STUDY 5.0 FLOW DEPLETION AND FLOW DIVERSION

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. The Project is able to divert up to 3,500 cfs of water. This is the capacity of the Loup Power Canal as well as the maximum allowed by the District's water right.

Resource management agencies have expressed concern that diminished natural flows in the Loup River bypass reach related to Project operations may affect riverine habitat distribution, including interior least tern (*Sterna antillarum*) and piping plover (*Charadrius melodus*) habitat and fisheries habitat. In addition, depletions attributed to the Loup Power Canal, regulating reservoirs, and irrigation activities may result in flow depletion in the Lower Platte River.

This study will evaluate the effects of Project flow diversion on the Loup River bypass reach and the Lower Platte River. For the purposes of this study, flow depletion is defined as water lost to consumptive use (that is, evaporation and evapotranspiration [ET]). All other water that is diverted or seeped to or from the groundwater is not technically lost as this area is hydraulically connected and any water that is not lost to the atmosphere will eventually return to the Lower Platte River system. That is, the flow may be time lagged, but not lost.

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 goals of the flow depletion and flow diversion study are to determine if Project operations result in a flow depletion on the Lower Platte River and to what extent the magnitude, frequency, duration, and timing of flows affect the Loup River bypass reach. The results will be used to determine if the Project operations relative to flow depletion and flow diversion adversely affect the habitat used by interior least tern and piping plover populations, the fisheries, and the riverine habitat in the Loup River bypass reach and the Lower Platte River.

The objectives of the flow depletion and flow diversion study are as follows:

1. To quantify flow depletion in the Loup Power Canal, regulating reservoirs, and Loup River bypass reach by calculating consumptive use and making a comparison to alternative conditions.
2. To determine the net consumptive losses associated with Project operations compared to alternative conditions.
3. To use existing gage data to develop flood frequency and flow duration curves in the Loup River bypass reach for current Project operations and for alternative operations.
4. To use current and historic USGS gage rating curves to evaluate change in stage in the Loup River bypass reach during Project operations and compare against alternative hydrographs.
5. To evaluate historic flow trends on the Loup and Platte rivers since Project inception.
6. To determine the extent of interior least tern and piping plover nesting on the Loup River above and below the Diversion Weir.
7. To determine the relative significance of the Loup River bypass reach to the overall fishery habitat for the Loup River.

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). Furthermore, USFWS stated that its resource goal related to flow depletion evaluations includes protecting and enhancing river-related habitat for interior least terns, piping plovers, and pallid sturgeon (*Scaphirhynchus albus*) using the Platte River system downstream of Project operations (USFWS, February 9, 2009).

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

The proposed study area includes the Loup Power Canal and associated regulating reservoirs, the Loup River bypass reach, and the Lower Platte River from the confluence with the Loup River to the USGS gage at North Bend (see Section 5, Study Area and Study Sites).

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 historic 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 supplies of 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 habitats thought to be important to interior least tern and piping plover populations.

Some aspects of the Project may affect wildlife habitat connectivity and suitability in the Loup River bypass reach and Lower Platte River through possible depletion of flow due to net consumptive loss caused by flow diversion. The amount of flow is important to a variety of life stages of fish and wildlife, including the interior least tern (*Sterna antillarum*), piping plover (*Charadrius melodus*), and pallid sturgeon (*Scaphirhynchus albus*), three species Federally listed as threatened or endangered.

Sandbar habitat in the Loup and Platte rivers 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 District Operating Procedures

As stated in the PAD, Project operation is heavily dependent on flow conditions in the Loup River. There have been many changes to the flow regime of the river in the 7 decades since the Project was constructed. Storage reservoirs and diversion dams have been constructed in the headwater streams, and hundreds of water appropriations and consumptive use permits have been issued for domestic, agricultural, and industrial depletions of the natural river flow. The quantity of flow diverted for Project power generation is dependent on river flow and sediment conditions at the Headworks. Diverted flow is measured and recorded at the outlet of the Settling Basin (USGS Gage 06792500, Loup River Power Canal near Genoa, NE). The flow rate ranges from 0 cfs to a maximum of 3,500 cfs. The average diversion rate, as measured at the USGS gage, is 1,610 cfs (from 1937 through 2007). The Project operates on a run-of-river basis from the Headworks to the regulating reservoirs.

Seasonal high flow conditions on the Loup River typically occur during the spring runoff months of February and March. At the beginning of these high flow events, the District will typically reduce the intake amount to prevent trash and debris from entering the Settling Basin. During the remainder of these high flows, the District will operate normally, taking in as much as conditions will allow (up to 3,500 cfs).

