STUDY 2.0 HYDROCYCLING

The Project is located in Nance and Platte counties, where water is diverted from the Loup River and routed through the 35-mile-long Loup Power Canal, which empties into the Platte River near Columbus. The Project includes various hydraulic structures, two powerhouses, and two regulating reservoirs. The portion of the Loup River from the Diversion Weir to the confluence with the Platte River is referred to as the Loup River bypass reach.

Upstream of the regulating reservoirs, the Loup Power Canal and the Monroe Powerhouse operate in a run-of-river mode with no storage capacity. Average daily flow in this reach is 1,610 cfs; maximum flow is limited by water rights and hydraulic capacity to 3,500 cfs. The interconnected regulating reservoirs, Lake Babcock and Lake North, accumulate water and build head during a portion of each day. Accumulated water is then released through the Columbus Powerhouse to produce energy during the high demand period of the day as directed by the Nebraska Public Power District (NPPD), the exclusive purchaser of Project power. This sub-daily manipulation of daily flow at the Columbus Powerhouse is called hydrocycling.

Except during brief ramp-up and ramp-down periods, operating discharge from the Columbus Powerhouse ranges from a minimum of about 1,000 cfs with one turbine operating to a high of about 4,800 cfs with all three turbines operating at high efficiency. Water discharged from the powerhouse flows down the 5-mile-long Tailrace Canal and enters the Platte River at the Outlet Weir. This weir is located approximately 2 miles downstream of the confluence of the Loup and Platte rivers. Tailrace Canal flow is recorded at the Nebraska Department of Natural Resources (NDNR) gage at the 8th Street bridge in Columbus. Including local inflows unrelated to the Project, Tailrace Canal discharge to the Platte River ranges from less than 100 cfs to over as 6,300 cfs.

Hydrocycling flows entering the Lower Platte River may or may not affect riverine habitat and morphology, including habitat used by the interior least tern (*Sterna antillarum*), piping plover (*Charadrius melodus*), and pallid sturgeon (*Scaphirhynchus albus*). These possible effects are derived from the sub-daily variability, rate of change, and proportion of hydrocycling flows relative to flows already in the Platte River. Therefore, this study will evaluate the physical effects of hydrocycling operations in the Lower Platte River.

1. GOALS AND OBJECTIVES OF STUDY

"Describe the goals and objectives of each study proposal and the information to be obtained;" 18 CFR §5.11(d)(1)

The goal of the hydrocycling study is to determine if Project hydrocycling operations adversely affect or benefit the habitat used by interior least terns, piping plovers, and pallid sturgeon in the Lower Platte River. The physical effects of hydrocycling will be quantified and compared to alternative conditions.

The objectives of the hydrocycling study are as follows:

1. To conduct a gage analysis using existing U.S. Geological Survey (USGS) and NDNR flow and stage data to accurately determine the timing, frequency, rate of change, travel time, and magnitude of sub-daily flow and stage changes attributable to Project hydrocycling at established gage locations in the Tailrace Canal and the Lower Platte River.
2. To compare the sub-daily Project hydrocycling operation values (maximum and minimum flow and stage) to daily values (mean flow and stage). In addition to same-day comparisons, periods of weeks, months, and specific seasons of interest to protected species will be evaluated to characterize the relative degrees of variance between hydrocycling (actual) and alternative conditions in the study area.
3. To determine the flow characteristics (magnitude and occurrence) during the interior least tern and piping plover nesting season compared to a maximum (benchmark) flow event occurring just prior to, or during, initiation of the nesting season. This will indicate the potential for nest inundation due to both hydrocycling and alternative conditions.
4. To assess effects, if any, of hydrocycling on sediment transport parameters (see Study 1.0, Sedimentation).
5. To compare river stage variations of Project hydrocycling with flow and stage variations of the every-third-day cycling program on the Missouri River below Gavins Point Dam (or another relevant example) to identify material differences in potential effects on inundation of interior least tern and piping plover nests and pallid sturgeon habitat.

