DRAFT REPORT

Economic Analysis of South Platte River Water Supply Development

Prepared for

State of Nebraska Department of Natural Resources

December 23, 2021

Prepared by

ERA Economics LLC

Table of Contents

1. Executive Summary 5
2. Introduction 8
3. Project Setting 10
3.1 The Platte River in Nebraska 10
3.2 Agricultural Water Use 10
3.3 Municipal and Industrial (M&I) Water Use 13
3.4 Hydroelectric Power Generation and Flood Control 16
3.5 Recreational Water Use 17
3.6 Environmental Water 19
4. Project Economic Analysis Overview 21
4.1 The Without Project Condition 21
4.1.1 Without-project future hydrologic condition 21
4.1.2 Other without-project future conditions 22
4.2 With Project Conditions and Operations 23
5. Direct Economic Benefits 24
5.1 Project Benefits Calculation Methods 24
5.2 Planning Horizon, Inflation, and Discount Rate 25
5.3 Agriculture 26
5.3.1 Project Agricultural Water Supply Benefits 26
5.3.2 Alternative Valuation of Agricultural Water Supply Benefits 29
5.4 Recreation 30
5.4.1 Project Recreation Benefits 31
5.4.2 Alternative Valuation of Recreation Benefits 34
5.5 Environmental Water Supply 36
5.5.1 Project Environmental Water Benefits 37
5.5.1 Alternative Valuation of Environmental Benefits 38
5.6 Municipal & Industrial (M&I) 39
5.6.1 Alternative Valuation of M&I Benefits 41
5.7 Hydropower 42
5.7.1 Project Hydropower Benefits 43
5.7.2 Alternative Hydropower Benefits 44
5.8 Other Non-Monetized Project Benefits 44
6. Regional Economic Effects 46
7. Summary and Discussion 51
8. References 54

List of Figures

Figure 1. Platte River Basin Water Use Overview 10
Figure 2. Gross Value of Agricultural Products, State of Nebraska 2017 11
Figure 3. Nebraska Cropping Patterns 12
Figure 4. Nebraska Corn Acreage Trends 12
Figure 5. Population Growth in Selected Nebraska Counties, 2010-2020 14
Figure 6. Minimum 10-Day Average Streamflow at Ashland, Selected Years 15
Figure 7. US Drought Monitor Index for Nebraska, 2000 - 2021 16
Figure 8. Existing Water Recreation and Approximate Project Location 18
Figure 9. Nebraska Irrigated Corn Price, Yield, and Gross Revenue Trends (1980 – 2021) 27
Figure 10. Nebraska Dryland Corn Price, Yield, and Gross Revenue Trends (1980 – 2021) 27
Figure 11. Lake McConaughy Visitor Demand Summary (Visit Nebraska 2007-2018) 33
Figure 12. Lake McConaughy Bathymetry and Energy Production 43

List of Tables

Table ES-1. Project Physical Benefits Summary 6
Table ES-2. Project Economic Benefits Summary 7
Table ES-3. Project Regional Economic Effects Summary 7
Table 4. Nebraska Crop Acreage Totals, Million Acres 11
Table 5. Corn Acreage by Agricultural District (average 2016 – 2018) 13
Table 6. Population in Platte Basin Water Supply Dependent Counties, 2020 13
Table 7. Estimated Water Demand, City of Lincoln 15
Table 8. City of Lincoln Wellfield Pumping Capacity (with four collection wells) 15
Table 9. Economic Output of Selected Recreation Industries 2020, ($2021) 17
Table 10. Water Supply Benefits Methodology Summary 25
Table 11. Statewide Corn Production Cost Summary 26
Table 12. Statewide Dryland Corn Production Cost Summary 27
Table 13. Value of Project Agricultural Water Supply 28
Table 14. Project Agricultural Water Supply Benefits Summary 28
Table 15. Nebraska Land Valuation Summary Table 30
Table 16. USACE Unit Day Values 2021 32
Table 17. Population Trends in CO and NE, (US Census, 2010-2019) 33
Table 18. Annual Recreation Demand Summary 34
Table 19. Project Recreational Benefits Summary 34
Table 20. Project Environmental Benefits Summary 38
Table 21. Missouri River Intake Facility Cost Estimates 40
Table 22. Platte River Intake Facility Preliminary Cost Estimates 41
Table 23. Alternative Costs for Municipal Users 41
Table 24. Project M&I Water Supply Benefits Summary 41
Table 25. Project Hydroelectric Water Supply Benefits Summary 44
Table 26. Regional Economic Effects Included in the Analysis 48
Table 27. Regional Economic Effects (million $ per year) 48
Table 28. Regional Economic Effects Sensitivity (million $ per year) 49
Table 29 Project Yield Summary 51
Table 30. Project Economic Benefits Summary (million $) 52
Table 31. Project Regional Economic Effects Summary 52

1. Executive Summary

The State of Nebraska Department of Natural Resources commissioned a reconnaissance-level analysis of the economic benefits of developing additional storage and conveyance off the South Platte to meet current and future water supply needs in Nebraska. The project considered is the Perkins County Canal Project, also known as the South Divide Canal Project (the Project). The Project's purpose and general configuration is described in Article VI of the South Platte River Compact between Nebraska and Colorado. It states that "*Colorado consents that Nebraska and its citizens may hereafter construct, maintain and operate such a canal and thereby may divert water from the South Platte River within Colorado for use in Nebraska*." Article VI allows for a Project diversion between October 15 and April 1 subject to conditions or exceptions stated within the Article.

An engineering study of the Project was developed by the Bureau of Reclamation in 1982 (USBR 1982). A diversion dam, canals and subcanals, pumping plants, and six potential reservoirs were considered. The diversion dam and canal were designed for winter flow conditions. One alternative included the Riverview West Dam and the Roscoe Low Dam and was estimated to cost $115 million (in 1982 dollars) without any distribution system.

At this time the overall operations and yield of the Project have not been fully evaluated, including how it would fit into and affect the operation of the larger Platte River system. For the purposes of this reconnaissance-level economic assessment, the general Project operations and volumes of water available to different uses and users, were provided. The Project is expected to collect excess wintertime flows and store the water in a system of up to six reservoirs, providing an average annual yield of 200,000 acre-feet (AF) available for use during the summer. It is assumed that conveyance and storage facilities will be designed to deliver this level of supply. These supplies would be directly available for a variety of users in the South Platte and Lower Platte Basins, and in the North Platte Basin through exchanges or reoperation of the broader system of canals, reservoirs, and hydropower facilities. The Project would additionally provide recreational opportunities and improve Platte River flows for habitat and ecosystem objectives. Reasonable assumptions were made about area available for recreational uses and the timing of environmental flows.

The economic analysis provides a preliminary assessment of the range of economic benefits provided by the Project. Conservative economic methods and assumptions are applied to establish the economic benefits of the Project. Some potential benefits, such as flood control and endangered species-specific improvements, are not quantified but could add additional value for the State of Nebraska. These considerations are left for future analyses and refinements as the Project configuration and operations are more clearly defined. The economic benefits of the Project for this initial analysis include:

- **Environmental Flows**. The Project would store winter water for releases in the irrigation season, which would provide additional flows for the Associated Habitats Reach on the Platte River. This would help meet Platte River Recovery Implementation Program objectives and future Endangered Species Act compliance. It would provide potential benefits to habitat for Sandhill Cranes, Least tern, Pallid Sturgeon, and Piping Plover as well as other species and ecosystems along the river.

- **Agriculture**. The Project would provide water supply for growers along the Platte River. In addition, by providing additional flows for habitat the Project would allow more irrigated agriculture to remain in production. This provides a direct economic benefit from corn farming and economic activity in ancillary industries, particularly in rural communities across the state.
- **Municipal and Industrial (M&I)**. The cities of Lincoln and Omaha continue to grow. Recent water supply planning reports for both cities show that future demands are likely to exceed available supplies. The Project would provide additional supply that would allow the cities to forgo more expensive alternative water project development, including development on the Missouri River. The Project could additionally provide M&I water supply for smaller cities and communities along the river.
- **Recreation**. Recreation demand for flatwater and river-based water activities is an important part of the tourism economy in Nebraska. Lake McConaughy capped annual visitations at 2 million in response to strong demand. The Project would develop additional reservoirs that would support additional water recreation and additional flows on the Platte River may improve river-based activities.
- **Hydropower**. The Project would provide water supply for hydropower through reoperation of the existing system. The additional power generation provides a direct benefit to Nebraska.
- **Other Benefits**. Other Project benefits considered but not analyzed in this initial assessment include water quality and flood control. In addition, Project construction and operations would encourage additional economic activity in Nebraska, with associated regional economic effects. These, and other, potential economic benefits of the Project can be refined under future planning studies.

Table ES-1 provides a summary of Project physical benefits by source. The average annual yield of the Project is 200,000 AF. Approximately 20,000 AF of this water would be available for both habitat (Platte River Recovery Implementation Plan (PRRIP) / Endangered Species Act (ESA)) and users downstream of the habitat reach (e.g., cities of Lincoln and Omaha). This reuse of flow for more than one purpose increases the estimated total yield to 220,000 AF. In addition, 8,000 acres of new water surface and related facilities would provide for recreational uses.

Table ES-1. Project Physical Benefits Summary

	Annual Yield (AF)	Other
Agriculture and Environmental Flows	100,000	
M&I	100,000	
Recreation		8,000 acres
Hydroelectric	20,000	

A series of economic analyses were developed to quantify the direct economic benefits of the Project. Direct economic benefits were based on the physical benefit quantities (shown in Table ES-1) and were monetized using different methods for each water supply type. Environmental flows were valued at the opportunity cost of the most likely alternative use given up to provide that water in absence of the Project, irrigated agriculture.

Table ES-2 summarizes the results of the economic analysis. The annual direct economic benefit corresponds to the volumes of water shown in table ES-1. For each Project benefit category, the table includes both a likely probable annual benefit and a range derived by varying key assumptions and valuation methods. The average annual direct economic benefit of the Project is estimated to be about $57 million in this reconnaissance-level assessment. The range in total annual benefit is $44 to $68.5 million. The present value of direct economic benefits over a 50-year economic life of the project is $1.38 billion. The range is $1.08 to $1.79 billion. These are the direct economic benefits of the Project and do not include any secondary regional economic, or "multiplier," effects.

Table ES-2. Project Economic Benefits Summary

	Annual Benefit	Annual Benefit Range	50-Year NPV	50-Year NPV Range
Agriculture / Environment	$22.1	$19.5 - $32	$586.0	$517 - $849
M&I	$25	$19.9 - $30.1	$662.5	$527 - $797
Recreation	$7.1	n/a	$133.2	n/a
Hydroelectric	$0.04	$0.01 – 0.09	$0.9	$0.3 - $3
Total	**$57.4**	**$44.5 - $68.5**	**$1,382.8**	**$1,085 - $1,688**

The economic analysis additionally estimated the regional economic effects that would occur each year from the start of Project operations, summarized in Table ES-3. These were assessed using regional economic multipliers from a modeling system called RIMS that is developed by the U.S. Bureau of Economic Analysis (BEA). The Project would generate $51 to $82 million in value added to the Nebraska economy on a total output value of $108 to $187 million. It would create an estimated 880 to 1,300 full-time-equivalent jobs. This does not include additional multiplier effects from expenditures for Project construction, operations, and maintenance, which could generate an additional 2,000 to 4,000 jobs.

Table ES-3. Project Regional Economic Effects Summary

Industry	Project Benefits	Output ($ millions)	Value Added ($ millions)	Jobs
Agriculture	100,000 AF	$78 - $155	$34 - $64	450 – 825
Hydropower	20,000 AF	n/a	n/a	n/a
Municipal	100,000 AF	n/a	n/a	n/a
Environmental Flows	(included with ag)	n/a	n/a	n/a
Recreation	8,000 acres	$30 - $32	$17 - $18	420 – 490
Project Operations	n/a	n/a	n/a	2,000 – 4,000
Total (excluding Project Operations)		$108 - $187	$51 - $82	880 – 1,300

Note: Values may not add exactly due to rounding

2. Introduction

The State of Nebraska commissioned a reconnaissance-level analysis of the economic benefit and impacts of the proposed Perkins County Canal Project, also known as the South Divide Canal Project (the Project). The economic analysis provides a preliminary assessment of the range of economic benefits provided by the Project, which would include water supply for irrigated agriculture, river and flatwater recreation, municipal and industrial users, environmental habitat flows, and hydropower generation. This initial assessment applies conservative economic methods and assumptions to establish the economic benefits of the Project. Some potential benefits, such as flood control and endangered species-specific improvements, are not quantified but could add additional value for the State of Nebraska. These considerations are left for future analyses and refinements as the project configuration and operations are more clearly defined.

The Project's purpose and general configuration is described in Article VI of the South Platte River Compact between Nebraska and Colorado. It states that "*Colorado consents that Nebraska and its citizens may hereafter construct, maintain and operate such a canal and thereby may divert water from the South Platte River within Colorado for use in Nebraska*." Article VI allows for a Project diversion between October 15 and April 1 subject to conditions or exceptions stated within the Article.

An engineering study of the Project was developed by the Bureau of Reclamation in 1982 (USBR 1982). A diversion dam, canals and subcanals, pumping plants, and six potential reservoirs were considered. The diversion dam and canal were designed for winter flow conditions. One alternative included the Riverview West Dam and the Roscoe Low Dam and was estimated to cost $115 million (in 1982 dollars) without any distribution system.

The Project is expected to collect excess wintertime flows and store the water in a system of up to six reservoirs, providing an average annual yield of 200,000 AF available for use during the summer. It is assumed that conveyance and storage facilities will be designed to deliver this level of supply. These supplies would be directly available for a variety of users in the South Platte and Lower Platte Basins, and in the North Platte Basin through exchanges or reoperation of the broader system of canals, reservoirs, and hydropower facilities. The Project would provide recreational opportunities and improve Platte River flows. Reasonable assumptions were made about area available for recreational uses and the timing of environmental flows.

This report summarizes the data, methods, and results of an economic analysis of potential Project benefits. The analysis focuses primarily on direct economic benefits, and the main conclusions of the report are based on that. It also considers annual regional economic effects such as total value added and jobs that would result at full Project operations.

The economic benefits of the Project are established relative to a baseline (without-Project) condition that defines water supply and demand in the absence of the Project. The economic benefit of the Project is the incremental change from the without-Project baseline. This report provides a quantitative assessment of baseline conditions for each industry that would receive water supply from the Project. It a lso provides a qualitative overview of the Project operations and water supply under without-Project conditions.

The report is structured as follows. The following section summarizes the Project setting and without-Project conditions. This includes a detailed summary of each of the major industries that would receive water supply from the Project. Section 4 provides an overview of the economic analysis method and considerations for Project development. Section 5 describes the direct economic benefits attributable to the Project. A preferred analysis is presented in addition to a series of sensitivity analyses. A literature review of existing studies was also conducted to illustrate the range of Project benefits. Section 6 calculates the regional economic effects of the Project. These are the annual effects of the Project on the Nebraska economy once it is fully operational. Metrics include jobs, gross output value, and value added (i.e., net economic activity for the State of Nebraska). The final section provides a summary and recommendations for next steps.