Seasonal low flow conditions on the Loup River generally occur during the summer months when river flow is often impacted by upstream irrigation withdrawals. During these periods, the Project continues to operate normally, albeit with reduced flow available for diversion and generation. In addition, the District has entered into an agreement to temporarily halt dredging operations in early June until mid- to late August to allow protected interior least terns and piping plovers to nest, forage, and raise young in the sandy habitat created by dredging (that is, the North Sand Management Area). As a result, the amount of flow that the District can divert is reduced due to accumulating sediment in the Settling Basin.

According to USGS gage records and observations, the minimum leakage rate at the Diversion Weir and Sluice Gate Structure is approximately 50 cfs. This value represents the minimum flow in the Loup River bypass reach immediately downstream of the Diversion Weir.

Since 1995, the District's primary Project operating response to hot weather, warm water conditions has been to maintain a flow of 50 to 75 cfs in the Loup River bypass reach when ambient air temperature conditions warrant. In 2008, the District temporarily suspended this practice due to water accounting issues raised by the Nebraska Department of Natural Resources (NDNR). The District is currently working with NDNR to resolve these issues.

3.3 Available Flow Data

Flow data from USGS and NDNR gage stations shown in Figure 5-1 will be used for this flow depletion and flow diversion 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 06794000, Beaver Creek near Genoa, NE – Available discharge and gage height data from October 1, 1940, to current includes daily and 30-minute interval data.

3.4 Available Atmospheric Data

Daily maximum temperature, evaporation, and precipitation data will be obtained from National Weather Service stations at Grand Island, Columbus, and Valley, Nebraska (NOAA NCDC, August 2002).

Beaver Creek

Boone Co

St Edward

Platte Co

Tarnov

Platte Center

Dodge Co

Colfax Co

06794000
Beaver Creek
near Genoa, NE

Loup Power Canal

Monroe

06796000
Platte River
at North Bend, NE

Platte River

Rogers

06792500
Loup River Power Canal
near Genoa, NE

Genoa

Columbus

00082100
Trailrace Canal
at Columbus, NE

Schuyler

Loup River

Nance Co

06774000
Platte River
near Duncan, NE

Morse Bluff

Linwood

Duncan

Platte River

06793000
Loup River
near Genoa, NE

06794500
Loup River at
Columbus, NE

Bellwood

Octavia

Silver Creek

Prague

Bruno

Saunders Co

Merrick Co

Butler Co

David City

Clarks

Polk Co

Rising City

Shelby

Weston

Osceola

Brainard

Garrison

Project Location

Nance & Platte Counties, Nebraska

Stromsburg

4 2 0 4
Miles

Legend

- NDNR Gaging Station
- USGS Gaging Station
- Rivers/Streams
- Loup Power Canal
- Corporate Limits
- County Line

Loup Power District Hydro Project

Flow Depletion and Flow Diversion Study Area

Loup River Hydroelectric Project
FERC Project No. 1256
Proposed Study Plan

DATE
March 2009

FIGURE
5-1

Z:\Projects\Loup_Power_District\37104_LPD_FERC_Relicensing\map_docs\mxd\Loup_Bypass_Flow_Depletion_Study_Plan.mxd\feb09\jcm

3.5 Relevant Reports

The following reports are relevant to this flow depletion and flow diversion study:

- Ginting, Zelt, and Linard, 2008, "Temporal Differences in the Hydrologic Regime of the Lower Platte River, Nebraska, 1895-2006," USGS Scientific Investigations Report 2007-5267.
- Nebraska Department of Natural Resources, October 2007, "2008 Annual Evaluation of Availability of Hydrologically Connected Water Supplies."
- Parham, 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.
- Platte River Recovery Implementation Program Cooperative Agreement, October 24, 2006.

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 Project diverts water from the Loup River near Genoa into the Loup Power Canal and then releases diverted water into the Platte River through the Tailrace Canal at Columbus, approximately 2 miles downstream of the confluence of the Loup and Platte rivers. Project operations and any net consumptive losses resulting from water diversion from the Loup River to the Loup Power Canal may or may not result in changes to habitat used by interior least terns and piping plovers and habitat connectivity for fish (including the pallid sturgeon in the Lower Platte River) and other riverine species in the Loup River bypass reach and the Lower Platte River.