2. RELEVANT RESOURCE MANAGEMENT GOALS

"Address any known resource management goals of the agencies or Indian tribes with jurisdiction over the resource to be studied;" 18 CFR §5.11(d)(2)

The U.S. Fish and Wildlife Service (USFWS) is responsible for the conservation and management of migratory, threatened, and endangered fish and wildlife resources under a number of authorities, including the Endangered Species Act of 1973 (16 USC 1531 et seq.), the Fish and Wildlife Coordination Act (16 USC 661 et seq.),

the Bald and Golden Eagle Protection Act (16 USC 703-712, as amended), and the Migratory Bird Treaty Act (16 USC 703-712, as amended). Compliance with all of these statutes and regulations is required to be in compliance with the National Environmental Policy Act (NEPA) (42 USC 4321-4347). The mission of USFWS is "working with others to conserve, protect, and enhance fish, wildlife, and plants and their habitats for the continuing benefit of the American people" (USFWS, June 15, 1999).

3. BACKGROUND AND EXISTING INFORMATION

"Describe existing information concerning the subject of the study proposal, and the need for additional information;" 18 CFR §5.11(d)(3)

3.1 Relevance to Threatened and Endangered Species

Flow in the Loup and Platte rivers is seasonally influenced. Flows are relatively high in the spring and early summer due to snow melt and weather events, and flows are low during the late summer and fall due to irrigation and infrequent rainfall. The Lower Platte River retains many of the important flow characteristics of its historical natural hydrograph. The variable timing of water inputs from upstream sources provides baseflow throughout much of the year. The channel of the Lower Platte River still contains a wide range of habitats, from large sandbars to woody islands to shallow sandbars and swift channels (Parham, 2007). The combinations of ample sediment and flows in the effective discharge range alternatively create transverse bars and then dissect the macroforms, lending support to the development and maintenance of habitat used by interior least tern and piping plover populations.

It is possible that Project operations may affect wildlife habitat diversity, connectivity, and suitability in the Lower Platte River due to erosion of sandbars and inundation of nests. The amount of flow is important to a variety of life stages of fish and wildlife, including the interior least tern, piping plover, and pallid sturgeon, three species Federally listed as threatened or endangered.

Sandbar habitat in the Lower Platte River is considered primary habitat for interior least terns and piping plovers and is used by these birds for breeding, nesting, loafing, and foraging. These birds migrate to the Nebraska rivers in mid-April to early June, with breeding, nesting, and egg-laying commencing in mid-May to early July (USFWS, September 1990 and June 28, 1994). After chicks have fledged in mid- to late August, interior least terns and piping plovers abandon the habitat and migrate to their wintering grounds along the Gulf of Mexico.

Riverine nesting areas of interior least terns and piping plovers are sparsely vegetated sand and gravel bars within a wide unobstructed river channel. Nesting locations are usually at higher elevations and away from the water's edge because nesting is typically initiated when river flows are high and small amounts of sand are exposed. Interior least terns and piping plovers have been observed to nest on sandbar habitats

with less than 25 percent vegetative cover and an abundance of bare or sparsely vegetated sand and gravel (Sidle and Kirsch, 1993) with an average area of 1.45 hectares and at an average height of 0.49 meters (Ziewitz et al., 1992). Sandbar habitat is favored for nesting because it is usually surrounded by the channel during sufficient flows, which allows for a degree of protection for young from terrestrial predators, such as mink, raccoons, and bull snakes.

The interior least tern is pisivorous, feeding in shallow waters of rivers, streams, and lakes, along sandbars and sandy shores. Interior least terns usually feed close to their nesting sites but have been known to travel up to 3.2 kilometers to fish. Fish prey is small sized, usually between 2 and 8 centimeters long. Interior least terns are believed to be opportunistic feeders, exploiting any fish within an edible size range (USFWS, September 1990). Interior least terns have been noted to nest near large areas of water for proximity to foraging habitat. Piping plovers feed primarily on exposed beach substrates by pecking for invertebrates at, or less than, 1 centimeter below the surface. Piping plovers are believed to be opportunistic feeders, consuming a variety of invertebrate genus and species. Proximity of feeding areas to nests is important to piping plover chicks. Chicks are mobile within 3 to 5 days of hatching and begin foraging immediately after becoming mobile (USFWS, June 28, 1994).