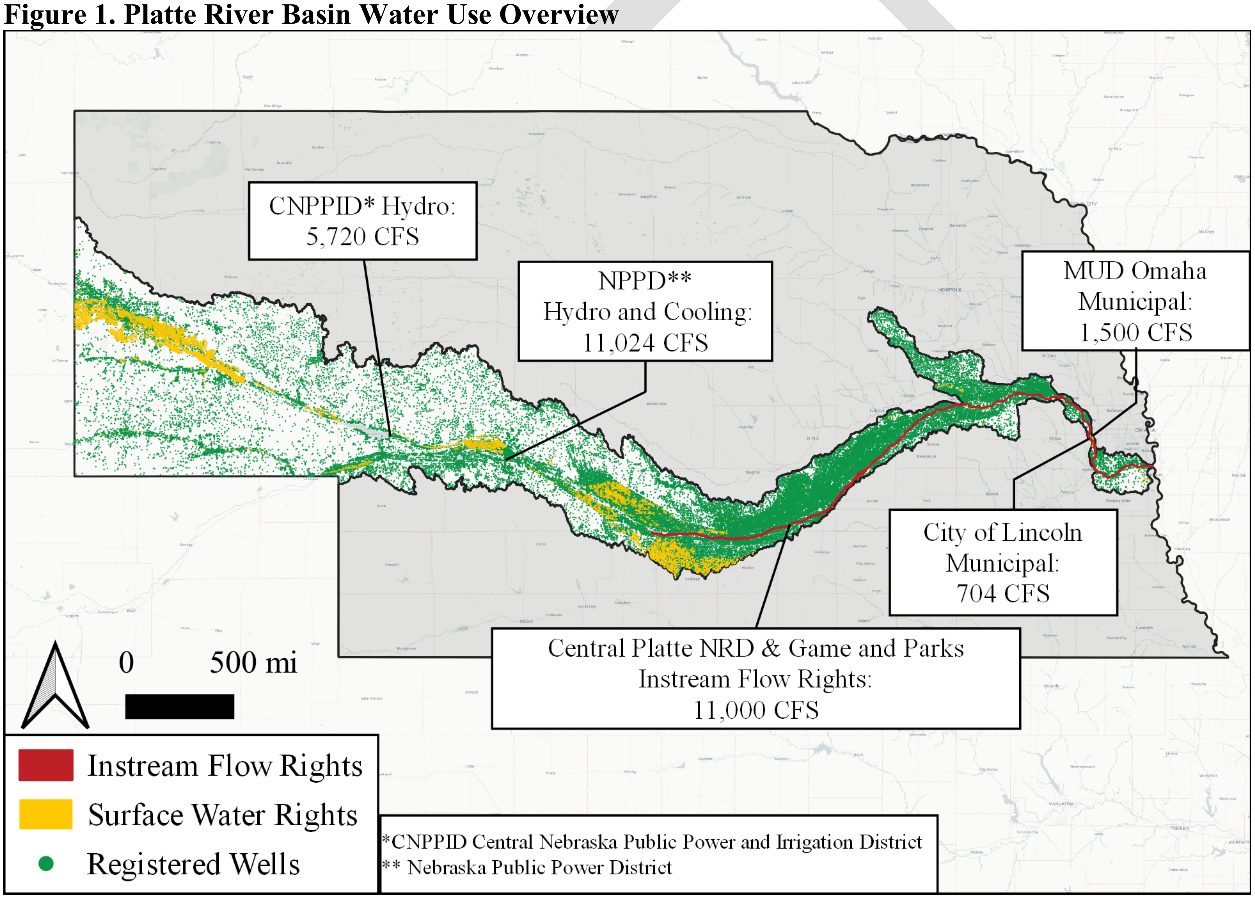
3. Project Setting

This section provides an overview of existing conditions in the greater Project area, focusing on the key water-dependent industries in Nebraska.

3.1 The Platte River in Nebraska

The Platte River spans the width of Nebraska, providing a variety of economic benefits to agricultural users, municipal users, hydroelectric power generation, coal and natural gas electricity generation, recreation, and habitat/environmental benefits. By volume, the largest surface water right holders along the Platte are non-consumptive rights for hydropower, cooling, and instream flows. The largest consumptive use category in the basin is irrigation, followed by induced groundwater recharge for municipal and industrial uses. Figure 1 provides an overview of the Platte Basin in Nebraska, illustrating the location of surface water rights, instream flow rights, registered wells, and major water rights.

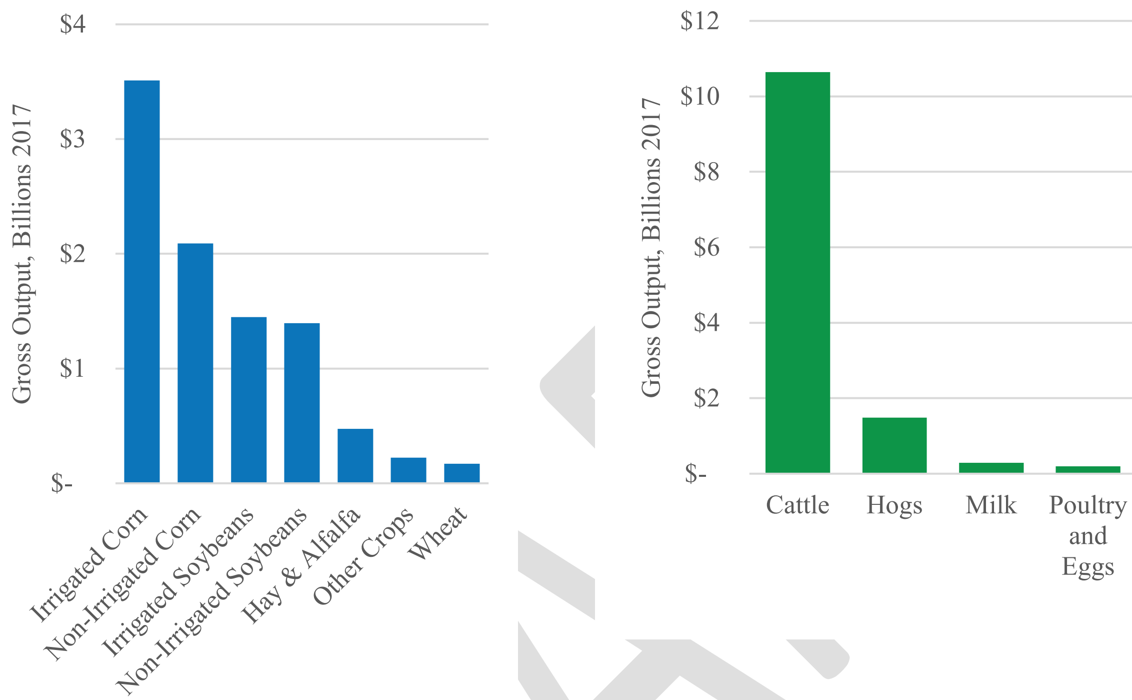
Figure 1. Platte River Basin Water Use Overview



3.2 Agricultural Water Use

In 2020 Nebraska harvested 19.1 million acres of cropland (USDA 2021). Of the 19.1 million acres, 8.4 million, or about 44 percent of harvested land, was irrigated. The Platte Basin in Nebraska contains 2.4 million irrigated acres, 28 percent of statewide irrigated acreage or 12 percent of total statewide acreage. Corn for grain is the largest crop in the state by both acreage and value, accounting for 52 percent of harvested acreage and 65 percent of crop value. Grain production is an important component of the state's most valuable agricultural industry, livestock production. Figure 2 illustrates statewide gross output values for both crop production and livestock industries.

Figure 2. Gross Value of Agricultural Products, State of Nebraska 2017



Source: USDA.

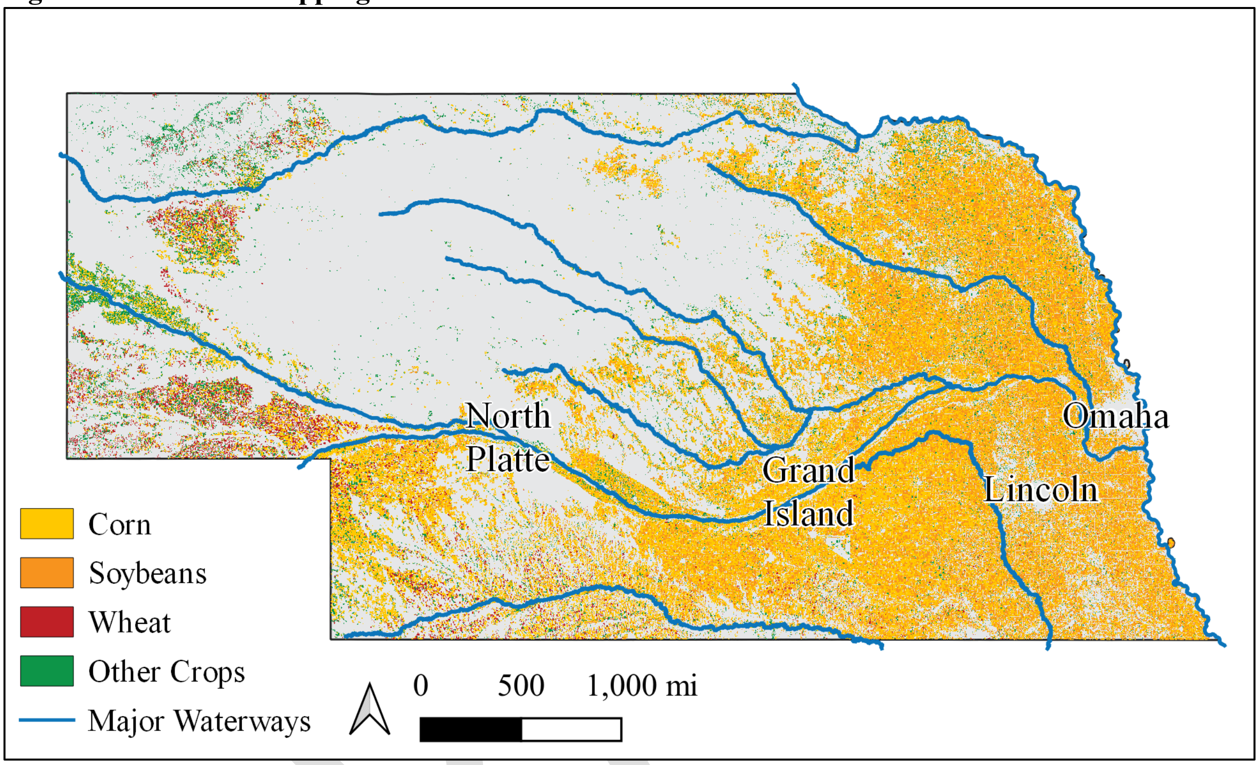
Irrigated agriculture is an important component of the diverse economy in Nebraska, particularly the rural economy. The United States Department of Agriculture (USDA) estimates the gross value of production in Nebraska to be around $25 million annually. Crops include a mix of grains, hays, and poultry and livestock production. Most irrigated agriculture along the Platte River is in corn rotations. Table 4 summarizes statewide crop statistics.

Table 4. Nebraska Crop Acreage Totals, Million Acres

Crop	2018	2019	2020
Corn	9.7	10.6	10.7
Soybeans	5.7	4.9	5.2
Alfalfa	1.2	1.1	1.2
Wheat	1.1	1.0	0.8
Sorghum	0.2	0.2	0.2
Other	0.5	0.5	0.5
Total	**18.3**	**18.3**	**18.6**

Most of the benefits of the Project would be for the protection of existing irrigated agriculture along the Platte River. This would primarily include a mix of corn. Figure 3 illustrates the dominance of corn acreage, including along the Platte River.

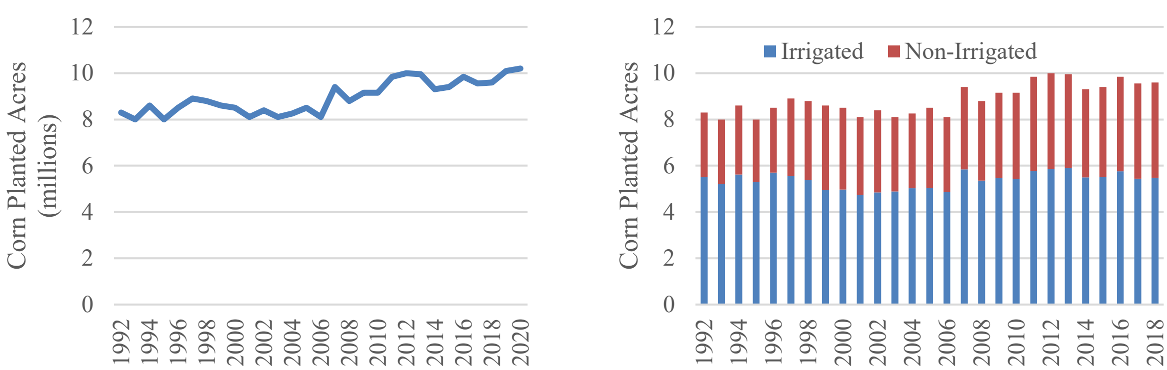
Figure 3. Nebraska Cropping Patterns



Source: USDA Cropland Data Layer GIS Mapping Data.

The primary crop receiving agricultural water supply provided by the Project would be corn. Around 10 million acres of corn are planted annually in Nebraska. A little more than half of the planted corn acres are irrigated in a typical year. Dryland corn farming is less common in the Panhandle and Southeastern counties. These regions could receive a share of Project water supply benefits. Figure 4 provides a summary of planted corn acreage over time and a breakdown of irrigated and non-irrigated acres.

Figure 4. Nebraska Corn Acreage Trends



Source: USDA National Agricultural Statistics Service.

The specific locations for agricultural water provided by the Project have not been defined because facilities and operations have not been fully evaluated. These will be specified in future feasibility analyses. The general location of Project irrigation benefits includes the Northwest, Southwest, South, and Central agricultural districts. Table 5 summarizes the average annual planted corn acreage (irrigated and non-irrigated) between 2016 and 2018 and shows the proportional share by region. The primary regions that would benefit from Project water supply account for approximately 40 percent of total planted acres and 48 percent of irrigated acres.

Table 5. Corn Acreage by Agricultural District (average 2016 – 2018)

Ag District	Total Planted Acres Corn	Share	Irrigated Planted Acres Corn	Share
Central	1,147,375	12%	945,667	17%
East	2,097,500	21%	1,158,667	21%
North	410,625	4%	355,500	6%
Northeast	1,779,750	18%	745,000	13%
Northwest	504,125	5%	331,833	6%
South	1,075,125	11%	730,000	13%
Southeast	1,552,250	16%	642,333	12%
Southwest	1,208,250	12%	650,333	12%

Source: USDA National Agricultural Statistics Service.

3.3 Municipal and Industrial (M&I) Water Use

In addition to Omaha and Lincoln, many of the state's other largest cities are located in and rely on water supplies of the Platte Basin, including Grand Island, Kearny, Fremont, North Platte, Columbus, and Scottsbluff. Water users in Douglas, Lancaster, and Sarpy lay partially or fully outside the basin but import water from the Platte into their counties, so these areas are also dependent on the reliability of water supplies in the Platte Basin. These areas account for 72 percent of the state's 1.9 million inhabitants. Table 6 summarizes the Platte Basin regions and share of population.

Table 6. Population in Platte Basin Water Supply Dependent Counties, 2020

	Population 2020	**Share of State Population**
Platte Basin Water Users	1,401,679	72%
Overlying Counties	317,841	16%
Douglas County	574,332	30%
Lancaster County	320,650	17%
Sarpy County	188,856	10%
Nebraska	**1,937,552**	

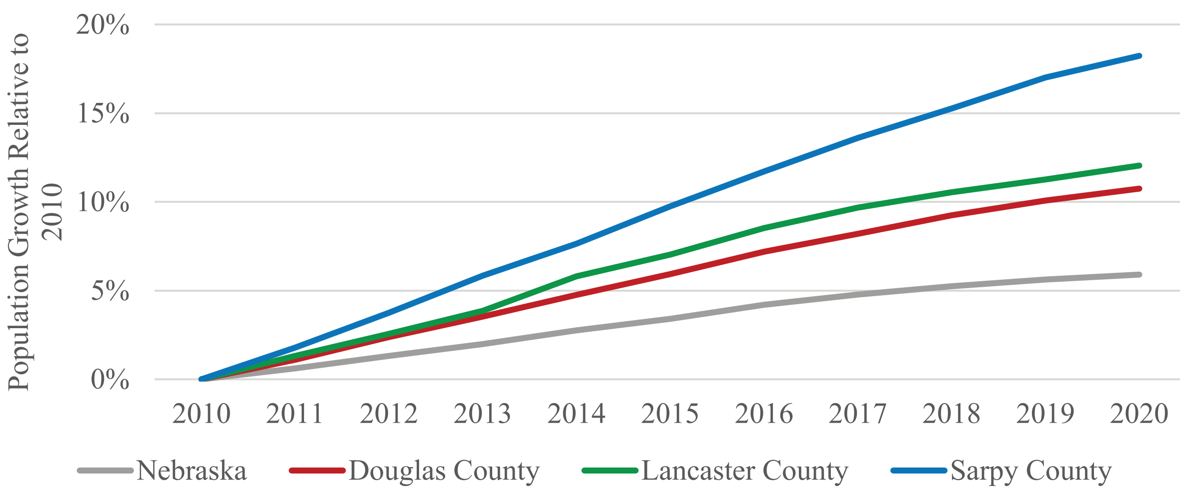
Source: US Census Bureau. 2020.

Management for drinking water quality is an important concern for M&I providers. Municipal providers monitor and regulate management of lands surrounding a water supply well to prevent contamination of the water supply, and providers treat water diverted from surface sources. Groundwater management falls under the federal Safe Drinking Water Act of 1974, which recommended development of Wellhead Protection Plans to manage areas near existing municipal supply wells and potential sources of contamination. Nebraska adopted the Nebraska Wellhead Protection Area Act in 1998 (LB 1161) with the goal of minimizing potential contaminants on lands that are near public water supply wells. The municipal providers in Omaha and Lincoln have developed Wellhead Protection Plans.

Rural communities rely on groundwater for drinking water supply. Cities in the Omaha Municipal Utilities District (MUD) area including Gretna, Valley, and Springfield receive groundwater from local wells. Management of water quality is essential for meeting drinking water standards.

