapman is the focus of impact assessment for both plovers and terns. This reach is the focus of analysis because, as potential nesting habitat, it exhibits indications (e.g., lower numbers of young fledged when compared to other sites) that nesting conditions are less favorable here than those at other sites. Less favorable nesting conditions within this reach are believed linked to an altered hydrograph, reduced flows, reduced sediment supply, and other issues as discussed in Chapter 2—and more specifically in Chapter 4 of the FPEIS—River Geomorphology.

As discussed below, other areas and/or issues will also receive attention during impact assessment to ensure that potential alternative effects are documented. These areas include Lake McConaughy, the Platte River between North Platte and Lexington (river channel and sand pits), and the Platte River between Chapman and Columbus, Nebraska.

Modifications to Original Indicators

Several impact indicators for both plovers and terns were evaluated in the DEIS. Those indicators and their treatment in the DEIS generated considerable comments during the review process. The review process and subsequent analyses have resulted in a reorganization of indicators to focus the analysis on the river channel between Lexington and Chapman. Some of the original indicators were dropped from further analyses, or received further analyses and were moved to other sections within the FPEIS, and some additional issues were addressed. This appendix attempts to address changes since the original appendix was developed, and present additional analyses as appropriate.

Channel Width, Channel Stability, and Sediment Transport

Historic accounts and contemporary studies indicate that plovers and terns that nest within stream channels generally do so on dry sandbars—with less than 25 percent vegetative cover—that are located near midstream in wide, open channels (Faanes 1983, Schwalbach 1988, Ziewitz *et al*. 1992). The natural occurrence (as opposed to mechanically maintained) of bare sandbars with little or no vegetation implies an abundant sediment supply and flows high enough to retard vegetation development through periodic inundation and restructuring of sediment deposits that are not anchored

with large woody vegetation. It is assumed that peak or high flows in the pre-regulation hydrograph, and significant post-regulation spills from Lake McConaughy, provided the dynamic interaction of sediment and hydraulic energy necessary to periodically restructure sediment deposits into sandbars subsequently used by plovers and terns within the Central Platte and Lower Platte Rivers. Examples of the pre-regulation hydrograph and significant post-regulation spills from Lake McConaughy can be found in the FPEIS.

The dynamic interactions between flow and sediment have been altered in the Platte River system over the last 65-100 years. Parameters linked to channel dynamics such as channel width, stability, and sediment transport were used as indicators for plovers and tern nesting in the DEIS. Channel width would be mechanically manipulated under various alternatives, and channel stability and sediment transport are inherent considerations of the SEDVEG Gen3 Model. While important impact indicators, these indicators are addressed in depth in other sections of the FPEIS, and those analyses need not be repeated here. Here, channel dynamics are referenced as addressed in depth within the FPEIS and other appendices. For example, channel stability and sediment transport are treated in detail within Chapter 4—River Geomorphology, of the FPEIS. Channel stability, sediment transport, and change in the frequency and magnitude of spills from Lake McConaughy are also treated in the FPEIS, and below in less depth under the heading of "Channel Resources".

Water Quality

The DEIS addressed selenium, turbidity, and water temperature as possible issues of concern for plovers (selenium may bioaccumulate and cause reproductive impairment) and terns (change in turbidity may affect vulnerability of forage fish and high water temperature may adversely affect forage fish).

Selenium is a naturally occurring semi-metallic trace element with biochemical properties similar to sulfur. Portions of the Republican River Basin south of the Platte River are underlain with deposits of Cretaceous marine shales containing selenium. Selenium from soils derived from shales, or groundwater containing selenium, can enter surface waters through natural runoff and/or through constructed pathways such as irrigation return flows. Historically, most selenium issues were restricted to the Republican River Basin. The groundwater mound south of the Platte River has created conditions that now make seleniferous groundwater potentially available to the Platte River Basin. The Platte River receives some selenium from the South Platte River, and a smaller portion from the North Platte River, but the majority of selenium comes from the groundwater mound south of the Platte River (see Water Quality Appendix).

Selenium is an essential trace nutrient necessary for normal metabolic functions. Because of its similarities to sulfur, selenium is readily incorporated into an organism's body during protein synthesis and other metabolic pathways. One of the interesting features of selenium is the narrow margin between nutritionally optimal and potentially toxic dietary exposure concentrations for vertebrates (U.S. Department of the Interior 1998). The toxic effects result from the incorporation of selenium—rather than sulfur—

in amino acids, and the subsequent alteration of protein structure and impaired enzymatic function (Amweg *et al*. 2003). Effects of selenium toxicity (selenosis) range from hair/feather loss to death, with reproductive impairment a common concern in wildlife studies.

Selenium is an important consideration in fish and wildlife studies because of bioaccumulation. Bioaccumulation is a process that results in the sequestering of an outside substance within the organism at a concentration higher than the organism's outside environment. Although selenium can be acquired through the gills or skin, dietary exposure is the dominant uptake pathway in animals (Hamilton 2004). The largest "step" in the bioaccumulation process occurs when selenium concentrations go from parts per billion (ppb) in water to parts per million (ppm) in plants and invertebrates. As additional layers, or trophic levels, of fish and wildlife feed on lower food-chain levels, selenium may bioaccumulate and can reach concentrations resulting in reproductive impairment or death.

Birds exhibit rapid accumulation and loss patterns for selenium (Heinz 1996). Because of these patterns, selenium concentrations in eggs are good representations of local selenium levels. The embryo is also the most sensitive stage of a bird's life cycle to selenium. Therefore, selenium concentrations in eggs are a sensitive measure for evaluating selenium risks to birds. Extensive selenium studies over a range of conditions and locations have permitted the development of probable effect levels tied to various selenium concentrations in bird eggs. For example, Heinz (1996) reviewed numerous laboratory and field studies and concluded that a reproductive toxicity threshold occurred for bird eggs with selenium concentrations of about 10 ppm dry weight (dw). At this level, egg viability (hatchability) would begin to be reduced. However, this concentration (about 10 ppm dry weight dw) should be viewed as a general guideline because some birds are more sensitive to selenium, and other birds are less sensitive. For example, the threshold level for reproductive toxicity in black-necked stilts is 6 ppm dw (Skorupa 1998), and the National Irrigation Water Quality Program (NIWQP) Guidelines recommends 3-6 ppm dw selenium in eggs as a "level of concern", and a "toxicity threshold" level at > 6 ppm (U.S. Department of the Interior 1998).