The pallid sturgeon is considered to be a large turbid river species. The habitat used by different life stages of this species varies widely. Although no recorded spawning grounds have officially been mapped or documented for the pallid sturgeon, there is evidence that the Platte River is used by this species as spawning habitat (Peters and Parham, 2008a). Fertilized eggs of sturgeon sink to the bottom of a river and adhere to the substrate (Simpkins and LaBay, 2007, as cited in Peters and Parham, 2008b). After hatching, embryos drift downstream in water currents. The period of drift may carry them over 300 kilometers downstream (Kynard et al., 2007, as cited in Peters and Parham, 2008b). When sturgeon embryos have developed fin rays, they are considered in a larval stage. During this stage, they begin to actively move to different habitat for feeding. As they lose their fin folds and develop caudal fin rays, they transition to a juvenile stage, where they begin to transition to consuming fish. Pallid sturgeon are considered adults after gonadal development. In the juvenile and adult stage, they mainly use large, fast flowing, turbid rivers such as the Missouri for feeding.

Pallid sturgeon have been captured in the Platte River up to the confluence with the Elkhorn River. Pallid sturgeon in the Lower Platte River use areas associated with the downstream ends of sandbars and in deeper channels along the edge of sandbars (Peters and Parham, 2008a). It is speculated that accessibility of habitat is related to river discharge and flow. High discharge events produce flow velocities that scour deeper channels, which create and maintain the habitats favored by pallid sturgeon. Pallid sturgeon have been found to use the deepest water available in the Platte River, using depths ranging from 0.33 to 1.27 meters, with average column velocities in the range of 0.52 to 0.82 meters per second (Peters and Parham, 2008a).

3.2 Project Operations and Hydrocycling

As described in the PAD, the Project operates in a run-of-river mode from the Headworks to the regulating reservoirs. The interconnected regulating reservoirs, Lake Babcock and Lake North, accumulate water and build head during a portion of each day. Accumulated water is then released through the Columbus Powerhouse to produce energy during the high demand period of the day. This sub-daily manipulation of Columbus Powerhouse flow releases is called hydrocycling. Unless prevented from doing so (such as by ice, flooding, or equipment problems), the Project hydrocycles nearly every day of the year. The specific times, durations, and magnitudes of sub-daily Project flow releases are directly related to the power generation requested by NPPD.

There is no spillway or alternative bypass flow path at the Columbus Powerhouse. All flow exiting the regulating reservoirs must pass through the three powerhouse turbine units. Except during brief turbine ramp-up and ramp-down periods, operating discharge from the powerhouse ranges from a minimum of about 1,000 cfs with one turbine operating to a high of about 4,800 cfs with all three turbines operating at high efficiency. Releasing flows less than 1,000 cfs is possible for short periods. However, it makes inefficient use of the water and increases wear on the generating equipment. Water discharged from the powerhouse flows down the 5-mile-long Tailrace Canal and enters the Platte River at the Outlet Weir. This weir is located approximately 2 miles downstream of the confluence of the Loup and Platte rivers.

Tailrace Canal flow is recorded at the NDNR gage at the 8th Street bridge in Columbus approximately 2 miles before discharging into the Platte River at the Outlet Weir. Total Tailrace Canal discharge to the Platte River ranges from less than 100 cfs to over 6,300 cfs. Differences between powerhouse discharge and the total Outlet Weir discharge are due to non-Project canal inflows from the Lost Creek Flood Control Project and local surface drainage.

3.3 Available Flow Data

Flow data from USGS and NDNR gage stations in the vicinity of the study area will be used for this hydrocycling study. Each gage station is accompanied by the associated rating curves and velocity and cross-sectional data used to create the rating curves. Flow data that will be used for this study include:

- USGS Gage 06793000, Loup River near Genoa, NE – Available discharge and gage height data from April 1, 1929, to current includes daily and 30-minute interval data.
- USGS Gage 06792500, Loup River Power Canal near Genoa, NE – Available discharge and gage height data from January 1, 1937, to current includes daily and 30-minute interval data.

