

ADDENDUM No. 1

July 10, 2012

to

**Garrison Dam/Lake Sakakawea Project, North Dakota
Final Surplus Water Report and Environmental Assessment
March 2011**

1. This Addendum No. 1 modifies the *Final Garrison Dam/Lake Sakakawea Surplus Water Report and Environmental Assessment (EA) (Volumes I and II)*, dated March 2011, to reflect the policy direction regarding surplus water provided in the Assistant Secretary of the Army for Civil Works (ASA(CW)) memorandum, dated May 8, 2012, subject: Lake Sakakawea Surplus Water Report (copy attached).

2. As described in the paragraphs that follow, this Addendum No. 1 replaces aspects of the surplus water pricing and agreement/easement/license process described in the March 2011 Report and EA, and the recommended pricing suggested by Headquarters, U.S. Army Corps of Engineers in the transmittal memorandum, dated April 19, 2011, with the interim direction provided in the ASA(CW) memorandum for implementing surplus water agreements for municipal and industrial (M&I) water supply under Section 6 of the Flood Control Act of 1944 (Public Law 78-534) at Lake Sakakawea until a national policy for surplus water pricing is developed through rulemaking. This Addendum does not change the report finding that 100,000 acre-feet/year of surplus water is available at Lake Sakakawea to meet M&I water supply needs for the period of the next ten years, and does not affect the environmental conditions or impacts evaluated in the EA. This Addendum also reflects the ASA (CW)'s acknowledgement of the report's conclusion regarding the availability of surplus water.

3. As directed in the ASA(CW) memorandum, the Corps of Engineers is initiating actions to establish a nationwide policy with input from all interested parties for uses and pricing of surplus water for M&I water supply under Section 6 of the Flood Control Act of 1944. This nationwide policy will be developed as expeditiously as possible through notice and comment rulemaking in accordance with the Administrative Procedure Act, 5 U.S.C. 553.

4. In the interim, until the rulemaking to develop the new nationwide surplus water policy is complete, the following pricing directives and agreement/easement/license process will be implemented at Lake Sakakawea for surplus water for M&I water supply purposes:

- a. For new M&I users, defined as those requesting withdrawal of surplus water for M&I purposes for the first time, or those seeking a new, modified, or renewed easement or license in order to increase their current use or change from irrigation to M&I use:
 - i. The new users will be required to enter into surplus water agreements as part of the application process for obtaining, renewing, or modifying easements or licenses. The terms of such agreements will be no longer than five years, although provision may be made for extension by mutual agreement of the parties for another five-year period. The agreements will not contain any charges for withdrawals during the notice and comment rulemaking period.
 - ii. Upon completion of the notice and comment rulemaking, a modified or new surplus water agreement will be required for continued M&I surplus water withdrawals, on terms for use and pricing consistent with the new final rule.

iii. The consideration or fees associated with entering into a real estate easement or license will still apply.

b. For existing M&I users, who do not seek any changes in their continuing water withdrawals:

i. During a transitional period until the completion of the rulemaking process, existing M&I users with current easements or licenses may continue to make withdrawals without an agreement or charge for the use of surplus water, but will be on notice that surplus water agreements will be required for continued M&I surplus water use once rulemaking is completed, on terms for use and pricing consistent with the new final rule.

ii. Any easements or licenses expiring before the final rule is published may be extended for a period not to exceed five years, with the condition that surplus water agreements will be required for continued M&I surplus water use once rulemaking is completed, on terms for use and pricing consistent with the new final rule. The consideration or fees associated with extending the real estate easement or license will still apply.

5. Upon completion of rulemaking, all users of surplus water for M&I purposes will be required to have in effect a surplus water agreement and associated easement or license that reflect the new use and pricing policy established via the rulemaking process.



DEPARTMENT OF THE ARMY
OFFICE OF THE ASSISTANT SECRETARY
CIVIL WORKS
108 ARMY PENTAGON
WASHINGTON DC 20310-0108

MAY -8 2012

MEMORANDUM FOR DIRECTOR OF CIVIL WORKS

SUBJECT: Lake Sakakawea Surplus Water Report

1. References:

- a. ASA(CW) memorandum dated 17 February 2012, subject: Lake Sakakawea Surplus Water Report and Pending Irrigation Use Applications.
- b. CECW-P memorandum dated 3 February 2012, subject: Audit of Water Withdrawals from the Missouri River Main Stem Reservoirs.
- c. ASA(CW) memorandum dated 1 December 2011, subject: Lake Sakakawea Surplus Water Report.
- d. CECW-NWD memorandum dated 19 April 2011, subject: Garrison Dam/Lake Sakakawea, North Dakota, Surplus Water Report.
- e. ASA(CW) memorandum dated 24 March 1987, subject: Sale of Surplus Water.

2. Reference 1.d. transmitted the Surplus Water Report for Garrison Dam/Lake Sakakawea, North Dakota, ("Report") prepared by the Omaha District, along with two specific recommendations. In particular, you recommend that I: (1) accept the conclusion in the report that 100,000 acre-feet of surplus water is available for annual withdrawal over the next 10 years, and (2) approve on an interim basis a pricing methodology based on recovering operation and maintenance costs rather than cost-of-storage as presently contemplated in Engineer Regulation 1105-2-100. Although I acknowledge the Report's findings regarding the availability of surplus water, I decline to establish a nationwide pricing policy without more input from all interested stakeholders. Accordingly, in the near-term, I do not oppose the Corps entering into new agreements for the use of surplus water¹ at Lake Sakakawea as identified in the Report, with one important exception – that no charge shall be made for surplus water uses pending the outcome of the notice and comment rulemaking as directed below. Additionally, as discussed in reference 1.c., the surplus water reports for the other Missouri River main stem reservoirs shall be finalized as soon as possible and forwarded to me for review, although all pricing policy issues raised therein will be deferred pending completion of the rulemaking process.

¹ Pursuant to Section 6 of the Flood Control Act of 1944.

3. I agree that long-term contracts for municipal and industrial water supply storage should be executed under the authority of the Water Supply Act of 1958. Such long-term water supply storage agreements envision recovering the cost-of-storage, which generally includes amortized costs of construction, operation and maintenance. Short-term municipal and industrial uses of surplus water, in contrast, are accommodated under the authority provided in Section 6 of the Flood Control Act of 1944. Because the use of surplus water under Section 6 does not confer long-term or permanent rights to storage, you recommended a different pricing structure. Establishing a definitive policy that reflects the distinction between these two authorities would add significant and necessary clarity to the Corps' water supply practice for Lake Sakakawea and nationwide. The application of these statutory authorities to the withdrawals of water at Lake Sakakawea and other Missouri River main stem reservoirs has remained unsettled far too long. I am committed to resolving this uncertainty by establishing a nationwide policy for Section 6 surplus water uses through formal rulemaking.

4. Accordingly, I direct the following:

a. Confirm the source of authority for all water withdrawals in the Missouri River main stem within 30 days from the date of this memorandum or as expeditiously as possible. Reference 1.b., Table 1, does not identify with certainty the authority the Corps considers applicable to a number of withdrawals of water. Your audit report suggests a Bureau of Reclamation authority may be applicable.

b. Initiate action immediately to pursue notice and comment rulemaking in accordance with the Administrative Procedure Act to establish a nationwide policy for surplus water uses under Section 6. Rulemaking will allow all stakeholders to express their views and recommendations. It is imperative that this rulemaking process conclude at the earliest date possible. Provide me within the next two weeks a timeline with key milestones dates for concluding the rulemaking process within 18 months or as expeditiously as possible.

c. For all new municipal and industrial uses of surplus water at Lake Sakakawea (i.e., those requesting to use surplus water for the first time) proceed as proposed in your memorandum to enter into surplus water agreements which contain terms that provide appropriate notice to the user that use of the water will be at no cost pending completion of the rulemaking. The term of these agreements and any supporting easements or licenses shall be for a period not to exceed the time needed to conclude the rulemaking process. Surplus water agreements executed after the final rule is published shall be in accordance with the newly-established policies.

d. Provide appropriate notice that all users of surplus water at Lake Sakakawea will be required to enter into new or revised surplus water agreements once the nationwide rule becomes effective. Any agreements and supporting easements or licenses expiring before the final rule is published may be extended consistent with paragraph 4.c. above.


e. Adopt, as expeditiously as possible, a method to measure and account for current and future demands for water and to provide accurate and reliable data on all actual withdrawals of water from Lake Sakakawea.

f. Proceed with any necessary and appropriate water reallocation studies for the Missouri River main stem reservoirs and finalize these studies at the earliest date possible.

5. I am acutely aware of the views expressed by the Governors of North and South Dakota regarding water use within their state boundaries. Recognizing how long certain issues regarding water withdrawals from the Missouri River main stem reservoirs (i.e., Section 6 surplus water) have remained unresolved, and the need for consistent water supply policy nationwide, it is appropriate, in my view, to provide for a transition period equal to the time necessary to publish a final rule during which time new municipal and industrial users of surplus water may do so without cost. After publication of the final rule, the transition period shall expire and all municipal and industrial users of Section 6 surplus water, at Lake Sakakawea and elsewhere, shall comply with the nationwide policy.

6. Reference 1.a. directs that water use for irrigation may continue without a Department of the Army contract until the gap in the authority is remedied by Congress. The General Counsel's office will initiate discussions with the Department of Interior aimed at clarifying the policy regarding withdrawals of water for irrigation.

7. Any and all provisions and policies contained in reference 1.e. that are inconsistent or conflict with this memorandum are hereby rescinded and revoked.


Jo-Ellen Darcy
Assistant Secretary of the Army
(Civil Works)



US Army Corps
of Engineers
Omaha District

Final
Garrison Dam/Lake Sakakawea Project
North Dakota
Surplus Water Report

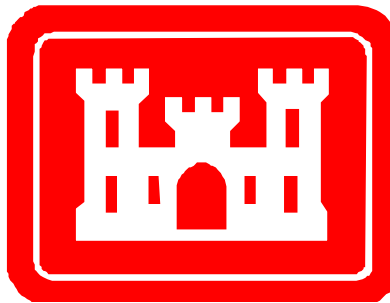


Volume 1
Surplus Water Report
Appendix A – Environmental Assessment

March 2011

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**GARRISON DAM / LAKE SAKAKAWEA PROJECT, NORTH
DAKOTA
SURPLUS WATER REPORT**



**Omaha District
U.S. Army Corps of Engineers**

March 2011

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GARRISON DAM / LAKE SAKAKAWEA, NORTH DAKOTA SURPLUS WATER REPORT

March 2011

Prepared By:

The U.S. Army Corps of Engineers, Omaha District
Omaha, NE

Abstract: The Omaha District is proposing to temporarily make available 100,000 acre-feet/year of surplus water (equivalent to 257,000 acre-feet of storage) from sediment and irrigation storage of the Garrison Dam / Lake Sakakawea Project, North Dakota to meet municipal and industrial (M&I) water supply needs. Under Section 6 of the Flood Control Act of 1944 (Public Law 78-534), the Secretary of the Army is authorized to make agreements with states, municipalities, private concerns, or individuals for surplus water that may be available at any reservoir under the control of the Department. Terms of the agreements are normally for five (5) years, with an option for a five (5) year extension, subject to recalculation of reimbursement after the initial five (5) year period.

This proposed action will allow the Omaha District to enter into surplus water agreements with interested water purveyors and to issue easements for up to the total amount of surplus water to meet regional water needs. During the temporary period the Corps recommends that a comprehensive strategy to address long-term regional water needs be developed that may involve the Administration, Congress and stakeholders. The Proposed Action (temporary use of surplus water) will not impede the capability and function of Garrison Dam / Lake Sakakawea to serve its authorized purposes. An Environmental Assessment, which is attached to this Surplus Water Report, identifies the baseline environmental conditions and provides an analysis of potential impacts from the proposed use of surplus water. There are no significant environmental impacts associated with implementing the proposed action.

For more information contact:

Commander, U.S. Army Corps of Engineers

Attn: Ms. Kayla Eckert-Uptmor, Chief, Planning Branch, Omaha District

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EXECUTIVE SUMMARY

The Omaha District, U.S. Army Corps of Engineers (Corps) under the Operation & Maintenance Program has prepared this Garrison Dam / Lake Sakakawea, ND, Surplus Water Report to identify and quantify whether surplus water is available in the Project, as defined in Section 6 of the 1944 Flood Control Act. Surplus water agreements with water users derived from this process may be executed with existing and potential future applicants, pursuant to policy, upon approval of this Report by the Assistant Secretary of the Army (Civil Works) and completion of required NEPA coordination. The term of the proposed temporary surplus water use is for a five (5) year period, renewable for an additional five (5) year period, subject to recalculation of reimbursement after the initial five (5) year period.

This Surplus Water Report and accompanying Environmental Assessment investigate the engineering and economic feasibility and environmental effects of temporary use of up to 100,000 acre-feet/year of surplus water (257,000 acre-feet of storage) from the sediment and irrigation storage in the Garrison Dam / Lake Sakakawea Project. Surplus water, if available, may be used to meet existing and projected municipal and industrial (M&I) water supply needs in the region. The 100,000 acre-feet/year of yield (257,000 acre-feet of storage) evaluated for surplus water use in this report is an estimate that was selected to ensure that an adequate quantity of water was identified to meet the needs of existing and future M&I water users. This Surplus Water Report will serve as the basis to enter into surplus water agreements. A 10-year study period has been established for this surplus water study. The length of the study period was selected for several reasons. First, surplus water agreements may be executed for a five (5) year period, renewable for an additional five (5) year period. Second, prior to the end of the 10-year study period, the Corps recommends that a comprehensive strategy to address long-term regional water needs be developed that may involve the Administration, Congress and stakeholders. Third, the primary water demand driving regional water needs at this time is the North Dakota oil and gas industry. Industry and state estimates indicate that demand from this industry is temporary and will decrease significantly after 10 years. The surplus water agreements executed upon the approval of this Report will serve as measures to address temporary water needs of the region during the 10-year study period.

The Garrison Dam/Lake Sakakawea Project is a unit of the comprehensive Pick-Sloan Plan for development in the Missouri River Basin. The operation of the upper Missouri River's six mainstem reservoirs and the lower Missouri River's levees and navigation channel provides for flood control, navigation, irrigation, hydropower, municipal and industrial water supply, fish and wildlife, water quality, and recreation. The temporary use of 100,000 acre-feet/year of surplus water in Lake Sakakawea would result in net annual depletions of 527 acre-feet from the system for the ten year period, because all but 527 acre-feet of the 100,000 acre-feet/year in water use will come from the Missouri River under both with and without project conditions. The primary difference between with and without project conditions is the location of the water withdrawals. Under without project conditions (No Action), the vast majority of withdrawals will come from the free-flowing reaches of the Missouri River upstream of Lake Sakakawea. Under the with project conditions (Proposed Action), withdrawals will come from the Garrison Dam / Lake Sakakawea Project.

The Daily Routing Model (DRM), developed during the 1990's as part of the Missouri River Mainstem Reservoir System Master Water Control Manual Review and Update Study (Master

Manual), was used as an analytical tool in this study to estimate the hydrologic effects that an additional 527 acre-feet of depletions would have at Lake Sakakawea, the other system reservoirs, and free-flowing reaches of the Missouri River.

A comparison of DRM simulated water surface elevations, stream flows, and river stages between without project conditions and a depletion of 527 acre-feet from Lake Sakakawea (with project conditions) was performed to assess the magnitude of changes resulting from the proposed temporary use of surplus water from the Project. Modeling results indicate that stage and flow reduction estimates throughout the system are extremely small, because all but 527 acre-feet of the 100,000 acre-feet/year in surplus water will come from the Missouri River under both with and without project conditions. Because the Missouri River projects are operated as an integrated system taking into account system withdrawals both in and outside of the Federal projects, no changes to system operations will be required as a result of the temporary use of surplus water from the Garrison Dam / Lake Sakakawea Project.

The method used to estimate the cost to the surplus water user for the capital investment of surplus water in the Garrison Dam/Lake Sakakawea Project is the updated cost of storage method, because it results in a greater value than benefits foregone by the temporary use of surplus water, revenues foregone, or replacement cost of the water. The relationship between reservoir storage and provided yield was calculated as 2.57, indicating that 257,000 acre-feet of storage (1.079% of total usable storage) would be required to provide a yield of 100,000 acre-feet/year.

The reasonable annual price for the use of surplus water is determined by the same procedure used to determine the annual payment for an equivalent amount of storage annualized over a 30-year period plus an estimated annual cost for operation and maintenance, repair, replacement, and rehabilitation (OMRR&R). Annual payments for these surplus agreements are based on a 30-year payment schedule and the repayment interest rate identified in EGM 11-01 Federal Interest Rates for Corps of Engineers Projects for Fiscal Year 2011. The appropriate interest rate is the Water Supply Interest Rate based on PL 99-662. The FY 11 interest rate is 4.25%. The annual payment for the updated cost of temporary surplus water (\$35,383,148 over a 30-year period at an interest rate of 4.25%) is \$2,022,804. The total annual cost of storage, including the annual estimated OMRR&R costs allocated to the surplus water storage (\$67,733), is \$2,090,537 which is an annual cost of \$20.91 per acre-foot of yield at FY 2011 price levels (equivalent to \$8.13 per acre-foot of surplus water storage). The actual annual price for any surplus water agreement will be calculated based upon the appropriate price level for the fiscal year in which the surplus water agreement is signed.

Repayment costs will be recalculated at the end of the first five (5) year period of the surplus water agreements. All cost figures based on the WSA of 1958 interest rates will need to be recalculated at that time, using the current Water Supply Interest Rate based on PL 99-662.

An alternatives analysis was conducted, which assessed non-structural measures (conservation, recycling, and temporary permits to convert irrigation water to industrial use) and structural measures (project modifications to increase storage capacity, temporary use of surplus water including associated infrastructure, groundwater withdrawals including associated infrastructure, and surface water withdrawals including associated infrastructure). The No Action – Next Least Costly Alternative is a combination of measures, including: improvements to the Williston Regional Water Treatment Plant, temporary permits to convert irrigation water to industrial use,

continued use of existing water depots, continued use of existing Lake Sakakawea water intake easements, and withdrawals from free-flowing reaches of the Missouri River.

A test of financial feasibility was conducted, which demonstrated that entering into agreements for the use of surplus water from the Garrison Dam / Lake Sakakawea Project is a lower cost alternative than the most likely, least costly alternative for providing the needed water supply. An analysis of environmental impacts was conducted using the same DRM outputs that were used to assess impacts to project purposes. The analysis of environmental impacts identified no significant impacts from entering into agreements for the use of surplus water from the Garrison Dam / Lake Sakakawea Project. Environmental benefits may result from fewer truck miles travelled under with-project conditions because entering into agreements for the use of surplus water from the Project may allow some water providers to be closer to water use locations than under without project conditions.