Reclamation scientists evaluated contaminants in plover (n = 64) and tern (n = 38) egg data collected between 1991 and 1993, and provided by the U.S. Fish and Wildlife Service (see Water Quality Appendix for details). Selenium concentrations in plover eggs ranged from a minimum of 2.7 ppm dw to a maximum of 15.0 ppm (median = 5.3 ppm). Tern eggs ranged from 1.1 ppm dw selenium to a maximum of 7.8 ppm (median = 4.9). The egg viability threshold for plovers or terns has not been identified, but both plover and tern egg median selenium concentrations fall within the NIWQP level of concern for bird eggs, and some eggs would have exceeded the toxicity threshold level.

If Heinz's (1996) conclusions—that egg concentrations reflect local food-chain levels of selenium—are correct, then aquatic invertebrates (plover food) and fish (tern food) in the central Platte River may be experiencing bioaccumulation of selenium. No selenium concentration data for invertebrates were found, but Reclamation scientists did evaluate

fish data (1983-1997) provided by the Nebraska Department of Environmental Quality (see Water Quality Appendix for details). The wet weight concentrations of selenium in these samples ranged from a minimum of 0.52 ppm to a maximum of 4.73 ppm (median = 1.41 ppm). (Note that the conversion of wet weight concentrations to dry weight would result in a higher dry weight concentration). Although there was a trend for increasing selenium concentrations with time, the fish were all large (smallest was about 5 inches) rather than the small fish (~ 1.5 inches) terns eat, and there was a trend for more recent samples to be processed as fillets rather than whole body samples (whole body concentrations would likely be higher). Therefore, these sample data can not be used directly to evaluate selenium bioaccumulation risk to terns on the central Platte River. However, the presence of selenium concentrations in both tern and plover eggs within the level of concern, and higher, indicate the need for targeted sampling and selenium-concentration analyses of plover and tern food in future studies.

Two of the action alternatives have the potential to increase selenium concentrations in the central Platte River, if proper precautions are not taken (see Water Quality—Chapter 5 of the FPEIS and the Water Quality Appendix). For example, the Water Emphasis Alternative would use riverside drains to augment Platte River flows. Drains should not be installed on the south side of the river where they may intercept the groundwater mound and convey water with elevated selenium levels into the Platte River. Other locations may be found that would achieve the alternative's objective but avoid areas of higher selenium concentrations.

Both the Governance Committee Alternative and the Water Emphasis Alternative contain an element which involves management of the groundwater mound south of the central Platte River. The Governance Committee Alternative's Water Action Plan contains an element that has several options for managing or using this groundwater to increase Platte River flows. All options would be the subject of further feasibility analysis as well as NEPA analysis prior to selection and implementation of an approach. Options that would remove water from the groundwater mound containing high levels of selenium and move that water to the Platte River should be avoided. Other approaches, such as conjunctive use plans that would store and retrieve Platte River water from the mound to use for irrigation should not increase selenium inputs to the Platte River, but any plan should be carefully evaluated for selenium issues prior to implementation.

The Governance Committee Alternative contains another Water Action Plan element, the Dry Creek/Fort Kearney Cutoff, that also has the potential to increase selenium inputs to the Platte River by moving either water from Funk Lagoon or agricultural drain water to the river. This element should also be carefully evaluated—prior to implementation—for possible transport of selenium to the Platte River.

We agree with Water Quality Appendix recommendations for a selenium monitoring effort designed to address both potential food-chain bioaccumulation and potential reproductive toxicity thresholds in plovers and terns. Selenium concentrations within their respective food chains may be a factor limiting the reproductive potential of some plovers and terns feeding from the central Platte River. However, a change in selenium

concentration in Platte River water—if proper precautions are taken—is not among the potential effects of the proposed action addressed in the FPEIS. Without a change in water concentrations, no obvious mechanism exists to alter food-chain concentrations, and ultimately selenium concentrations in plover and tern eggs. This means that present condition selenium concentrations in the central Platte River would continue under any alternative implemented—if the above precautions are addressed. Selenium has therefore been eliminated from further analysis in the FPEIS.

Turbidity was also addressed in the DEIS as it relates to forage fish. The treatment of turbidity is addressed below under forage fish.

Invertebrate Food

The DEIS addressed invertebrate food as a possible issue of concern for piping plovers using channel nesting sites in the Platte River reach between Lexington and Chapman. We have re-examined the significance of invertebrate food as a limiting factor for nesting plovers feeding from or near the Platte River.

Piping plovers are sight feeders obtaining food on or near the surface substrate (they do not probe), or from wave wash. Definitive food-habit studies that actually identify prey items taken by plovers are limited. Plovers appear to consume the same types of invertebrates in the same proportions to what is available at feeding sites (Haig and Elliott-Smith 2004). Most studies observe feeding plovers and then try to determine what is available as potential food. For example, Corn and Armbruster (1993) sampled surface and subsurface sites at various distances from water at both channel and sandpit locations frequented by feeding plovers along the central Platte River. Adult life stages of terrestrial insects dominated both channel and sandpit surface samples, with channel sample sites producing a greater diversity and abundance of terrestrial insects.

Investigators speculated that terrestrial insects flew into or were blown into channel and sandpit sites from surrounding uplands. Channel sites may also have exhibited greater diversity and abundance of insects because of more diverse juxtaposed vegetation than that supported by or near sandpits. In addition, channel sites also generally supported more surface area of moist sediment edge (e.g., dry sand—moist edge—water), and may have thus attracted more insects than did sandpit conditions. Subsurface sediment samples produced few potential food items. Some insect larvae and annelid worms were recovered from fine (e.g., silt) near-bank channel sediment deposits (and such sites may have been the source of some terrestrial adults such as dipteran flies), but few potential food items were recovered from subsurface channel sand deposits regardless of the distance to water.

No indication that food limits adult plovers (reviewed by Haig and Elliott-Smith 2004), or young in channel nesting situations was found in the scientific literature. Mechanical restructuring of the channel at some sites under some proposed action alternatives may remove some vegetated islands that support some insects, but other sources of terrestrial insects would remain. In addition, the mechanical restructuring of channel sites may

increase the attractiveness of such sites to terrestrial insects by increasing the area of moist sediment edge. Because of these considerations, the abundance of invertebrates as food for piping plovers has been eliminated from further analysis.