- NDNR Gage 00082100, Loup River Power Canal Return [Tailrace Canal] at Columbus, NE – Available discharge and gage height data from October 1, 2002, to current includes daily and 15-minute interval data.
- USGS Gage 06794500, Loup River at Columbus, NE – Available daily discharge and gage height data from April 1, 1934, to October 10, 1978. This gage was restarted by NDNR on September 23, 2008.
- USGS Gage 06774000, Platte River near Duncan, NE – Available discharge and gage height data from May 3, 1895, to current includes daily and 30-minute interval data.
- USGS Gage 06796000, Platte River at North Bend, NE – Available discharge and gage height data from April 1, 1949, to current includes daily and 30-minute interval data.
- USGS Gage 06796500, Platte River at Leshara, NE – Available discharge and gage height data from June 29, 1994, to current includes daily and 30-minute interval data.
- USGS Gage 068010000, Platte River near Ashland, NE – Available discharge and gage height data from September 1, 1928, to current includes daily and 30-minute interval data.
- USGS Gage 06805500, Platte River at Louisville, NE – Available discharge and gage height data from June 1, 1953, to current includes daily and hourly interval data.

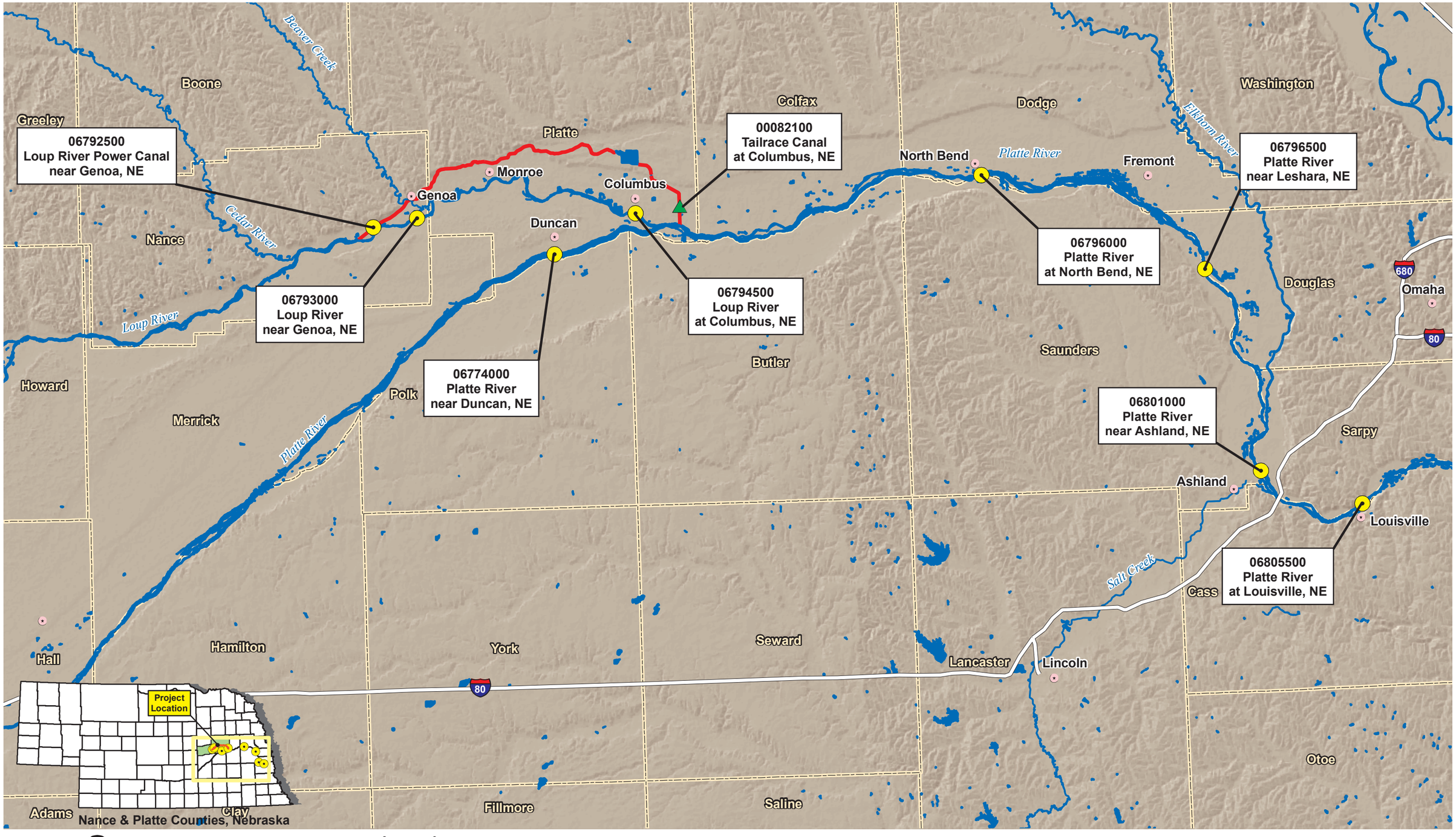
4. PROJECT NEXUS

"Explain any nexus between project operations and effects (direct, indirect, and/or cumulative) on the resource to be studied;" 18 CFR §5.11(d)(4)

The Columbus Powerhouse is operated in a sub-daily hydrocycling mode to generate power as requested by NPPD. Project flow releases enter the Platte River from the Tailrace Canal near Columbus. This hydrocycling operation may result in impacts, whether adverse or beneficial, on habitat used by interior least terns, piping plovers, and pallid sturgeon.

5. STUDY AREA AND STUDY SITES

The proposed study area includes the Tailrace Canal and the Lower Platte River from the Project Outlet Weir to the USGS gage on the Platte River at Louisville, shown in Figure 2-1. Stream gage information from upstream locations on both the Loup and Platte rivers will be used in development of total flow information at the Outlet Weir location. Existing stream gage locations on the Lower Platte River will serve as study sites for analyses.


Beaver Creek
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Tailrace Canal
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Dodge
North Bend
Platte River
Fremont
Washington
Elkhorn River
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Platte River
near Leshara, NE
Cedar River
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Duncan
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Platte River
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Butler
Saunders
Howard
Polk
06774000
Platte River
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06801000