The temporary use of surplus water assessed in this report is both economically and financially justified and will not affect the authorized purposes of Garrison Dam / Lake Sakakawea Project. It is recommended that 100,000 acre-feet/year of yield (equivalent to 257,000 acre-feet of storage) in the Garrison Dam / Lake Sakakawea Project be made available for temporary use for municipal and industrial water users for a period of five years, with an option to renew for an additional five years. The annual payment is \$20.91 per acre-foot of yield (equivalent to \$8.13 per acre-foot of storage) at FY 2011 price levels.

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GARRISON DAM / LAKE SAKAKAWEA, NORTH DAKOTA

SURPLUS WATER REPORT

1. INTRODUCTION

1.1 Study Purpose

The purpose of the Garrison Dam / Lake Sakakawea, ND, Surplus Water Report is to identify and quantify whether surplus water is available in the Project, as defined in Section 6 of the 1944 Flood Control Act that the Secretary of the Army can use to execute surplus water supply agreements with water users, and to determine whether use of surplus water is the most efficient method for meeting regional municipal and industrial (M&I) water needs.

This Surplus Water Report (Report) and attached Environmental Assessment (EA) investigate the engineering and economic feasibility and environmental effects of temporary use of up to 100,000 acre-feet/year of yield (257,000 acre-feet of storage) from the Garrison Dam / Lake Sakakawea Project to meet municipal and industrial (M&I) water supply needs in the region over the 10-year study period. This Report has been prepared by the Omaha District, U.S. Army Corps of Engineers (Corps) under the Operation & Maintenance Program. The water supply agreements derived from this process will be executed with potential easement applicants upon approval of this Report by the Assistant Secretary of the Army (Civil Works) and completion of required NEPA coordination. The term of the surplus water agreement is for a five (5) year period, renewable for an additional five (5) year period, subject to recalculation of reimbursement after the initial five (5) year period.

A 10-year study period has been established for this surplus water study. The length of the study period was selected for several reasons. First, surplus water agreements may be executed for a five (5) year period, renewable for an additional five (5) year period. Second, prior to the end of the 10-year study period, the Corps recommends that a comprehensive strategy to address long-term regional water needs be developed that may involve the Administration, Congress and stakeholders. Third, the primary water demand driving regional water needs at this time is the North Dakota oil and gas industry. Industry and state estimates indicate that demand from this industry is temporary and will decrease significantly after 10 years. The surplus water agreements executed upon the approval of this Report will serve as measures to address temporary water needs of the region during the 10-year study period.

The temporary use of a total of 100,000 acre-feet/year of yield (257,000 acre-feet of storage) being analyzed is in excess of the total amount for which easements have currently been requested, and was selected based on potential future demand over the 10-year study period. The amount in excess of intake easement requests received to date has been included for the purposes of efficiency and responsiveness, so that expected requests over the period of analysis can be evaluated and approved.

1.2 Study Authority

The Garrison Dam / Lake Sakakawea, ND, Surplus Water Report study is being conducted under the authority of Section 6 of Public Law 78-534, the 1944 Flood Control Act. Under Section 6, the Secretary of the Army is authorized to enter into agreements for surplus water with states,

municipalities, private concerns, or individuals at any reservoir under the control of the Department of the Army. Specifically, Section 6 states that:

“[T]he Secretary of War is authorized to make contracts with States, municipalities, private concerns, or individuals, at such prices and on such terms as he may deem reasonable, for domestic and industrial uses for surplus water that may be available at any reservoir under the control of the War Department: Provided, That no contracts for such water shall adversely affect the existing lawful uses of such water. All moneys received from such contracts shall be deposited in the Treasury of the United States as miscellaneous receipts.”

ER 1105-2-100, page 3-32, paragraph 3-8a states:

“The Secretary of the Army can also enter into agreements with states, municipalities, private entities or individuals for the use of surplus water as defined in, and under the conditions described in, Paragraph 3-8b(4). Surplus water can also be used to respond to droughts and other emergencies affecting municipal and industrial water supplies.”

ER 1105-2-100, paragraph 3-8b(4), entitled, “Surplus Water” states:

“Under Section 6 of the Flood Control Act of 1944, the Secretary of the Army is authorized to make agreements with states, municipalities, private concerns, or individuals for surplus water that may be available at any reservoir under the control of the Department. These agreements may be for domestic, municipal, and industrial uses, but not for crop irrigation.

ER 1105-2-100, paragraph E-57b(2) states:

(2) Classification.

(a) Surplus Water will be classified as either:

(1) water stored in a Department of Army reservoir that is not required because the authorized use for the water never developed or the need was reduced by changes that occurred since authorization or construction; or

(2) water that would be more beneficially used as a municipal and industrial water than for the authorized purpose and which, when withdrawn, would not significantly affect authorized purposes over some specified time period.

(b) An Army General Counsel opinion of March 13, 1986, states that Section 6 of the 1944 Flood Control Act empowers the Secretary of the Army to make reasonable reallocations between different project purposes. Thus, water stored for purposes no longer necessary can be considered surplus. In addition, the Secretary may use his broad discretionary authority to reduce project outputs, envisioned at the time of authorization and construction, if it is believed that the municipal and industrial use of the water is a higher and more beneficial use....

(3) Requirements and Restrictions. Surplus water declarations will only be made when related withdrawals would not significantly affect authorized purposes. Surplus water agreements shall be accompanied by a brief letter Report similar to reallocation Reports and shall include how and why the storage is determined surplus. Surplus water agreements will normally be for small amounts of water and/or for temporary use as opposed to storage reallocations and a permanent right to that storage. Normally, surplus water agreements will be limited to 5 year periods. Use of the Section 6 authority should be encouraged only where non-Federal sponsors do not want to buy storage because the need of the water is short term or the use is temporary pending the development of the authorized use. The views of the affected state(s) will be obtained, as appropriate, prior to entering into any agreement under Section 6. The annual price deemed reasonable for this use of surplus water is determined by the same procedure used to determine the annual payment for an equivalent amount of reallocated storage plus an estimated annual cost for operation and maintenance, repair, replacement, and rehabilitation. The total annual price is to be limited to the annual costs of the least cost alternative, but never less than the benefits foregone (in the case of hydropower, revenues forgone).

1.3 Need for Surplus Water

Identification of surplus water within the Garrison Dam / Lake Sakakawea Project would allow the Corps of Engineers to satisfy urgent temporary M&I water supply demands within the region. Approval of this Report is a necessary pre-condition to executing surplus water agreements with, and issuing easements to, applicants for withdrawal of surplus water from the Corps Project.

Temporary use of surplus water is not expected to cause significant adverse effects to existing authorized purposes and will not involve any structural changes to the project.

The Environmental Assessment (EA) is provided as Appendix A to this Report and further explains the needs, benefits and effects of this proposed use of surplus water in Lake Sakakawea. Descriptions of existing conditions are contained in the Environmental Assessment and incorporated into this Surplus Water Report by reference, in the interest of brevity.

1.4 Report Organization

The Water Surplus Report summarizes the results of the technical investigations in support of a request for use of surplus water from the Garrison Dam / Lake Sakakawea Project. Report sections include:

- Executive Summary
- Section 1 – Introduction
- Section 2 – Project Background
- Section 3 – Plan Formulation
- Section 4 – Plan Implementation
- Section 5 – Conclusions

Section 6 - Recommendations

Technical appendices, which present details of technical investigations and supporting documentation, are provided in separate volumes. Technical Appendices include:

Appendix A – Environmental Assessment / FONSI

Appendix B - Public and Agency Coordination and Letters / Views of Federal, State and Local Interests

2. PROJECT BACKGROUND

2.1 Project Location

The Garrison Dam/Lake Sakakawea Project is a multi-purpose project on the Missouri River located at river mile (RM) 1390, 75 miles upstream from Bismarck in western North Dakota and 11 miles south of the town of Garrison, North Dakota (see Figure 2-1). The Garrison Dam/Lake Sakakawea Project is the largest of the six Missouri River mainstem- system projects. The other five Missouri River mainstem projects are also shown in Figure 2-1, and include: Fort Peck, Gavins Point, Fort Randall, Big Bend, and Oahe.

2.2 Project Authorization

Garrison Dam was constructed as part of the Pick-Sloan Plan for development of the upper Missouri River Basin. Comprehensive development was proposed by the U.S. Army Corps of Engineers (Corps) in House Document 475 and by the Bureau of Reclamation (BOR) in Senate Document 191; the coordinated plan was presented to Congress in Senate Document 247 (all 78th Congress, 2nd session). Under this Act, the Corps was given the responsibility for development of projects on the main stem of the Missouri River. Tributary projects were made the responsibility of the Corps if the dominant purpose was flood control.

The Department of the Interior was designated as the marketing agent for all power, beyond project requirements, produced at Corps projects. The Department of the Interior subsequently designated the BOR as the marketing agent for power generated by the main stem projects.

The Department of Energy Act (1977 Department of Interior Organization Act) established the Department of Energy and simultaneously withdrew the power marketing function from the Department of Interior and moved it to the new Department of Energy.

The Garrison Dam/Lake Sakakawea Project was authorized by the Flood Control Act of 1944, Public Law (P.L.) 78-534, along with four other Missouri River mainstem projects: Gavins Point, Fort Randall, Big Bend, and Oahe. These five mainstem reservoirs are elements of the comprehensive development program in the Missouri River Basin, known as the Pick-Sloan Plan. This comprehensive plan became known as the Pick-Sloan Missouri Basin Program. Fort Peck Dam, located in northern Montana, was constructed prior to the Pick-Sloan Plan, but is operated as part of the Missouri River System.

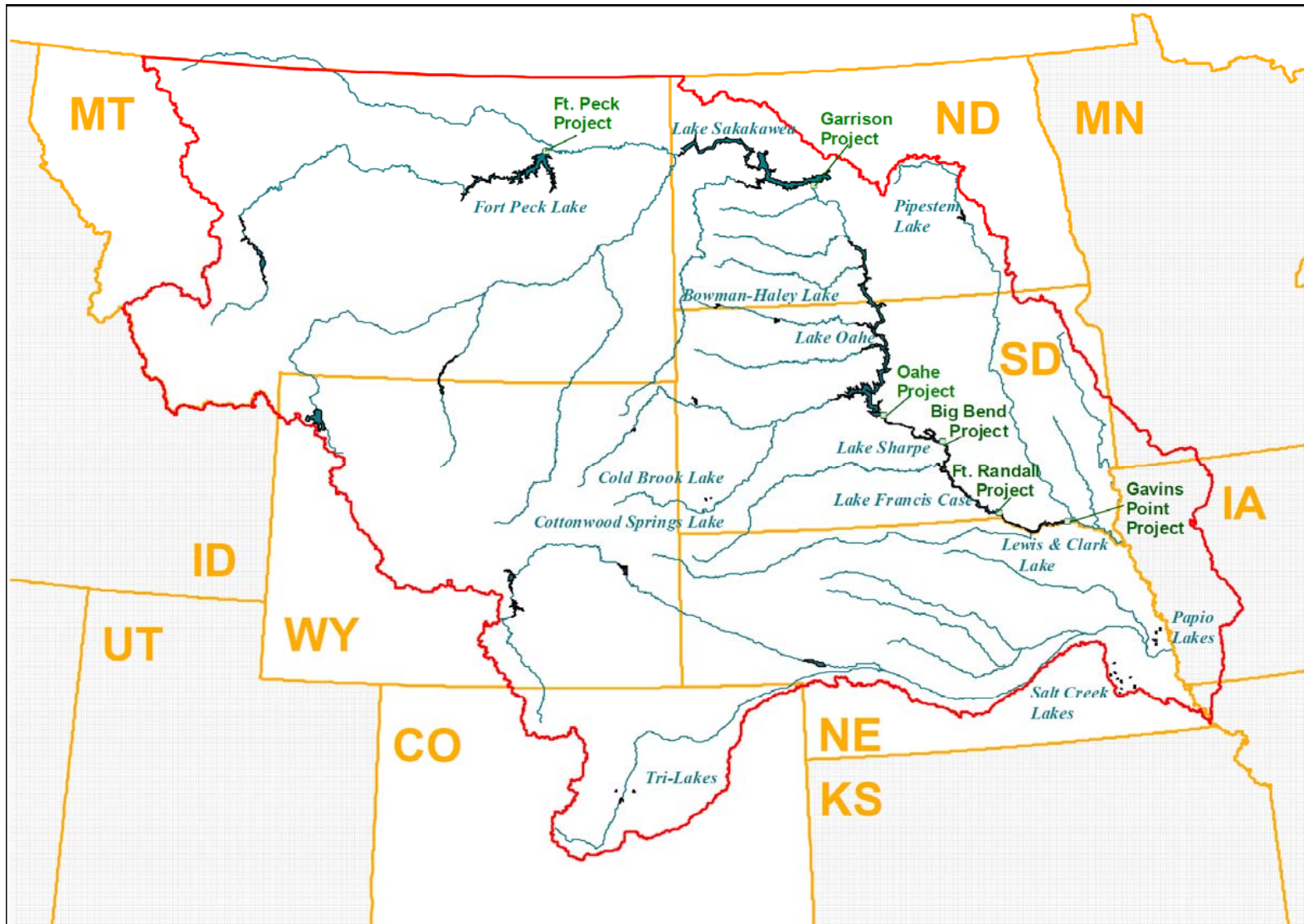
2.3 Project Description

2.3.1 Garrison Dam

Construction on the \$300 million¹ Garrison Dam project began in 1946 and closure of the embankment occurred in April 1953. Earthwork was completed in the fall of 1954 and the navigation and flood control functions of the project were placed in operation in 1955. At over two miles in length, Garrison Dam is one of the largest rolled earth-fill dams in the world and is the fifth largest dam in the United States. The dam is 210 feet high and 11,300 feet long. It

¹ Source: Annual Report on Civil Works Activities for Fiscal Year 2008, Assistant Secretary of the Army.

Figure 2-1
Omaha District Civil Works Boundary and Mainstem Projects



provides five power units (three units rated at 121,600 kilowatts each and two units rated at 109,250 kilowatts each), three flood control tunnels, and a gated spillway.

The first power unit of the project went on the line in January 1956, followed by the second and third units in March and August of the same year. Power units 4 and 5 were placed in operation in October 1960. Lake Sakakawea first reached its minimum operating level in late 1955. Due to drought conditions, the Carryover Multiple Use Zone was first filled ten years later, in 1965.

2.3.2 Lake Sakakawea

Lake Sakakawea, the impoundment created by Garrison Dam, is the third largest man-made lake in the United States. Authorized for flood control, navigation, irrigation, hydropower, municipal and industrial water supply, fish and wildlife, water quality and recreation, the Garrison Dam/Lake Sakakawea Project creates an approximately 178-mile long and up to 6-mile wide pool on the mainstem of the Missouri River from near Williston, ND to near Riverdale, ND (see Figure 2-2). The reservoir covers approximately 380,000 acres, with more than 1,500 miles of shoreline, and 23.8 million acre-feet of water storage at full pool, which is nearly one-third of the total storage capacity of the Missouri River reservoir system.

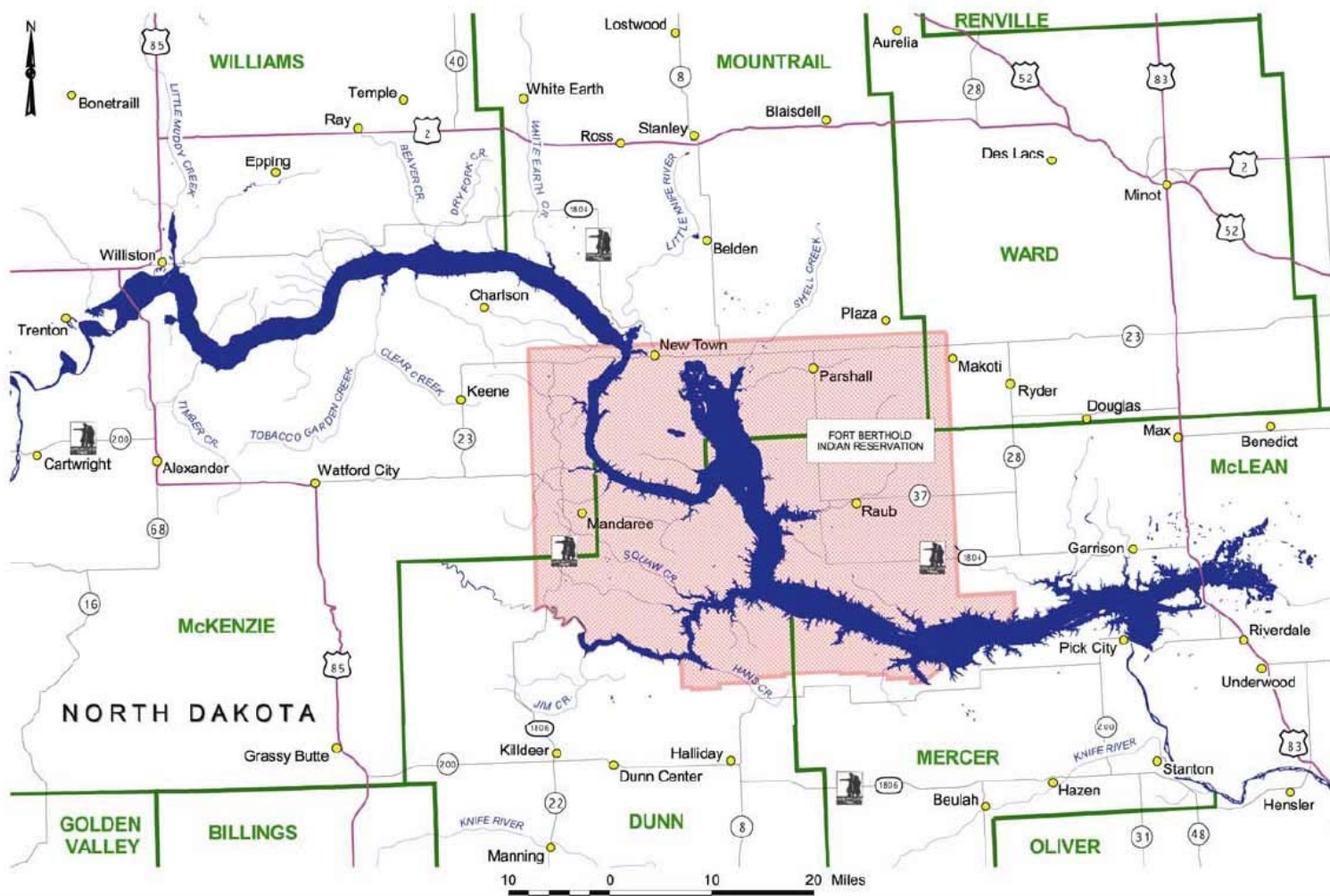
As shown in Figure 2-2, about 220,840 surface acres of Lake Sakakawea and about 600 miles of its shoreline are included within the boundaries of the Fort Berthold Reservation. Within the Fort Berthold Reservation are the Mandan, Hidatsa, and Arikara Nations. The Reservation includes portions of six counties in North Dakota: Mountrail, McLean, Dunn, McKenzie, Mercer, and Ward.