There is a potential issue with invertebrates as food for piping plovers that warrants further study in the Program's first increment. The issue is selenium and the potential for this element to bioaccumulate within the plover's food chain. As discussed under the Water Quality section above, plovers—and terns—have exhibited median egg selenium concentrations within the NIWQP's level of concern. It is highly likely that selenium sources are local and that bioaccumulation occurs through invertebrate prey. Aquatic invertebrates were less abundant than terrestrial insects in samples collected by Corn and Armbruster (1993), but aquatic invertebrates (e.g., insect larvae) are the likely link between water and perhaps sediment selenium concentrations and selenium levels in plover eggs.

We agree with Water Quality Appendix recommendations for a selenium monitoring effort designed to address both potential food-chain bioaccumulation and potential reproductive toxicity thresholds in plovers and terns. Selenium concentrations within their respective food chains may be a factor limiting the reproductive potential of some (e.g., selenium egg concentrations > 10 ppm) plovers and terns feeding in and/or along the central Platte River. However, a change in selenium concentration in Platte River water is not among the potential effects of the proposed action addressed in the FPEIS.

Forage Fish

No indication that food currently limits least terns from nesting on channel sandbars in the central Platte River between Lexington and Chapman was found in the scientific literature. However, no definitive studies have been conducted that evaluated the link between prey abundance and nesting success. Obviously, no flow (i.e., a dry channel) or very low flow conditions would affect forage fish, and thus least terns if such a flow event occurred during the nesting season. Currently, we are uncomfortable with our ability to predict no-flow events, but believe we can identify temperature thresholds and use them—as described below—as indicators of potential lethal or no-flow events.

Forage fish are an important resource to nesting terns and an important component of their respective aquatic communities. Forage fish are treated in depth in the Central Platte Forage Fish section of the FPEIS. Forage fish are also treated here—with reference to the Forage Fish and Water Quality sections of the FPEIS—as a component of tern channel nesting habitat, and occur under "Channel Resources" below.

IMPACT INDICATORS AND ASSESSMENT METHODS

The indicators addressed here for both piping plovers and interior least terns include:

- flow potential to build sandbars
- fledging days

- non-channel nest sites
- channel resources.

This analysis relied heavily on output from the SEGVEG Gen3 Model and the Platte River Hydrology Operations Model (Ops Model). These tools are addressed elsewhere within the FPEIS, and in their respective appendices. SEGVEG Gen3 output for analysis of flow potential to build sandbars, and fledging days, were manipulated post-processing with spreadsheet routines developed by Reclamation scientists. As might be expected, the post-processing of SEDVEG Gen3 output generates large volumes of data. Example output from these manipulations are provided in Attachment A, but the routines are too large for inclusion. Readers interested in the routines should contact the addressee listed with the FPEIS.

Hydrology data from the Ops Model were evaluated and it was determined that these data distributions were non-normal. Statistical analyses were therefore preformed on Ops Model output using the Mann-Whitney U test with $\alpha = 0.10$. No statistical evaluations of SEDVEG Gen3 output were performed.

Flow Potential to Build Sandbars

The DEIS evaluated flow potential to build sandbars at two time intervals; a 1-year interval and a 3-year interval. The analysis in the FPEIS relies on a 1.5-year flow and that analysis is presented in Chapter 4 and 5—River Geomorphology, of the FPEIS. Only summary information is present here and the reader is referred to the detailed analysis presented in FPEIS for further information.

Plovers and terns utilize exposed sediment deposits (sandbars) in the river channel for nesting that provide some elevation protection from minor increases in flow during the nesting season. Potential nest sites generally support no or very sparse vegetative cover at nest initiation. Sandbars require frequent disturbance such as overtopping or restructuring by higher river flows in order to remain both vegetation-free and high enough to prevent nest inundation.

The indicator used here to represent flow potential to build sandbars is used in the River Geomorphology section of the FPEIS in comparisons of surface elevations for mean annual flows and 1.5 year flows. Basically, the indicator evaluates the difference in water surface elevation between the mean annual flow and the 1.5-year flow events for each alternative. The assumption here is that the greater the difference, the greater the potential to overtop sandbars and possibly deposit new sediments and/or scour any annual vegetation that may have developed during the previous growing season. Chapter 5—River Geomorphology, of the FPEIS provides data for four river reaches:

- Reach 1—Jeffreys Island (River Mile-RM 249) to Elm Creek (RM 231)
- Reach 2—Elm Creek (RM 231) to Gibbon (RM 202)
- Reach 3—Gibbon (RM 202) to Wood River (RM 187)
- Reach 4—Wood River (RM 187) to Chapman (RM 154)

The reader should note that because the difference between annual mean flow and 1.5-year flow events is not linked directly to existing sandbars or channel nest sites, the value serves as an indicator to flow potential to build sandbars with limited vegetation and suitable elevation for nesting. The indicator is useful in comparing relative differences between Present Conditions and proposed action alternatives.

The indicator—flow potential to build sandbars—values were obtained by post-processing manipulations of some portions of the SEDVEG Gen3 Model output. It was assumed that management activities—both flow and mechanical channel restructuring—would occur throughout the 13-year first increment period of the Program. 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, data from the 48-year post alternative implementation period were used in all analyses. It is believed that this period better represents conditions with any of the alternatives in place.

Fledging Days

The remaining requisite for successful channel nesting—if sandbars of adequate height and limited vegetation are available (above indicator)—is a period of reasonably steady or even declining flow without the danger of inundation to established nests. If suitable channel sites are available, plovers and terns may nest on exposed sediments in close proximity to the water surface level. However, their nests are at constant risk from rising water levels. If the water surface level rises to or above the elevation at which a nest is located, the nest and its eggs and/or young would be lost.

Piping plovers may begin nest initiation as early as May 1, and require at least 53 days before the young fledge. "Fledging" references the developmental attainment of flight by young birds and is often used to identify the beginning of independence from parental care. Fledging is used here in reference to successful nesting attempts. Although several other variables are involved, successful nesting is a requisite to increasing numbers of plovers and terns. Least terns may begin nest initiation as early as May 20, and need at least 46 days until the young fledge. The indicator—fledging days—is defined here as the number of inundation-free consecutive days in excess of those days needed for plover or tern nests to successfully fledge young. It is assumed that the longer this period lasts the higher the probability of nests avoiding inundation.

The fledging-day value is calculated within the period May 1 (plovers) or May 20 (terns) through August 15. The value itself is the 48-year mean number of days in excess of the minimum needed for fledging, with water surface elevations less than the elevation on the day the count begins. For example, the count for plovers would begin on May 1 and compare the water surface elevation on that day with each subsequent day's surface elevation. If water surface elevations are less than those elevations on May 1 at the end of 53 days (for plovers), the count of fledging days would begin and continue until the water surface elevation exceeds the elevation on May 1. The count is restarted at any

time after May 1 on the day water surface elevations exceed the elevations of the start date. Multiple restarts are possible as long as a 53-day interval remains before August 15. The procedure for terns is identical except for a May 20 start date and duration of the nesting cycle (46 days).