Platte River
near Ashland, NE
Merrick
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Louisville
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Salt Creek
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Hamilton
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Interstate
Stream/River
Loup Power Canal
Waterbody
County
Loup Power District
Hydro Project
Hydrocycling Study Area
Loup River Hydroelectric Project
FERC Project No. 1256
Proposed Study Plan
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6. PROPOSED METHODOLOGY

"A detailed description of the study and the methodology to be used;" 18 CFR §5.11(b)(1)

"Explain how any proposed study methodology (including any preferred data collection and analysis techniques, or objectively quantified information, and a schedule including appropriate field season(s) and the duration) is consistent with generally accepted practice in the scientific community or, as appropriate, considers any known tribal interests;" 18 CFR §5.11(d)(5)

The methodology for the hydrocycling study includes six tasks, described below.

Task 1 Data Collection

Flow and gage height data will be collected for each USGS and NDNR gage listed in Section 3.3, Available Flow Data, for the respective periods of record.

Task 2 Gage Analysis

A gage analysis will be performed using existing USGS and NDNR flow and stage data from the listed study sites to accurately determine the timing, frequency, rate of change, travel time, conveyance losses or gains, and magnitude of sub-daily flow and stage changes attributable to Project hydrocycling. The period of analysis for this task will be the time period during which the NDNR gage at the 8th Street bridge in Columbus has been in operation.

Task 3 Hydrographs for the Project versus Alternative Conditions

Hydrographs for each Platte River study site as well as the Tailrace Canal will be plotted for periods of weeks, months, and specific seasons of interest to protected species for the period of record for each site. Daily maximum, minimum, and mean flows and their respective stage heights will be plotted for each time interval. The overall time period that will be used to create these plots will be the time period during which the NDNR gage at the 8th Street bridge in Columbus has been in operation. A synthetic hydrograph will be developed at the Tailrace Canal for current Project operations. The conveyance losses or gains will be determined and applied appropriately.

Synthetic hydrographs will be developed for alternative conditions. The conveyance losses or gains will be determined and applied appropriately. The synthetic hydrographs for each study site will be plotted for periods of weeks, months, and specific seasons of interest to protected species for the period of analysis. Maximum, minimum, and mean flow and stage height will be plotted.