2.4 Authorized Project Purposes

The Garrison Dam/Lake Sakakawea Project is a unit of the comprehensive Pick-Sloan Plan for development in the Missouri River Basin. The operation of the upper Missouri River's six mainstem reservoirs and the lower Missouri River's levees and navigation channel provides for flood control, navigation, irrigation, hydropower, municipal and industrial water supply, fish and wildlife, water quality, and recreation.

The Missouri River begins at the junction of the Jefferson, Madison, and Gallatin Rivers, near Three Forks in the Rocky Mountains of south-central Montana. Figure 2-1 illustrates the Upper Missouri River Basin. The Garrison Dam / Lake Sakakawea Project is operated as an integral component of the Missouri River Mainstem Reservoir System. To achieve full coordination within the entire Missouri River basin and to meet all of the authorized project purposes, operation of all six mainstem reservoirs is directed by the Missouri River Basin Water Management Division located in Omaha, Nebraska, part of the U.S. Army Corps of Engineers (Corps) Northwestern Division.

Figure 2-2
Garrison Dam / Lake Sakakawea Project



The six mainstem reservoirs operated by the Corps are listed in Table 2-1. Lake Sakakawea provides a significant storage contribution to the mainstem system of reservoirs. It is the largest of the six reservoirs, with a storage capacity of approximately 23.8 million acre-feet (MAF), which comprises nearly one third of the total 73.1 MAF storage capacity in the mainstem system.

**Table 2-1
Missouri River Mainstem Reservoirs**

Project (Dam and Reservoir)	Incremental Drainage Area (Square Miles)	Year of Closure	Annual Flood Control and Multiple Use Storage in Acre-Feet (AF)	Total Storage in Acre-Feet (AF)
Fort Peck Dam/ Fort Peck Lake	57,500	1937	2,704,000	18,463,000
Garrison Dam/ Lake Sakakawea	123,900	1953	4,222,000	23,821,000
Oahe Dam/ Lake Oahe	62,090	1958	3,201,000	23,137,000
Big Bend Dam/ Lake Sharpe	5,840	1963	117,000	1,798,000
Fort Randall Dam/ Lake Francis Case	14,150	1952	1,309,000	5,418,000
Gavins Point Dam/ Lewis & Clark Lake	16,000	1955	90,000	470,000

2.5 Missouri River System Reservoir Regulation

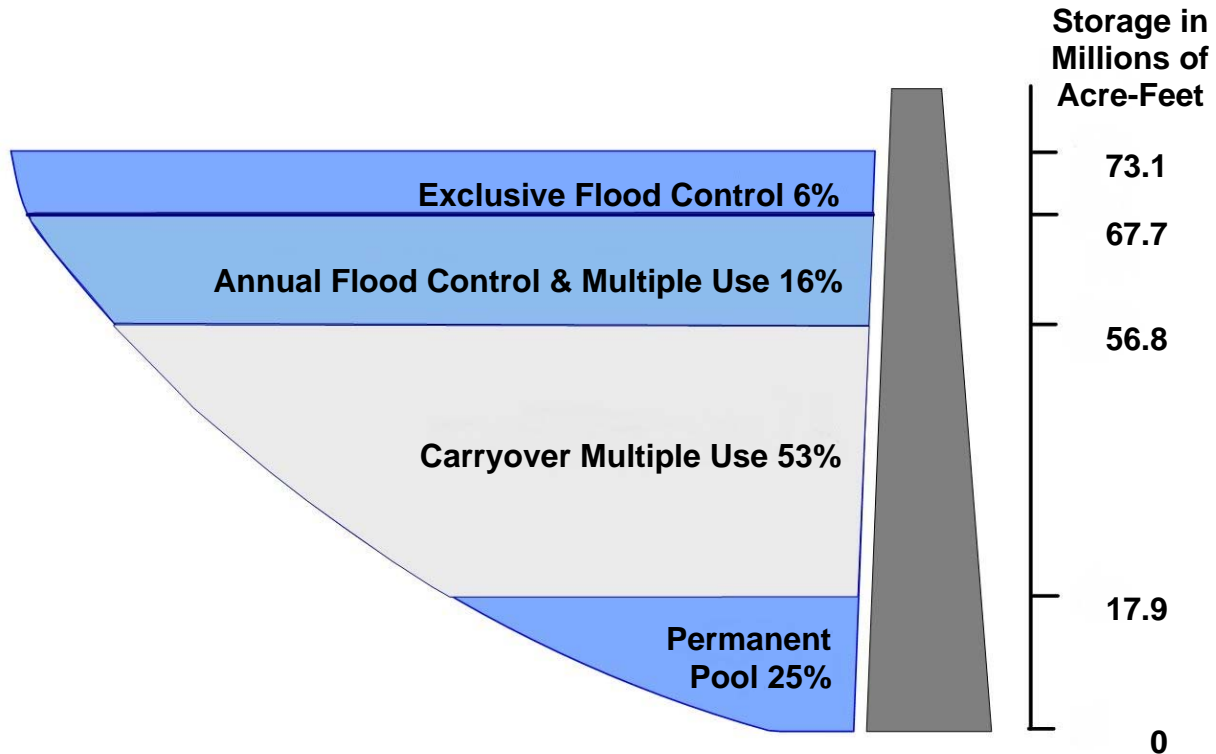
The six Missouri River projects are operated as an integrated system by the U.S. Army Corps of Engineers, Missouri River Basin Water Management Division. Operations of the system are guided by the Missouri River Basin Mainstem Reservoir System Master Water Control Manual (Revised March 2006) (Master Manual). In order to achieve the multi-purpose benefits for which they were authorized and constructed, the six System reservoirs are operated as a hydraulically and electrically integrated system. The Master Manual describes the integrated operation of these six projects. The Master Manual serves as a guide to meeting the operational objectives of the System when regulating the six System reservoirs. The Master Manual also includes the integrated operation of both System and tributary reservoir water control plans so that an effective plan for flood control and conservation operations exists within the basin.

Each of the six mainstem projects, including the Garrison Dam / Lake Sakakawea Project, has its own Water Control Manual. Annual water management plans (Annual Operating Plans, or AOPs) are prepared each year, based on the water control criteria contained in the Master Manual, in order to detail reservoir regulation of the System for the current operating year.

For the purpose of reservoir regulation, the storage capacity at Lake Sakakawea (and for the five other mainstem reservoirs) is divided into four zones. Figure 2-3 displays the four zones and shows total capacity in each zone for all system reservoirs combined. The text following the

Figure describes the storage volumes in each zone just for the Garrison Dam / Lake Sakakawea Project.

**Figure 2-3
Missouri River System Storage Zones**



For the Garrison Dam / Lake Sakakawea Project, starting at the bottom, there is the 5.15 million acre foot (MAF) permanent pool between elevations 1775.0 and 1673.0 feet mean sea level (msl). This zone provides minimum power head and sediment storage capacity. Above the permanent pool there is the 13.1 MAF carry-over multiple-use zone between elevations 1837.5 and 1775.0 feet msl. This intermediate zone provides a storage reserve for irrigation, navigation, power production, and other beneficial conservation uses. This zone also provides carry-over storage for maintaining downstream flows through a succession of years in which runoff is below normal. The next zone is the 4.2 MAF annual flood control and multiple use zone between elevations 1837.5 and 1850.0 feet msl. This is the desired operating zone. Water stored in this zone is normally evacuated by March 1 of each year to provide adequate storage capacity for the flood season. During the flood period, water is impounded in this space as required. Finally, the upper zone, or exclusive flood control zone, consists of 1.5 MAF of storage between elevations 1850.0 and 1854.0 feet msl. This zone is used only during periods of extreme floods and is evacuated as soon as downstream conditions permit.

The original project design included an evaluation of the estimated sediment inflow rate which was used to determine a project life. The original sediment deposition rate was estimated as

48,000 acre-feet/year. Monitoring data and analysis indicates that the sediment deposition rate is less than the rate originally estimated. During the design phase of each of the main stem projects, specific storage zones were not identified. Therefore, the sediment deposition was not specifically allocated within the storage zones during original project design. It wasn't until development of the first master water control manual that storage zones were identified for each project. The various zones were identified to meet both the individual project needs (e.g. minimum heads), as well as the system needs (flood control, drought management, etc.).

Regulating the Missouri River Mainstem Reservoir System is essentially a repetitive annual cycle. Except during extreme drought, the reservoirs are evacuated to the bottom of the annual flood control and multiple use zone (1837.5 feet msl for Lake Sakakawea) by March 1. Because the major portion of the annual runoff enters the reservoirs between March and July, storage accumulates and usually reaches a peak during early July. Releases from Fort Peck Lake are scheduled throughout the remainder of the year to provide support for hydropower production and other authorized purposes. Releases during the summer and winter are generally higher than those in the spring and fall because of increased demand for hydropower.

During periods of normal to above normal runoff, these releases evacuate the water stored in the annual flood control and multiple use zone, drawing the reservoir down to the top of the carryover multiple-use zone (1837.5 feet msl for Lake Sakakawea) by the following March 1, when the cycle begins once more. During a period of extended drought, water is drafted from the large carryover multiple-use zone. The conservation storage provided in the carryover multiple use zones of the six mainstem reservoirs was designed to serve all authorized project purposes through a drought like that of the 1930s, though at reduced levels.

Table 2-2 shows the maximum, average, and minimum Lake Sakakawea elevations for the period of record, 1967-2006, since the mainstem reservoir system first filled to normal operating levels in June 1967. This actual 40-year period of record is comprised of 24 years of near normal to much above normal annual runoffs and 16 years of drought (1977, 1980-81, 1987-92, and 2000-2006). During extreme flood events, the reservoir level could reach as high into the surcharge pool as elevation 1854.8 feet msl.

Table 2-2
Summary of Lake Sakakawea Pool Elevations and Releases, by Month
(June 1967 - December 2006)

Month	Pool Elevation (feet msl)			Daily Release (cfs)		
	Max	Min	Mean	Max	Min	Mean
Jan	1845.3	1808.4	1833.6	34,200	12,500	23,200
Feb	1843.6	1808.2	1832.2	36,000	11,000	24,400
Mar	1847.9	1808.2	1832.3	37,800	4,100	19,700
Apr	1847.7	1806.6	1833.6	39,100	8,700	19,300
May	1848.0	1805.8	1834.2	41,200	9,100	21,400
Jun	1853.7	1809.1	1837.1	50,100	9,500	23,300
Jul	1854.8	1815.2	1840.0	65,200	9,500	24,700
Aug	1854.6	1811.9	1839.4	65,100	12,100	24,500
Sep	1851.3	1809.5	1837.7	50,100	6,000	20,900
Oct	1848.2	1809.3	1836.8	49,700	9,200	19,300
Nov	1847.4	1808.9	1836.0	50,100	9,300	20,200
Dec	1846.8	1807.8	1834.5	39,100	12,500	20,500
Annual	1854.8	1805.8	1835.5	65,200	4,100	21,700

Source: Garrison Dam/Lake Sakakawea Master Plan, December 14, 2007

2.5.1 Flood Control

Lake Sakakawea, the second most upstream project in the mainstem system, is operated as part of the system to assist in the control of downstream flooding along the Missouri River. As described above, the system is operated to draw down the pool to the base of the flood control and multiple use zone (1837.5 feet msl for Lake Sakakawea) by March 1 of every year in order to prepare for the spring and summer flood seasons. Reservoir levels are lowered to provide maximum flood control storage levels during the high flood risk period, which is comprised of the plains snowmelt season (late February – April) and the mountain snowmelt period (May through July). Table 2-2 above shows that this operational target has been achieved at Lake Sakakawea over the 40-year period of record, with mean March monthly pool levels of 1832.3. A review of the minimum, maximum and mean daily releases during the months leading up to and including March is indicative of the wide range of flexibility in managing outflows to reach the target pool levels. The six Missouri River mainstem dams (including the Garrison Dam / Lake Sakakawea Project) have prevented over \$37 billion in flood damages (at September 2009

price levels) through September of 2005, of which \$11.5 billion can be credited to the Garrison project.

2.5.2 Navigation

The Missouri River Reservoir System is operated in part to meet the needs of downstream navigation interests. The normal 8-month navigation season extends from April 1 through November 30. During this period, System releases are scheduled, in combination with downstream tributary flows, to meet downstream target flows. Daily releases from Gavins Point, commonly referred to as the System releases, fall into two classes. Open-water releases, generally in the range of 21,000 to 35,000 cfs, are made in support of Missouri River navigation and other downstream uses. Winter releases after the close of navigation season are much lower, and vary depending on the need to conserve or evacuate System storage while managing downstream river stages for water supply given ice conditions. In years with adequate water supply, System releases are scheduled to provide adequate flows for navigation at the target locations of Sioux City, Omaha, Nebraska City, and Kansas City (if navigation is occurring on the reaches associated with those targets). As described in the Master Manual, flow support for navigation and other downstream purposes is defined based on service level. A “full-service” level of 35,000 cfs results in target flows of 31,000 cfs at Sioux City and Omaha, 37,000 cfs at Nebraska City and 41,000 cfs at Kansas City. Similarly, a “minimum-service” level of 29,000 cfs results in target flow values of 6,000 cfs less than the full service levels.

The relation of System storage to navigation service level is presented in Table 2-3. Selection of the appropriate service level is based on the actual volume of System storage on March 15 and July 1st of each year. With the present level of streamflow depletions, inflows to the System are sufficient to support the minimum-service flow levels or higher for the full 8-month navigation season in 78 years of the 100-year record period (inflows from 1898 to 1997) and full-service flows or higher for the 8-month navigation season in 55 years of the 100-year period

**Table 2-3
Relation of System Storage to Navigation Service Level**

Date	System Storage	Navigation Service Level
March 15	54.5 MAF or more	35,000 cfs (full-service)
March 15	49.0 to 31 MAF	29,000 cfs (minimum-service)
March 15	31.0 MAF or less	No navigation service
July 1	57.0 MAF or more	35,000 cfs (full-service)
July 1	50.5 MAF or less	29,000 cfs (minimum-service)

Although navigation on the Missouri River through North Dakota was critically important to the original settlement of the region, there is no commercial navigation in the North Dakota reach of the river today. Releases from mainstem reservoirs serve navigation interests downstream from Gavins Point Dam in the lower reaches of the Missouri River, to its confluence with the Mississippi River.

Overall commercial navigation throughout the Missouri River has waned significantly over the past four decades, from 3,300,000 tons in 1977, to 1,300,000 tons in 2000, to 245,000 tons in 2009.

2.5.3 Irrigation

The original planning studies carried out by both the Bureau of Reclamation (Senate Document 78-191) and the Corps (House Document 78-475) anticipated that Federal irrigation projects would be supported for the Missouri River Basin Mainstem System. The Corps plans allowed for an irrigation withdrawal from the Garrison Project to provide for water supply into the Dakotas. The Bureau's plans provided for over ninety new projects that would provide irrigation service to over 4,700,000 additional acres of land in the basin. Over half of these additional acres, or approximately 2,300,000 acres would be served by the existing Fort Peck project in Montana and three new mainstem projects. A key component of the Bureau's plan was the proposed Oahe project which would hold almost 7 million more acre feet of water than the total of two projects that were planned by the Corps in the same area. Irrigation was also a primary component of the Corps cost allocations for the Mainstem System Projects. As an example, the Corps 1958 cost allocation report anticipated an average annual depletion from the mainstem system for irrigation of 6,387,000 acre feet of which 2,534,000 would be for irrigation from tributaries above Sioux City and 3,853,000 acre feet of depletion related to irrigation from main stem projects.

The Corps and Bureau's combined plan for the mainstem system (Senate document 78-247), was incorporated by Congress into the 1944 Flood Control Act. The combined plan for the mainstem system provided for the Corps' Garrison Project, the larger Oahe project that had been proposed by the Bureau, along with three smaller downstream projects, and the already constructed Ft. Peck Project in Montana. Thus, the mainstem projects as approved by Congress in the 1944 Flood Control Act included substantial capacity in the mainstem system which would be able to provide for the irrigation of 2,300,000 acres of land when fully developed.

Between 1944 and 1965, the Bureau of Reclamation carried out studies to assess the feasibility of irrigating lands planned for North Dakota by diversions from the Ft. Peck project. The studies indicated that the soil was not suitable for irrigation primarily because of glacial subsoil. The Bureau of Reclamation revised the diversion plan proposing to take water from the Garrison Dam to irrigate other lands to the east. With the new name "Garrison Diversion," the Bureau of Reclamation 1957 feasibility study on the redesigned project recommended irrigation of 1,007,000 acres and other water development in central and eastern North Dakota.

Because of changes to the Bureau's original irrigation plans for the upper basin and language in a 1964 appropriations act requiring specific reauthorization for all units of the Bureau's Pick-Sloan Missouri Basin Program, legislation was sought by the Bureau for the revised project plan. In 1965 Congress authorized the revised plan in the Garrison Diversion Unit Act and construction began in 1967. The GDU project was designed to divert Missouri River water to central and eastern North Dakota for municipal and industrial water, fish and wildlife development, recreation and flood control along with irrigation of 250,000 acres. The Snake Creek Pumping Plant, McClusky Canal, and New Rockford Canal are largely constructed components of the authorized Principal Supply Works of the GDU, however these features are not yet considered plant in service. The 1986 Garrison Diversion Unit Reformulation Act reduced irrigation emphasis of the GDU and increased the emphasis on meeting municipal, rural, and industrial

(MR&I) water needs throughout North Dakota. The Act authorized a Sheyenne River water supply and release feature and water treatment plant. Appraisal level studies were conducted from 1994 to 2000. The Dakota Water Resources Act of 2000 (P.L. 89-108) authorized the Secretary of the Interior to develop irrigation for 13,700 acres in the Turtle Lake service area, 10,000 acres in the McClusky Canal service area, 1,200 acres in the New Rockford Canal service area, 15,200 acres within the boundaries of the Fort Berthold Indian Reservation, and 2,380 acres within the Standing Rock Indian Reservation. In addition to the above projects, 31 agricultural irrigation water systems have intakes for withdrawing water directly from Lake Sakakawea, although the Army does not have authority to enter into agreements with irrigators.