It was determined that a count of nesting days and the tracking of water elevations would begin on May 1 for plovers and May 20 for terns for purposes of analysis. Obviously, plovers and terns may not elect to initiate nests on these dates, and current information from sandpit nests, and current and historic hydrographs indicate that nest initiation may often occur later than these dates. The count-restart mechanism mimics re-nesting attempts and allows the identification of an inundation-free period regardless of where it occurs within each of 48 potential nesting seasons (the Ops Model period of record used as input for SEDVEG Gen3).

SEDVEG Gen3 transect outputs were grouped to facilitate evaluations of different management options and river reaches. These groupings included:

- all transects (all 62 transects providing output data within the study area)
- managed transects (9 transects representing actions such as island leveling)
- non-managed transects (the remaining 53 transects not receiving management)
- 26 transects above (upstream from) Kearney (managed and non-managed)
- 36 transects below (downstream from) Kearney (managed and non-managed)

Most groupings are self explanatory, except perhaps for the Kearney division. There are indications that the channel may function differently above Kearney than below Kearney and the reader is referred to Chapter 4—River Geomorphology of the FPEIS for details.

This analysis approach has limitations. For example, water elevations used to develop the fledging day value are not linked directly to existing sandbars or channel nest sites. Because of these limitations, the fledging day value serves best as an indicator to potential successful nesting, and is useful in comparing relative differences between Present Conditions and other alternatives.

Non-Channel Nest Sites

This indicator addresses potential effects from proposed alternatives on beach nesting at Lake McConaughy and nesting at sandpits within the Lexington to Chapman reach of the central Platte River.

Beaches at Lake McConaughy have become important nesting areas for piping plovers and least terns, especially during the recent regional drought (Table-PT-1). The May end-of-month elevations for Lake McConaughy is used as an indicator to beach area available for use by plovers and terns. The end of May was selected because most inflow would be in storage and plovers and terns would have initiated, or be initiating, nests on exposed beaches. It is assumed with this assessment that median lake surface elevations less than Present Conditions would represent an increase in beach area. As in the above

analysis, this value is not linked directly to the suitability of existing nesting areas, and thus the value serves only as an indicator to potential use by plovers and terns. The value is useful in comparing relative differences between Present Conditions and other alternatives.

Sandpits can provide conditions that support successful plover and tern nesting (Table-PT-1). Some sandpits are currently actively managed for plover and tern nesting habitat along the central Platte River Lexington to Chapman reach. Managed sandpits are generally post-mining operations sites where vegetation is controlled. Some sites are also protected by some type of predator control. Some alternatives in the FPEIS propose to increase the acreage of sandpits managed for plover and tern nesting. It is assumed that an increase in area of managed sandpits suitable for nesting would benefit plovers and terns. No statistical comparisons on area of managed sandpits were performed.

Channel Resources

This indicator spans a rather diverse group of resources and measures that are generally indirectly tied to plover and tern habitat resources in the central Platte River. Specifically, they address the frequency and magnitude of spills from Lake McConaughy, annual flow volume at Cozad, water quality parameters between Lexington and Chapman (for forage fish), and median July flows at Grand Island. The selection rational and description of each member of this group are provided below.

Lake McConaughy 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 (see Hydrology section in the FPEIS for details). 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.

Lake McConaughy spills are important in maintaining the current character of the central Platte River channel and any habitat value the channel provides. Future frequency and magnitude of spills from Lake McConaughy were evaluated for change from Present Conditions.

Annual Flow at Cozad

Plovers and terns make some use of the river and adjacent sandpits between North Platte and Lexington. Table-PT-1 provides one example of sandpit use within this reach. This example is the largest site—in terms of nests and continuous data—within the reach, but

other examples of more limited use also occur (Central Nebraska Public Power and Irrigation District and Nebraska Public Power District 2005).

The purpose for evaluating annual flow at Cozad is linked to the assumption that the river channel is currently providing resources such as food for both plovers (adults and young often move to the channel to feed post-nesting—Lingle 1993) and terns (the channel likely provides a more diverse and therefore potentially more suitable fish prey base than found at most sandpits. The annual flow volume at Cozad, along with the frequency and magnitude of spills from Lake McConaughy, provide indicators of channel maintenance processes at work within this reach. It is assumed that these indicators of channel processes reflect conditions that currently support resources (e.g., food) used by nesting plovers and terns between North Platte and Lexington. Deviations from current channel processes that dictate current conditions supporting these resources, may affect plovers and terns use of this river reach.

Water Quality Parameters and Forage Fish

Numerous factors affect habitat suitability for fish in the central Platte River. Many of these factors are addressed in detail in the Water Quality and the Central Platte Forage Fish sections of the FPEIS, and their respective appendices. A subset of those parameters—water temperature and turbidity—are discussed here for least terns.

The probability of July temperatures exceeding 90º F at Grand Island is used here as an indicator of summer channel conditions for forage fish. July was selected because forage needs should be high during this month as tern young hatch. A fish kill resulting from high temperatures could locally affect nesting terns with young. The temperature (90º F) is a State water quality parameter.

Turbidity is also treated in detail in the Water Quality and the Central Platte Forage Fish sections of the FPEIS. Median and maximum Jackson Turbidity Units (JTU) are used here as an indicator to the more detailed analyses of turbidity that occurs in the Water Quality Appendix and water quality sections within the FPEIS.

July Flows at Grand Island

Plovers and terns nest on sandbars in the Platte River between Chapman and the river's confluence with the Missouri River (Table-PT-1). It is assumed that Present Conditions within the channel (i.e., flow and sediment transport) support resources that permit successful plover and tern nesting in the lower river. Most channel nesting in the lower river occurs between Columbus and the Missouri River (Sidle et al. 1993, Kirsch 1996), and would likely be most influenced by the Loup River It is unlikely that plover and tern nests located in the channel below the Loup River would be affected by actions associated with alternatives proposed in the FPEIS. However, this assumption was evaluated by an assessment of median July flows at Grand Island.