Synthesized alternative conditions flow and stage variations that occur over a week, month, or specific seasons of interest to protected species will be compared with weekly, monthly, and seasonal summaries of subdaily variations due to hydrocycling.

Comparisons will be made between the weekly, monthly, and seasonal maximum, minimum, and mean flows and stage heights between the hydrographs for the Project and for alternative conditions. The results of this analysis will be reviewed in context with the life requisites of the pallid sturgeon.

Task 4 Seasonal Inundation Heights

Pre-nesting high flow (benchmark) events will be identified for each interior least tern and piping plover nesting season by identifying the highest river stage that occurred from May 1 to May 21. Subsequent flow events occurring from May 22 to August 1 that are equal to or greater than the benchmark events will be identified and counted. These subsequent flow events are those that could potentially inundate sandbar nests built at or below the benchmark event elevation. This information will be compared to alternative conditions to identify any scenarios in which the exceedence of the benchmark event elevation could have been avoided by modified Project operations. The time period that will be used to perform this analysis will be the time period during which the NDNR gage at the 8th Street bridge in Columbus has been in operation.

If the benchmark stage is not exceeded after May 21 as a result of normal Project operations, then it can be concluded that Project operations do not negatively impact sandbar nests for that period of analysis. In addition, if Project operations do not increase the number of nest inundation events after May 21 relative to alternative conditions, then it can be concluded that the Project does not adversely impact sandbar nests.

Task 5 Effects of Hydrocycling on Sediment Transport Parameters

Effects of hydrocycling on sediment transport parameters will be evaluated using methodologies outlined for Study 1.0, Sedimentation. The total sediment transport will be calculated for a series of representative days with hydrocycling. The results will be compared to alternative conditions for the same series of representative days to maintain conservation of mass. If the total sediment does not materially differ between hydrocycling and alternative conditions, then it can be concluded that hydrocycling does not impact daily sediment transport.

Task 6 Effects of Hydrocycling on Interior Least Tern and Piping Plover Nesting and Forage and Isolation of Backwaters and Side Channels

Hydrocycling or fluctuating river conditions will be evaluated at selected locations in other rivers, such as the Missouri River below Gavins Point Dam and the Yellowstone River below Intake, Montana, to determine if similarities exist that will permit specific comparison of impacts on interior least tern and piping plover nesting and foraging, on isolation of backwater and side channel areas, and on effects on the pallid sturgeon.

7. CONSULTATION WITH AGENCIES, TRIBES, AND OTHER STAKEHOLDERS

This study plan was developed based on discussions with agencies prior to submittal of the PAD. The District will work with agencies to resolve any issues or concerns during the course of the study plan meetings prior to preparation of the revised study plan.

8. WORK PRODUCTS

"Provisions for periodic progress reports, including the manner and extent to which information will be shared; and sufficient time for technical review of the analysis and results;" 18 CFR §5.11(b)(3)

The intended work product for the hydrocycling study is a study report. The study report will document the physical magnitude, if any, of Project hydrocycling in the Lower Platte River. Along with the study report, a database of the data gathered and used in the analysis will be available.

Updates regarding the hydrocycling study will be included in the study progress reports to be submitted to FERC in December 2009, March 2010, and June 2010.

9. LEVEL OF EFFORT AND COST

"Describe considerations of level of effort and cost, as applicable." 18 CFR §5.11(d)(6)

It is estimated that the hydrocycling study will cost approximately $230,000. This work will be completed by qualified water resources engineers and biologists.

10. SCHEDULE

"A schedule for conducting the study;" 18 CFR §5.11(b)(2)

"The potential applicant's proposed study plan must also include provisions for the initial and updated study reports and meetings provided for in §5.15." 18 CFR §5.11(c)

The hydrocycling study is scheduled to begin in the fourth quarter of 2009 and to be completed in the third quarter of 2010. The final study report is to be submitted in the third quarter of 2010.

11. REFERENCES

Parham, James E. 2007. "Hydrologic Analysis of the Lower Platte River from 1954-2004, with special emphasis on habitats of the Endangered Least Tern, Piping Plover, and Pallid Sturgeon." Nebraska Game and Parks Commission.

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