Population growth in Douglas, Sarpy, and Lancaster counties is increasing demand for municipal water supplies. Census estimates for 2020 show a population of 574,000 in Douglas County, 321,000 in Lancaster County, and 189,000 in Sarpy County for a total of 1.1 million individuals, or 56 percent of the state's estimated population of 1.9 million. Population growth relative to 2010 for each of these counties has been well above the state population growth rate. Figure 5 illustrates recent trends in population growth relative to the state average.

Figure 5. Population Growth in Selected Nebraska Counties, 2010-2020



Source: US Census Bureau. 2020.

As the population continues to grow, new water supply development will be necessary to meet the needs of Omaha and Lincoln. Omaha's Metropolitan Utilities District currently obtains municipal supplies from one intake facility along the Missouri River and two intake facilities along the Platte. The City of Lincoln receives most of its municipal water supply from a single intake facility on the Platte. Given its proximity to new development, the Platte is expected to remain the lowest cost source of supply into the future, although flows on the Platte are already stressed during drought years.

The City of Lincoln's 2013 Facilities Master Plan provides a detailed analysis of flow conditions on the Platte and how municipal water supplies are threatened during times of low flow. At the time, Lincoln's average daily demand was roughly 45 mgd (million gallons per day) and average summertime demand was roughly 60 mgd. Projections for future demand were estimated as part of the report and summarized in Table 7 below. The conclusion of the water supply planning analysis was that Lincoln would need to develop additional facilities to meet projected future demands and to respond to future drought conditions.

Table 7. Estimated Water Demand, City of Lincoln

Year	Average Daily Demand (mgd)	Seasonal Peak Average Daily Demand (mgd)	Maximum Daily Demand (mgd)
2014	45	65	80
2020	45	75	110
2030	50	80	125
2040	60	95	140
2050	65	105	155
2060	75	115	175

Source: Lincoln 2013 Water Master Plan

Lincoln's Platte intake facility at Ashland has a maximum capacity that varies depending on streamflow conditions and pumping duration. These capacities are summarized in Table 8 below.

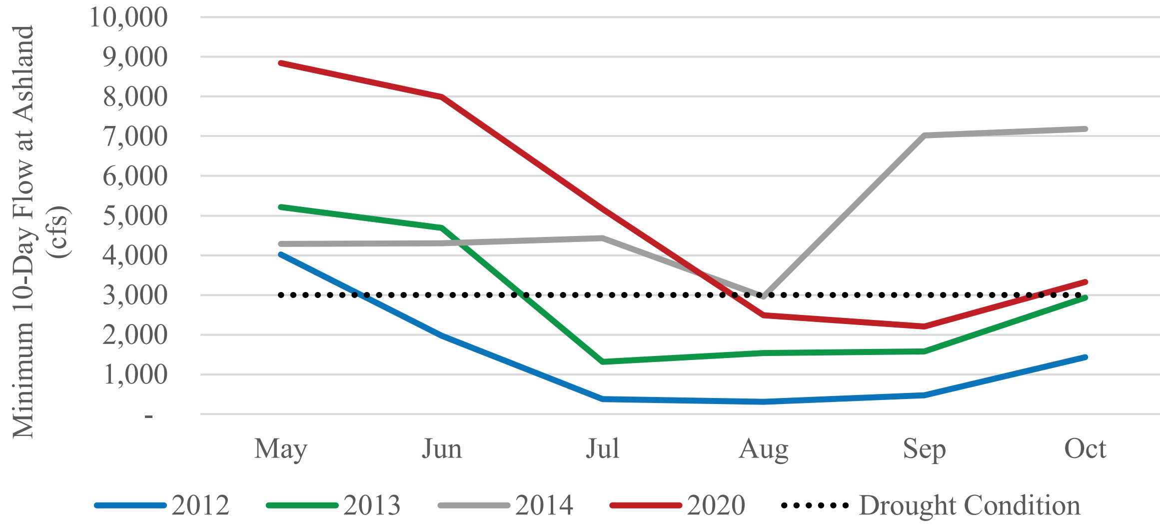
Table 8. City of Lincoln Wellfield Pumping Capacity (with four collection wells)

Streamflow	Maximum Instantaneous Pumping (mgd)	Maximum Pumping for 2 Months (mgd)	Maximum Pumping for 3 Months (mgd)
> 3,000 cfs	145	120	115
1,000 to 500 cfs	135	90	85
< 500 cfs	125	87	81

Source: Lincoln 2013 Water Master Plan

From 2010 to 2020, streamflow on the Platte fell below 3,000 cfs at Ashland for a 10-day period in 4 out of 11 years. In 2012 streamflow fell below 1,000 cfs, falling as low as 300 cfs in July and August. Minimum 10-day average streamflow for each of the four years that dipped below 3,000 CFS (2012, 2013, 2014, 2020) are displayed in Figure 6 below.

Figure 6. Minimum 10-Day Average Streamflow at Ashland, Selected Years



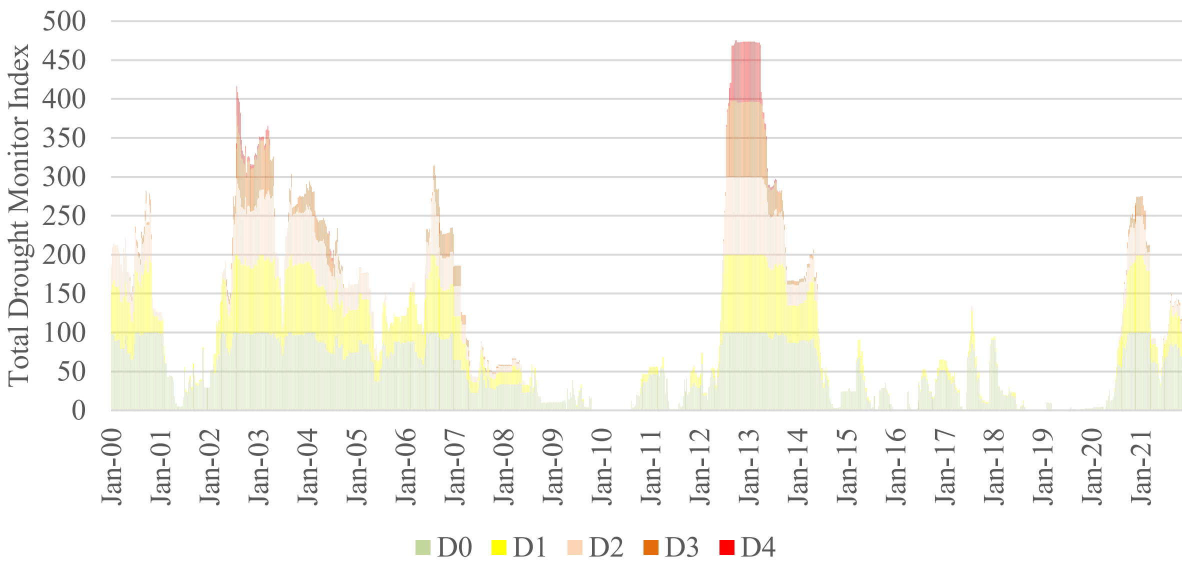
Source: United States Geological Survey.

From this data, the City of Lincoln concludes in its 2013 Facilities Master Plan that the development of a second intake facility will be necessary to meet the city's future water supply needs. The plan recommends that the city pursue development of an intake facility in the Missouri River Basin, rather than along the Platte, given the Platte's current and projected water supply conditions.

The City of Lincoln also evaluated other alternatives. This included mandatory rationing and shortages during severe extended drought conditions. Rationing and shortages result in substantial economic costs to utilities and ratepayers (individuals and businesses), as evidenced by recent events in response to water shortage across the West (e.g., curtailments in California and mandatory cutbacks for users on the Colorado River). However, more variable climate conditions in the future emphasize the importance of additional water supply development for M&I providers.

Figure 7 illustrates recent hydrologic conditions in Nebraska using the US Drought Monitor index. Classifications range from D0 to D4, with D4 representing "exceptional" drought conditions. The prior drought of 2012 is clearly visible in the data. The widespread drought affecting the western U.S. extended into parts of the Midwest, with Nebraska slipping into drought conditions in 2020 and 2021. Future expectations are generally for a warmer, drier (or at least more variable) climate. This would put additional pressure on Nebraska water resources, including supply for drinking water and other M&I uses.

Figure 7. US Drought Monitor Index for Nebraska, 2000 - 2021



Source: United States Drought Monitor.

3.4 Hydroelectric Power Generation and Flood Control

Two of Nebraska's three largest hydropower facilities are in the Platte Basin: Kingsley Dam and North Platte Hydro. The two facilities have the combined capacity to produce 137 megawatts. Hydroelectric power generation represents a small (4 percent) share of Nebraska's total power generation. However, both facilities are in Western Nebraska so they are able to provide significant operational flexibility to water users on the Platte and help keep flows above minimum thresholds during times of shortage.

Flooding in 2019 caused an estimated $3.4 billion in damage statewide along the Platte, Elkhorn, Big Blue, and Missouri Rivers. Flooding damaged roads, homes, and rail infrastructure and prompted evacuations along the Platte. Some of the most severe damage occurred along the Missouri River, with significant damage at Offutt Air Force Base. Flood control operations on the Platte have the potential to alleviate flood risk along both the Platte and Missouri Rivers. At the time of flooding in March 2019, reservoirs along the Platte were at or near 100% capacity.

3.5 Recreational Water Use

Reliable water supply in the Platte Basin plays an important role in the state's tourism and recreation economy. Lake McConaughy on the North Platte has become the state's most visited attraction with 2 million annual visitors (Visit Nebraska 2018). On the mainstem of the Platte, Sandhill Crane migration each spring attracts more than 46,500 annual visitors to the Central Platte Region (Dority et al. 2017).

Maintaining sufficient water levels is critical for supporting the regional economy and providing recreation opportunities for both in-state users and out of state visitors. Table 9 summarizes the value added of selected tourism-related industries in Nebraska (Department of Commerce 2020). Outdoor recreational activities generate over $2.4 billion in value annually. The industry brings substantial visitors to the region, providing jobs, income, and supporting businesses across the region.

Table 9. Economic Output of Selected Recreation Industries 2020, ($2021)

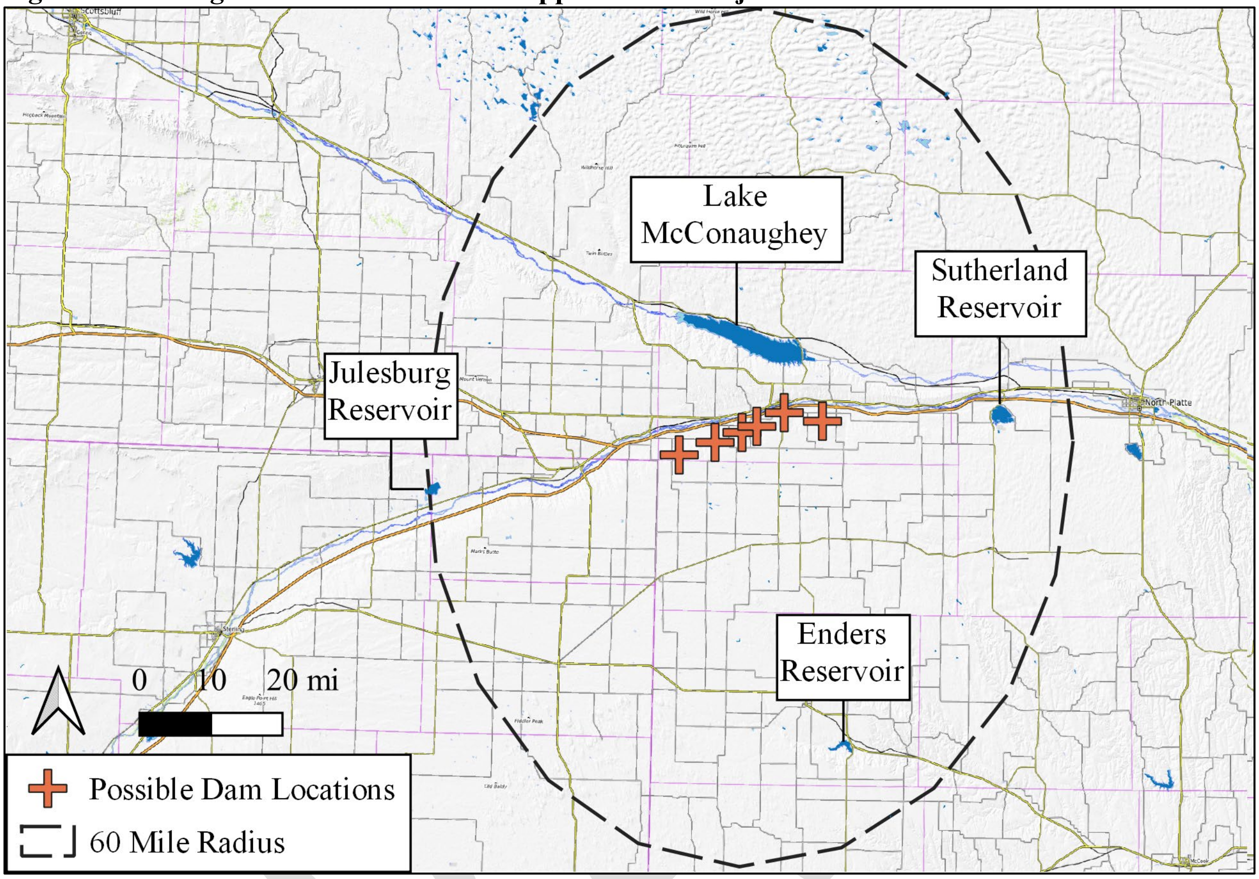
Outdoor Recreation Category	Value Added
Travel and Tourism	$654
Boating/Fishing	$298
Hunting, Shooting, and Trapping	$214
Climbing, Hiking, Camping	$178
RVing	$64
Other Outdoor Recreation Categories	$1,054
Total Outdoor Recreation Output	**$2,461**

Source: Department of Commerce. Contribution measured as gross domestic output.

Recreational opportunities and recreational facility development vary in the Project region and across Nebraska. Recreation at Lake McConaughy is the primary regional attraction. Recreation on the Platte River and on and around smaller reservoirs is also common. The Project would create a series of smaller reservoirs in Keith and Perkins counties. These smaller reservoirs are comparable to existing reservoirs such as Sutherland Reservoir, Lake Maloney, and Johnson Lake because of similarities in location, vegetation communities, elevation, and topography. All have seasonally fluctuating water levels, and peak use occurs between May and October.

A range of recreational facility development exists at current Nebraska reservoirs. Visitors typically come from Nebraska and Colorado. Existing reservoirs McConaughy and Johnson have a mix of private and public facilities. These water recreation sites could be affected by the addition of other recreational opportunities in the greater area, including the proposed Project. Figure 8 illustrates the existing recreation areas in relation to the proposed Project area.

Figure 8. Existing Water Recreation and Approximate Project Location



Existing recreation facilities in the greater Project area vary widely in amenities and use. The Project is expected to create approximately 8,000 new surface acres of reservoirs. Any recreational facilities at the new reservoirs are not known at this time. These may include trails, parks, beaches, and other day-use activities.

The Project may provide recreation benefits at Lake McConaughy and other regional reservoirs. Although a detailed operations plan has not yet been developed, the flows and facilities of the Project could enable the reoperation of the Platte system. Releases from the Project may allow other reservoirs along the Platte to maintain higher water levels. Additional flows on the Platte River may provide additional recreational opportunities and benefits for river-based activities in those areas.

Recreation demand has been increasing in Nebraska. Approximately 75 percent of Lake McConaughy's 2 million annual visitors are from Colorado. This provides direct economic value to the Nebraska economy. The Project location is along the I-80 corridor, which provides substantial recreation opportunities for RV-ing and similar activities.

3.6 Environmental Water

Environmental water use is defined as any flow or storage of water that provides or increases desirable fish, wildlife, habitat, or water quality in a natural setting. Improved in-stream water quality may become a municipal water benefit when water is diverted, and an increase in fish and wildlife may provide a recreation benefit when the desired species are viewed or harvested. Environmental water benefits can occur in a formal context such as flow or instream water quality standards, but they can also occur in any situation where people benefit from the improvement.

A primary feature of the Project is to provide additional flows in the Platte River that would meet the goals of the Platte River Recovery Implementation Program (PRRIP). The PRRIP provides compliance for four species covered under the Endangered Species Act (ESA) for new and existing water-related projects in the Platte River Basin. The covered species are the whooping crane (Grus americana), pallid sturgeon (Scaphirhynchus albus), piping plover (Charadrius melodus), and the interior least tern (Sternula antillarum). The pallid sturgeon was delisted in 2020 but remains covered under the PRRIP, as amended.