Although the Bureau's originally envisioned Federal mainstem irrigation projects have not developed as initially planned, numerous irrigators withdraw water directly from the reservoirs and downstream river reaches. Demand for this irrigation use is relatively small and minimum releases established for water quality control and other uses are usually ample to meet the needs of irrigators. However, low reservoir levels and low river stages can at times make access to the available water supply difficult or inconvenient to obtain for these users. When reasonably possible, the System is regulated to serve this authorized project purpose. However present use for irrigation is relatively minor and the full mainstem system capacity originally planned for irrigation has not yet developed.

2.5.4 Municipal and Industrial (M&I) Water Supply

Minimum daily releases at Garrison (and also at Fort Peck, Fort Randall, and Gavins Point) are established as those necessary to supply water quality control and downstream water intake requirements. Numerous water intakes are located along the Missouri River both within and below the System. These intakes are primarily for the purposes of municipal water supplies, nuclear and thermal electric powerplant cooling, and irrigation supplies withdrawn directly from the Missouri River. Reduced releases during periods of extended drought contribute to access problems at several of these intakes; however, in all cases the problems have been a matter of restricted access to the river rather than insufficient water supply. In several river reaches, including near Sioux City and near Kansas City, channel degradation at low flows has impacted several water intakes. Other water supply problems can occur due to the formation of sandbars or sediment deposition, or due to ice jamming on the river during the winter months. Modifications have been required at some intakes to ensure operability over a wide range of river conditions.

The minimum daily flow requirements established for water supply are designed to prevent operational problems at municipal and thermal powerplant intakes to the extent reasonably possible. At Garrison, a minimum average daily release of 9,000 cfs has been established as a guide to provide for downstream intakes. Evaluations are continuing by appropriate state agencies in coordination with water plant operators to determine the minimum stage and flow requirement at each intake location for satisfactory hydraulic operation. During any non-navigation time period, releases will be made to ensure adequate flows to serve water supply in the river reaches downstream of the System and between the System dams to the extent reasonably possible.

Intakes for communities on the Fort Berthold Reservation are located at Four Bears, Mandaree, Twin Buttes, and White Shield. The Southwest Pipeline Project provides water to the city of Dickinson along with 27 other communities, 18 bulk users, and 3,089 rural water users in

southwest North Dakota (Frink 2007a). The cities of Garrison, Parshall, Pick City and Riverdale, and three industrial water systems also obtain water from Lake Sakakawea or from Garrison Dam's penstocks for municipal and industrial use. If the Northwest Area Water Supply (NAWS) Project is completed, it will provide up to 15,000 acre-feet of Missouri River water annually to at least 63,000 water users (Frink 2007a). In addition, approximately 19 communities / subdivisions and 186 homes located close to the reservoir have intakes for withdrawing water from Lake Sakakawea for domestic consumption. There are also water intakes for public, domestic, and commercial uses at and downstream from Lake Sakakawea.

In regard to water supply provided by the Bureau of Reclamation from the Garrison Dam/Lake Sakakawea Project, the Dakota Water Resources Act of 2000 (P.L. 89-108) shifted the water supply emphasis from irrigation to municipal, rural, and industrial (MR&I) water supply. The Red River Valley Water Supply Project would divert water from Lake Sakakawea via GDU facilities and a pipeline to the Sheyenne River.

2.5.5 Hydropower

The six System dams support 36 hydropower units with a combined plant capacity of 2,501 megawatts (MW) of potential power generation. These units provide an average of 10 million megawatt-hours (MWh) of energy per year. The Garrison power plant houses five turbine and generator units with a combined plant capacity of 583 MW. The generators produce approximately 2.462 billion kilowatt-hours of energy each year. Garrison power generation is integrated with the generation provided from other five mainstem projects, as well as that generated from other public and private facilities throughout the power marketing area. All power generated is marketed by the Western Area Power Administration (Western).

Firm energy is marketed on both an annual and a seasonal basis, recognizing the seasonal pattern of releases made for navigation and required for flood control. During the navigation season, releases from the four uppermost reservoirs are varied in an effort to generate the greatest amount of energy at the times the power loads are the greatest. During the winter period, the most critical with respect to maintaining load requirements, releases from Fort Peck and Garrison are scheduled at relatively high rates to compensate for reduced power production at the downstream powerplants. The fall drawdown at Fort Randall makes available space for recapture of winter power releases from upstream reservoirs. In years of low energy generation due to downstream ice problems or low water availability, energy from other sources is obtained in the winter to help serve firm loads. Generally, the navigation season energy generation is adequate to meet firm load requirements; however, during periods of reduced System releases for downstream flood control or during extended drought periods, WAPA must also purchase large amounts of energy in the summer to serve firm loads.

The highest average power generation period extends from mid-April to mid-October, with high peaking loads during the winter heating season (mid-December to mid-February) and the summer air conditioning season (mid-June to mid-August). The major maintenance periods for the System hydropower facilities extend from March through mid-May and September through November, which normally are the lower demand and off-peak energy periods.

During the summer, releases at all projects other than Gavins Point are normally within the powerplant discharge capacity, the river channel downstream usually being more than adequate to carry such releases. Discharges from all projects will usually be made through the

powerplant. At all projects except Gavins Point, hourly release rates may vary widely as necessary to meet fluctuating power loads. Unusually large inflows during any particular year may require significant releases that bypass the powerplants at any or all projects to evacuate flood waters and thereby maintain the future flood control capability of the System.

2.5.6 Fish and Wildlife

Fish and wildlife is considered a high priority project purpose on all project lands, regardless of the land use classification². All areas classified as Project Operations or Recreation are developed and managed to benefit wildlife through a variety of different techniques, including vegetation management alternatives to enhance and benefit wildlife species. The remaining project lands are also managed to enhance and benefit wildlife species. The Lake Audubon and Lake Sakakawea General Plans, signed by the Corps, the Assistant Secretary for Fish and Wildlife and Parks of the U.S. Department of the Interior; and the North Dakota Game and Fish Department (NDGFD) in 1982 and 1983, identified 26,020 acres at Lake Audubon and 51,000 acres at Lake Sakakawea to be used primarily for the conservation and management of wildlife. These General Plans revised the original General Plan signed in 1955 so that the wildlife management areas in the General Plan would be consistent with those in the 1978 Master Plan. Minimum release restrictions and pool fluctuations for fish spawning management generally occur from April through June.

Construction of the System has been one of the most important contributions to sport fishing in the Missouri River basin. The large, popular reservoirs attract fishermen from many states to fish for trophy size northern pike, walleye, sauger, lake trout, and chinook salmon. The construction and regulation of the System has, however, altered the natural streamflow of the Missouri River. An early spring rise and a late spring-summer rise characterized the natural hydrograph. High flows resulted from the plains snowmelt, from spring and summer rains, and from the mountain snowmelt. Low flows typically occurred in late summer and fall. Regulation of flows by the System has reduced spring flows and has increased late summer, fall, and winter flows to varying degrees, depending on how far downstream from Gavins Point the reach is located, thus altering the habitat of native riverine fish species. River reaches between the reservoirs are now characterized by cooler water temperatures with widely fluctuating daily stages. In addition, the System is regulated to provide protection for the three ESA listed species: the endangered interior least tern, the threatened piping plover, and the endangered pallid sturgeon. A detailed discussion of the effects of System operations on fish and wildlife is provided in the attached Environmental Assessment.

2.5.7 Recreation

Recreational use of project lands is encouraged through public parks and recreation facilities. Mainstem projects are managed to provide a high quality outdoor-recreation experience and as much diversity as is practicable. Recreational planning and improvements are supportive of and compatible with the North Dakota Statewide Comprehensive Outdoor Recreation Plan (SCORP). Planning for development and use of recreational facilities is coordinated with Tribal, state, county, municipal, and local non-governmental entities, which lease and manage most of the

² Garrison Dam/Lake Sakakawea Master Plan with Integrated Environmental Assessment, Design Memorandum MGR-107D, CENWO-DE, 14 December 2007.

intensively used recreation areas at Lake Sakakawea. There are 35 recreation areas around Lake Sakakawea, including 14 facilities managed by the Corps of Engineers, and North Dakota state facilities at Lake Sakakawea State Park and Fort Stevenson State Park (for a full listing of recreation facilities, see the Environmental Assessment). Recreation activities include: fishing, boating, waterskiing, swimming, camping, hiking, hunting, picnicking, and nature-watching. Total annual visitation at Lake Sakakawea recreation facilities was estimated at 1,297,735 in 2010. In addition, significant amounts of river recreation take place downstream of the reservoir in Missouri River reaches affected by Garrison Dam releases.

Water levels are a key factor in recreational use of the reservoirs and river reaches. Pool levels at the upper three reservoirs, including Lake Sakakawea, vary widely in response to drought conditions. Although recreation may be affected by high reservoir levels and releases, periods of extended drought that result in significant lowering of reservoir levels and releases have a greater impact. At low reservoir levels, some boat ramps and recreational areas do not provide access to the reservoirs. Low releases may impact boat access and maneuverability between and below System dams. During the two major droughts since the System first filled, many boat ramps have been extended or relocated to maintain access. Shortening of the navigation season during droughts also has the effect of shortening the recreation season below the System due to the greatly reduced flows, and the shortening also results in an earlier drawdown for Fort Randall, impacting recreation access on that reservoir.

2.5.8 Water Quality

Water quality was specified as a project purpose in the authorizing documents in terms of silt control; soil-erosion prevention; pollution abatement; adequate and safe municipal water supplies; improving quality of water for irrigation; provision of water suitable for domestic, sanitary, and industrial purposes; and improving clarity of water for recreation and for fish and wildlife. Silt control was also expected to aid the navigation channel downstream. Water quality in Lake Sakakawea must comply with the State of North Dakota's standards for a Class 1 lake.³ As such, its water quality has to be suitable for a cold water fishery, aquatic life, and wildlife; swimming and other water-based recreation; stock watering; irrigation; and water supply for municipal, domestic, or industrial use after appropriate treatment.

2.6 North Dakota Water Permit Process

Understanding the North Dakota water permit process is critical to the accurate assessment of both without and with project conditions, because all entities desiring water allocations in the State (other than on Tribal lands) must first obtain a water permit from the State, including those requesting water from the Federal project.

The North Dakota State Water Commission, through the Office of the State Engineer, regulates, administers and allocates water on behalf of the State (other than on Tribal lands). Water permits from the State are required for:

- irrigation of more than five acres,

³ Garrison Dam/Lake Sakakawea Master Plan with Integrated Environmental Assessment, Design Memorandum MGR-107D, CENWO-DE, 14 December 2007.

- industrial use, municipal use, rural water systems, and
- storage of more than 12.5 acre-feet behind a dam.

Water-use permits are not required for domestic, livestock, or fish and wildlife purposes, unless their annual water use exceeds 12.5 acre-feet.

Applications for water permits are considered if senior water rights are not unreasonably affected, water intake infrastructure is adequate, the use of water is deemed beneficial, and the proposed use is in the public interest. Established water rights have superiority over any water right with a later priority date. Priority date is established by the date the application is received by the Office of the State Engineer.

Water permits for competing applications from the same source, where the source is insufficient to supply all applicants, are granted in the following priority order (if they are received by the State Engineer within 90 days of each other):

1. domestic,
2. municipal,
3. livestock,
4. irrigation,
5. industrial,
6. fish, wildlife, and other outdoor recreational uses.

Any applicant for a Corps of Engineers easement for water intake structures in Lake Sakakawea must first obtain a necessary state or Tribal water right from either the Three Affiliated Tribes or the State of North Dakota.^{4 5} Water permits are required from Three Affiliated Tribes when the water permits are located upon the Fort Berthold Indian Reservation. If the water permit is for withdrawal of water from Lake Sakakawea, then the permit holder must also subsequently enter into a water supply agreement, or surplus water agreement, with the Corps of Engineers and obtain a Corps easement and any required permits, as described in Section 2.7 below. It is important to note that the Bureau of Reclamation's position is that their projects that have been specifically authorized by Congress for withdrawal from the Missouri River System are exempt from the Corps' policy. The Corps generally concurs in Reclamation's conclusion, however, this issue will be revisited on a case by case basis as the issue arises.

2.7 Corps of Engineers Surplus Water Agreements, Easements, and Permits

Surplus water agreements, easements, and any necessary permits will be required for any entity requesting surplus water from the Garrison Dam / Lake Sakakawea Project. These are separate legal / regulatory instruments and are described individually below. As stated previously, the Corps of Engineers will not issue a surplus water agreement, water pipeline or water intake structure easement, or an accompanying permit with any entity without their already having obtained a water right from either the State of North Dakota or the Three Affiliated Tribes.

⁴ Constitution of the State of North Dakota, Article XI

⁵ Title 61 (Chapters 61-01 and 61-04) of the North Dakota Century Code

2.7.1 Surplus Water Agreements

Surplus water agreements are negotiated agreements between the Army Corps of Engineers and a non-Federal entity for the authorized use of surplus water in a Corps project or facility. These agreements are executed under authority of Section 6 of the Flood Control Act of 1944 (33 U.S.C. 708). Execution of a Surplus Water Agreement may be required from any entity requesting water from the Garrison Dam / Lake Sakakawea Project.

2.7.2 Easements

Easements are required for water pipelines and water intake structures on Corps project lands. No easement that supports a water supply agreement will be issued prior to the water supply agreement being executed by all parties. All future easements will contain an explicit reference to the surplus water agreement or water storage agreement and provide an explicit provision for termination of the easement for noncompliance with any of the terms and conditions of the surplus water agreement.

2.7.3 Regulatory Permits

Regulatory permits are required from the Corps of Engineers for any action potentially affecting navigable waters subject to federal laws and regulations including, but not limited to: Section 10 of the Rivers and Harbors Act, provisions (including Sections 401, 402 and 404) of the Clean Water Act, the National Environmental Protection Act (NEPA), the National Historical Preservation Act (NHPA), the Endangered Species Act (ESA), and several other laws, regulations and policies. The Missouri River system is navigable water, and any party intending to divert water from, and any action in or affecting the Missouri River within the State of North Dakota, whether free flowing or impounded, may also require a regulatory permit from the U.S. Army Corps of Engineers.

2.7.4 Existing Agreements, Easements, and Permits

There is not a one-to-one correlation between existing agreements, easements and permits. As of November 2010, the Corps has only one water storage agreement for Lake Sakakawea. That agreement is with the Basin-Electric Power Company (also known as the Dakota Gasification Company), for 54,390 acre-feet of storage, which allows for 21,000 acre-feet of water withdrawals (yield) in any given year.⁶

The Corps has also issued approximately 780 easements for use of Corps lands surrounding the Garrison Dam / Lake Sakakawea Project. Of these 780 easements, 142 are water intake easements (including Basin-Electric). The remaining 638 easements are for right-of-way easements not relevant to this analysis, such as power lines, oil pipelines, and cattle grazing. The total quantity of water being withdrawn through the 142 water intake easements (i.e., annual usage) is estimated to be approximately 30,000 acre-feet per year based on best available data, of

⁶ The storage-yield ratio of 2.59 for Basin Electric was calculated as the ratio between 39 million acre feet of carryover storage in the system needed to provide an annual system yield of 15.2 million (7.7 million acre feet of depletions and 7.4 million acre feet of flow at Sioux City, IA). Storage-yield relationship is defined (in this instance) as the storage in the reservoir (i.e., 54,390 acre-feet) required to supply a given yield (i.e., 21,000 acre-feet).

which approximately 17,500 is withdrawn by Basin Electric. This is discussed in detail in section 3.2.2 Water Supply Demand: Existing Lake Sakakawea Users.

2.7.5 Pending Agreements, Easements, and Permits

In response to the increase in demand for water in the oil and gas fields, a number of companies and individuals, and one state agency, have submitted recent applications for water intake easements from the Garrison Dam / Lake Sakakawea Project. The Corps has determined that nine of these applications are from applicants that have a reasonable chance of being granted, if all conditions are met. The nine applications are for seventeen different intake sites, with seven different representatives. Three separate applicants (Sakakawea Water Depot, Bernard Pease, and Continental Resources) have hired the same engineering firm, Element Solutions, to help them expedite the application process. Each of the nine applicants has proposed from one to six different intake sites, and from 600 to 8,000 acre-feet of annual water withdrawal. The nine applications currently being considered include requests for a combined total of 34,150 acre-feet of annual water withdrawals (yield).

While easement applications do not require that the applicant state the proposed use of the requested water, investigations conducted for this study have determined that all applications are intended to service the water needs of the oil and gas industry. However, the 34,150 acre-feet of requested withdrawals should not be considered a direct estimate of demand, for several reasons. First, as prospective providers to the oil and gas industry, applicants are in competition with each other to service industry demand and may over-estimate the market share they will be able to capture. Second, applicants may request more water than necessary to compensate for uncertainty as to when their applications will be approved, and for uncertainty as to which of their proposed intake sites will be approved (and at what level of water use). Timing and location is critically important for water haulers competing to service the oil and gas industry, since transportation distance and cost play heavily in determining their competitiveness in the industry. Third, the total amount of water needed to service the industry is uncertain as technological change in industry drilling practices has resulted in increasing water demand. Therefore easement applicants may conservatively over-estimate the market size and their market share, due to the time and cost to obtain an easement. An independent estimate of oil and gas industry demand is presented in Section 3.3, which indicates that the total acre-feet of intake easement requests likely over-estimates projected industry demand (34,150 acre-feet of easement requests – 27,000 acre-feet projected demand = 7,150 acre-feet of excess easement requests).

While all nine of these easement applications are credible and are considered in the water needs and demand analysis, only the three applications received prior to June of 2010 are being directly considered in the Environmental Assessment that accompanies this Surplus Water Report. The other six applications are also considered in the cumulative effect assessment of the accompanying EA, but will require separate NEPA actions to address their site specific environmental effects, since adequate information was not available for the remaining six applications at the time this study was initiated. A summary of the nine applications currently being considered in the demand analysis and cumulative effects assessment are provided in Table 2-4.