The Grand Island gauge was selected because it should be the last stream gauge to represent Program effects. The inclusion of flow data from the Duncan, Nebraska, guage just upstream from the Loup River would have been beneficial to this analysis, but these data for alternative flows were unavailable. For this analysis, it was assumed that any significant increase in July flows may represent adverse effects to sandbar nest sites in the lower river. July was selected because it represents a time period when sandbar nesting should be well underway, and it is unlikely that nests lost during July would be replaced by re-nesting attempts.

PRESENT CONDITIONS

The following sections address the impact indicators as represented by Present Conditions. Present Conditions are largely defined by hydrology data for the period of record (1947-1994), and in some cases, by those data subsequent use in the SEDVEG Gen3 model and the output generated by those analyses. Present Conditions serve as the standard against which action alternative values are compared.

Flow Potential to Build Sandbars

Two stream gauges provide data for Present Conditions. At Overton, the mean annual flow is 1,751 cfs, and the 1.5-year flow event would average 3,696 cfs. Comparable values at Grand Island are 1,746 cfs (mean annual flow) and 4,609 cfs (1.5-year flow). The reader is referred to Chapter 4 and 5—River Geomorphology section in the FPEIS for further details.

Fledging Days

Piping plovers may begin nest initiation as early as May 1, and require at least 53 days before the first young fledge. Least terns may begin nest initiation as early as May 20, and need at least 46 days until the first young fledge. Under Present Conditions between Lexington and Chapman (all transects), plovers currently have an average of the 53 required days plus an additional 6.2 “fledging days” in which young could fledge before flows again reach the surface elevation of May 1, or of any subsequent re-start date. Terns currently have an average of 7.4 fledging days (46 + 7.4) in which their young could fledge.

When only transects that would be managed under the action alternatives are evaluated, plovers have 6.4 additional fledging days to fledge young. Transects that would not be managed under the action alternatives produce 6.1 additional fledging days. Transects above Kearney would produce 5.5 fledging days, and transects below Kearney would produce 6.7 additional fledging days for plovers.

When only transects that would be managed under the action alternatives are evaluated, terns have 7.7 additional days to fledge. Transects that would not be managed under the action alternatives produce 7.3 fledging days. Transects above Kearney produce 6.5

fledging days, and transects below Kearney produce 8.0 additional fledging days for terns.

The number of fledging days serves as an indicator with which to compare action alternatives. A higher number of fledging days represents a higher opportunity for successful nesting by piping plovers and least terns.

Non-Channel Nest Sites

The median May end-of-month elevation for Lake McConaughy under Present Conditions is 3258.3 feet. It is assumed that this median elevation is associated with some quantity of nesting substrate that supports current levels of nesting activity at Lake McConaughy. Readers should note that the average nesting activity is likely less than that depicted in Table-PT-1 for years 2001-2004. Lake McConaughy, like many western reservoirs, has experienced drought related reduced elevations in recent years. These reduced elevations—and the accompanying increases in beach area—may provide favorable nesting conditions for plovers and terns.

There are 16 sandpits currently surveyed for plover and tern use (Platte River Executive Directors Office 2005). Of these 16, 6 received some type of management. Management actions include singularly or in combination: electric fencing, predator control, and pre-emergent herbicide application. No acreage values are available for these sandpits.

Channel Resources

Channel resources address the frequency and magnitude of spills from Lake McConaughy, annual flow volume at Cozad, water quality parameters between Lexington and Chapman (for forage fish), and median July flows at Grand Island.

Lake McConaughy Spills

Of the 48 years of hydrology record used in this study, 29 years experienced some level of spill from Kingsly Dam. Under Present Conditions, the average annual volume of spills is 169,100 acre feet, with March (28) and April (27) having the highest numbers of spills, and June having the highest average volume of spills (54,900 acre feet). For the seven years in which June spills occurred, the average spill was 376,315 acre feet. The single largest recorded spill occurred in June 1983 at 600,900 acre feet.

Annual Flow at Cozad

The median annual flow at Cozad is 287,300 acre feet. It is assumed that these flows result in conditions that support resources such as food, for plovers and terns using the Platte River between North Platte and Lexington.

Water Quality Parameters and Forage Fish

The probability of water temperatures exceeding 90º F in July at Grand Island is 0.329 under Present Conditions. The median and maximum JTU under Present Conditions are 25 (median) and 44 (maximum) respectively.

July Flows at Grand Island

Median July flows at Grand Island equal about 858.6 cfs. It is assumed that these flows result in conditions that play a part in supporting resources such as food and nest sites, for plovers and terns using the Platte River between Chapman and the Missouri River.

COMPARISON OF ALTERNATIVES VIA RESOURCE INDICATORS

The primary focus of this analysis is channel nesting conditions in the central Platte River between Lexington and Chapman, NE. However, because actions taken to improve channel conditions and the resources that support these conditions, may affect resources at other sites, several additional locations are included in the analysis. These locations include Lake McConaughy, the Platte River between North Platte and Lexington, NE, and the Platte River between Chapman and Columbus. Resources such as beaches, food, sandpits, and channel sediment deposits (sandbars) are addressed as appropriate for each of these locations.

Flow Potential to Build Sandbars

The flow potential to build sandbars evaluates the difference in water surface elevation between the mean annual flow and the 1.5-year flow events for each alternative. The assumption here is that the greater the difference, the greater the potential to overtop sandbars and possibly deposit new sediments and/or scour any annual vegetation that may have developed during the previous growing season. Analyses within Chapter 5—River Geomorphology of the FPEIS illustrates the differences between water surface elevations for mean annual flows and a 1.5-year event for each alternative, and this information is only briefly addressed here.

Governance Committee Alternative

SedVeg Gen 3 output indicates that the potential to build sandbars via a 1.5-year flow event is greatest under the Governance Committee Alternative. Percent change from Present Conditions are predicted to range from 56 to 58 percent, with the largest increase occurring in Reach 1. Because the estimated 1.5-year flow event may be greater upstream (e.g., Reach 1), flow potential to build sandbars may be greater at upstream sites. Actual

benefits from these events to plovers and terns would be determined via a monitoring program.

Full Water Leasing Alternative

SedVeg Gen 3 output indicates that the potential to build sandbars via a 1.5-year flow event under the Full Water Leasing Alternative may be the lowest of the four proposed action alternatives. Percent change from Present Conditions are predicted to range from 26 to 31 percent, with the largest increase occurring in Reach 1.

Wet Meadow Alternative

SedVeg Gen 3 output indicates that the Wet Meadow Alternative would lie between the Water Emphasis (see below) and Full Water Leasing Alternatives in its potential to build sandbars via 1.5-year flow events. Percent change from Present Conditions are predicted to range from 49 to 53 percent, with the largest increase occurring in Reach 1.