The goal of the PRRIP is to restore habitat by adaptive management of land and water in the Platte River Basin. The adaptive management of the PRRIP encourages continual review of the data and science for the best use of land and water resources to benefit the covered species. The land component of the PRRIP involves acquiring and restoring 10,000 acres of land in the section of river between Lexington and Chapman. This has been largely successful, with over 10,000 acres acquired for the PRRIP through 2020. The water component of the PRRIP involves reducing deficits to the FWS target flows of 130,000 to 150,000 AF per year. Water has been an ongoing challenge for the PRRIP. Storage at Lake McConaughy and additional flows at Julesburg were able to meet some of the PRRIP objectives, but additional projects to reduce flow deficits are increasingly expensive. Short-term leasing programs with the Central Nebraska Public Power and Irrigation District have been generally successful, the PRRIP remains short of its water targets. An April 2021 presentation by staff at Headwaters Corporation showed that the unit cost of water for potential projects ranged from under $100 per AF to more than $500 per AF (Headwaters 2021).

Under the PRRIP, each state proposed specific actions to meet the additional 130,000 to 150,00 per year in reduced depletions. In Colorado, water supply is from the Tamarack Project of managed groundwater recharge. In Nebraska, water is from an environmental storage account that primarily uses Lake McConaughy (1.74 MAF) on the North Platte. In Wyoming, water is provided through an environmental account at Pathfinder Reservoir. These actions were expected to provide around 80,000 AF of the 130,000 to 150,000 targets. The remaining water would come from incentive-based water conservation and supply activities under broader Water Action Plan (WAP) projects. These include leasing of water from irrigators in the Central Platte, groundwater recharge in Elwood Reservoir in Nebraska, and recharge in six existing canals near the Associated Habitats Reach during the non-irrigation season. Additional projects involving leasing and recharge are in various stages of development.

Success of the WAP also relies on implementation of agreed-upon New Depletions Plans in the three states. This is likely to become increasingly important as irrigated agriculture, urban use, and hydropower demands on the river increase in the future. The residents of major cities along the Platte River in Nebraska rely on wellfields that are hydrologically connected to the river. Management of the river is essential for the continued economic growth of the Nebraska economy.

The Project would provide important economic benefits for the PRRIP and water and habitat management on the Platte River more broadly. The Central Platte River Valley is a critical point for the central flyway, with the river flows, grasslands, wetlands, and associated ecosystems providing important benefits for migratory birds and fish (LaGrange 2005).

The Platte River and its habitat provide important economic benefits to the State of Nebraska. These include habitat viewing and out-of-state visitors that come to the region, spend money at local businesses, and enjoy the natural beauty of the river. For example, in the spring more than 500,000 Sandhill Cranes migrate through the Platte River Valley in Nebraska attracting birding enthusiasts from around the world (Stoll et al 2006). Dority et al (2017) estimated that the annual economic benefit of Sandhill Crane tourism was $14.3 million ($15.7 million in current dollars), supporting over 130 full time jobs.

The combined benefits of river-based and flatwater recreation and habitat viewing opportunities provide jobs and economic value to the region and the state. The Project would increase flows in an important habitat reach of the Platte River. The economic analysis described in Section 5 below establishes potential direct economic benefits based on the cost of the most likely alternative source of water to increase flows, so it uses the alternative cost of idling agricultural land to provide the same volume of water as the Project.

4. Project Economic Analysis Overview

Project evaluation involves a comparison of a future with the Project as compared to a future without the Project. Economic benefits and related effects are estimated for the without and with-project conditions, and the difference between the two provides estimated economic benefits. This section describes the with and without-project conditions and discusses how project water use and benefits are valued. A detailed operations analysis of the Platte River system with and without the project has not been completed, so information from existing studies or reasonable assumptions about quantities and changes are described.

4.1 The Without Project Condition

The without-project setting describes, and quantifies where possible, the characteristics of the region, resources, and uses affected by the Project. Important elements of the setting include temporal, geographic, institutional, hydrologic, and economic characteristics.

The planning horizon for a water project is the future period of years over which the project is expected to incur costs and provide benefits. The Project would develop water supply infrastructure including canals, pumps, pipelines and reservoirs having a useful life of up to 100 years. The Project planning and construction period could last several years. A conservative 50-year planning horizon is applied for this reconnaissance-level assessment. Project benefits and costs would be scheduled out over time when they are expected to occur for future feasibility analyses.

The geographic scope must include the region directly affected by the project, regions affected by inter-related water management, and the affected economic region of interest. The Project could have wide-ranging effects on other water management facilities and operations, including Lake McConaughy, downstream flows on the mainstem Platte River including the Associated Habitats Reach, and municipal water use in Grand Island and Lincoln. Through secondary/regional economic effects, the entire State of Nebraska could be affected.

The institutional setting includes the South Platte River Compact (the Compact) as well as the Platte River Recovery Implementation Program (PRRIP). As described under Section 3.6, the PRRIP provides Endangered Species Act (ESA) coverage for four species under the Endangered Species Act (ESA) for new and existing water-related projects in the Platte River Basin.

The hydrologic setting is discussed below in qualitative terms. Flow of the South Platte River is highly variable from year to year, but increasing upstream depletions and perhaps other factors suggest that average flow entering Nebraska will decline in the future in the absence of the Project.

4.1.1 Without-project future hydrologic condition

Stantec and Leonard Rice Engineers (2017) provided a detailed analysis of South Platte River water available for storage in Colorado based on data from the Julesburg gage. The 2020 South Platte Regional Opportunities Water Group Feasibility Study Report provides additional analysis of potential projects on the South Platte (SPRWOG 2020). These plans set out goals to be achieved by 2050. Future expected depletions are estimated from Identified Processes and Priorities (IPPs) as well as conditional water rights that are expected to be developed. If fully implemented, the IPPs and conditional rights would reduce annual average available water at Julesburg from 397,000 AF to 332,000 AF, a reduction of 65,000 AF or 16.4 percent (Stantec 2017). This works out to about five percent per decade. The reports also detail additional Colorado storage options that are not included in the 2050 Colorado Water Plan estimates. Associated depletions could add to total depletions before 2050 and contribute to increased depletions thereafter.

These additional potential depletions by Colorado suggest that, without the Project, over much of the planning horizon for the Project, the average amount of South Platte flow entering Nebraska would be declining. This has several important implications for water supply and Project benefits estimates. These include:

- The Project may not require compensation by Nebraska's New Depletions Plan. One implication of the declining South Platte River flow is that the Project will not have much effect on depletions in Nebraska because it will sustain existing depletions, not create new ones. This means that little of the Project supply may be required to meet Nebraska PRRIP requirements. On the other hand, Colorado is expecting depletions to increase over time. This means that Colorado's New Depletions Plan will need to identify a supply to compensate for its depletions.
- The Project could facilitate multiple use and reuse of diverted supplies. As South Platte flow declines in future, the Project would provide greater operational flexibility to get multiple uses out of the limited flow. For example, water stored in the reservoirs would provide recreation. The same water released for agricultural and M&I use could provide instream flow enroute to its destination. For example, water provided for municipal use in Grand Island would flow through the Associated Habitats Reach. Some of the agricultural water use would become return flow and instream flow and might be reused by other agricultural users.

4.1.2 Other without-project future conditions

Population is expected to increase statewide and in more urban areas of Nebraska. This means that M&I water demands in the urban areas will increase. Also, demands for recreation amenities will increase. Population declines may be expected in rural counties including Keith and Lincoln. As discussed below, population decline in these counties could be reduced by new water infrastructure like the Project.

Increased upstream depletions would cause the condition of the South Platte River in Nebraska to deteriorate. This means that existing beneficial uses of the river would be diminished in quantity or quality. Existing agricultural use may decline because water is unavailable at times or aquifers decline in levels or quality.

The economic benefits of the Project under potential declining flows in the absence of the Project are increased. For example, economic benefits analysis for new irrigation water supply projects typically estimates benefits of new water use on previously non-irrigated agricultural lands. In that case, the analysis should include all associated costs of irrigation development and farming. In the case of the Project, much and perhaps all of the irrigation water would be provided to compensate for reduced flows entering Nebraska. The Project would sustain existing irrigation use rather than enable new use. In this case, some of the infrastructure required for irrigation is already in place and cannot be repurposed, and therefore is a sunk cost. Some assets, especially farm-level water conveyance and certain irrigation equipment, cannot be repurposed or moved to another use. A field ditch is completely immobile. Other equipment requires a significant cost to re-employ elsewhere. Sunk costs do not need to be counted as an economic cost, so the economic benefit of sustaining existing irrigation use is greater than the economic benefit of developing new use, all else equal.

Direct economic benefits also produce secondary economic effects, often called secondary impacts (or multiplier effects). The total (direct plus secondary) effects provide a measure of total economic activity in the local or regional economy as the direct benefit spreads through linked economic sectors. A variety of economic measures can be used for total economic effects, including value of output, value added, income, and employment. Secondary economic effects associated with linked economic activities in a region are often estimated with input-output models. A key assumption in these models is that all sector relationships and activities scale up or down in fixed proportions. In reality, the economic effect of sustaining existing economic activity may not be the same as that associated with adding new economic activity. Sustaining economic activity can prevent outmigration of labor and population, while new economic activity may bring in different mixes of labor skills. Therefore, models of secondary and total economic activity are useful but imprecise.

4.2 With Project Conditions and Operations

The Project timeline has not been defined at this time. It is generally anticipated that initial Project operations would start within a few years. This would follow initial feasibility assessments, permitting, engineering design, and construction. The Project could be expected to operate for up to 100 years, but the economic benefits analysis applies a more conservative 50-year planning horizon.

The Project would include a diversion dam and a canal originating near Ovid, Colorado. It would divert up to 500 cfs of flow between October 15 and April 1 to be stored in reservoirs in Nebraska. Additional diversions may occur outside of this time frame.

Water would be stored in a series of reservoirs and released into a distribution system or returned to the river. Water supply might be conveyed directly to users or groundwater recharge might be used to maintain irrigation water use. Water provided for environmental use would be delivered to the Associated Habitats Reach directly or by exchange. Water for hydroelectric generation would be provided by exchange. Water for municipal use would be provided directly or conveyed by the South Platte and mainstem Platte Rivers to downstream users.

The analysis in this report assumes that the Project would be operated to sustain existing agricultural water use rather than develop new use. Agricultural use could occur in Keith and Lincoln counties, or by exchange agricultural use might be preserved in counties along the North Platte. Additional releases to provide flow in the PRRIP Associated Habitats Reach could provide supply to preserve agriculture downstream along the mainstem Platte River. The location of agricultural water use is not specified any more precisely at this time.

5. Direct Economic Benefits

Project benefits were evaluated in accordance with standard feasibility analysis guidelines for water supply projects. The direct economic benefits are defined as the direct value provided by the project. For example, the direct benefit of agricultural water supply is the net return to crop production, defined as crop revenue net of all relevant costs.

Direct economic benefits are defined as the net returns, cost savings, or net willingness-to-pay provided by the project water supply. Benefits can be expressed per unit value of water provided by the Project and as total values based on the Project operations and water supply volumes defined under Section 4. Benefits would occur over the entire operational life of the project. To account for the time value of money and accurately compare Project benefits to costs for future economic and financial feasibility analyses, all future benefits and costs are discounted to current (2021) dollars using an appropriate discount rate.

5.1 Project Benefits Calculation Methods

Table 10 summarizes the methodologies applied to evaluate the direct economic benefits of the Project. For each water supply type provided by the Project, alternative valuation approaches are shown, and one is selected. The valuation approaches are summarized as follows:

- Residual water value uses crop production budgets to estimate net farming income attributed to the water supply and is sometimes referred to as net returns to water. Comparing net income using irrigation water provided by the Project versus net income of non-irrigated production (i.e., without the project) provides the value of Project agricultural water supply.
- Alternative cost is the cost of the next least expensive option for obtaining the same good. Either the good must be purchased or it will be because its benefit is believed to be more than the alternative cost. For environmental water, the alternative cost of acquiring the water from irrigated agriculture is used because it is the lowest cost, and therefore the most likely, alternative source for the water.
- Avoided cost is the cost that would otherwise have to be paid and therefore can be avoided by the Project. For hydropower the net benefit of additional power generation is estimated.
- Unit values are benefits per unit that are provided by a standard reference source. For recreation, the U.S. Army Corps of engineers provides unit day values which represent the benefits recreationists receive above their direct costs.

The alternative valuation methods were conducted for sensitivity analysis and are described in the subsequent sections.

Table 10. Water Supply Benefits Methodology Summary

Water Supply Benefit	Valuation Method	Alternative Methods Applied	Notes on Preferred Valuation
Agriculture	Residual water value	Agricultural land value; review of water market transfers	Residual valuation approach selected to reflect direct benefits to agricultural users
Municipal & Industrial	Alternative cost	n/a	Alternative cost of providing the same quantity and reliability of water for Lincoln and Omaha
Environmental	Alternative cost	Willingness to pay; contingent valuation approaches	Environmental flows are conservatively valued at the alternative cost of acquiring it from irrigated agriculture upstream on the Platte
Hydropower	Avoided cost	Electricity generation under alternative operations	Conservative value based on releases from McConaughy
Recreation	Unit values	Willingness to pay	Valuation using standard U.S. Army Corps of Engineers approach

5.2 Planning Horizon, Inflation, and Discount Rate

All Project benefits and costs are analyzed over a 50-year planning horizon. Project benefits are expressed in current dollars using a discount rate. The discount rate reflects the time value of money.

Since 2017 the annual average U.S. inflation based on the Consumer Price Index (CPI) has ranged between 1 and 2.5 percent, and early 2021 forecast of inflation by the Federal Reserve Board of Cleveland indicated an average annual rate of about 1.57 percent over the next 10 years. This has since increased to around 2.7 percent with recent inflationary pressure (Cleveland Fed, 2021). The most recent CPI data indicate higher inflation in the last few months, though it is unclear how much is long-term versus transitory (St. Louis Fed, 2021).

Nebraska borrowing rates on recent bonds were reviewed. The University of Nebraska system issued $400 million in bonds at an effective interest rate of 2.99 percent in 2021. This was prior to the current increase in inflation expectations. This would imply a real discount rate of 1.42 percent (2.99 – 1.57).

The current federal discount rate for water supply projects is 2.25 percent (DOI, 2021). Adjusting for inflation, the real discount rate is less than 1 percent.

It is not clear whether the current spike in inflation will be transitory or is the start of a longer trend toward higher inflation. The recent Nebraska borrowing rates (2.99 percent) is a useful indicator for Nebraska borrowing costs, but the bonds were issued prior to the recent increases in inflation. The standard approach to adjust a nominal interest rate to a real (inflation-free) rate is to subtract expected inflation. However, the costs and returns of this Project are uncertain at this time, meaning that the Project would be relatively more risky than borrowing by the University of Nebraska, and the nominal interest rate would likely be greater than 2.99 percent. In light of these uncertainties, a real (inflation-adjusted) discount rate of 3 percent is applied for this initial analysis.

5.3 Agriculture

The Project would provide direct water supply benefits to existing agricultural producers along the South, North, or mainstem Platte River. Specific locations for agricultural water use have not been defined because Project operations and facilities have not been defined. These will be specified under future feasibility analyses. The general region of agricultural benefits would be within Nebraska's Northwest, Southwest, South, and Central agricultural districts. The main Project canal area would be in Lincoln and Keith counties.

The Project would provide agricultural water supply benefits by keeping irrigated lands in production. This would primarily be irrigated corn acreage along the Platte River. Three approaches were considered to establish the benefits of agricultural water supply. The residual water valuation approach was selected as the preferred approach. Additional sensitivity analyses were conducted using alternative methods.

5.3.1 Project Agricultural Water Supply Benefits

The residual valuation approach was applied to establish was supply benefits for irrigated agriculture. Residual valuation approximates the value marginal product of water in irrigated agriculture to establish the economic benefit of water supply. For the purposes of this analysis, the value of agricultural water is calculated as the residual net return after accounting for the cost of other inputs. The residual valuation approach is consistent with best practices, as described in state and federal guidelines for water supply planning feasibility studies (CWC 2016, US Water Resources Council 1983).

Statewide corn budgets from the University of Nebraska Extension services are used to characterize costs and returns for corn production (Nebraska 2021). The representative crop budget is for Bt corn under conventional tillage under diesel powered pivot irrigation. The applied water rate is 13 acre-inches, which is generally consistent with other panhandle crop budgets. Table 11 summarizes the operating costs that total approximately $780 per acre, including all overhead costs.