**Table 2-4
Pending Applications for Water Intake Easements from Lake Sakakawea**

Applicant	Site	Amount (AF)	Environmental Assessment
International Western Company	Charlson	6,000	*
International Western Company	Thompson	4,950	*
International Western Company	Iverson	2,000	*
International Western Total		12,950	
Southwest Pipeline Project	SW Pipeline	8,000	
Southwest Pipeline Project Total		8,000	
Element Solutions - Sakakawea Water Depot LLC	Mandaree	1,000	*
Element Solutions - Sakakawea Water Depot LLC	New Town	1,000	
Element Solutions - Bernard Pease	Pease	1,000	
Element Solutions - Continental Resources	Continental	1,000	
Element Solutions Total		4,000	
Kodiak Oil & Gas Corp.	Kodiak	3,000	
Kodiak Total		3,000	
Pennington	Pennington	800	
Pennington Total		800	
Krenz, Darwin	Krenz	600	
Krenz Total		600	
Lake Sakakawea & Associates (LittleSoldier)	Site 3	1,600	*
Lake Sakakawea & Associates (LittleSoldier)	Site 5	1,600	*
Lake Sakakawea & Associates (LittleSoldier)	Site 8	1,600	*
Lake Sakakawea & Associates Total		4,800	
TOTAL		34,150	

*Applications being evaluated in the Corps' Environmental Assessment.
Applications not noted with a * will require separate NEPA actions.

2.8 Historic Water Use

The ND State Water Commission keeps excellent data on water use within the state. The 11 county area surrounding Lake Sakakawea and the Bakken Formation is the study area for this analysis of regional water use and surplus water demand. The study area is shown in Figure 2-4. Average total water use in the 11 county area was nearly 97,000 acre-feet per year for the period 1989 to 2009, with only a very slight upward trend. Within the past 10 years, average total water use was 101,000 acre-feet per year with no significant trend in either direction.

Figure 2-4
Lake Sakakawea Study Area

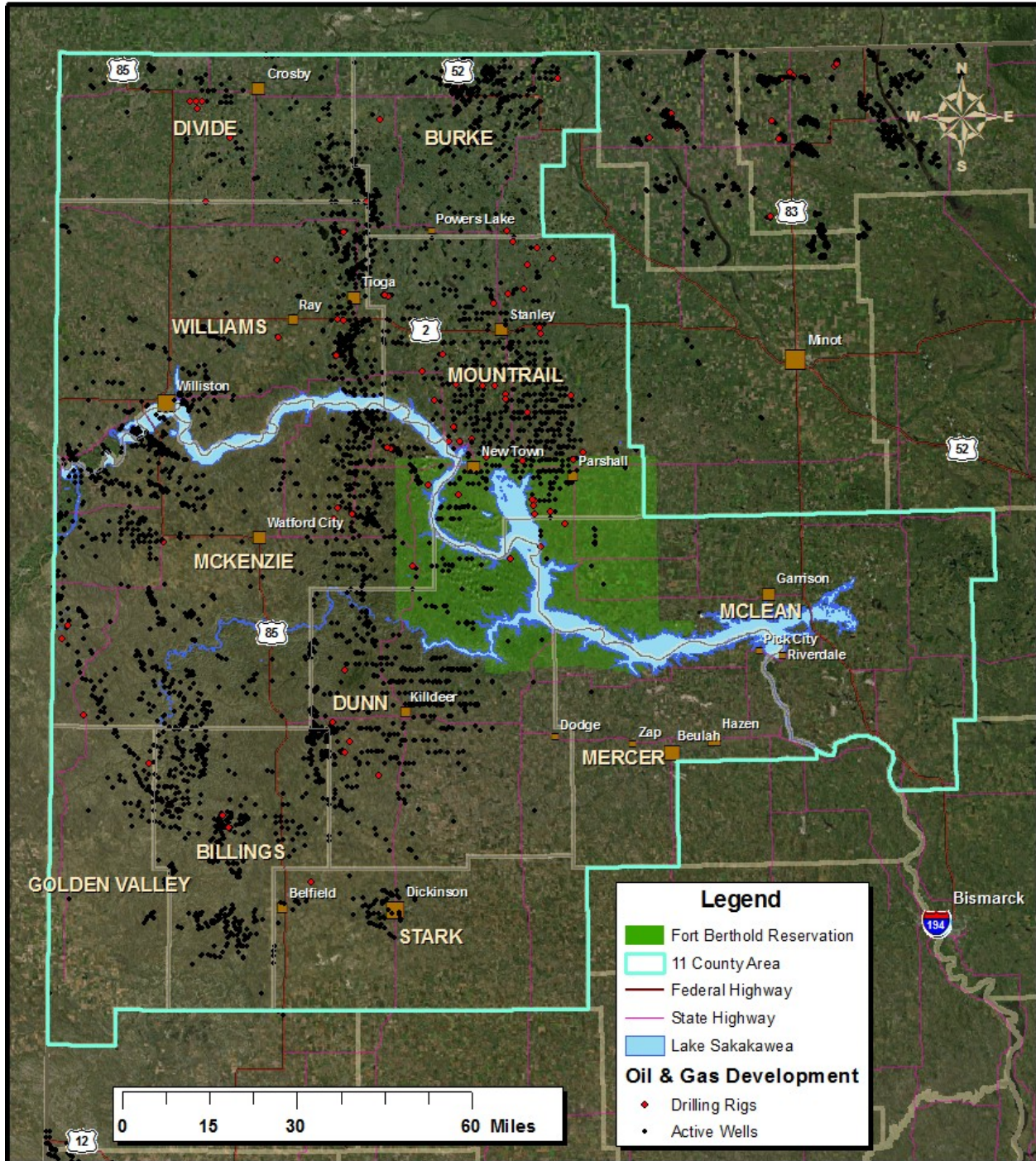


Table 2-5 displays average water use by type, county, and source for the 21 year period from 1989 to 2009. The counties of Mercer (31%), Williams (29%), McLean (18%) and McKenzie (14%) account for the vast majority of water use, with the remaining 7 counties accounting for less than 10% of total water use. Similarly, just four use-types account for over 98% of water

use: Irrigation (53%), Power Generation (29%), Industrial (11%), and Municipal (9%). Other use types include Rural Water, Commercial, Domestic, Stock, Fish & Wildlife, Recreation and Multiple Use. The relative proportion of these uses has not changed significantly in the last 20 years.

**Table 2-5
Average Water Use by Type, County and Source, 1989-2009**

Type	Water Use by Use-Type			County	Water Use by County		
	Ground	Surface*	Total		Ground	Surface*	Total
Irrigation	12,869	36,226	49,095	Mercer	2,129	27,574	29,703
Power Generation	15	27,267	27,281	Williams	7,323	20,349	27,672
Industrial	2,517	7,785	10,302	McLean	2,506	14,901	17,407
Municipal	2,686	5,671	8,358	McKenzie	2,106	11,070	13,176
Rural Water	854	233	1,086	Divide	2,688	149	2,837
Multiple Use		747	747	Stark	671	986	1,657
Commercial	5		5	Dunn	331	1,062	1,393
Domestic	16		16	Mountrail	461	528	989
				Billings	286	535	822
				Golden Valley	177	548	725
				Burke	284	227	511
Total	18,962	77,929	96,891	Total	18,962	77,929	96,891

Source: North Dakota State Water Commission

*Surface water refers to all surface water sources, including Lake Sakakawea

Proportional and historic water use by use-type, county and source are shown on Figures 2-5 to 2-9. Within the Lake Sakakawea area, approximately 20% of water for all purposes combined comes from groundwater sources and 80% from surface water sources. Water for power generation and multiple use is provided nearly exclusively from surface water. Water for irrigation, industrial, and municipal uses is supplied primarily from surface water (70-75%), while water for rural water is supplied primarily from groundwater, and water for commercial and domestic uses is provided entirely from groundwater.

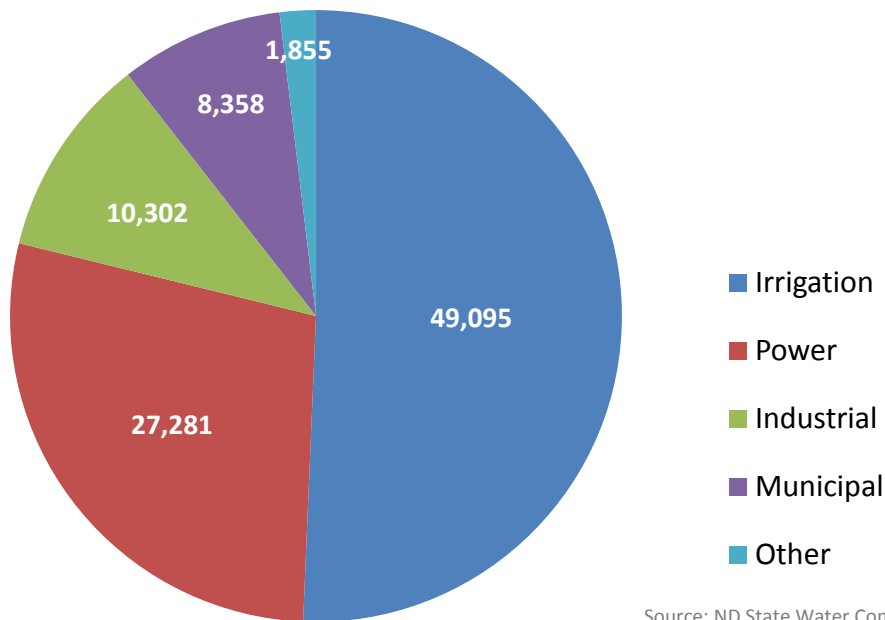
Irrigation has accounted for nearly half of the water usage in the Lake Sakakawea area over the last two decades. Irrigation is the most volatile of the water uses, fluctuating from a low of less than 30,000 acre-feet in 1993 to a high of nearly 60,000 acre-feet in 1989 and 2003. This is

consistent with the variation in regional precipitation patterns over the period of analysis. Improvements in irrigation practices are also responsible for a portion of the reduction in irrigation water usage since 2003.⁷

The remaining major categories of consumptive water use, including power, industrial, municipal, and rural water, have been notably constant over the 1989 to 2009 period. This is reflective of the flat population and industrial growth experienced over this period in the eleven western North Dakota counties adjacent to Lake Sakakawea.

The end of the 1989 to 2009 period corresponds with the beginning of a major increase in industrial water demand generated by the oil and gas industry, which is described in the water demand analysis contained in Section 3.3. This increase in industry demand is expected to cause an upward shift in regional water usage that is not reflected in the historic water usage data.

Figure 2-5
Water Use in the Lake Sakakawea Area⁸ by Type of Use



Source: ND State Water Commission

⁷ “Irrigation on district farms has fallen in recent years--and not just because of rain”, Joe Mahon, Fedgazette, April 2010, Federal Reserve Bank of Minneapolis, http://www.minneapolisfed.org/publications_papers/pub_display.cfm?id=4412

⁸ The Lake Sakakawea area (i.e., study area) is defined as the 11 counties listed in Table 2-4

Figure 2-6
Historic Water Use in the Lake Sakakawea Area by Type

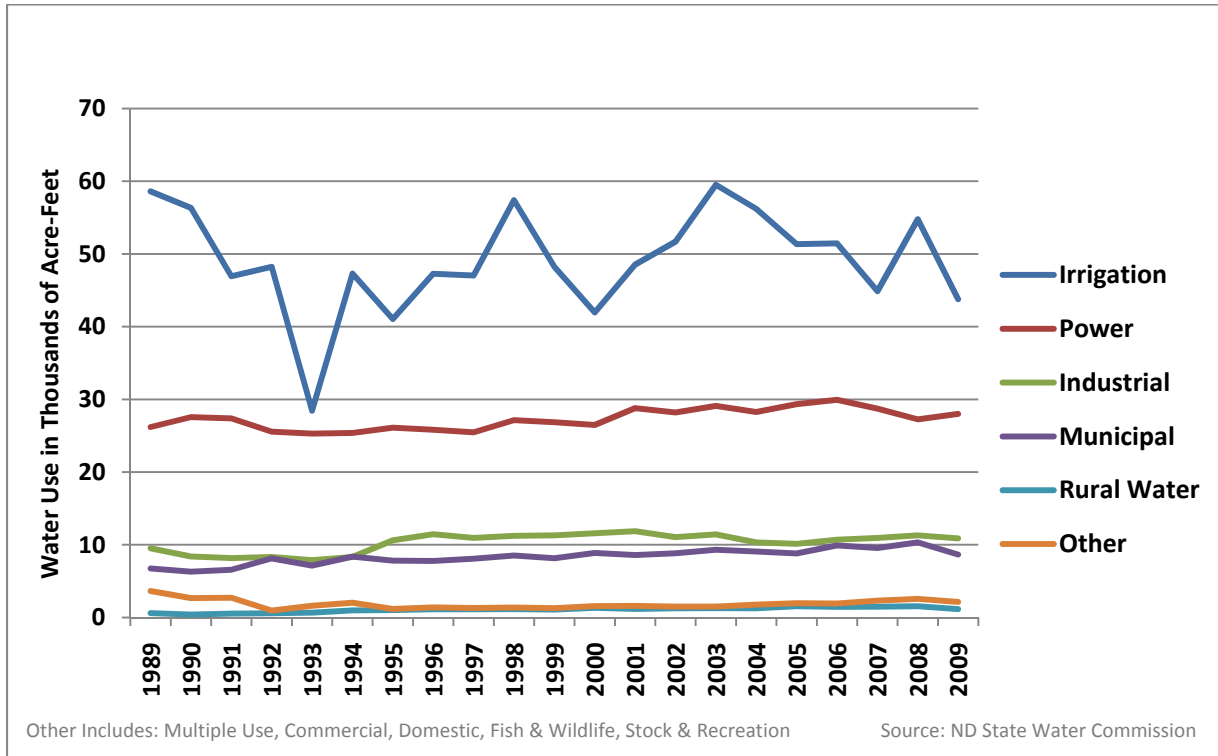


Figure 2-7
Average Annual Water Use by County (1989-2009)

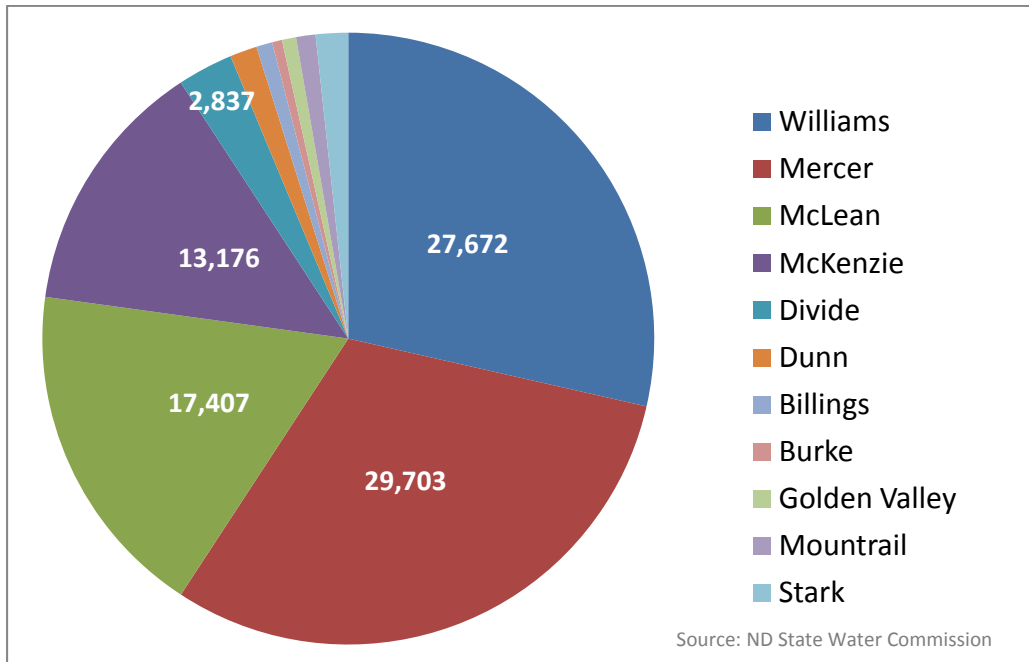


Figure 2-8
Annual Historic Water Use by County (1989-2009)

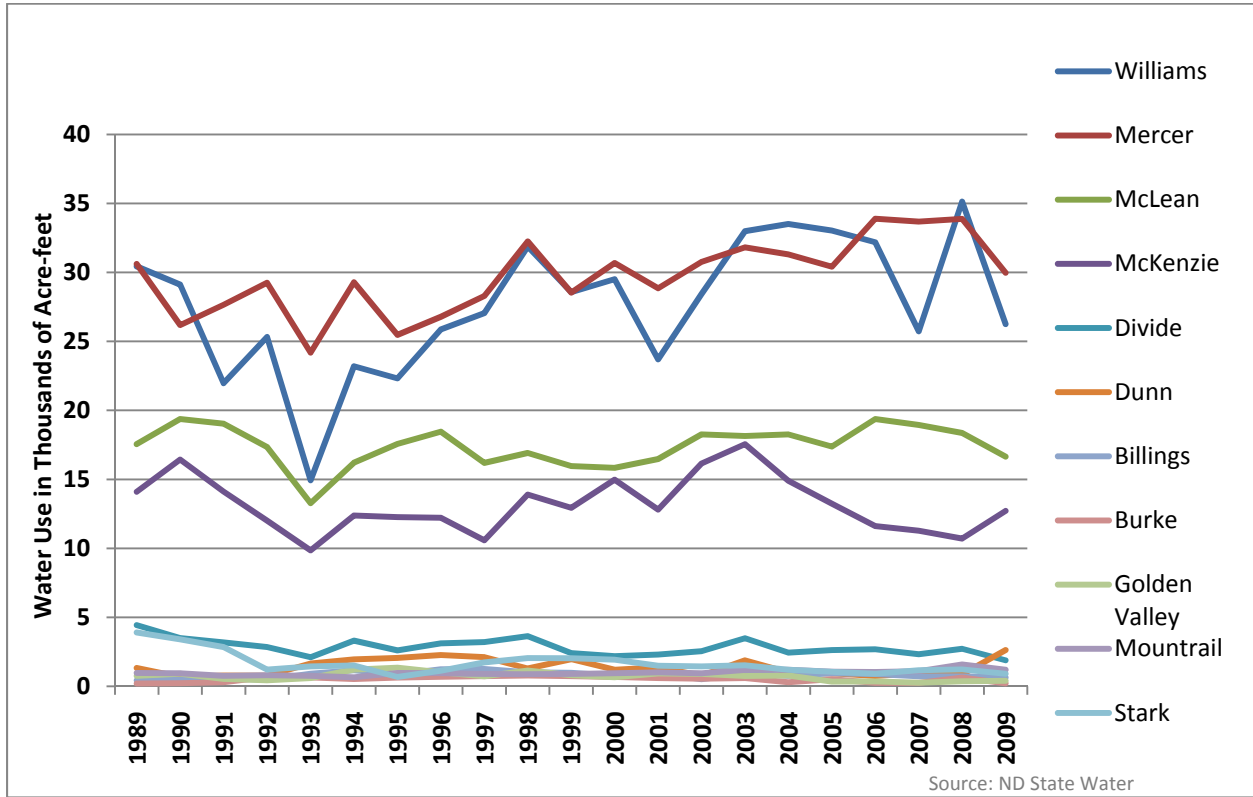
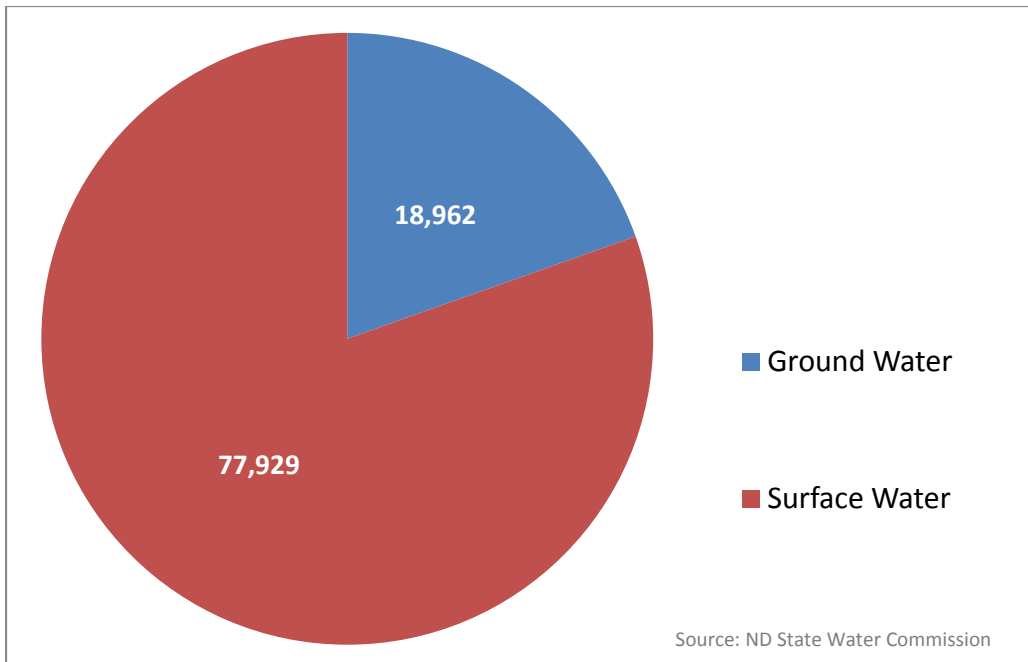