Water Emphasis Alternative

SedVeg Gen 3 output indicates that the Water Emphasis Alternative would lie between the Governance Committee (highest) and Wet Meadow Alternatives in its potential to build sandbars via 1.5-year flow events. Percent change from Present Conditions are predicted to range from 52 to 55 percent, with the largest increase occurring in Reach 1. As with all action alternatives, actual benefits from these events to plovers and terns would be determined via a monitoring program.

Fledging Days

Fledging days for both plovers and terns would increase from Present Conditions for all transect categories under all action alternatives (Table-PT-2).

Table-PT-2. Fledging days (the number of inundation-free consecutive days—in addition to the required days needed—for which successful fledging would be possible for piping plovers and least terns) under Present Conditions and each of the action alternatives.

	Present Conditions		Governance Committee		Full Water Leasing		Wet Meadow		Water Emphasis	
	Plovers	Terns	Plovers	Terns	Plovers	Terns	Plovers	Terns	Plovers	Terns
All transects	6.2	7.4	8.5	9.2	8.3	9.4	8.3	8.7	8.8	9.3
Managed Transects	6.4	7.7	8.8	9.5	8.5	9.7	8.4	8.8	9.2	9.8
Non-	6.1	7.3	8.5	9.1	8.2	9.3	8.3	8.7	8.8	9.3

managed Transects										
Above Kearney	5.5	6.5	7.7	8.2	7.3	8.2	7.2	7.5	8.0	8.3
Below Kearney	6.7	8.0	9.1	9.9	9.0	10.3	9.0	9.6	9.4	10.1

These comparisons indicate that plovers and terns initiating channel sandbar nests within the May 1 (plovers) or May 20 (terns) to August 15 defined nesting period, would have an adequate inundation-free time interval to fledge young if suitable nesting substrate exists. Fledging days would increase over Present Conditions for both plover and terns under each of the proposed alternatives under each of the transect groupings. Recall again however, that fledging days is only an indicator of potential nesting success if suitable sandbar substrate is available, and actual plover and tern nesting response would be the focus of detailed monitoring studies.

Non-Channel Nest Sites

Median May end-of-month elevations for Lake McConaughy would be lower than Present Conditions for all alternatives. Elevations would be significantly lower than Present Conditions (3,259.5 feet) for the Governance Committee Alternative (3254.2 feet), the Wet Meadow Alternative (3255.6 feet), and the Water Emphasis Alternative (3255.8 feet), but not for the Full Water Leasing Alternative (3258.6 feet). Lower May elevations may provide increased beach substrate, and thus an increase in beach nesting opportunity for piping plovers and least terns. Additional information associated with the analysis of this indicator can be found in Attachment A.

An undetermined, but additional acreage of sandpits, would be managed for plover and tern nesting under all the action alternatives. As indicated in Table-PT-1, sandpits provide nest sites throughout the study area and any additional managed acreage—near the active river channel—would benefit plovers and terns.

Channel Resources

Recall that this collection of indicators spans a rather diverse group of resources and measures that are generally indirectly tied to plover and tern habitat in the central Platte River. For example, Lake McConaughy spills are important in maintaining the current character of the central Platte River channel and any nesting value the channel provides. In addition to potential nest sites and food, the channel also serves an important function in providing "a post-nesting congregation or staging area" (Lingle (1993:190). Future frequency and magnitude of spills from Lake McConaughy are evaluated for change from Present Conditions. Plovers and terns make some use of the river and adjacent sandpits between North Platte and Lexington. The annual flow volume at Cozad, along with the frequency and magnitude of spills from Lake McConaughy, provide indicators of channel

maintenance processes at work within this reach. It is assumed that these indicators reflect conditions that currently support resources (e.g., food) used by nesting plovers and terns between North Platte and Lexington. Deviations from current conditions may affect theses resources. Water quality parameters discussed in this section include turbidity and temperature as they relate to forage fish. It is assumed that large deviations from current water quality parameter values may affect habitat conditions for forage fish. Finally, median July flows at Grand Island are evaluated for changes from Present Conditions. It is assumed that any significant increase in July flows may represent adverse effects to sandbar nest sites in the lower river.

Lake McConaughy Spills

Both the frequency and magnitude of spills from Lake McConaughy would be reduced from Present Conditions by all the proposed action alternatives (Figure-PT-1). The magnitude of spills would be significantly lower than Present Conditions (169.1 kaf) for the Governance Committee Alternative (95.3 kaf), the Wet Meadow Alternative (82.3 kaf), and the Water Emphasis Alternative (102.2 kaf), but not the Full Water Leasing Alternative (165.6 kaf). (Note: Spill volumes are presented here as mean values because reduced frequency under the action alternatives result in a "zero" (0) median value for all action alternatives except Full Water Leasing).

Additional information associated with the analysis of this indicator can be found in Attachment A.

Annual Flow at Cozad

Median annual flow at Cozad would be numerically higher than Present Conditions (287.3 kaf), for all four of the action alternatives: Governance Committee (323.0 kaf), Full Water Leasing (372.5 kaf), Wet Meadow (337.7 kaf), and Water Emphasis (346.1 kaf). The difference is significant between Present Conditions and the Full Water Leasing Alternative. Although median flows are higher than the Present Condition, two alternatives—the Governance Committee and Wet Meadow Alternatives—support mean annual and lower total annual flows that are lower than Present Conditions. Monitoring should address any changes in the channel within this reach that may adversely affect future resources (e.g., food) potentially used by plovers and terns.

Additional information associated with the analysis of this indicator can be found in Attachment A.