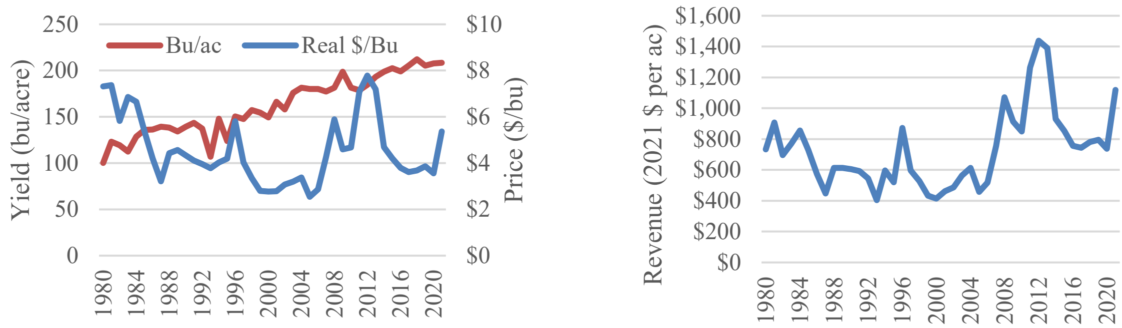
Table 11. Statewide Corn Production Cost Summary

Pivot Irrigated Corn Cost Categories	Cost ($/acre)
Field Operations	$202.40
Materials & Services	$279.24
Interest on Operating Capital	$11.41
Overhead (including land)	$285.31
Total Cost	$778.36

Returns to corn production vary over time. For example, ethanol plants that opened in the mid-2010's boosted the demand for corn, with prices topping $7 per bushel in several years. Since then, prices have softened, with a sharp rebound in 2021.

Crop prices are typically correlated with yields. Therefore, it is important to consider measures of gross revenue (price*yield) over time to approximate average expected returns to corn farming. Figure 9 illustrates recent trends in Nebraska corn prices and yields, as well as gross revenue per acre. All prices are in current, 2021 dollars, indexed using the GDP-IPD.

Figure 9. Nebraska Irrigated Corn Price, Yield, and Gross Revenue Trends (1980 – 2021)



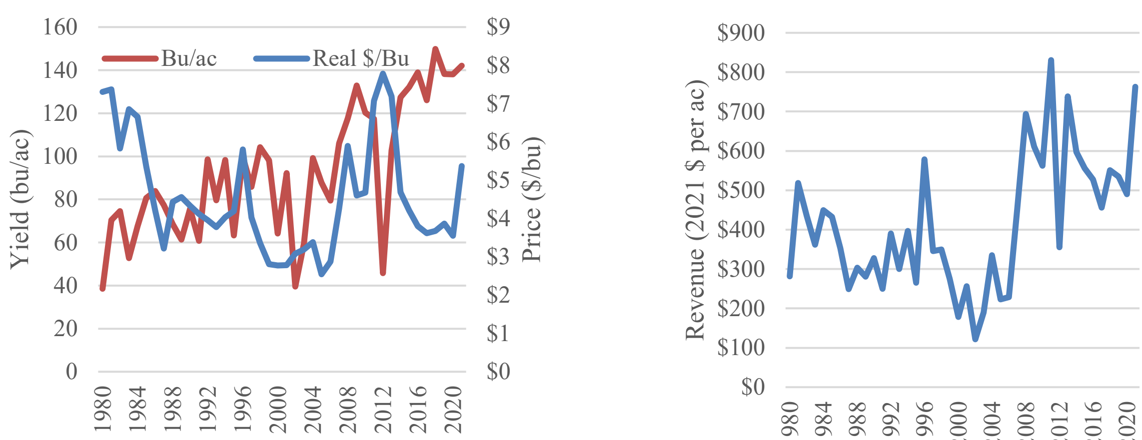
A budget for dryland corn was selected for the analysis as the alternative to center pivot irrigated corn production. Table 12 summarizes the dryland corn crop budget. The operating costs total approximately $462.47 per acre, inclusive of all overhead costs.

Table 12. Statewide Dryland Corn Production Cost Summary

Dryland Corn Cost Categories	Cost ($/acre)
Field Operations	$74.57
Materials & Services	$221.28
Interest on Operating Capital	$7.11
Overhead (including land)	$159.51
Total	$462.47

Dryland corn yields are lower and more variable than irrigated yields. Figure 10 illustrates trends in Nebraska dryland corn yields, corn prices, and dryland gross revenues. Dryland yields and associated gross revenues are more volatile than those of irrigated corn, and average revenues are lower. All prices are in current, 2021 dollars using the GDP-IPD.

Figure 10. Nebraska Dryland Corn Price, Yield, and Gross Revenue Trends (1980 – 2021)



The direct economic benefit of the Project to irrigated agriculture in Nebraska is calculated as the difference between the residual return to water for irrigated corn and dryland corn. All benefits are from the perspective of long-run project planning and therefore include all fixed production costs. However, land costs are excluded because the difference between the value and rental rates of irrigated land and non-irrigated land is largely attributable to the value of water. The land cost in the irrigated corn budget is $183.75 per acre and in the dryland corn budget is $94.95 per acre. The costs are excluded from the residual return comparison because including them as costs would remove some of the differences in return to water that the residual method is trying to estimate.

A 10-year historical average was selected to be representative of recent historical price and yield trends for Nebraska agriculture. USDA data are available through 2018. Therefore, the 10-year average is for the period 2009 – 2018. The Table 13 summarizes the results of the analysis. The estimated value of Project agricultural water supply is approximately $176 per acre-foot.

Table 13. Value of Project Agricultural Water Supply

10-Yr Average	Units	Irrigated	Non-Irrigated	Difference
Gross Revenue	$/ac	$991.84	$578.70	
Cost (Excl. Land)	$/ac	$584.91	$362.49	
Net per acre	$/ac	$406.93	$216.22	$190.71
Applied Water	af	1.08		
Value per ac-ft	$/af			$176.04

Based on the Project supplying 20,000 AF per year, annual benefits would equal $3.5 million dollars. The present value of benefits over the life of the Project would equal $93 million. Table 14 summarizes the results of the analysis.

Table 14. Project Agricultural Water Supply Benefits Summary

Measure	Value
Agriculture	$176 per AF
Agricultural Supply	20,000 AF
Annual Benefits	$3.5 million
NPV Benefits	$93 million

Several sensitivity analyses were developed to evaluate the range of agricultural water supply benefits:

- The residual value was also calculated using data for selected regions, rather using than using the statewide averages. The timing and location of Project deliveries for agricultural water users is not known at this time. The general Project location is in Lincoln County. Lincoln County irrigated crop values were applied and used to calculate the residual value. These were found to be greater than the value shown in table 14 (approximately $275 - $300 per AF). In addition, the analysis was completed using crop production budgets from the panhandle region. The value of water was found to be similar to the statewide values shown in table 14.

- Alternative years were selected for the historical period for the analysis. This included 5-year and 20-year averages. The value of water was in the same general range if alternative time series were used. In addition, the analysis was conducted by using historical averages and dropping the historical highs and lows. These sensitivity analyses were shown to affect the value of water, but there was no empirical basis for justifying an alternative historical period.

Future refinements to the analysis will be developed as the Project is defined in more detail. These may include additional geospatial analysis of the location of crops that would benefit from Project water supply. Alternative crops may be considered in some regions. For example, dryland wheat is the only feasible dryland alternative in some parts of the state. In addition, crop budgets may be reviewed and refined to identify fixed (overhead) costs that are sunk and would be excluded from the analysis.

5.3.2 Alternative Valuation of Agricultural Water Supply Benefits

Alternative methods for valuing agricultural water supply benefits were also considered and developed. Two primary alternatives included direct land and water valuation.

The land valuation method concept is that the difference in value for irrigated and non-irrigated land is partially attributable to the value of water. There are a range of other factors that affect land values in addition to water supply (e.g., soil quality, location, slope). The goal of the land valuation method is to isolate the effect of water on the value of land, separate from other factors. This type of analysis requires comprehensive data on irrigated and non-irrigated land sales. The standard approach is to develop a hedonic regression analysis to isolate the value of water from other factors affecting the value of land.

Existing studies of hedonic land valuation approaches were reviewed. There are limited examples in the peer-reviewed agricultural economic literature. The theoretical basis for the method is solid. The empirical application is difficult because data are limited and it is hard to identify all factors affecting land values in an appropriate statistical model. A recent example by Mukherjee and Schwabe (2015) applies the method to a dataset in California and provides a nice overview of the literature. Examples in Nebraska include papers that were not subject to peer review by Schultz and Schmitz (2010) and Schultz (2010). It is important to note these Nebraska studies were conducted using a historical period of depressed corn prices (and associated low land values). Therefore, this is a very low estimate of the value of water for irrigation in regions of Nebraska.

- Schultz and Schmitz (2010) shows irrigation values per acre of about $780 dollars, in nominal terms, ranging to $460 per acre in regions that would apply for the Project. The study does not specify what year dollars it was developed in. Assuming values are real 2009 dollars, the current value after adjusting for general inflation using the GDP-IPD would be $963 to $568 per acre, in current dollars. At an average applied water of 13 ac-in and a discount rate of 8 percent,[1] the annual value would be $41 to $71 per acre-foot.

[1] A discount rate of 8% is applied for illustrative purposes, which reflects private returns on a standard portfolio mix of bonds and stocks. This reflects private investment, in contrast to the discount rate applied for the economic analysis of the public water supply project considered in this report.

- Schultz (2010), in a separate study of Nebraska agricultural lands, finds values of $62 to $67 per acre-foot in nominal terms. This is $76 to $82 per acre-foot in current dollars. Houk and Frasier (2002) estimate values between $33 and $177 per AF ($177 to $256 in current dollars).

An approximation of the hedonic method was developed for this report using the difference in reported irrigated and non-irrigated land values under more current market conditions. The University of Nebraska Extension land values for 2021 were summarized (Jansen and Stokes 2021). The difference between irrigated and non-irrigated land with irrigation potential values was calculated. This is translated to a value per acre-foot by dividing by the total applied water (13 acre-inches). This value is then annualized using a discount rate of 8%. Table 15 summarizes the results of the analysis. The value of water is between $188 in the Southwest and $275 in the Central regions of the state.

Table 15. Nebraska Land Valuation Summary Table

Land Values	Units	Southwest	Central
Irrigated Land	$/ac	$4,170.00	$7,265.00
Non-Irrigated w/ Potential	$/ac	$1,615.00	$3,535.00
Difference	$/ac	$2,555.00	$3,730.00
Per Unit Water	$/af	$2,358.46	$3,443.08
Annualized Water Value	$/af	$188.68	$275.45

Other valuation approaches include mathematical programming models or water market transactions. No mathematical programming model was developed for this stage of the analysis. No comprehensive water market transactions were available. A statistical analysis of those transactions would be required.

The conclusion of the sensitivity analysis is that the residual valuation applied here produces reasonable, conservative direct economic benefit values for agricultural water supply attributable to the Project. It is consistent with best practices and supported by other existing studies. The point-estimate direct economic benefit of the Project for agriculture is $176 per af.

The approximate sensitivity range for this preliminary assessment is between $150 and $275 per AF. These figures will be refined as part of subsequent Project development and feasibility assessments. The annual benefit range for 20,000 AF of agricultural water is between $3 and $5.5 million. The present value of direct benefits is $79 to $145 million. These benefit values are also used to value environmental flows (see Section 5.5 below).

5.4 Recreation

The Project would provide recreational benefits from the reservoirs developed as part of the Project, additional recreation on the Platte River due to increased flows, potential additional recreation at Lake McConaughy (depending on how the Project is operated), and potentially greater recreation demand in the region. Specific locations for recreational uses have not been defined because Project operations and facilities have not been detailed. These will be specified under future feasibility analyses.

Several approaches were considered to establish the benefits of recreation attributable to the Project. The US Army Corps of Engineers (USACE) Unit Day Values for Recreation approach was selected as the preferred approach (USACE 2000, USACE 2020). The USACE Unit Day approach is consistent with best practices, as described in state and federal guidelines for water supply planning feasibility studies (CWC 2016, US Water Resources Council 1983). Additional sensitivity analyses were conducted using alternative methods and a review of existing studies.

5.4.1 Project Recreation Benefits

The US Army Corps of Engineers (USACE) Unit Day Values were applied to estimate the value of new recreational opportunities created by the Project. The Project is expected to generate approximately 8,000 new surface acres of reservoirs. The benefit of these additional 8,000 acres was calculated. No additional benefits for other recreation facilities or Platte River water activities were calculated. These may be considered in future iterations of this analysis when more complete operational analysis has been completed.

Unit Day Values were used to approximate the average willingness to pay for recreation. The Unit Day Value was then multiplied by the estimated number of visitor days spent at the reservoir to calculate the annual recreation value.

Unit Day Values were estimated using a 0-100 points system defined by USACE (USACE 2000):

1. Recreation experience (number of unique activities). Unique activities include standard outdoor recreation activities such as boating, fishing, hunting, and camping, as well as number of high quality activities. High quality activities are activities not common to the region, such as big game hunting.
2. Availability of nearby recreational facilities. Points are assigned based on the number of nearby facilities within certain travel times.
3. On site facilities. Qualitative facility ranking ranging from "Minimum facility for development for public health and safety" to "Ultimate facilities to achieve intent of selected alternative."
4. Accessibility. Access to the both the site and areas within the site, as well as quality of roads.
5. Environmental quality. Includes esthetic qualities such as geology, topography, water, and vegetation as well as quality reducing factors such as pollution, pests, and unsightly adjacent areas.

Reservoir recreation activities are classified according to different types. These include:

- General Recreation and General Fishing and Hunting. Activities in this category are associated with relatively intensive development. Facilities with more activities and larger carrying capacities are ranked higher in these categories.
- Specialized Recreation and Specialized Fishing and Hunting. Specialized categories are used to value unique activities that benefit from low density use. These facilities use a different criteria for Recreation Experience that adds points based not on number of activities, but rather how crowded the facility is. For example, a facility that supports big game hunting or wilderness camping is more valuable when it is less crowded.

The USACE provides a scoring matrix for reservoir amenities. The estimated point value for the new reservoirs based on expected Project facilities is 42/100. This assumes the reservoirs would have a level of development like other reservoirs along the Platte, such as Johnson Lake. If reservoirs were developed for a specific purpose they may fall under the specialized category, however projected visitors would likely decrease. The Unit Day Value general recreation value for 42 points is $8 per Unit Day of visitation.

Table 16 summarizes the Unit Day values across all points categories. The analysis applies a conservative estimate, using the lowest general recreation values. This will be reassessed in the future as Project operations and facilities are better defined.

Table 16. USACE Unit Day Values 2021

Points	General Recreation	General Fishing and Hunting	Specialized Fishing and Hunting	Specialized Recreation
0	$5	$6	$32	$18
10	$5	$7	$32	$19
20	$6	$8	$33	$21
30	$7	$9	$34	$23
40	$8	$10	$35	$24
50	$10	$10	$38	$27
60	$10	$12	$41	$30
70	$11	$12	$44	$36
80	$12	$13	$47	$42
90	$13	$13	$51	$48
100	$14	$14	$53	$53

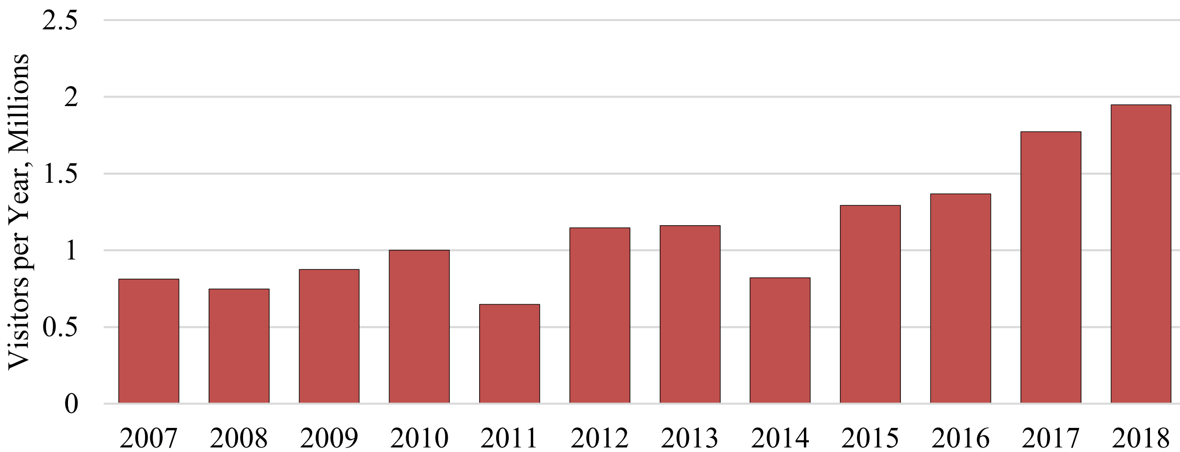
The second step in the analysis was to establish the number of visitor days associated with the Project. As described under Section 3.5, recreation demand in the region is strong and growing. The most similar recreational attraction in the area is Lake McConaughy. Lake McConaughy recently implemented a cap on total visitor days. Structural shifts in recreation activities since the start of the COVID-19 pandemic are likely to continue to support demand for outdoor recreation, such as those offered by the Project.