Figure 2-9
Average Annual Water Use in the Lake Sakakawea Area by Source



2.9 Corps Studies and Reports by Others

Numerous documents and reports have been prepared describing the Garrison Dam / Lake Sakakawea Project, project operations, and operations of the Missouri River system. A more comprehensive listing of past reports is contained in the Environmental Assessment (Appendix A). Principal source documents for this analysis included the following Corps of Engineers reports:

- Missouri River Mainstem Reservoir System Master Water Control Manual Missouri River Basin, Reservoir Control Center U. S. Army Corps of Engineers Northwestern Division - Missouri River Basin Omaha, Nebraska, Revised March 2006
- Garrison Dam/Lake Sakakawea Master Plan with Integrated Programmatic Environmental Assessment, Missouri River, North Dakota, Update of Design Memorandum MGR-107D, December 14, 2007
- Water Appropriation Requirements, Current Water Use, & Water Availability for Energy Industries in North Dakota: A 2010 Summary, Response to House Bill 1322, Section 2 of the 61st Legislative Assembly of North Dakota prepared by W. M. Schuh Water Resources Investigation No. 49 North Dakota State Water Commission, August 2010.

3. PLAN FORMULATION

Plan formulation for the Garrison Dam/Lake Sakakawea Surplus Water Study has been conducted in accordance with the six-step planning process described in *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies* (1983) and the *Planning Guidance Notebook* (ER 1105-2-100, dated April 2000). The six steps in the iterative plan formulation process are:

1. Specify water and related land resources problems and opportunities;
2. Inventory and forecast existing conditions;
3. Formulate alternative plans;
4. Evaluate alternative plans;
5. Compare alternative plans; and
6. Select the recommended plan.

The basis for selection of the recommended plan for the study is fully documented below, including the rationale used in plan formulation and plan selection.

3.1 Problems and Opportunities / Need for Surplus Water

As stated in Section 1.1, the purpose of this study is to identify and quantify whether surplus water is available in the Project, as defined in Section 6 of the 1944 Flood Control Act that the Secretary of the Army can use to execute surplus water supply agreements with water users, and to determine whether use of surplus water is the most efficient method for meeting regional municipal and industrial (M&I) water needs. The Omaha District, U.S. Army Corps of Engineers has received requests for nine new water supply easements from suppliers to the oil and gas industry. Three of the nine requested easements are addressed in the attached Environmental Assessment (Appendix A). Six of the nine easement requests have been received since this Surplus Water study has been initiated and are accounted for in the demand analysis and cumulative effects analysis of the EA, but will require separate NEPA actions because they were not ripe for action when this study was initiated. Based on Corps policy, none of the nine easement requests can be processed until a determination is made by the Secretary of the Army that surplus water is available in the Garrison Dam / Lake Sakakawea Project and that use of the surplus water will not significantly affect existing lawful uses of Lake Sakakawea water.

In addition to the water needs of the oil and gas industry, 110 of the 142 existing easements for water intakes at Garrison Dam / Lake Sakakawea will expire over the 10-year period of analysis, and may require surplus water agreements prior to renewal. Corps guidance states that “no easement that supports any type of water supply agreement will be executed prior to the water supply agreement being executed by all parties.”⁹ It is important to note that the Bureau of Reclamation’s position is that their projects that have been specifically authorized by Congress for withdrawal from the Missouri River System are exempt from the Corps’ policy. The Corps generally concurs in Reclamation's conclusion, however, this issue will be revisited on a case by

⁹ Real Estate Policy Guidance Letter No. 26 - Easements to Support Water Supply Storage Agreements and Surplus Water Agreements, 10 June 2008, CEMP-CR/CECC-R, paragraph 3

case basis as the issue arises. An analysis of total demand for surplus water storage at Garrison Dam / Lake Sakakawea over the 10-year planning period is provided below.

Because of uncertainty in the rate of oil and gas development, and resulting water demand over the 10-year planning period, temporary use of 100,000 acre-feet/year of yield (equivalent to a storage of 257,000 acre-feet) is being evaluated (see Section 3.8.2.1 Storage-Yield Analysis). This is somewhat in excess of the amount of new easements requests and total estimated demand. The 100,000 acre-feet/year of surplus water was selected by the Omaha District based on the potential for growth in future M&I water demand over the 10-year planning period. Demand for water from Lake Sakakawea has grown rapidly just over the last 18 months, as exemplified by the fact that six new easement applications have been received just during the short period of time that this study has been underway. Therefore, a surplus water determination in excess of current easement applications received to date has been evaluated for the purposes of efficiency and responsiveness, so that the storage volume associated with all reasonably foreseeable future surplus water needs over the period of analysis could be evaluated and approved in one single action by the Assistant Secretary. Should resource impacts from temporary use of 100,000 acre-feet/year of surplus water (equivalent to 257,000 acre-feet of storage) prove significant, then lesser amounts could be evaluated.

The problem of cost effective municipal and industrial (M&I) water supply to support the oil and gas industry in North Dakota, and the need for surplus water from Garrison Dam / Lake Sakakawea Project to meet expected demand, is quantified in the following demand analysis.

3.2 Identification of Surplus Water

An agreement for “surplus water” conveys the right to use water from a Corps Project. The authority to contract for the use of surplus water was granted to the Secretary of the Army by Section 6 of the 1944 Flood Control Act, as amended. Section 6, states in relevant part as follows:

“That the Secretary of War [now Army] is authorized to make contracts with States, municipalities, private concerns, or individuals, at such prices and on such terms as he may deem reasonable, for domestic and industrial uses for surplus water that may be available at any reservoir under the control of the War Department: Provided, That no contracts for such water shall adversely affect the existing lawful uses of such water. All moneys received ...”

These agreements may be for domestic, municipal and industrial uses, but not for crop irrigation. The Corps’ implementation guidance for Section 6 of the FCA, set forth in Section E-57 b., Appendix E, ER 1105-2-100, provides that surplus water can be, “water stored in a Department of the Army reservoir that is not required because the authorized use for the water never developed or the need was reduced by changes that occurred since authorization or construction; ...” Thus, water can be identified as surplus because an authorized project purpose has not developed as anticipated. Corps guidance further provides that surplus water contracts (or sometimes called agreements) will be accompanied by a brief report covering topics similar to those of storage reallocation reports and shall include how and why the storage is determined to be surplus. At Garrison, approximately 257,000 acre feet of storage are necessary to provide a dependable annual yield of 100,000 acre feet of water.

This section is intended to answer the question of how and why water stored in a Corps’ reservoir is determined to be surplus. In summary, in evaluating Lake Sakakawea individually

and the Missouri River Main Stem System as a whole it appears clear that 100,000 acre feet of water can be identified as temporary surplus water, the use of which over the next 10 years would not significantly affect project purposes (see Section 3.8.1.1 and Table 3-21). The following paragraphs provide justification for this conclusion.

3.2.1 Storage for Mainstem System Irrigation

As stated at the beginning of this section the Corps' implementation guidance for Section 6 of the FCA, set forth in Section E-57 b., Appendix E, ER 1105-2-100, provides that surplus water can be, "water stored in a Department of the Army reservoir that is not required because the authorized use for the water never developed or the need was reduced by changes that occurred since authorization or construction; ..." Thus, water can be identified as surplus because an authorized project purpose has not developed as anticipated.

The planning documents for the mainstem system anticipated that approximately 2.3 million acres of land in the upper basin from Fort Peck to Sioux City would be irrigated out of the mainstem system¹⁰. The plan originally developed by the Department of the Army for the mainstem system was increased in the final joint plan by over 6 million acre feet of storage to accommodate this projected irrigation need¹¹. However, only a small fraction of the water in the mainstem system that was intended to be used for irrigation has been applied to that purpose to date. Because the mainstem system projects are operated as a system, the undeveloped irrigation needs would have been supplied directly by the Garrison project, or coordinated through intrasystem operations. Accordingly, utilizing only a small portion of the water in the mainstem reservoirs, including Garrison, originally anticipated to be used for irrigation, and not anticipated to be used for that purpose within the next 5-10 years, to serve municipal and industrial needs, is considered appropriate as that water is deemed surplus in accordance with current Corps guidance.

3.2.2 Impacts to Existing Lawful Uses of Water

In addition to determining that water stored in an Army reservoir is surplus because the authorized use for the water never developed or the need was reduced by changes that occurred since authorization or construction, Section 6 of the FCA also provides that contracts for the use of surplus water "shall not adversely affect then existing lawful uses of such water." This condition is fulfilled in two ways. First, a condition of surplus water agreements is that the recipients of such agreements hold the necessary State water rights, or in applicable cases, a water right issued by the appropriate Tribal government. By requiring such rights, the Corps ensures that agreements for use of surplus water will not adversely affect any other preexisting lawful use of the water to be contracted and that use of the water is consistent with water right priorities established by State or Tribal laws. A condition of Corps agreements for the use of surplus water requires that the recipient demonstrate an appropriate State or Tribal water right.

Second, in addition to requiring a State or Tribal water rights to withdraw water, the Corps ensures that lawful downstream uses will not be adversely affected by ensuring that the use of the water will not significantly affect operations for authorized purposes. This report documents

¹⁰ Reference Section 2.5.3 Irrigation

¹¹ Senate Document 78-247

that the use of a projected 100,000 acre feet of surplus water at Lake Sakakawea would not significantly affect operations for authorized purposes. Lake Sakakawea is formed by the waters of the Missouri River stored behind the Garrison Dam. Garrison Dam is one of six mainstem dams operated as a coordinated unit providing flood control protection, storage for navigation, hydropower and other authorized uses. As described in this report the use of 100,000 acre feet of water in a project with a total capacity of 28,300,000 acre feet, and a system with a capacity of almost 75 million acre feet of water will have a very minimal effect on mainstem system and project operational needs. The impacts associated with the use of 100,000 acre feet of water on authorized project purposes as described in this report are summarized in section 3.8.

3.2.3 System Storage

The six mainstem system projects hold a combined storage of approximately 73.1 MAF. This storage is divided into four zones, the exclusive flood control zone, which is used only for flood storage, the annual flood control and multiple use zone, which the projects normally operate under a wide range of runoff conditions, the carry over multiple use zone and the permanent pool zone. See generally, Master Manual, Chapter VII. As indicated in the Master Manual the carry over multiple use zone provides a storage reserve for irrigation, navigation, power production, water supply, recreation, and fish and wildlife. The storage in this zone at Fort Peck, Garrison, and Oahe is designed to maintain downstream flows through a succession of well-below-normal runoff years. Serving the authorized purposes during an extended drought is an important regulation objective of the System and the primary reason the upper three System reservoirs are so large compared to other Federal water resource projects. See Section 6-02.3, Master Manual. Because federal irrigation projects have not developed as planned, the capacity of this zone to serve other authorized purposes during drought conditions has been greatly extended. The Permanent Pool Zone is an inactive zone and provides for a minimum power head, sediment storage capacity and other purposes.

3.2.4 Storage for Sediment

In its natural state, the Missouri River transported a sediment load averaging 25 million tons per year in the vicinity of Fort Peck, Montana; 150 million tons per year at Yankton, South Dakota; 175 million tons per year at Omaha, Nebraska; and approximately 250 million tons per year at Hermann, Missouri, near its confluence with the Mississippi River. With the construction of each of the System and tributary dams, the reservoirs have acted as catchments for the tremendous load of sediment carried by the Missouri River and its tributaries.

During the design phase of each of the main stem projects, sedimentation was acknowledged, sediment yield was estimated, and was a consideration in the project design. In the Garrison Dam Design memorandum (1945) it stated that 48,000 acre feet of sedimentation was anticipated on an average annual basis and that the amount designated for sediment storage would be completely filled in 100 years.

Specific storage zones were not identified in the design memorandum, though. This meant that the sediment deposition was not specifically allocated within the storage zones during original project design. It wasn't until development of the first master water control manual that storage zones were identified for each project. The various zones were identified to meet both the individual project needs (e.g. minimum heads), as well as the system needs (flood control, drought management, etc.).

At Lake Sakakawea the Permanent Pool Zone was designed to provide 5.152 million acre foot (MAF) of storage. Storage within this zone is the minimum necessary to maintain project operations (sediment storage) and to meet minimum head requirements needed to support hydropower operations. The original project design memorandum included an evaluation of the estimated sediment inflow rate which was used to determine a project life. The original sediment deposition rate was estimated at 48,000 acre feet/yr. Current monitoring data and analysis indicates that the sediment deposition rate is less than the rate originally estimated, as illustrated in the Master Manual, Plate II-1 (March 2004), where it shows a deposition rate of 25,900 acre-feet/year. The difference in estimated versus measured sediment depletion in the 58 years since Garrison Dam was closed is 1,282,000 acre feet. This volume is not being used as originally intended.

The fact that system-wide sedimentation is less than anticipated further supports the conclusion that there is surplus water in Lake Sakakawea.

3.3 Water Supply Demand Analysis

For this study, water supply demand originates from two sources. The first is the rapidly expanding oil and gas industry in western North Dakota; the second is existing water intake easement holders in the Garrison Dam / Lake Sakakawea Project. These two sources of demand are described separately in the sections below.

3.3.1 Oil & Gas Industry Water Supply Demand

As described in Section 2.8, existing water usage in the study area was relatively stable for the 21 year period from 1989 through 2009, with the exception of irrigation water, which varies significantly according to annual precipitation. A major new source of water demand in western North Dakota, as described previously in this report, is due to the recent boom in oil and gas development in the Bakken Formation of western North Dakota. Figure 3-1 below depicts the rapid increase in oil production in the eleven county Lake Sakakawea study area. The following paragraphs describe the relationship between oil and gas development and increasing industrial water demand.

The boom in oil and gas exploration in western North Dakota is in large part due to the recent advancement of hydraulic fracturing (also known as hydro-fracing, or fracing) technology, which allows for cost-effective extraction of oil and gas from hydrocarbon-rich oil shale. This new technology is critically dependent on large volumes of high quality fresh water. Water, in combination with sand and proprietary chemical gelling mixtures, is forced into various locations along an oil-shale formation to fracture the shale and allow the oil and gas to travel through the fractures into the well. According to industry experts and state regulators, the quantity of water required to “frac” a well varies widely, and can range from less than 2-acre-feet to more than 12-acre-feet per well.

This wide disparity in the quantity of water required to frac an oil well is primarily explained by the variation in water requirements of vertical versus horizontal wells. As previously described, very recent advances in drilling technology now allow for wells to be drilled vertically for thousands of feet, then horizontally along the oil seam for even greater distances. Reported data for fracing water requirements in North Dakota are primarily based on previous vertical drilling technologies, while current fracing estimates are based on the newer, horizontal drilling technology. As an example of increasing industry water requirements, drilling data for the

Barnett Shale in Texas indicate that the newer, horizontal drilling technologies employed there in recent years require an average of three times the water previously required for vertical drilling.¹²

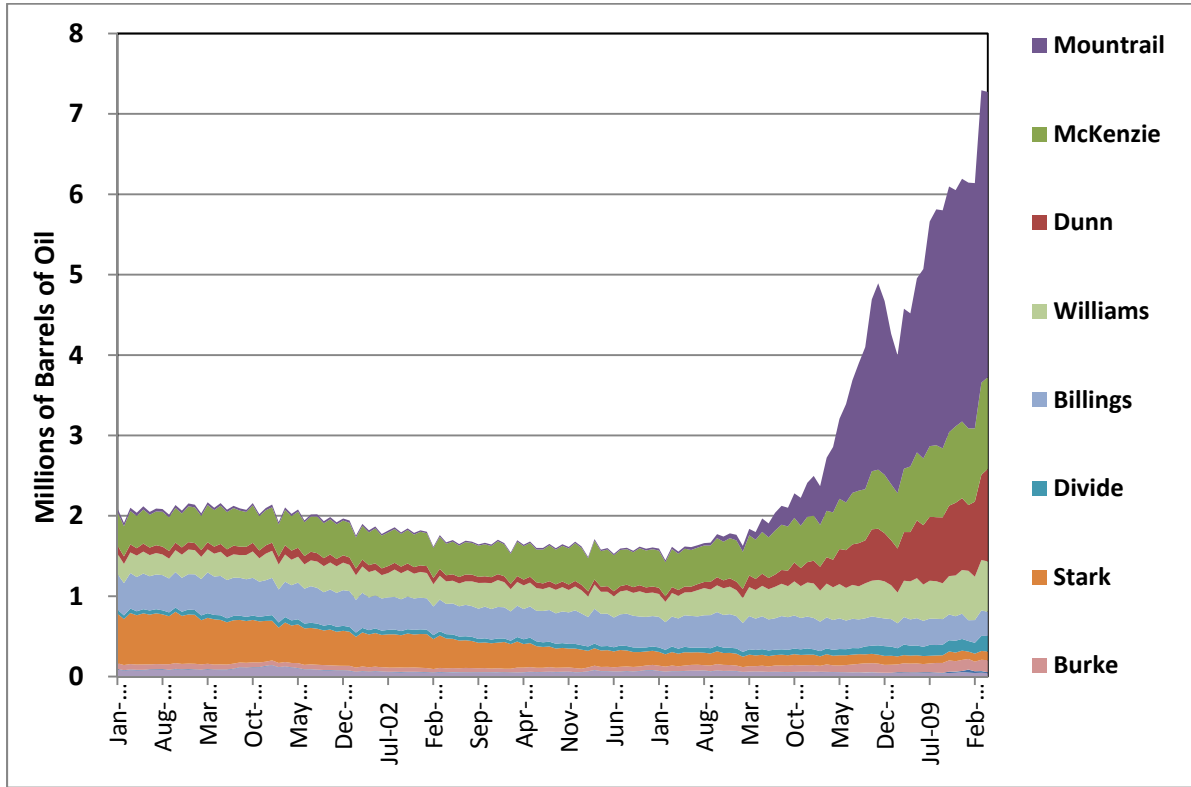
In addition to water used for fracing, there is also a large quantity of water required for drilling and casing each newly drilled well. The drilling process uses large quantities of drilling ‘mud’, which is a mud-like mixture that is pumped past the drill head to both cool the drill bit and collect drilled material and transport it to the surface. Wells are commonly drilled thousands of feet deep, and then subsequently drilled several thousands of feet horizontally through the formations. This extensive drilling requires large quantities of drilling mud and, as such, large quantities of water are used to mix the mud.