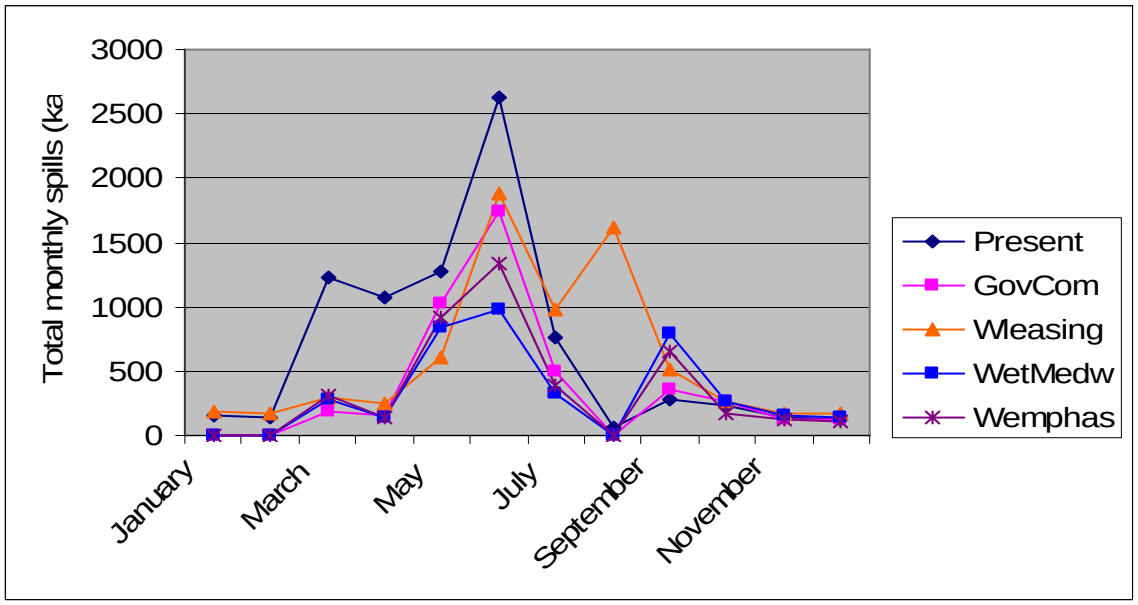
Water Quality Parameters and Forage Fish

The probability of exceeding a water temperature of 90º F in July at Grand Island are similar for all alternatives. When compared to Present Conditions (0.329), the Governance Committee Alternative (0.325) would result in a small reduction in the probability of July water temperatures exceeding 90º F. The remaining alternatives would equal Present Conditions (Water Emphasis and Wet Meadow), or increase the

probability of July water temperatures exceeding 90º F under the Full Water Leasing Alternative (0.339).

Turbidity would remain similar to Present Conditions under the proposed alternatives, with a small increase in median values and a small reduction in maximum values for the four action alternatives. For example, median turbidity JTU's would increase from 25 (Present Conditions) to 28 under the Governance Committee Alternative, while maximum JTU's would decline from 44 (Present Conditions) to 43 JTU. Median turbidity JTU's would increase to 29, while maximum JTU's would decline to 43 JTU under the Full Water Leasing Alternative. Median turbidity JTU's would increase to 28,

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



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

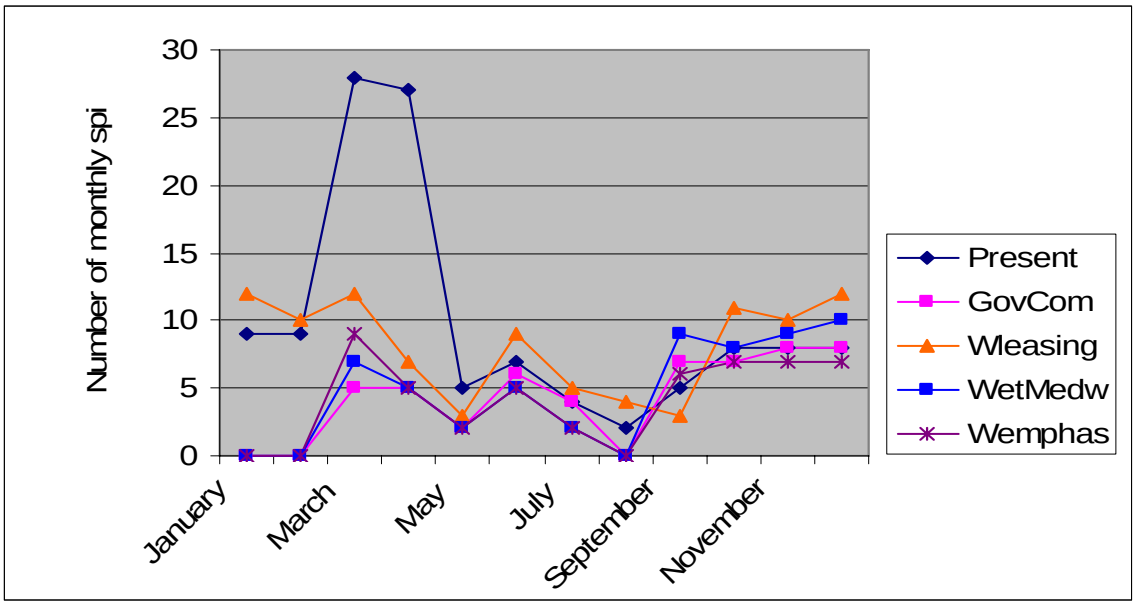


Figure-PT-1. The magnitude and frequency of spills from Lake McConaughy under Present Conditions compared to simulated hydrology for the proposed action alternatives over the 48-year period of record.

while maximum JTU's would decline to 42 JTU under the Wet Meadow Alternative.). Median turbidity JTU's would increase to 29, while maximum JTU's would decline to 43 JTU under the Water Emphasis Alternative.

It is unlikely that these changes would elicit a measurable response in the forage fish communities of the central Platte River. However, the reader is referred to the Water Quality and Central Platte Forage Fish sections of the FPEIS, and their respective appendices for a complete treatment of the fishery resource.

Median July Flows at Grand Island

Median July flow at Grand Island would be less than Present Conditions (858.6cfs) for the Full Water Leasing Alternative (812.8 cfs), and greater than Present Conditions for the Governance Committee (924.7 cfs), Wet Meadow (924.3 cfs), and Water Emphasis (933.1 cfs) Alternatives. Median July flows for the action alternatives are not significantly different from Present Conditions. Mean July flows at Grand Island for the action alternatives are lower than Present Conditions.

Additional information associated with the analysis of this indicator can be found in Attachment A.

SUMMARY OF POSSIBLE EFFECTS

Some of the above indicators reflect a potential for positive benefits for piping plovers and least terns using the central Platte River (Table-PT-3). For example, there are indications that flows in the 1.5-year event range would have the potential to build sandbars somewhat higher than Present Conditions under some alternatives at some sites between Lexington and Chapman. Adequate sediment would have to be available for such flows to build sandbars.

As discussed previously, this indicator of sandbar potential is not directly linked to actual sandbars and/or nest sites. Therefore, a monitoring program would be necessary to determine the ability of flows under any implemented alternative to build sandbars suitable for nesting.