Recreation demand for reservoirs along the I-80 corridor was estimated. McConaughy attracts roughly 2 million visitors annually and in 2021 a reservation system was implemented at Lake McConaughy to cap attendees. This illustrates an excess demand for lake recreation in the area (Nebraska Game and Parks 2021).

The 8,000 new surface acres are assumed to be able to support the same number of annual guests per acre as Lake McConaughy. This analysis also assumes that demand for recreational activities will continue to grow with Colorado’s population. Nebraska Game and Parks estimates 75 percent of visitors come from nearby Colorado (NE Game and Parks 2016).

Figure 11 summarizes historical Lake McConaughy visitation. The current cap is 2 million annually. As shown, recreation demand has been steadily increasing. The total surface area of the reservoir is 35,669 acres. Average annual visitor days are around 56 per reservoir acre.

Figure 11. Lake McConaughy Visitor Demand Summary (Visit Nebraska 2007-2018)



The current pandemic has increased demand for outdoor activities and this is expected to continue to increase. Recent trends in population growth were reviewed in the Colorado and Nebraska areas to estimate future water-based recreation demand. Colorado population has increased at approximately 1.23% per year over the last 10 years (US Census, 2019). Table 17 summarizes recent trends in Colorado and Nebraska population.

Table 17. Population Trends in CO and NE, (US Census, 2010-2019)

Geographic Area	Population 2019 (Millions)	Growth 2010-2019
Colorado	5.61	12%
Counties >100,000	4.75	13%
Counties <100,000	0.86	5%
Nebraska	1.93	6%
Counties >100,000	1.08	12%
Counties <100,000	0.86	-1%
Total	**15.09**	**10%**

Each new visitor is estimated to spend 1.88 Unit Days at the new recreation facilities. This value is based on US Forest Service data, which estimates average visit time spent at sites with overnight use to be 45.2 hours or 1.88 days (USFS 2016-2020). This means that the 8,000 surface acres are expected to provide 844,090 Unit Days of recreation.

The recent historical trends in population growth were used to extrapolate future visitor demand in the region. Beginning with a regional demand of 2 million visitors per year, regional demand is increased by 1.23% per year until the regional capacity with the Project (2.45 million) is hit (in 2038). Table 18 summarizes the results of this analysis.

Table 18. Annual Recreation Demand Summary

Year	Regional Demand (million visitors)	New Unit Day Visitation (million visitor days)	Annual Benefit ($ millions)		
			High	Average	Low
2021	2.00	-	$-	$-	$-
2022	2.02	0.05	$0.47	$0.39	$0.31
2023	2.05	0.09	$0.94	$0.79	$0.63
2024	2.07	0.14	$1.43	$1.19	$0.95
2025	2.10	0.19	$1.91	$1.59	$1.27
2026	2.13	0.24	$2.40	$2.00	$1.60
2027	2.15	0.29	$2.90	$2.42	$1.94
2028	2.18	0.34	$3.41	$2.84	$2.27
2029	2.21	0.39	$3.92	$3.27	$2.61
2030	2.23	0.44	$4.44	$3.70	$2.96
2031	2.26	0.49	$4.96	$4.13	$3.31
2032	2.29	0.54	$5.49	$4.58	$3.66
2033	2.32	0.60	$6.03	$5.02	$4.02
2034	2.34	0.65	$6.57	$5.48	$4.38
2035	2.37	0.70	$7.12	$5.93	$4.75
2036	2.40	0.76	$7.68	$6.40	$5.12
2037	2.43	0.81	$8.24	$6.87	$5.49
2038 +	**2.45**	**0.84**	**$8.55**	**$7.12**	**$5.70**

Using the $8 per day value, the average annual recreation benefit the Project provides is equal to $7.12 million by 2038. Table 19 summarizes the average annual benefits. The present value over a 50-year implementation period is $133 million. Table 19 summarizes the results of the analysis.

Table 19. Project Recreational Benefits Summary

Measure	Value
Recreation	8,000 surface acres
Total Annual Benefit	$7.1 million
NPV Benefits	$133 million

5.4.2 Alternative Valuation of Recreation Benefits

Alternative methods for valuing recreation benefits were also considered and developed and a literature review was conducted.

Recreation use at new facilities, or changes in use at existing facilities, is the basis for recreation economic benefits. The most common metric of recreation use is a visitor-day (i.e., one person visiting for any part or all of a calendar day). Analysis alternatives include:

- Visitation can be quantified using econometric models of recreational use. These models typically include multiple site-specific characteristics that affect recreational demand (Ward et. al 1996). The model specification requires comprehensive timeseries and cross-sectional data on facility characteristics, visitors, demographic, and economic data.
- Economic benefits of visitation can be quantified using travel cost methods. These can be combined with recreational demand models and used to simultaneously estimate project benefits and visitation. The method requires comprehensive data to estimate the demand for quantity of recreational use and benefits, and calculate measures of consumer surplus (Loomis and Cooper 1996).
- Other benefit transfer approaches can be applied to value recreation benefits from a new facility. This requires identifying appropriate studies (or a study) from other similar reservoirs, and then adjusting the output of that study to be applicable to the current facility of interest.

An important consideration for recreation benefits is avoiding double-counting of benefits by calculating the increase in recreation at a new facility without considering substitution effects between facilities. For this reconnaissance-level assessment of the Project, other existing recreation opportunities (e.g., Lake McConaughy) were shown to be at capacity. Regional demand in excess of capacity suggests few or no substitution – demand will support the new facilities. Therefore, no additional substitution effects were considered.

A literature review was conducted to assess the value of alternative water-based recreation facilities and to determine if other representative studies would be suitable for a benefit transfer approach. These are briefly summarized:

- McKean and Taylor (2000) developed a continent valuation study of recreation demand in the Snake River Basin in central Idaho. They quantified economic benefits (consumer surplus) of about \$87.24 per person per trip. The average number of recreation trips per year was 2.76 in their sample. Therefore, the average annual benefits were \$241 per year per recreationist, which is about \$363 in current dollars.
- McKean et al. (2003) developed a travel cost model to value flatwater recreation activities on the lower Snake River. They estimated consumer surplus (economic benefits) of \$25 to \$35 per person per trip for Snake River reservoirs (\$35 to \$50 in current dollars). This was substantially higher than other comparable studies that they cited that were between \$8 and \$14 per person per trip (\$11 to \$20 in current dollars).
- For Nebraska recreation, Supalla and Buell (2007) estimated that Lake McConaughy recreation visitor day was valued at \$14.43 per day (\$18.28 in current dollars). At the time of their study, average annual visitors were between 400,000 and 800,000 per year. The number of visitors has since increased. It is noted that the estimated benefits are substantially greater than the \$8 valuation applied for this study.
- In another assessment of the Snake River, Taylor et al (2010) estimate fishing trip benefits between \$18 and \$43 per person per day (\$22 to \$53 in current dollars).

The range of benefits in other studies of recreation demand was found to be substantially greater than what was applied for the Project. Recreation benefits may be re-evaluated under future iterations of Project development when more detail is known about facilities, operations, and quality of recreational experience.

It is further noted that additional water-based recreation benefits were not monetized in this reconnaissance-level analysis. These may include:

- River-based recreation. This may include additional visitation due to additional flows on stretches of the Platte. It may also include additional visitation due to improved water quality.
- Recreational demand depends on Project reservoir facilities. This may include trails, camping, or other day-use activities. The proximity to the I-80 corridor may support additional economic value for these activities.
- Project operations are not defined at this time. If Lake McConaughy is operated differently this may increase recreational benefits at that facility. For example, higher lake levels later in the season may encourage additional visitation.
- Other wildlife viewing activities associated with the Platte River. For example, Eubanks et al (1998), Dority et al (2017), and other studies have estimated the economic benefits of recreation/tourism for wildlife viewing on the Platte River. Estimated annual out-of-region visitors as of 2017 were around 44,000, staying just under 3 days on average. Average daily spending was around $94 dollars ($103 in current dollars). In short, the wildlife viewing benefits of the Platte River are potentially substantially in excess of flatwater recreation benefits. However, Project operations and construction are not yet defined, and this is left for future economic analysis work.

The conclusion of the sensitivity analysis is that the valuation applied here produces reasonable, conservative direct economic benefit values for recreation attributable to the Project. It is consistent with best practices and supported by other existing studies. The literature review supported higher recreation benefit values. These may be considered as part of future Project planning.

5.5 Environmental Water Supply

The value of maintaining environmental flows is estimated as the avoided cost of converting irrigated agricultural land. This approach was applied because Project operations and the effect on river flows were not available for this reconnaissance-level assessment. Therefore the most likely source of water for equivalent flows to those provided by the Project were assumed to be from converting irrigated land to dryland production. Depending on Project operations and without-Project conditions, alternative valuation approaches establishing consumer willingness to pay for habitat benefits may be appropriate and considered in the future.

In addition to helping maintain environmental flows, the Project may be used to generate high flow events (pulse flows) on the Platte that clear sandbars and increase habitat for threatened and endangered species.

5.5.1 Project Environmental Water Benefits

The Project provides two direct environmental water supply benefits. The first is additional flows in the Associated Habitats Reach of the Platte River that would provide benefits for the three covered species (in addition to pallid sturgeon that continue to be managed under the PRRIP). The second benefit is from periodic pulse flows that would clear sand bars and provide additional habitat benefits.

The benefits of environmental water are valued at the alternative cost of converting irrigated agricultural lands to dryland. The assumption is that the Project would provide flows to meet required minimum flows. These flows would need to be met regardless of whether the Project is implemented. Converting agricultural land, for example using temporary leasing programs to pay for the saved irrigation water, is evaluated as the appropriate opportunity cost. Additional projects or programs to increase flows in appropriate reaches of the Platte River (e.g., as described under the PRRIP) may also be considered but were not evaluated as part of this reconnaissance-level assessment.

The method for quantifying agricultural water values was described under Section 5.3. The benefit per AF is $176.04. This benefit value is applied to monetize the value of additional flows provided by the Project. Environmental water provided by the Project is estimated at 100,000 AF per year (which includes 20,000 of agricultural water). The annual benefit would be $17.6 million

Potential pulse flows provided by the Project were evaluated separately. The current source of water to generate high flow events is water stored in Lake McConaughy's Environmental Account. Due to a chokepoint in the river, releases from McConaughy can only be used to generate flows of 3,000 cfs without the risk of flooding. The target amount for these high flow events is greater, around 5,000 – 8,000 cfs. These flows would need to occur for three consecutive days two out of every 3 years. The Project may provide operational flexibility needed to generate the pulse flow events.

The pulse flows are at least 2,000 cfs greater than the current capacity of the system. The PRRIP authorized a study in 2008 to look at potential projects to provide water for these high flow events. Thirteen projects were analyzed that could provide the required minimum pulse flows. Unit costs ranged from $460 to $1,075 per AF ($571 to $1,337 per AF in current dollars). The most reasonable of the proposed projects was judged to be expanding the Tamarack Reservoir in Colorado along the South Platte and simultaneously releasing water from Lake McConaughy on the North Platte to generate flows in excess of 5,000 cfs.

Using the Tamarack expansion as the least cost alternative to generate these high flow events, the alternative cost of providing pulse flows would be $571 per AF. To achieve the desired flow, the Project would need to provide at least 2,000 cfs for three consecutive days two out of every three years. This translates to 11,898 AF in release years or an average annual volume of 7,932 AF. The average annual benefit of the Project for pule flows would be $4.5 million.

Combining the annual flows and the pulse flows values, the annual direct benefit of the Project is $22.1 million. This includes 20,000 AF of water attributable to agricultural benefits. The present value over the planning horizon of the Project is $466.5 million. Table 20 summarizes the results of the analysis.

Table 20. Project Environmental Benefits Summary

Measure	Value
Flow Value	$176 per AF
Pulse Flow Value	$571 per AF
Flows	100 TAF per year (incl. 20 TAF of ag supply)
Pulse Flows	7.9 TAF per year
Total Annual Benefit	$22.1 million
NPV Benefits	$466.5 million

5.5.1 Alternative Valuation of Environmental Benefits

The alternative cost of agricultural water supply was applied to estimate Project environmental water benefits. Alternative methods for valuing environmental flow benefits were also considered and a literature review was conducted. Analysis alternatives include:

- Market data can be used to assess the willingness to pay for additional flows. The Central Nebraska Public Power and Irrigation District has a water leasing agreement with the PRRIP that pays lands to forgo irrigation in return for payments. Per acre payments have exceeded $220 per acre in some years, which is around $205 per AF at an average applied water of 13 ac-in.
- Ecosystem services, the goods provided by ecosystems, and the monetary benefits of ecosystem improvements can take many forms. Additional flows in the Platte River may provide a range of these benefits: for example, recreation (e.g., fishing for native fish improved by flows), water quality, flood control benefits provided by new wetlands, and other improvements in environmental outcomes valued by local residents. Valuing these services directly may be considered as part of future analyses.

A literature review was conducted to determine the potential benefits of habitat and flows on the Platte River. Studies reviewed include:

- Bergstrom and Loomis (2021) describe the total economic value of river restoration. As part of their study, they review 25 prior studies and find that the benefits of river restoration range between $4 to $350 per household per year, with an average of about $87 per household.
- Loomis et al (2000) summarize the results of a contingent valuation study of benefits from restoration of portions of the Platte River. They found that households would pay an average of $21 per month or $252 annually for the additional ecosystem services ($32 per household and $382 per year in current dollars). Results were substantially greater than the opportunity cost of water in irrigated agriculture or other upstream uses available for leasing. In a similar study focused on Colorado, Stein (2019) estimates willingness to pay for fishery improvement of $77 per person per year.
- Edwards and Thompson (2009) developed a similar economic contribution analysis as Dority et al (2017). Their study focused on Sandhill Crane migration and the Rowe Sanctuary in Nebraska. They concluded the annual economic benefit of the Rowe Sanctuary to the State of Nebraska was

about $5 million per year. These economic contribution analyses illustrate the importance of habitat tourism to the regional economy.

- Kroger and McMurray (2008) estimate the economic value of water uses along the Platte River in Nebraska. Angling and wildlife viewing alone were estimated to generate between $9.7 and $13.3 million annually ($12.1 to $16.3 in current dollars). The study also assessed the economic value of other amenities associated with the river.

The conclusion of the sensitivity analysis is that the valuation applied here produces reasonable, conservative direct economic benefit values for environmental water attributable to the Project. Valuation of specific habitat/environmental benefits could result in greater Project benefits. The sensitivity range for this reconnaissance-level assessment is set equal to the range shown in the agricultural direct benefits. The annual benefit range is $19.5 to 32 million. The present value of Project benefits is $517 to $848 million. These figures will be refined as part of subsequent Project development and feasibility assessments.

5.6 Municipal & Industrial (M&I)

The Project would provide municipal and industrial (M&I) water supply benefits to Nebraska. These would be from water supply developed by the Project and additional Platte River flows (depending on how the Project is operated). It is generally anticipated that the cities of Omaha and Lincoln would realize M&I benefits. Specific locations for M&I use may be refined as Project operations and construction is defined under future feasibility analyses. M&I benefits were calculated using an alternative cost method.

As described under Section 3, the Project is expected to provide an additional 100,000 AF per year for M&I use. In addition, the Project could increase streamflow during drought years. The analysis considers the benefits to M&I suppliers in Omaha and Lincoln.

The City of Omaha receives its water supply from multiple ground and surface water sources (Omaha MUD 2013a). Omaha Municipal Utilities District (MUD) holds ten total water rights on Big Papillion Creek, the Platte River, the Missouri River, and the Mulhalls Regulating Pit. Surface water is from the Omaha MUD Missouri River intake. Groundwater is pumped by more than fifty drinking water wells in wellfields across the region. This includes the South Platte Wellfield located in Sarpy County along the Platte River, in addition to one smaller wellfield in Sarpy County and several wellfields in Douglas County, including the West Platte Wellfield. Surface and groundwater resources are treated and managed for water quality. Omaha MUD describes some of its management actions for groundwater quality in its 2013 Wellhead Protection Plan (Omaha MUD 2013b).

The City of Lincoln's water supply is from pumping stations that deliver water from the Platte River Water Treatment Facility near Ashland. Its most recent water supply master plan found that the current configuration of the wellfields would not be able to meet projected demands for Lincoln in the future (Lincoln 2013). The water master plan also considered variability in Platte River flows under climate variability and concluded system facilities were insufficient to maintain sufficient water supply reliability. The master plan developed an evaluation of various raw water supply alternatives to increase supply to meet short and longer-run M&I demands. Short-run improvements included development of additional wellfields and limited ground and surface water storage. Mid- and longer-term options included development of an intake facility on the Missouri River.

The benefit of the Project is the alternative cost of additional water supply projects to increase water supply reliability and meet increasing demands in Lincoln and Omaha. Additional flows on the Platte River would make development of additional intake facilities potentially more feasible and reliable. This would allow M&I providers to avoid development of alternative supplies, including an intake facility on the Missouri River. The economic benefit of the Project is defined as the cost savings from maintaining the Platte River as the source and avoiding the alternative cost of developing water supplies in the Missouri River Basin.