Each well must also be cased, which means the well shaft must be encased in a solid tube of concrete so that neither fracing chemicals nor oil permeate into other geological layers, many of which contain sensitive fresh water aquifers. The concrete used to case such deep and long wells also requires a large quantity of water. According to a Marathon Oil representative, the amount of water required for drilling and casing a single well has increased from 12,000 gallons to 132,720 gallons of water (0.037 to 0.407 acre-feet) per well, in large part due to technological advances in horizontal drilling techniques that have resulted in much longer drilling runs and therefore more casing required.

As companies explore for and produce oil and gas, they generate various hazardous and non-hazardous liquid, semisolid, and solid wastes. Non-hazardous oil field wastes can be assigned to several categories: drilling wastes, produced water, and associated wastes. Produced water is primarily used frac water that is brought to the surface at the beginning of production. When hydrocarbons are produced, they are brought to the surface as a produced fluid mixture. The composition of this produced fluid generally includes a mixture of either liquid or gaseous hydrocarbons, produced water, dissolved or suspended solids, produced solids such as sand or silt, and injected fluids and additives that may have been placed in the formation as a result of exploration and production activities. The produced water is typically stored in tanks at the well site and transported by truck to a North Dakota approved disposal well location. Drilling muds are substantially recovered as part of the well construction process and are disposed of in accordance with required standards. Once extracted after drilling, recovered drilling muds are circulated in a closed system (if drilled on Corps lands) or in open pits (in most other cases).

¹² Water Use in the Barnett Shale, Railroad Commission of Texas, 10/11/10, http://www.rrc.state.tx.us/barnettshale/wateruse_barnettshale.php

**Figure 3-1
Oil Production in the Lake Sakakawea Area, by County**



In addition to water used for fracing, drilling, and casing of wells, there is additional water required for maintenance of existing wells. Maintenance of existing wells may include another water-intensive activity known as ‘de-brining’. De-brining is a process in which water is used to dilute salt brines that have a tendency to form in and throughout the well shaft due to high concentrations of salts. During de-brining, fresh water is used to reduce the overall salinity of the well and to dissolve obstructive salt brine formations in order to prevent clogging. The North Dakota State Water Commission estimates that 10% of existing wells require de-brining on an annual basis, using 526,000 gallons (1.614 acre-feet) of water per well.

Between fracing, drilling and casing, and de-brining, each new well in western North Dakota is estimated to require between 2.6 acre-feet and 13.2 acre-feet of water per well. Low end estimates are based on historic water-use data; however, new drilling technologies (i.e., horizontal drilling) require higher volumes of fracing water, and wells using these technologies are not yet fully represented in water-use data statistics. Therefore, total required water volumes have been calculated under a range of water requirements per well, and a summary of water-use estimates for new wells and the sources of each estimate can be seen in Table 3-1.

Table 3-1
Estimates of Oil & Gas Water Requirements (in Acre-Feet)

	Estimate		Source
	Low / Old	High / New	
Drilling & Casing (Per New Well)			
Drilling & Casing	0.037	0.407	Marathon Oil - Kovachedich
Drilling & Casing		1	ND State Water Commission - Bill Schuh
Fracing (Per New Well)			
Fracing	2.455		ND State Water Commission - Wanek
Fracing		4.910	Marathon Oil - Kovachedich
Fracing		6.44	Kodiak Oil & Gas - Cunningham
2009 minimum	0.004		North Dakota Industrial Commission
2009 maximum	9.820		North Dakota Industrial Commission
2009 median	2.000		North Dakota Industrial Commission
2009 mean	2.000		North Dakota Industrial Commission
"Current Use"	4.603	12.276	Helms, Lynn - ND Industrial Commission
Maintenance of Existing Wells			
Per Well (De-brining)		1.614	ND State Water Commission - Bill Schuh
% Requiring Maintenance / year		10%	ND State Water Commission - Bill Schuh
Operational Wells			
Total Wells	4,606	4,644	ND Oil & Gas Division

As stated previously, estimates of future oil and gas water demand cannot be accurately projected based upon historic and current demand only, due to the shift in demand resulting from the new water requirements of the oil and gas industry. However, there are certain indicators of future demand which can be relied upon to project future water needs of the oil and gas industry independent of past water use trends. Data are available for three such indicators of future oil and gas industry water demand: 1) the number of drilling rigs currently in the area, 2) the number of new well starts in recent years, and 3) the number of oil & gas exploration permits issued in recent years.

The national distribution of drill rigs is an indicator of expected future drilling activity, which is in turn an indicator of future water needs of the industry. Drilling rigs are expensive, slow-moving, and limited in number. As of November, 2010, 142 of the 1,669 drilling rigs in the U.S. were actively drilling in western North Dakota. This is more than double the number of rigs actively drilling in the state during 2008 and 2009, and has continued to increase throughout 2010. The relocation of rigs to North Dakota is a strong indicator of the growth in oil and gas development in the region, and portends a corresponding increase in water demand for the industry.

The number of new well starts is also an indicator of expected water demand. New well starts have increased significantly in the last several years. Data available through June of 2010 show

that the number of new well starts for the year already exceeded the totals for 2008 and 2009, and is on pace to more than double the 2008 and 2009 average number of new well starts.

Oil and gas exploration permits show a similar, increasing, trend. Development permits through June of 2010 are also on pace to more than double the previous two year’s average.

These trends in indicators of future oil and gas development, and resulting water needs, are shown in Table 3-2 and Figure 3-2 below.

**Table 3-2
Indicators of Future Oil Development**

Year	2008	2009	2010*
Total Annual Oil Production (bbl)	62,776,123	79,736,468	107,802,917
Average Monthly Oil Production (bbl)	5,231,344	6,644,706	8,983,576
Average Wells Producing	4,084	4,421	4,795
Average Daily Production (bbl)	171,989	218,307	295,350
Development Permits	567	465	1,231
Total Spuds	720	622	1,484
Average Rig Count	75	53	116
Average Spuds per Rig per Year	9.7	11.7	12.8

*Pro-rated based on 9 months of data

Source: ND Industrial Commission, Department of Mineral Resources, Oil & Gas Division, Monthly Statistical Update: 2008, 2009, 2010

The best indicator of the number of new wells to be drilled in any particular area is the number of drilling rigs in that area. An idle drilling rig carries a very high opportunity cost, and as such, it does not often sit idle. Idle rigs are very quickly moved to a more productive region. Drilling rigs in western North Dakota operate all year long and frac wells a minimum of 8 months out of the year (fracing decreases during the coldest winter months). Not only have the number of drill rigs increased, but the average wells drilled per rig per year have also increased. In the 12 months from July 2009 through June of 2010 the average number of wells drilled per rig per year was 12.62. In the twelve months prior it was 10.19. Accordingly, the average length of time from spud (start of well drilling) to spud has decreased from 25 days to 20 days. With 142 rigs actively drilling 12.62 wells per year, western North Dakota is on pace to drill 1,792 wells per year. The ND State Industrial Commission had independently projected between 1,500 and 1,800 new wells per year for the next 10-11 years, which is consistent with this estimate.

Depending on which estimates are used for each of the aforementioned parameters, the potential for water supply demand from the oil and gas industry varies significantly. Demand could be as low as 7,000 acre-feet per year or as high as 27,000 acre-feet per year. Table 3-3 shows how

demand accumulates given different parameter estimates (see Table 3-1 above for the sources of each parameter estimate).

**Figure 3-2
Historic Trends in Drilling Rigs, Well Starts, and New Well Permits**

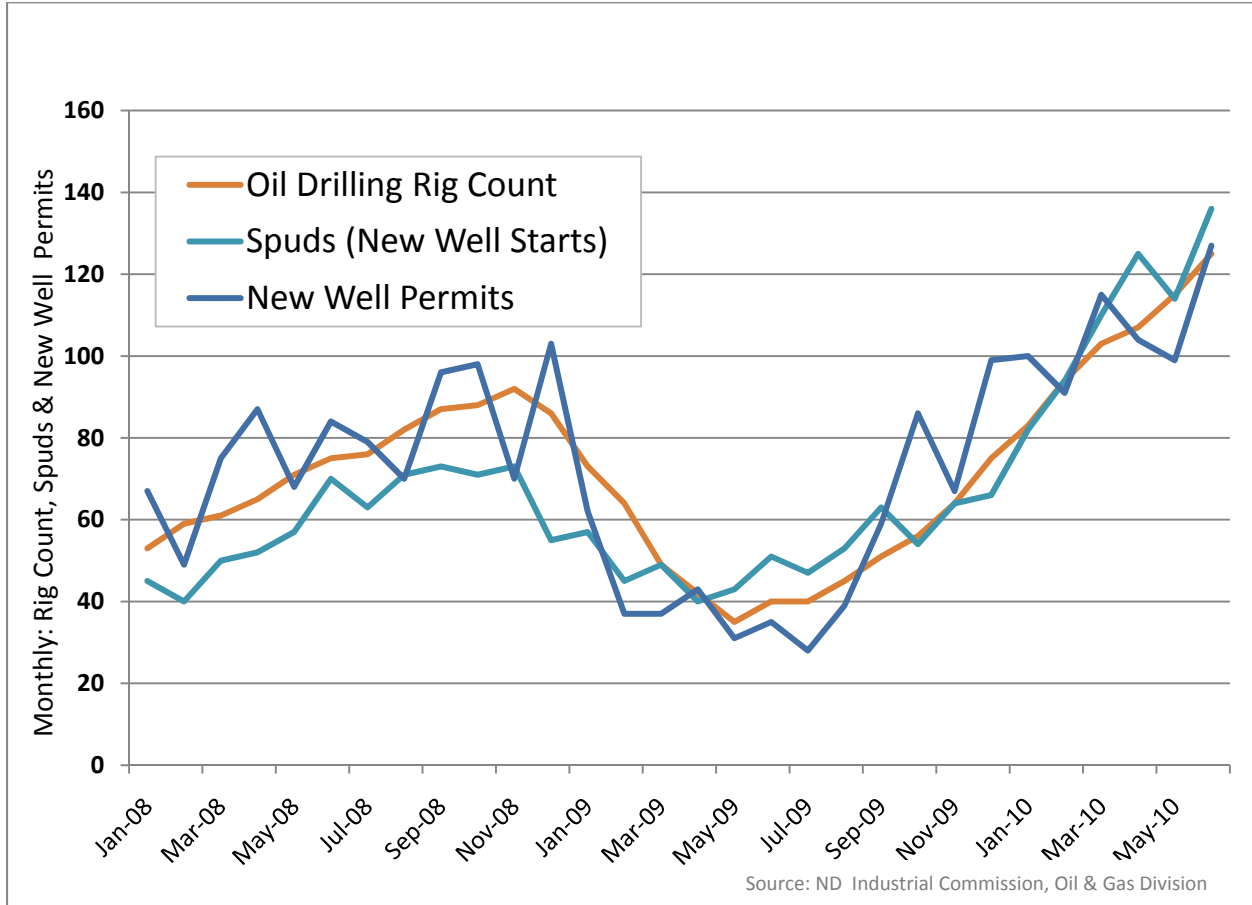


Table 3-3 shows estimates of 1,500 and 1,800 new wells per year over the next twenty years. This estimate was provided by the North Dakota State Water Commission and references information they received from the North Dakota Industrial Commission Oil and Gas Division. New well starts estimated for 2010 (based on January – June data prorated for the year) equaled 1,322, double that of 2009; indicating that the State estimate of 1,500-1,800 new wells is being rapidly approached.

The ND Oil & Gas Division estimates an eventual total of “over 21,000 Bakken and Three Forks wells on the landscape.” At steady rates of 1,500 to 1,800 new wells per year, the total well count in western North Dakota will surpass 21,000 in 10 to 11 years, respectively. Thus, if current rates of drilling continue, the demand for water supply from the oil and gas industry for drilling and new well fracing should decrease rapidly after approximately 10 to 11 years.

Estimates are shown in Table 3-3 for fracing requirements of 2, 4, 6 and 12 acre-feet per well, representing the range of estimates of water needs obtained from various sources in the State and the industry. These ranges of estimates for new wells and fracing requirements per well were then combined to produce a range of water requirement projections for the oil and gas industry of

7,000 to 27,000 acre-feet per year for the next 10-11 years. Estimated growth in water demand was suspended at the point that total well count reached 21,000.

The previous estimate, prepared for this study, is highly consistent with estimates independently prepared for the North Dakota State Water Commission¹³:

“Total estimated annual freshwater requirements for the B-S-TF play are about 13,000 to 23,000 acre-feet per year initially, depending on the number of wells drilled and the amount of frac-water required per well, and as much as 28,000 acre-feet per year at ten to 15 years from now. The annual amount of water used should decrease substantially as development of the B-S-TF play approaches completion, although it is possible that oil wells in the B-S-TF play will require “re-fracing” to enhance long-term oil recovery, thereby sustaining higher water demand.” (p. ES- 7)

**Table 3-3
Estimated Total Water Requirements for Oil and Gas Development**

Baseline # of wells	4606	4606	4606	4606
AF Drilling & Casing per new well	0.407	0.407	1	1
% needing maintenance per year	10%	10%	10%	10%
AF per maintenance well	1.614	1.614	1.614	1.614
Frac AF/Well	2	4	6	12
New Wells Per Year	1,500	1,500	1,800	1,800
Year	AF	AF	AF	AF
2011	4,597	7,596	13,634	24,434
2012	4,839	7,838	13,925	24,725
2013	5,081	8,080	14,215	25,015
2014	5,323	8,323	14,506	25,306
2015	5,565	8,565	14,796	25,596
2016	5,807	8,807	15,087	25,887
2017	6,049	9,049	15,377	26,177
2018	6,292	9,291	15,668	26,468
2019	6,534	9,533	15,959	26,759
2020	6,776	9,775	16,249	27,049
2021 ¹⁴	7,018	10,018		

Demand for maintenance water could continue for an additional 10-20 years beyond 2021 (the end of the 10-year period of analysis), and a number of existing wells may also be re-fraced over

¹³ Water Resources Investigation No.49, W.M. Schuh, August 2010

¹⁴ Estimated growth in water demand was suspended at the point that total well count reached 21,000

that time period. However, based on current estimates, the total demand for maintenance water would only be approximately 3,500 acre-feet per year (exclusive of re-fracing), after full development of the Bakken Formation.

The demand for hydrofracing can be considered inelastic to the price of water within a reasonable range. Water is a small part of the cost of a hydrofracing operation. There are millions of dollars of equipment, mineral rights, labor, fuel, chemicals, and associated costs required to develop an oil well utilizing this technology. The cost of water is a negligible part of these costs. The driving force behind hydrofracing is the price of oil. This price which has spiked many times over recent decades is currently sufficiently high that private individuals and companies are willing to risk large amounts of capital on potential wells. The average North Dakota well produced 22 thousand barrels of oil in 2010. At a price of just \$50/barrel this would produce an income of about \$1.1 million annually. At the more recent price of \$90/barrel of oil the income would be over \$2 million. The price of oil is much more important to the demand for inputs to the hydrofracing process, such as water, than the cost of water or other minor inputs. Accordingly it is believed that the demand for hydrofracing can be considered inelastic to the price of water within any foreseeable range and will not decrease or increase the number of wells developed.

The foregoing discussion is indicative of the temporary nature of the significant upward shift in industrial water demand from oil and gas development in western North Dakota. The large volume of water required, coupled with the temporary nature of industry's water demand, is highly compatible with the stated purposes for a surplus water declaration cited in the authorizing legislation.

3.3.2 Water Supply Demand: Existing Lake Sakakawea Water Users

The Corps has issued 142 water intake easements around Lake Sakakawea, only one of which has a water storage agreement (Basin Electric Power Cooperative). Of these 142 water intake easements, approximately 77% (110) will expire during the 10-year study period. According to Corps policy, holders of these easements may be required to execute surplus water agreements or water storage agreements with the Corps of Engineers as a pre-condition of re-issuance of their current easements.

The quantities of water being withdrawn through these easements are difficult to determine from the available data. The Corps keeps records on easement allocations, but does not collect data on actual water usage. The North Dakota State Water Commission does keep detailed data on permitted water usage, and all Corps easements also require a North Dakota or Tribal water permit. However, there is no data set that allows direct correlation of State water use permits with Corps easements. An analysis of all ND state water permits for surface water withdrawals within one mile of Lake Sakakawea shows that there are 115 permits totaling 30,664 acre-feet of allocations for small users¹⁵. From 1989-2009, average reported water use for these 115 small permit holders was 6,384 acre-feet (21% of total allocation).

¹⁵ *"small users" excludes the 15 largest permits, which are all institutional users. Most of these 15 institutional easements have not been used for decades and are therefore not deemed to be representative of 'typical' water permits.