Fledging days are predicted to increase over Present Conditions for all transect categories under all proposed action alternatives. If suitable sandbars are available, then these alternatives would provide an increase in the number of days free from potential inundation. Both situations (suitable sandbars and inundation free days) would be required to improve channel nesting conditions for plovers and terns.

It is likely that more nesting substrate would be available at Lake McConaughy under the proposed alternatives than under Present Conditions. In addition, all action alternatives would increase the acreage of sandpits managed for plover and tern nesting. Both factors should benefit plovers and terns using the Platte River Basin.

Factors examined under River Resources reflect a mixed future. Reduced spills from Kingsley Dam and increased annual flows at Cozad indicate the river between North Platte and Lexington may experience changes in the future—such as further channel

Table-PT-3. Summary of indicator values for piping plovers and least-terns by alternative. Potential to build sandbars and fledging days are mean values and all other values represent medians unless identified differently. Bolded values indicate significant difference from Present Conditions.

Indicator/Measurement Unit	Alternatives				
	Present Condition	Governance Committee	Water Leasing	Wet Meadow	Water Emphasis

Potential to Build Sandbars—Percent change from Present Conditions (1.5-year flow event)					
Reach 1		60	30	50	53
Reach 2		58	30	52	56
Reach 3		54	25	48	53
Reach 4		57	28	52	53
Fledging Days					
All transects—Piping Plovers	6.2	8.5	8.3	8.3	8.8
All transects—Least Terns	7.4	9.2	9.4	8.7	9.3
Non-Channel Nest Sites					
May End-of Month Elevations (feet)	3259.5	**3254.2**	3258.6	**3255.6**	**3255.8**
New Managed Sandpit Acres		Increased	Increased	Increased	Increased
Channel Resources					
Kingsley Spills (mean-kaf)	169.1	**93.5**	165.6	**82.3**	**102.2**
Annual flows at Cozad (kaf)	287.3	323.0	**372.5**	337.7	346.1
Turbidity (median JTU values)	25	28	29	28	29
July Water Temperature (P > 90º F)	0.329	0.325	0.339	0.329	0.329
July Flows at Grand Island (cfs)	858.6	924.7	812.8	924.3	933.1

narrowing—that may negatively affect the river's ability to provide resources to plovers and terns currently using this reach. In the Lexington to Chapman reach, mechanical restructuring of the channel and judicious use of pulse flows may offset effects from the significant reduction in frequency and magnitude of spills from Kingsley Dam. Turbidity and water temperature in the Lexington to Chapman reach would not change appreciably from Present Conditions, but readers are referred to sections on Water Quality and Central Platte Forage Fish of the FPEIS for a more complete treatment of forage fish issues. And finally, July flows at Grand Island would be similar or somewhat higher than Present Conditions.

Higher median July flows at Grand Island should be evaluated further to determine how they may affect stream flow at the Duncan guage just upstream from the confluence of the Loup River with the Platte River.(e.g., using the Duncan stream guage data with action alternative projections). If projected Program flows differ from Present Conditions at the Duncan guage, then further study of potential effects to plover and tern nest sites downstream appear warranted.
In summary, these alternatives would likely provide benefits to plovers and terns using Lake McConaughy, likely adversely affect channel conditions in the North Platte to Lexington reach that currently support plovers and terns, maintain to perhaps provide some improvement in channel nesting conditions in the Lexington to Chapman reach (while increasing sandpit nesting opportunities in this reach), and maintain present conditions for birds using sandpits and channel sites in the lower river if higher median flows are not implemented. The individual alternatives are summarized briefly below.

Governance Committee Alternative

These comparisons indicate different locations may be affected differently by this alternative. For example, the significant reduction in volume of Lake McConaughy spills under this alternative, and the absence of management actions in the North Platte to Lexington reach, may result in further narrowing of the channel in this reach. It is unlikely that the increase in annual flow would mitigate the effects of reduced spills in this reach. Further narrowing of the channel is unlikely to benefit plovers and terns using this reach. In other locations such as the Lexington to Chapman reach, proposed actions under this alternative may maintain to perhaps provide some improvement in channel nesting conditions, increase sandpit nesting opportunities, while temperature and turbidity indices would remain similar to Present Conditions.

In the Chapman to Columbus reach, increased July flows at Grand Island—although not significantly different from Present Conditions—may increase the potential for plover and tern nests to be flooded. Conditions should be monitored closely if this flow regime is implemented.

Full Water Leasing Alternative

These comparisons indicate different locations may be affected differently by this alternative. For example, the similar volume of Lake McConaughy spills under this alternative and the increase in annual flows at Cozad indicate that the channel may retain characteristics that currently support plover and tern nesting in the North Platte to Lexington reach. In other locations such as the Lexington to Chapman reach, proposed actions under this alternative may maintain to perhaps provide some improvement in channel nesting conditions, increase sandpit nesting opportunities, while temperature and turbidity indices would remain similar to Present Conditions. In the Chapman to Columbus reach, a small reduction in median July flow may reduce the chance of nest flooding downstream.

Wet Meadow Alternative

The significant reduction in volume of Lake McConaughy spills under this alternative, and the absence of management actions in the North Platte to Lexington reach, may result in further narrowing of the channel in this reach. It is unlikely that the increase in annual flow would mitigate the effects of reduced spills in this reach. Further narrowing of the channel is unlikely to benefit plovers and terns using this reach. In other locations such as the Lexington to Chapman reach, proposed actions under this alternative may maintain to perhaps provide some improvement in channel nesting conditions, increase sandpit nesting opportunities, while temperature and turbidity indices would remain similar to Present Conditions. In the Chapman to Columbus reach, July flow at Grand Island indicate conditions would remain similar to Present Conditions.

Water Emphasis Alternative

The significant reduction in volume of Lake McConaughy spills under this alternative, and the absence of management actions in the North Platte to Lexington reach, may result in further narrowing of the channel in this reach. It is unlikely that the increase in annual flow would mitigate the effects of reduced spills in this reach. Further narrowing of the channel is unlikely to benefit plovers and terns using this reach. In other locations such as the Lexington to Chapman reach, proposed actions under this alternative may maintain to perhaps provide some improvement in channel nesting conditions, increase sandpit nesting opportunities, while temperature and turbidity indices would remain similar to Present Conditions. In the Chapman to Columbus reach, increased July flows at Grand Island may increase the potential for plover and tern nests to be flooded downstream. Conditions should be monitored closely if this flow regime is implemented.

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PIPING PLOVERS AND INTERIOR LEAST TERNS

ATTACHMENT A