The City of Lincoln's water master plan estimated preliminary costs for an intake facility on the Missouri River to be between $500 and $650 million in 2013 dollars (Lincoln 2013). This is between $577 and $750 million in current, 2021 dollars. Costs are for capital costs only and do not include any additional development, planning, or permitting costs. Annual operating, maintenance, and repairs costs are also not included. Table 21 provides a breakdown of project costs.

Table 21. Missouri River Intake Facility Cost Estimates

Cost Item	Cost Estimate ($2013)	Current Dollars
Horizontal Collection Well Investigation Costs		
Horizontal Collection Well Costs		
Land Costs		
Access Roads		
Water Treatment Plant Costs	$1.71 - $2.93 per gallon	$1.97 - $3.38 per gallon
Transmission Main	$2.8 million per mile	$3.23 million per mile
Pump Stations	$146,000 per mgd per ten miles	$168,500 per mgd per ten miles
Total Project Costs	$500-$650 million	$577 - $750 million

The City of Lincoln estimated that the Missouri River intake facility could provide between 60 and 80 million gallons per day or roughly 67,000 to 89,000 acre feet per year. To receive an equivalent volume of water from the Platte River, Lincoln would need to expand its existing intake facilities and potentially construct a new intake facility to avoid local aquifer depletion. Table 22 summarizes the capital cost of additional water supply development on the Platte River.

Table 22. Platte River Intake Facility Preliminary Cost Estimates

Cost Item	Quantity	Cost Estimate ($2013 millions)	Current Dollars (millions)
Horizontal Collection Wells	2 wells	$12.6	$14.5
Land Costs			
Access Roads			
Water Treatment at Existing Facility		$0	
Transmission Main	20 miles	$56	$64.6
Pump Stations	80 mgd at two stations	$23	$26.55
Total Project Costs		$104-$200	$121 - $231

The alternative cost of the Project is the difference between the Missouri River facility and the additional Platte River intake facility. The Project would allow additional M&I diversions from the Platte River, Lincoln would still pay to develop those additional supplies but would avoid the cost of the larger Missouri River intake facility. Table 23 summarizes the estimated capital costs of each project and the difference in current dollars; the avoided cost of the project ranges from $655 to $360 million. The range of avoided cost and unit values per acre foot are displayed in Table 23 below.

Table 23. Alternative Costs for Municipal Users

	Low Estimate	**High Estimate**	**Average**
Missouri Intake Facility (millions)	$577	$751	$664
Platte Intake Facility (millions)	$121	$231	$176
Difference in Capital Cost (millions)	$457	$520	$488
Capital Cost Savings per AF	$5,131	$7,756	$6,443
Annualized Savings (Benefit) per AF	$199	$301	$250

Using $250 per acre foot as the alternative cost to water users in Lincoln and Omaha, the annual benefit of the project is estimated at $25 million. The present value of the avoided cost benefit over a fifty-year implementation period is $662 million dollars. Table 24 summarizes the results of the analysis.

Table 24. Project M&I Water Supply Benefits Summary

Measure	Value
M&I Water Supply	100,000 AF
Total Annual Benefit	$25 million
NPV Benefits	$662.5 million

5.6.1 Alternative Valuation of M&I Benefits

Alternative valuation approaches were generally not possible to develop or implement at this time. Potential approaches include:

- Avoided costs can be applied to value M&I water supply benefits of the Project, but this would require a more complete definition of Project operations. Avoided costs may be appropriate for valuing Project benefits if there are avoided costs of other water supply projects that were planned but are not needed. Other potential situations include avoiding transfers or if there are situations where the amount of without-project supply provided by existing projects will be reduced. These may be evaluated in the future as Project operations are more clearly defined.
- Water market transactions data are limited but could be used to establish the willingness-to-pay for water supply. This could include leasing for instream flows. Establishing the value of M&I water from water transfers requires comprehensive data (typically time series and cross-sectional) that would be analyzed in a statistical or econometric model. These data were not available from a comprehensive, public source in Nebraska.
- M&I consumer surplus losses may be appropriate for valuation of water supply in shortage conditions. Additional analysis of the without-Project conditions would be required to determine if such conditions are likely. However, the City of Lincoln's water supply master plan indicates that future drought conditions are increasing likely. Under shortage conditions, a method for estimating M&I consumer surplus costs during shortage would define an economic demand function for the affected water users and used to calculate the loss of consumer surplus.

It is further noted that additional M&I benefits were not monetized in this reconnaissance-level analysis. These include:

- Drought resilience under changing climate conditions. More frequent severe weather events are generally expected in the future. Additional Project benefits include water supply flows in the South Platte, which would increase drought resilience for M&I providers in Omaha and Lincoln.
- Additional water quality benefits were not explicitly considered in this reconnaissance-level assessment. Water planning documents for the cities of Lincoln and Omaha indicate groundwater quality management is a substantial cost and important for public health. Therefore, the Project may provide water quality benefits that were not monetized as part of this reconnaissance-level assessment. These would be evaluated under future Project feasibility studies.
- The Project may provide additional benefits for rural areas or regions upstream of Lincoln. Additional M&I benefits would be specified under future Project operations.

A range for M&I benefits was estimated based on the alternative cost analysis for the Project plus additional allowance for potential non-monetized benefits. This was estimated to be $199 to $301 per AF based on the alternative cost assessment. The total annual benefit range is $19.9 to $30 million. The present value of the benefits over the Project life is between $527 and $797 million.

5.7 Hydropower

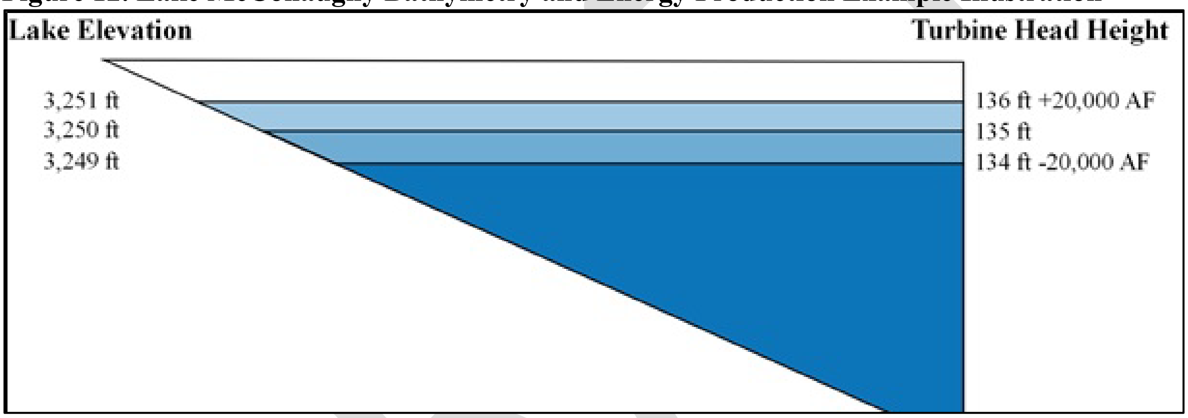
The economic benefits of additional hydropower generation are estimated in this study as the wholesale value of additional electricity generated and sold.

5.7.1 Project Hydropower Benefits

The benefit of additional hydropower sales is estimated using a two-step process. First, the additional power generation provided by the additional Project water is calculated. It is assumed that the Project water would be released in lieu of equivalent releases from Kingsley Dam. The increased power generation is estimated as a function of the change in head height (water level) provided by the Project and the physical characteristics of Kingsley Dam. The second step in the analysis calculated the value of the additional power generated using the wholesale cost of that power.

The Project is estimated to provide 20,000 acre-feet in hydropower water supply. At normal water levels in Lake McConaughy, a 20,000 AF change translates to roughly 1 ft in lake level elevation (USGS 2005). During drought conditions this is closer to 1.5 ft in lake elevation. At full capacity the 20,000 AF change translates to only about a 0.5 ft change in lake elevation. Changes in lake elevation result in changes in the production capacity of a hydroelectric facility. Figure 12 illustrates this relationship.

Figure 12. Lake McConaughy Bathymetry and Energy Production Example Illustration



On average the facility at Kingsley Dam produces 88,050 MWh per year (LIHI 2018). The dam's operating head typically varies between 135 ft and 140 ft. To estimate the total annual flow to generate that amount of power, we calculate the necessary flow to generate that quantity of electricity (USBR 2005). With an operating efficiency of 90%, it is estimated that the facility uses 681,707 AF per year for power generation. Average annual inflow to the lake is estimated to be 1,468 cfs or 1,062,832 AF per year. As such, the reservoir uses roughly 65% of inflows for hydropower generation, with the other 35% being lost to releases through the facilities spillway or to evaporation. These ratios are similar to those reported by previous work done on hydropower use in the Niobrara Basin (Shultz 2010). It is noted that this evapotranspiration would not be increased substantially by a small increase in water level. These calculations may be refined as part of future Project feasibility assessments.

Using these relationships, an additional 1 ft change in head attributable to the Project translates to a 629 MWh per year change. The benefit of the Project is the value of the 629 MWh per year. This additional generation was valued at the wholesale electricity cost rather than the retail electricity cost. Wholesale electricity costs reflect the cost of generating and delivering electricity, and provide an estimate of the avoided cost of purchasing the electricity from other sources. Average wholesale prices were reported at 5.8 cents per KWh in 2019 by Fitch Ratings using data from the Nebraska Public Power District (NPPD).

The value of an additional 20,000 AF provided for hydropower is equal to $35,200 per year or $1.76 per acre foot. The increase in elevation has a power value when the lake levels are below the optimal operating level and thus power output is increased.

Table 25. Project Hydroelectric Water Supply Benefits Summary

Measure	Value
Hydropower value	$1.76 per AF
Total Annual Benefit	$35,200
NPV Benefits	$0.9 million

5.7.2 Alternative Hydropower Benefits

A potential alternative valuation approach was considered that follows the approach taken by Shultz (2010). Shultz values hydropower on the Niobrara by dividing total lake inflows by total power output. Using this approach, we estimate a value of $4.80 per acre foot or $96,100 per year.

It is further noted that additional hydropower benefits were not monetized in this reconnaissance-level analysis. These include avoided CO_2 emissions from non-renewable power facilities that would be in addition to the values estimated in this analysis.

An estimated range for hydropower benefits was estimated including additional allowance for potential non-monetized benefits. The estimated range is $0.57 to $4.6 per AF. The total annual hydropower benefits are between $11,400 and $92,000. The present value of benefits is between $0.3 and $2.3 million.

5.8 Other Non-Monetized Project Benefits

Other types of Project benefits were considered but were not analyzed in this initial reconnaissance-level assessment.

- The Project operations are still being defined and refined. The additional water supply would likely provide additional operational flexibility for the entire Platte River system. These additional considerations would require a water supply operations analysis to understand and quantify. None has been completed to date.
- The Project may also provide additional benefits under future variable climate conditions. No climate change analysis of flows in the Platte River, including its tributaries and upstream demands on the river, has been completed for this initial assessment.
- There may be additional opportunities for re-operating the system considering diversions in Colorado. For example, this could include exchanges with Colorado to meet minimum flow requirements.

- The Project may provide additional flood control benefits. As described earlier, the Project may allow for releases of pulse flows for habitat benefits. These were previously not feasible due to flood management requirements.
- In addition to pulse flows, the Project may be able to provide other habitat benefits over and above what are required by the PRRIP.

6. Regional Economic Effects

The regional economic effects of the Project were evaluated in addition to direct economic benefits. Regional effects are measures of total economic activity and consider how the industries (e.g., farming, municipal water users, recreation) and economic sectors linked to them would be affected by the additional water supply provided by the Project. Regional effects are expressed in terms of direct, indirect, and induced economic activity. Direct effects are the increase in the economic activity measure (e.g., output value or employment) for affected industries (e.g., additional corn sales). Indirect effects measure how industries that provide inputs (e.g., farm equipment and seed suppliers) are affected by the Project. Induced effects measure how household/employee expenditures change in response to the Project. The sum of these effects is called the total economic effect (or this is sometimes referred to as an economic "impact" or "contribution").

Farming and other industries that would benefit from the Project are an important component of the Nebraska economy, including economic activities for rural communities across the state. A recent economic contribution analysis by Thompson et al (2020) estimated the total economic impact of Nebraska agricultural industries. The authors estimated that the gross output value of agricultural industries was around $82 billion, accounting for more than one-third of the state's total output value. The value added to the state economy (gross state product) was around $26 billion, representing about 22% of the state economy. Around 321,000 jobs were attributable to the agricultural sector and related industries, which is about 23% of the state total. In short, agriculture, which would benefit substantially from the Project, accounts for up to one-quarter of the Nebraska economy.

A preliminary assessment of Project regional economic effects was developed. The analysis uses the Bureau of Economic Analysis (BEA) Regional Input-Output Modeling System (RIMS II) data. Regional economic effects of the Project follow from the direct benefits analysis described earlier in this report. The regional effects are annual values that are assessed at the time the Project is operating. However, regional effects should not be confused with the direct economic benefits of the project. Regional effects include:

- **Agriculture**. Agriculture would receive Project water supply of approximately 20,000 AF per year. The regional effect of the additional water supply would be to keep additional land in irrigated production. Therefore, the total regional economic effect is the direct, indirect, and induced effect resulting from the difference (gross output value) between irrigated and dryland corn production. For purposes of the regional effects analysis, this 20,000 AF is included as part of the environmental flow effect because it is also valued based on its allowing corn acreage to remain irrigated.

  Alternatively, if the Project were to bring additional land that is not currently farmed into production, the regional economic effect would be greater because it would include the full effect of newly developed irrigated lands, not just the difference between irrigated and dryland production. This is included as a sensitivity analysis.

- **Municipal and industrial**. The Project would provide 100,000 AF for municipal and industrial uses, primarily for the Lincoln and Omaha areas. The regional economic effects of this additional water supply were not assessed for this reconnaissance-level analysis. Additional M&I supply would allow Lincoln and Omaha to avoid the cost of some planned water supply projects. The regional effects depend on how that avoided cost would then be reallocated and spent in the regional economy. This may be considered under future analyses.

- **Environment**. Environmental flow benefits are based on the alternative cost of irrigated agriculture. The environmental flows provided by the Project would allow Nebraska to keep additional corn land in irrigated uses. The total volume of flows is 100,000 AF per year (inclusive of the 20,000 AF of agricultural water supply). The regional economic effect is the difference in economic activity (gross output value) between irrigated and dryland corn production. This is equal to $413 per acre (difference between irrigated and dryland corn) over 92,300 acres (100,00 AF with an average applied water of 13 inches per acre). The total annual gross value is $38.13 million.

  If the Project were to bring additional land that is not currently farmed into production, the regional economic effect would be greater because it would include the full effect of newly developed irrigated lands. This is included as a sensitivity analysis. The total annual gross value equals $91.55 million if all lands are newly developed.

- **Recreation**. The Project would develop around 8,000 acres of new reservoirs. The economic effect is the additional spending by out-of-state visitors. As described under Section 4, around 75 percent of recreational visits in Nebraska are from out-of-state. An average recreational expenditure of $27 per day was applied to estimate the total gross value. With 844,090 visitor days, the annual gross value is $17.1 million.

  The Project may also spur some new spending by existing Nebraska residents that increase water-based recreation. This is included as a sensitivity analysis. The annual gross value is $22.8 million if all recreation is included as new spending in Nebraska.

- **Hydropower**. The Project would create 20,000 AF for hydropower. Now new facilities would be constructed or operated. The additional power would be from the reoperation of existing facilities. Any regional economic effects were not considered for this reconnaissance-level study.

- **Project Construction and Operations**. Project construction and operations would also generate regional economic effects. Construction would bring workers to the area and this would create additional local economic activity. The effect of the Project construction would end once construction is complete. Project operations may also include require additional employees. A recent, detailed cost estimate for the Project has not yet been prepared. Using early construction costs prepared by USBR (1982), indexed to current dollars, provides a rough estimate between $500 million and $850 million for illustrative purposes. However, due to the uncertainty of indexing nearly forty-year-old costs, the regional economic effects of Project construction and operations are reported separately and in terms of jobs only.

Table 26 summarizes the regional economic effects analysis. As shown, the effects for agriculture, environmental flows, and recreation area evaluated. M&I and hydropower are not. Effects for Project construction (but not operations) is included, but only as an illustrative example using existing USBR data.