5. STUDY AREA AND STUDY SITES

The study area is the Loup Power Canal and associated regulating reservoirs; the Loup River bypass reach, which begins at the Diversion Weir, located west of Genoa, and ends at the confluence with the Platte River at Columbus (see Figure 5-1); and the Lower Platte River from the confluence with the Loup River to the USGS gage at North Bend.

There are seven study sites within the study area where data will be collected. These sites are the USGS and NDNR gages listed in Section 3.3, Available Flow Data. An eighth study site is a point upstream of the Diversion Weir.

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 flow depletion and flow diversion study includes seven tasks, described below. The period of analysis varies by task.

Task 1 Data Collection

Flow and stage data will be collected at the gages listed in Section 3.3, Available Flow Data, along with the current and historic rating curves. Gage data will be collected for the period of record available at each site.

Atmospheric data, which includes pan evaporation, precipitation, and temperature, from NWS stations will be obtained from 1980 through 2009. This range of data was selected because it includes a moderate flow period (1980 to 1992), a wet period (1993 to 1998), and a dry period (1999-2009). Other data that will be used in Task 2, Net Consumptive Use, will also be collected, including soil data, irrigation metering data, areas of surface irrigated crop by type, and aerial and satellite images of the vegetation along the Loup River bypass reach. This data will also be obtained from 1980 through 2009.

Task 2 Net Consumptive Use

During preparation of the PAD, flow depletions on the Lower Platte River associated with the Loup Power Canal were estimated through development of an annual water budget. Incremental and cumulative water budgets were developed for the Loup Power Canal using USGS Gage 06792500 on the Loup Power Canal near Genoa, power generation records at the Columbus Powerhouse, and NDNR Gage 00082100 on the Tailrace Canal at Columbus. This task will build upon the flow depletion calculations described in the PAD by calculating monthly and seasonal net consumptive use for the time period of 1980 through 2009.

Net consumptive use will be calculated for the Loup Power Canal and Loup River bypass reach for current Project operations and for alternative conditions. Consumptive use losses are calculated by adding open water evaporative losses and ET losses from native vegetation and agricultural crops. Irrigation water return and groundwater seepage, which will eventually make its way back to the Loup River or Lower Platte River, albeit slightly time lagged, are therefore not a loss to the system and are not considered consumptive losses. This assumption is supported by the

10/50 line analysis performed by NDNR (October 2007) for hydraulically connected areas in the Lower Platte River Basin.

Consumptive Use in the Loup Power Canal and Associated Regulating Reservoirs

Consumptive use in the Loup Power Canal and associated regulating reservoirs will be calculated on a monthly and seasonal basis by adding the ET consumptive use losses and the evaporation consumptive use losses. The total amount of water diverted for irrigation and standard operations will be obtained from the metering records used for billing purposes to assess the upper bounds of consumptive use losses and District operation records. Consumptive losses from irrigation due to crop ET will be estimated by using the total volume obtained from the metering records, the acres by each type of crop, the rate of ET per each acre of each type of crop, the type of soil in the irrigated areas, local precipitation, and the shape of the demand curve used in the Crop Simulation Model (CROPSIM) (Martin, unpublished). The amount of water lost through ET by the crops will be calculated monthly for each growing season. For this analysis, it will be assumed that the water demanded by the crops is fully met. The fraction of the ET demand that is not met through precipitation is assumed to be met through irrigation. Monthly open water evaporative losses for the Loup Power Canal and regulating reservoirs will be estimated by using the total area exposed to the atmosphere and a relationship to pan evaporation data collected from the NWS stations. Surface area will be calculated from channel widths, length, and reservoir areas.

Consumptive Use in the Loup River Bypass Reach

Consumptive use in the Loup River bypass reach will be calculated on a monthly and seasonal basis by adding the ET consumptive use losses and the evaporation consumptive use losses. There are only two surface water rights holders along the Loup River bypass reach. The impact from these is considered negligible and will not be considered further. Consumptive losses due to ET from the trees and other large vegetation that line the Loup River bypass reach will be calculated by replicating the length of riparian vegetation that line the sides of the bypass reach observed from the aerial photographs and satellite images and estimating an ET rate per unit length. Monthly open water evaporative losses for the Loup River bypass reach will be estimated by using the surface area and evaporation data collected from the NWS stations. The surface area will be calculated from channel cross sectional top width and distance between USGS gages. The top width will be based on the 50 percent exceedence discharge, the surveyed USGS cross section, and the USGS rating curve.