Table 26. Regional Economic Effects Included in the Analysis

Industry	Project Benefits	Regional Effects Assessed?
Agriculture	100,000 AF	Yes
Hydropower	20,000 AF	No
Municipal	100,000 AF	No
Environmental Flows	(included with ag)	Yes (with ag)
Recreation	8,000 acres	Yes
Project Operations	n/a	Yes (example only)

Table 27 summarizes the results of the regional economic analysis. It shows the direct gross output value change for the industries analyzed and the regional economic effects. The Project would generate around $109 million in total output value in Nebraska. The net economic value added to the state would be $52 million, including $28 million in additional wage income. Statewide full-time-equivalent jobs increase by 879. This does not include any economic effects from M&I and hydropower water supply.

Table 27. Regional Economic Effects (million $ per year)

Industry	Output	Income	Value Added	Jobs
Recreation				
Final Demand Change	$17.1			
Direct + Indirect	$23.9	$7.6	$13.0	368
Induced	$7.1	$2.2	$4.2	58
Total Recreation Effect	$31.0	$9.8	$17.2	426
Agriculture				
Final Demand Change	$38.1			
Direct + Indirect	$64.9	$14.2	$26.7	344
Induced	$13.3	$4.1	$7.8	108
Total Agriculture Effect	$78.2	$18.3	$34.6	453
Total Project Effect	$109.2	$28.1	$51.8	879

The regional effects of Project construction and operations were separately assessed using the BEA RIMS II data. Due to the uncertainty associated with the old construction cost estimates, the results are not included in the summary tables. Nevertheless, assuming Project construction costs of $500 to $850 million, and that one-third to half of those costs are for Nebraska businesses, this would create between 2,000 and 4,000 construction-related jobs. These represent totals over the construction period, not jobs per year during construction, and would end after Project construction is completed.

Table 28 summarizes the results of the regional economic sensitivity analysis (as described earlier in this section for each water use sector). It shows the direct gross output value change for the industries analyzed and the regional economic effects under the sensitivity ranges described above. The Project would generate around $188 million in total output value in Nebraska. The net economic value added to the state would be $82 million, including $44 million in additional wage income. Statewide full-time-equivalent jobs increase by 1,317. This does not include any economic effects from M&I and hydropower water supply.

Table 28. Regional Economic Effects Sensitivity (million $ per year)

Industry	Output	Income	Value Added	Jobs
Recreation				
Final Demand Change	$22.8			
Direct + Indirect	$22.4	$7.2	$11.8	413
Induced	$9.5	$2.9	$5.6	77
Total Recreation Effect	$31.9	$10.1	$17.4	490
Agriculture				
Final Demand Change	$91.6			
Direct + Indirect	$123.8	$24.2	$45.4	567
Induced	$32.0	$9.8	$18.8	260
Total Agriculture Effect	$155.8	$34.0	$64.2	827
Total Project Effect	$187.7	$44.2	$81.6	1,317

The RIMS II data (as with all input-output analysis) supports indirect effects for backward-linked sectors, that is, sectors providing inputs to the direct production. It does not explicitly consider the effect of the Project on forward-linked industries such as dairy or ethanol production. These may be evaluated under future Project feasibility investigations. For example, the effects of maintaining irrigated corn production on persons who sell inputs to irrigated corn farmers, and everyone who in turn sells to the input sellers are counted. However, any impacts in forward-linked industries such as processers of corn grain or animal feeding operations, is not counted.

Forward-linkage effects depend very much on how much of the direct output is relied upon by the forward-linked industry. Consider ethanol production as an example. One source estimated that ethanol production currently uses 40 percent of Nebraska corn production.[2] Since Nebraska produces enough corn for its ethanol plants it is unlikely that the Project would have any effect on ethanol production or costs. Ethanol producers will produce the same amount of ethanol regardless of the Project. Similarly, animal feed operations will purchase enough feed in any case and the amount of meat production is not likely to be affected.

Input-output methods and multiplier effects normally assume that prices are unaffected. The Project could cause slightly lower prices for corn grain which would be a benefit for ethanol producers and livestock operations. A review of statistical analyses of corn grain prices might be justified to see if these effects could be significant. In addition, The Project could have small benefits for local storage and

[2] https://agecon.unl.edu/cornhusker-economics/2018/evolution-nebraska-corn-basis#:~:text=Nebraska%20currently%20has%2025%20ethanol,of%20Nebraska's%20annual%20corn%20production.

transportation operations that charge on the basis of weight of corn. The regional effects of the Project on forward-linked industries may be assessed as part of future Project planning.

7. Summary and Discussion

For the purposes of this reconnaissance-level economic assessment, the Project operations and facilities were defined at a conceptual level. The volumes of water available to different uses and users were specified and general Project operations that would affect the economic benefits were described throughout this report. The Project is expected to collect excess wintertime flows and store the water in up to six reservoirs, providing an average annual yield of 200,000 AF available for use during the summer. It is assumed that conveyance and storage facilities will be designed to deliver this level of supply. These supplies would be directly available for a variety of users in the South Platte and Lower Platte Basins, and in the North Platte Basin through exchanges or reoperation of the broader system of canals, reservoirs, and hydropower facilities.

Table 29 provides a summary of Project benefits by source. The average annual yield of the Project is 200,000 AF. Some of this water would be available for both habitat (PRRIP/ESA) and users downstream of the habitat reach (e.g., cities of Lincoln and Omaha). S some water can meet more than one benefit, but the total for this analysis is 200,000 AF. The volumes for different uses will be refined under future Project planning studies.

Table 29 Project Yield Summary

	Annual Yield (AF)	Other
Agriculture and Environmental Flows	100,000	
M&I	100,000	
Recreation		8,000 acres
Hydroelectric	20,000	

A series of economic analyses were developed to quantify the direct economic benefits of the project. Direct economic benefits were monetized using appropriate methods for each water supply type. Environmental flows were valued at the opportunity cost of irrigated agriculture.

Table 30 summarizes the results of the economic analysis for the volumes of water shown in table 29. For each benefit category, the table includes both a likely probable annual benefit and a range derived by varying key assumptions and valuation methods. The average annual direct economic benefit of the Project is estimated to be about $57 million in this reconnaissance-level assessment. The range in total annual benefit is $44 to $68.5 million. The present value of direct economic benefits over the 50-year economic life of the project is $1.38 billion. The range is $1.08 to $1.79 billion. This does not include any secondary regional economic, or "multiplier," effects.

Table 30. Project Economic Benefits Summary (million $)

	Annual Benefit	Annual Benefit Range	50-Year NPV	50-Year NPV Range
Agriculture / Environment	$22.1	$19.5 - $32	$586.0	$517 - $849
M&I	$25	$19.9 - $30.1	$662.5	$527 - $797
Recreation	$7.1	n/a	$133.2	n/a
Hydroelectric	$0.04	$0.01 – 0.09	$0.9	$0.3 - $3
Total	**$57.4**	**$44.5 - $68.5**	**$1,382.8**	**$1,085 - $1,688**

The economic analysis additionally estimated the regional economic effects that would occur each year from the start of Project operations. These were assessed using regional economic multipliers from a modeling system called RIMS II that is developed by the U.S. Bureau of Economic Analysis (BEA). The Project would generate $50 to $80 million in value added to the Nebraska economy from total output value of $108 to $187 million every year. It would create an estimated 850 to 1,300 full-time-equivalent jobs. This does not include additional multiplier effects from expenditures for Project construction, operations, and maintenance. Project construction could generate an additional 2,000 to 4,000 jobs during the construction period. Table 31 summarizes the results of the analysis.

Table 31. Project Regional Economic Effects Summary

Industry	Project Benefits	Output ($ millions)	Value Added ($ millions)	Jobs
Agriculture	100,000 AF	$78 - $155	$34 - $64	450 – 825
Hydropower	20,000 AF	n/a	n/a	n/a
Municipal	100,000 AF	n/a	n/a	n/a
Environmental Flows	(included with ag)	n/a	n/a	n/a
Recreation	8,000 acres	$30 - $32	$17 - $18	420 – 490
Project Operations	n/a	n/a	n/a	2,000 – 4,000
Total (excluding Project Operations)		$108 - $187	$50 - $82	880 – 1,300

Note: Values may not add exactly due to rounding

This reconnaissance-level economic assessment was based on the best available data and standard best practices. Due to limited information on project facilities and operations, some reasonable assumptions were made for the analysis, and these are described throughout the report. All benefit values (and regional economic effects) were presented as a range to give the reader an understanding of the uncertainty of the initial analysis, and importantly of additional Project benefits that were not evaluated. Recommended next steps for the economic analysis include:

- Refine the Project operations to provide better estimates of flows and supplies available for different uses. This would allow for estimating Project benefits more precisely.

- Expand the analysis for the direct benefits of each water supply option. This would include extending the analysis to include other benefits that were not monetized in this initial study.
- Refine Project construction and operation cost assumptions and use that to develop an economic feasibility assessment of alternative Project configurations. The analysis presented in this report (which may be refined in the future) provides a starting point for Project benefits, but no assessment of Project costs was developed beyond what USBR (1982) developed in its earlier engineering study.
- Refine the regional economic effects analysis based on updated Project operations and direct economic benefits. A preliminary assessment using BEA RIMS II data was presented. This should be updated with additional state data to provide more precise estimates of regional economic affects, and affected industries, attributable to the Project.

8. References

Bergstrom, John C., John B. Loomis. 2022. What is the Total Economic Value of River Restoration and Why is It Important? in River Restoration: Political, Social, and Economic Perspectives. Wiley Blackwell.

California Water Commission (CWC). 2016. Water Storage Investment Program Technical Reference. Sacramento, CA. November 2016.

City of Lincoln (Lincoln). 2014. Lincoln Water System Facilities Master Plan. Prepared by HDR Inc.

Dority, B., Thompson, E., Kaskie, S., and Tschauner, L. 2017. The Economic Impact of the Annual Crane Migration on Central Nebraska. University of Nebraska-Lincoln Report. 27 pp.

Eubanks, T.L., R.B. Ditton and J.R. Stoll. 1998. Platte River nature recreation study: The economic impact of wildlife watching on the Platte River in Nebraska. Prepared for the US Environmental Protection Agency Region VII. Austin, TX: Fermata, Inc. 86p.

Edwards, R., & Thompson, E. 2009. The Economic Impact of the Rowe Sanctuary and Sandhill Crane Migration on the Central Nebraska Region.

Headwaters Corp. Presentation to University of Nebraska Water for Food Daugherty Global Institute. April 2021. Available at: https://waterforfood.nebraska.edu/news-and-events/news/2021/04/experiences-using-economic-incentives-to-support-the-platte-river-ecosystem. Accessed December 4, 2021.

Houk, E. E., & Frasier, W. M. 2002. Identifying cost-effective sources for water transfers from agriculture to endangered species preservation in the Platte River Basin (No. 1843-2016-152412).

Jansen, J. and Stokes, J. Nebraska Farm Real Estate Market Highlights. 2020-2021. Center for Agricultural Profitability. University of Nebraska-Lincoln.

LaGrange, T. G. 2005. "A Guide to Nebraska's Wetlands and their Conservation Needs." Nebraska Game and Parks Commission, Lincoln

LIHI. 2018. Stage II Recertification Review for Kingsley Dam Low Impact Hydropower Institute's (LIHI) #37. 2018.

Loomis, J., B. Roach, F. Ward and R. Ready. 1995. Testing transferability of recreation demand models across regions: A study of Corps of Engineers reservoirs. Water Resources Research 31(3):721-730.

Loomis, John, Paula Kent, Liz Strange, Kurt Fausch, Alan Covich. 2000. Measuring the total economic value of restoring ecosystem services in an impaired river basin: results from a contingent valuation survey, Ecological Economics, Volume 33, Issue 1, 2000, Pages 103-117

McKean, J.R. and R.G. Taylor. 2000. Outdoor recreation use and value: Snake River basin of central Idaho. Idaho Experiment Station Bulletin. Moscow, ID: University of Idaho. 58p.

McKean, J.R., D. Johnson and R.G. Taylor. 2003. Measuring demand for flat water recreation using a two-stage/disequilibrium travel cost model with adjustment for overdispersion and self-selection. Water Resources Research 39(4):1107.

Mukherjee, M. and Schwabe, K. 2015. Irrigated Agricultural Adaptation to Water and Climate Variability: The Economic Value of a Water Portfolio. Amer. J. Agr. Econ. 97(3): 809–832; doi: 10.1093/ajae/aau101.

Nebraska Game and Parks. 2016. Lake McConaughy Lake Ogallala Master Plan. Lincoln, NE.

Nebraska Game and Parks. 2021. Recreation Summary Data. Accessed December 10, 2021. https://nebraskastateparks.reserveamerica.com/camping/lake-mcconaughy-sra/r/campgroundDetails.do?contractCode=NE&parkId=230099.

Omaha Municipal Utilities District (MUD). 2013a. Source Water Assessment. Technical Report Summary.

Omaha Municipal Utilities District (MUD). 2013b. South Platte Wellhead Protection Plan. Technical Report.

Shultz, S. 2010. The Extent and Value of Agricultural, Municipal, and Industrial Water Use in the Niobrara Basin. Research Paper. Funded by Nebraska Game and Parks Commission and the Nebraska Environmental Trust.

Shultz, S. and Schmitz, N. 2010. The Implicit Value of Irrigation Through Parcel Level Hedonic Price Modeling. Presentation at the American Agricultural Economics Association Annual Conference. July 2010.

South Platte Regional Opportunities Water Group (SPROWG). 2020. Feasibility Study Report. Prepared for Lower South Platte Water Conservancy District. March 2020.

Stantec and Leonard Rice Engineers. 2017. HB16-1256 South Platte Storage Study.

Stein, Samuel. 2019. Opportunity Cost of Water in the South Platte River; Comparing Economic Value Derived from Stated and Revealed Preferences. Diss. Colorado State University, 2019.

Stoll, J.R., R.B. Ditton and T.L. Eubanks. 2006. Platte River birding and the spring migration: Humans, value, and unique ecological resources. Human Dimensions of Wildlife 11(4):241-254.

Supalla, R. and Buell, T. 2006. Economics of Management Options for Lake McConaughy. Department of Agricultural Economics. University of Nebraska – Lincoln.

Taylor, R.G., J.R. McKean and D. Johnson. 2010. Measuring the location value of a recreation site. Journal of Agricultural and Resource Economics 35(1):87-104.

US Army Corps of Engineers (USACE). 2000. Planning Guidance Notebook. Engineer Regulation 1105-2-100. Washington, D.C. April.

US Army Corps of Engineers (USACE). 2021. Subject Economic Guidance Memorandum 22-03 Unit Day Values for Recreation for Fiscal Year 2022. CECW-P. November 10, 2021.

US Department of Agriculture. Drought Monitor. 2021. Nebraska Index. https://www.drought.gov/states/nebraska. Accessed December 20, 2021.

US Department of Agriculture. Forest Service (USFS). 2020. National Visitor Use Monitoring Survey Results National Summary Report. 2020.

US Department of Agriculture. National Agricultural Statistics Service. 2020. Cropland Data Layer.

US Department of Agriculture. National Agricultural Statistics Service. Various Years. Agricultural Survey.

Natural Resources Conservation Service (NRCS). 2021. https://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/technical/econ/prices/?cid=nrcs143_009685. December 15, 2021.

US Department of Commerce. Bureau of Economic Analysis. 2020. Regional Economic Accounts.

US Nebraska Game and Parks. 2016. Lake McConaughy Lake Ogallala Master Plan.

US Department of the Interior. Geological Survey (USGS). 2005. Comparison of Preconstruction and 2003 Bathymetric and Topographic Survey of Lake McConaughy, Nebraska. 2005.

US Department of the Interior. Bureau of Reclamation (USBR). 2005. Hydroelectric Power. July, 2005. Available at https://www.usbr.gov/power/edu/pamphlet.pdf

US Department of the Interior. Bureau of Reclamation (USBR). 1982. Perkins County Canal Project Technical Feasibility Study.

US Department of the Treasury (Treasury). 2021. Treasury Long Term Rate Data. https://www.treasury.gov/resource-center/data-chart-center/interest-rates/pages/TextView.aspx?data=longtermrate. Accessed December 15, 2021.

US Federal Reserve Bank of Cleveland (Cleveland Fed). 2021. https://www.clevelandfed.org/our-research/indicators-and-data/inflation-expectations.aspx. Downloaded November 30, 2021.

US Federal Reserve Bank of St. Louis (St. Louis Fed). 2021. Consumer Price Index for All Urban Consumers: All Items in U.S. City Average (CPIAUCSL). Downloaded December 1 from: https://fred.stlouisfed.org/series/CPIAUCSL

US Water Resources Council. 1983. Principles and Guidelines for Water and Related Land Resources Implementation Studies (P&G). Washington, D.C. March 1983.

Visit Nebraska. Various Years. Nebraska Attraction Attendance Counts.

Ward, F. A., B. A. Roach, J. B. Loomis, R. C Ready, and J. E Henderson. 1996. Regional Recreation Demand Models for Large Reservoirs: Database Development, Model Estimation, and Management Applications. Tech Report R96-2. U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.