Net Consumptive Use

The net consumptive use will be estimated by taking the difference between the consumptive use losses in the Loup Power Canal and the regulating reservoirs and the consumptive use losses in the Loup River bypass reach on a monthly, seasonal, and

annual basis from 1980 through 2009 for the current Project conditions and the alternative conditions. If Project operations result in less flow depletion in the Lower Platte River than the alternative conditions, it can be concluded that the Project operations do not adversely impact and may benefit the species relative to flow depletions. If Project operations results in an increase in flow depletions as compared to alternative conditions, then the District will coordinate with the agencies to determine reasonable and prudent alternatives.

Task 3 Loup River and Platte River Depletions

Historic flow records will be evaluated to determine if there has been a general decline of flows in the Loup and Platte rivers. USGS gages on the Loup River at Genoa and Columbus and USGS gages on the Platte River at Duncan and North Bend will be evaluated. A USGS report (Ginting, Zelt, and Linard, 2008) will be used to assess flow depletions in the Platte River.

Task 4 Flow Duration and Flood Frequency Curves

Flow duration curves will be created for the USGS gage on the Loup River near Genoa, the USGS gage on the Loup River at Columbus, and the synthetic point just upstream of the Diversion Weir for the period of record. As previously stated, the USGS gage on the Loup River at Columbus was discontinued in 1978. A relationship between the Loup River near Genoa and the Loup River at Columbus will be determined based on data from the coincident period of record between the gages. Data from the USGS gage on the Loup River at Columbus will then be extrapolated based on this relationship to match the period of record for data from the USGS gage on the Loup River near Genoa. The median discharge value for each site will be determined graphically as the flow associated with the 50 percent exceedance on the respective flow duration curve. Flood frequency curves will also be generated at each study site for the period of record using the U.S. Army Corps of Engineers HEC-FFA. Alternative flow duration and flood frequency at each gage will be synthesized using gage data. Conservation of mass will be verified using the flow volume of the gages.

Task 5 Stage

The stage in the Loup River bypass reach at Genoa and Columbus will be evaluated using current and historic USGS rating curves and the results from Task 4, Flow Duration and Flood Frequency Curves. The stage for Project operations will be compared with the stage for alternative conditions to obtain change in stage for the 25, 50, and 75 percent chance exceedence discharges for the time period of 1980 through 2009. If the Project operations stage is not materially different from an alternative stage, then it can be concluded that Project operations do not impact stage in the Loup River bypass reach.

Task 6 Interior Least Tern and Piping Plover Nesting on the Loup River Bypass Reach

Existing information from USFWS and the Nebraska Game and Parks Commission (NGPC) on interior least tern and piping plover nesting activities upstream and downstream of the Diversion Weir will be collected. Populations above the Diversion Weir will be compared to populations below the Diversion Weir and in context to populations on the Lower Platter River. If no significant differences in populations exist in context with populations on the Lower Platte River, it will be assumed that the Loup River bypass reach is not an important area for interior least terns and piping plovers.

If differences in populations do exist, then the riparian corridors for 5 miles above and below the Diversion Weir will be examined. The examination will use U.S. Department of Agriculture Natural Resources Conservation Service aerial imagery for 5 years of normal precipitation. The following characteristics will be identified: channel width, un-vegetated sandbars, vegetated sandbars (isolated and non-isolated), and presence and/or type of bank vegetation. The observed conditions for each year for these characteristics will be compared to determine to what extent flow diversion and the presence of the diversion weir may result in different river and riparian vegetation conditions. In addition, the habitat requirements of the interior least tern and piping plover will be examined to determine if any changes in the riparian corridor may have had an effect on these populations.

Task 7 Fishery Populations Above and Below the Diversion Weir

Existing information from NGPC on fishery populations above and below the Diversion Weir will be collected and analyzed to determine to what extent flow diversion results in different species populations upstream and downstream. In addition, the flow information developed in Task 4, Flow Duration and Flood Frequency Curves, will be used to calculate the opportunity for fish species to migrate upstream of the Diversion Weir during high flows when the Diversion Weir is submerged or the sluice gates are raised. If no significant differences in species diversity or richness exist, then it can be concluded that Project operations do not affect fishery populations in the Loup River bypass reach.

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 flow depletion and flow diversion study is a study report. The study report will document the magnitude of flow reduction in the Loup River bypass reach. Along with the study report, a database of the data gathered and used in the analysis will be available.

Updates regarding the flow depletion and flow diversion 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 flow depletion and flow diversion study will cost approximately $170,000. 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 study will begin in the fourth quarter 2009 and be completed by the second quarter of 2010.

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