There are also 15 State surface water permits within one mile of Lake Sakakawea held by large, institutional users. These 15 State surface water permit holders are displayed in Table 3-4. Permitted allocations for these 15 large institutional users total 3,344,589 acre-feet, but many allocations date back to the 1950s - 1960s and have never been utilized. From 1989-2009, average reported water use for these 15 large institutional permit holders was only 23,612 acre-feet (0.7% of total allocation), and water use was reported for only 6 of the 15 large institutional users. Maximum water usage over this 21-year period was 27,362 acre-feet. Figure 3-3 shows the range of water usage of the 15 large institutional users over the 21-year period.

Table 3-4
The 15 Largest Surface Water Permits within One Mile of Lake Sakakawea

Permit #	Permit Holder	Permitted Allocation	Average Use 1989-2009 (acre-feet)	Max Use 1989-2009 (acre-feet)
1416A	State Water Commission	1,917,652	0	0
1416	US Bureau of Reclamation	1,212,348	7	33
1413	Minot, City of	50,000	0	0
720	Williston, City of	40,325	2,376	2778
6124	International Western	18,000	0	0
3688	State Water Commission	17,100	2,698	4446
2179	Basin Electric	15,000	10,261	11574
1416A-01	State Water Commission	15,000	0	0
5097	Nesson Valley Irrigation District	14,790	0	0
1901A	Dakota Gasification	11,410	7,399	8471
3703	US Fish & Wildlife	10,122	0	0
5334	Elk/Charbon Irrigation District	9,600	0	0
926	US Fish & Wildlife	5,250	0	0
1078	Buford-Trenton Irrigation District	5,198	0	0
3710	Roedeske, Fred	2,794	871	2,083
Total		3,344,589	23,612	27,362

Figure 3-3
Water Use by the 15 Largest Permit Holders for Surface Water within One Mile of Lake Sakakawea

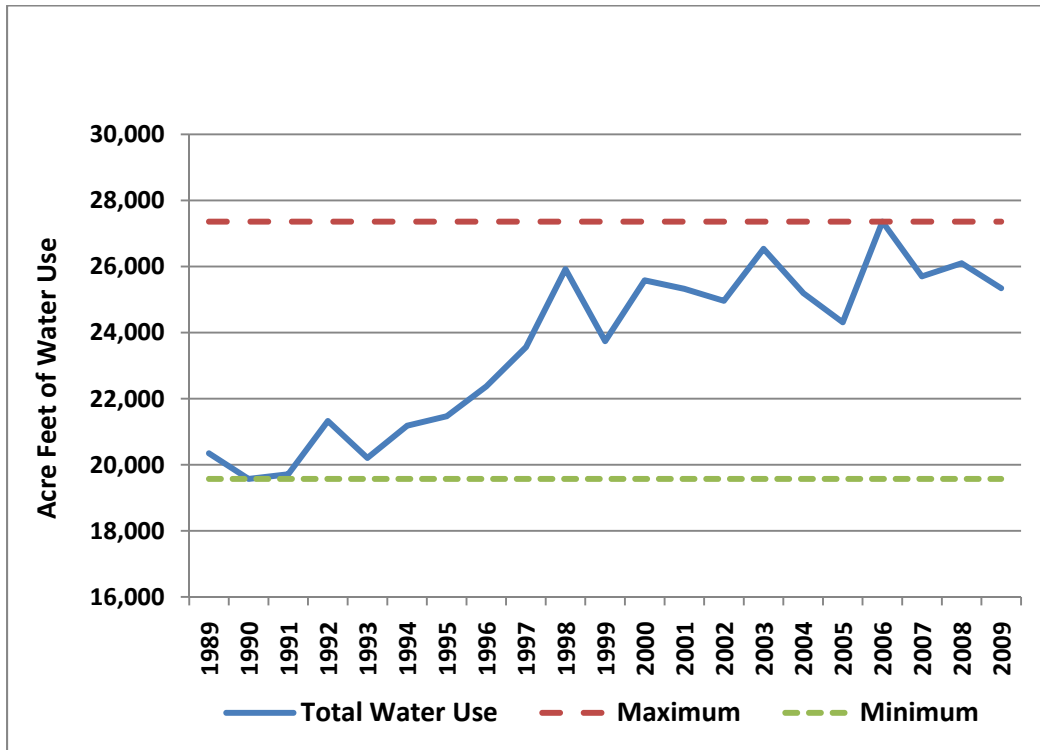


Table 3-5 below summarizes water allocations and actual water usage for all State surface water permits within one mile of Lake Sakakawea.

Table 3-5
Water Allocations and Usage for Surface Water Permits within One Mile of Lake Sakakawea

Users	Permit Count	Average Usage 1989-2009	Permitted Allocation	Usage as a Percent of Allocation
Small Users	115	6,384	30,664	20.8
Large Institutional Users	15	23,612	3,344,589	0.7
Total	130	29,996	3,375,253	0.9

Total average water use by all 130 State permit holders for this period was 29,996 acre-feet per year. The total of 130 State permits compares somewhat closely with the Corps' count of 142 intake easements. Many State water permits contain multiple points of diversion, which could require more than one easement from the Corps, possibly explaining the higher number of Corps intake easements when compared to State water permits. Furthermore, some State surface water

permits for water withdrawals from Lake Sakakawea may be mapped at the end of their pipeline, which could easily be more than 1 mile away from the reservoir, but would still require a Corps easement. These differences may account for some of the discrepancy between the 130 state permit count and the 142 Corps easement count.

Potential water demand for small water users was estimated as follows. Assuming 1) that the 30,664 acre-feet of State water permit allocations for small are distributed evenly across each permit, and 2) that 77% of the State permit holders hold Corps easements that will expire during the 10-year study period, then 23,754 permitted acre-feet of allocations for small users could require surplus water agreements with the Corps within the next ten years.

Actual water use can differ greatly from permitted allowance. Thus, if 77% of these users require new agreements with the Corps there could be 4,945 to 23,754 acre-feet of actual water demand from expiring small easements within the 10-year study period. Given State water policy (prior appropriations doctrine), it is conservatively assumed that expiring small easement holders would choose to exercise surplus water agreements for the full amount of their previous estimated allocations (23,754 acre-feet), rather than reduce their easement requests to more closely match actual water usage (4,945 acre-feet) and “give up” a portion of their water rights under State law. Therefore, 23,754 acre-feet is used as the estimate of future demand from current Lake Sakakawea small water intake easement holders during the 10-year study period. Most, if not all of the intakes for the Three Affiliated Tribes are specifically authorized Bureau of Reclamation projects. Those projects include Mandaree (847 AF/Yr), 4 Bears (1290 AF/Yr), Twin Buttes (484 AF/Yr) and White Shield (1290 AF/Yr). The Tribe is not required to obtain a state water permit and they are allowed to modify these intakes to increase capacity to meet the needs of the Tribes. These intakes are not included in the demand analysis since they are specifically authorized Reclamation projects and do not require an agreement with the Corps.

Potential water demand for large institutional water users was estimated as follows. The large discrepancy between allocation and actual use for this category of users suggests that allocations are not a reliable basis on which to estimate future water use. Only six of the 15 large institutional easement holders have used any water from Lake Sakakawea in the last 21 years (1989-2009). Over this period, usage by these six large institutional easement holders has ranged from under 20,000 acre-feet to 27,362 acre-feet. As discussed previously, Reclamation projects that have been specifically authorized by Congress do not require a water agreement from the Corps, are not considered in the demand analysis. Likewise, the Basin Electric/ Dakota Gasification intake already has a water storage agreement in place so they are not considered in the demand analysis. Given that maximum usage was achieved very recently (2006), it is conservatively assumed that future water demand for the remaining large institutional easement holders over the 10-year planning period is 2,083acre-feet (Table 3-4).

3.3.3 Total Water Supply Demand in the Study Area

Sections 2.8, 3.3.1, and 3.3.2 estimated demand from: 1) existing water users (Section 2.8), 2) the oil and gas industry (Section 3.3.1), and 3) existing Lake Sakakawea water intake easement holders (Section 3.3.2).

Existing water demand in the 11-county area surrounding Lake Sakakawea has been relatively steady over the 21 year period (with the exception of irrigation water) and is not expected to

change significantly over the 10-year study period, resulting in no new net demand for the region.

Water demand from the oil and gas industry has developed at a rapid and accelerating pace since 2008 and is expected to result in an increase in demand ranging from 7,000 acre-feet to 27,000 acre-feet annually for the next 10-11 years, and then decrease abruptly thereafter as the Bakken Formation is fully developed. The upper range of the estimate 27,000 acre-feet annually, has been used in this estimate of surplus water needs for the 10-year study period.

Water demand represented by Lake Sakakawea water intake small easement holders whose easements will expire within the 10-year study period has been estimated to be approximately 23,754 acre-feet per year, and has been used in this estimate of surplus water demand for this group of users.

The maximum water usage by Lake Sakakawea large institutional easement holders that may require agreements is estimated at 2,083 acre-feet per year. These existing and potential users of Lake Sakakawea may require use of surplus water from within the Garrison Dam / Lake Sakakawea Project during the 10-year study period.

The total estimate of water demand within the 11-county Lake Sakakawea study area is presented in Table 3-6. For the reasons stated previously, there is a significant amount of uncertainty associated with this estimate of total demand. Therefore, the Omaha District determined at the initiation of this study to request the authority to identify as surplus 100,000 acre-feet of yield (equivalent to 257,000 acre-feet of storage) to be able to address all Garrison Dam / Lake Sakakawea Project water easement requests that could reasonably be expected to arise over the proposed 10-year study period. Based on the estimate of identified demand of 52,837 acre-feet of water, a surplus declaration of 100,000 acre-feet of yield (equivalent to 257,000 acre-feet of storage) would provide an allowance of 47,163 acre-feet of additional yield that would be available to meet as yet unidentified M&I water demand that could arise during the 10-year study period.

**Table 3-6
Total Estimated Demand for Surplus Water from the Garrison Dam / Lake Sakakawea Project**

Sources of Demand	Demand (acre-feet / year)
Oil and Gas Industry Demand	27,000
Existing Garrison Dam / Lake Sakakawea Easement Holders	
Small Users with Expiring Easements	23,754
Large Institutional Users	2,083
Subtotal - Identified Demand	52,837
Subtotal – Unidentified Demand	47,163
Total Requested Usage / Yield	100,000

3.4 Planning Goals, Objectives, and Constraints

The following discussions identify the planning goals, objectives, and constraints used to formulate and evaluate the Federal interest in entering into agreements for the use of surplus water from the Garrison Dam / Lake Sakakawea Project to meet water supply needs in the planning area over the next 10 years.

3.4.1 Planning Goals and Objectives

The goal of the Surplus Water Report is to determine whether there is surplus water available in the Garrison Dam / Lake Sakakawea Project and to evaluate whether entering into agreements for the use of surplus water from the Project is the most cost effective means of meeting the near-term (10-year) water needs of the study area. The study area is defined as the 11-county area surrounding Lake Sakakawea in western North Dakota.

National water policy states that the primary responsibility for water supply rests with states and local entities, not the Federal government. However, the Corps can participate and cooperate with state and local entities in developing water supplies in connection with the construction, operation, or modification of Federal navigation, flood damage reduction, or multipurpose projects. Specifically, the Corps is authorized to provide storage in new or existing multipurpose reservoirs for municipal and industrial water supply. However, since water supply is a state and local responsibility, the cost of water supply storage and associated facilities in a Corps project must be paid for entirely by a non-Federal entity.

The Secretary of the Army is authorized to make agreements with states, municipalities and other non-Federal entities for the rights to utilize water supply storage in Corps reservoirs. The Secretary of the Army can enter into agreements with states, municipalities, private entities or individuals for the use of 'surplus water'. Under Section 6 of the Flood Control Act of 1944, the Secretary of the Army is authorized to make agreements with states, municipalities, private concerns, or individuals for surplus water that may be available at any Corps reservoir. Surplus water agreements may be for domestic, municipal, and industrial uses.

Planning objectives for this study were developed to be consistent with Federal, State and local laws and policies, and technical, economic, environmental, regional, social, and institutional considerations. The planning objectives were used to help formulate and evaluate plans to avoid, minimize, and mitigate (if necessary), any adverse project impacts to the environment. Planning objectives also provide a decision framework to identify the least cost water supply alternative, avoid adverse social impacts, and meet local preferences to the fullest extent possible.

In pursuit of the project goal, the following Federal planning objectives were established:

- Determine if surplus water is available at the Garrison Dam / Lake Sakakawea Project and determine the storage amount to be evaluated for potential impacts, over the next 10 years
- Anticipate demand and requests for surplus water agreements at the Project over the 10-year study period, including requests identified within this report and a forecast of additional requests.
- Determine repayment unit costs to apply to surplus water agreements

Also in pursuit of the project goal, the following regional planning objectives were established:

- Provide sufficient water to meet the needs of existing and prospective applicants for new surplus water agreements at Garrison Dam / Lake Sakakawea for the next 10 years by the most efficient means;
- Provide sufficient water to meet the needs of current Garrison Dam / Lake Sakakawea water supply users whose existing easements will expire within the next 10 years.

This study develops and evaluates alternatives to determine how best to meet the easement applicants' water needs within the constraints described below. The impacts of entering into agreements for the use of surplus water on other project purposes are assessed so that an optimal alternative that provides needed water supply and does not significantly impact other project purposes may be identified. The impacts assessed in this analysis include effects on: flood control, navigation, irrigation, hydropower, municipal and industrial water supply, fish and wildlife, recreation, water quality, and any associated environmental and economic effects.

3.4.2 Planning Constraints

Planning constraints related to reservoir operations include maintenance of the project's ability to support currently authorized project purposes and to support other incidental uses. Currently authorized project purposes are: flood control, navigation, irrigation, hydropower, municipal and industrial (M&I) water supply, fish and wildlife, recreation, and water quality.

A second planning constraint relates to the requirements of Section 6 of the Flood Control Act of 1944. Under Section 6, the Secretary of the Army is authorized to make agreements with states, municipalities, private concerns, or individuals for surplus water that may be available at any Corps reservoir. The formulation and evaluation of alternative plans is constrained by the limitations imposed by Congress and Corps policy for temporary reallocation of surplus water. These constraints/limitations include:

- No surplus water agreement can adversely affect then existing lawful uses of such water;
- No temporary surplus water agreement can be made for crop irrigation;
- Surplus water agreements can only be granted if the Secretary can classify surplus water as either: 1) water stored that is not required because the authorized use for the water was never developed or if the need for the authorized use was reduced or eliminated by changes in water demand that occurred since authorization or construction of the project; or 2) water that would be more beneficially used as municipal and industrial water than for the authorized project purposes and which, when withdrawn, would not significantly affect authorized purposes over some specified period of time; and
- Temporary surplus water reallocations are time limited and can only be granted for a period of up to 5 years, with a 5-year renewal option (for a total period of 10 years).

3.5 Management Measures

A management measure is a feature (i.e., a structural element that requires construction or assembly on-site), or an activity (i.e., a nonstructural action) that can either work alone or be combined with other management measures to form alternative plans. Management measures were developed to address study area problems and to capitalize upon study area opportunities. Management measures for this study were derived from a variety of sources including prior studies, agency and public input, and the project delivery team (PDT).

3.5.1 Identification of Management Measures

The following management measures were identified for initial consideration:

Structural Measures (Features)

- Structural modifications to the project to increase storage capacity
- Provision of surplus water from sediment and irrigation storage to M&I water supply for up to 10 years, including associated infrastructure (i.e., intakes, pipelines, storage and distribution facilities)
- Groundwater withdrawals, including associated infrastructure
- Surface water withdrawals from the Missouri River upstream of Lake Sakakawea, including associated infrastructure

Non-Structural Measures (Activities)

- Conservation / incentive programs / regulations / public education / drought contingency planning
- Water reuse / recycling
- Temporary State permits to convert irrigation water to industrial use

3.5.2 Screening of Management Measures

The following sub-sections evaluate and screen each of the structural and non-structural measures identified above to determine which measures should be carried forward in the planning process and included in the formulation of alternatives. The Corps of Engineers Principles and Guidelines¹⁶ identifies four criteria to be used in the formulation and evaluation of alternative plans: completeness, effectiveness, efficiency, and acceptability. At this phase of the planning process, management measures are screened, using these four criteria, to determine whether they have the potential to make meaningful contributions to achieving the goals and objectives of the project. While none of these criteria are absolute, it is clearly reasonable to screen out from further consideration any management measure that: 1) does not contribute to meeting study goals and objectives to any significant extent (completeness), 2) is not effective in resolving study area problems and needs (effectiveness), 3) is not an efficient means of solving the problem when compared to other potential measures (efficiency), or 4) is not an acceptable solution to other Federal and non-Federal agencies and affected publics (acceptability).

This is not to imply that some management measures that are screened out from further consideration may not be beneficial public policies or effective solutions to other legitimate problems of the study area. Rather, management measures are screened out from further consideration when it can be reasonably determined that they will not meaningfully contribute to meeting study goals and objectives or resolving the problems and needs that the study was initiated to address.

¹⁶ Economic and Environmental Principles for Water and Related Land Resources Implementation Studies and The Economic and Environmental Guidelines for Water and Related Land Resources Implementation Studies, U.S. Water Resources Council, February 1983

3.5.2.1 Structural Measures

Four structural measures are considered below. Two structural measures are screened out from further consideration (i.e., structural modifications to the project and groundwater withdrawals). Two structural measures are carried forward into formulation of alternative plans: 1) temporary provision of surplus water from Lake Sakakawea, and 2) surface water withdrawals from free-flowing reaches of the Missouri River).

Structural Modifications to the Project to Increase Storage Capacity

Corps of Engineers guidance¹⁷ states that existing Corps projects may be modified to add storage for municipal and industrial water supply. Structural measures to increase the storage capacity of an existing dam typically include: auxiliary spillways, lined overflow sections, raising the dam, modifications to the existing spillway, and combinations of these measures. Environmental criteria that must be assessed when considering structural measures to increase storage capacity include: avoiding adverse impacts to the environment, mitigating any unavoidable environmental impacts, maintaining water quality and ecosystem functions during and after the modification, and achieving no net loss in environmental values and functions.¹⁸

The advantages of structural measures to increase storage capacity is that the needs of municipal and industrial water supply can be met without the negative effects on project users associated with taking water storage away from other authorized project purposes. The disadvantages of structural measures to increase storage capacity is that the studies necessary to design such modifications are lengthy and costly; and construction activities are similarly costly, time consuming, and can have significant impacts on the physical and natural environment. As a result, structural modifications to increase storage capacity are typically only considered when municipal and industrial water needs are so significant relative to total existing storage capacity that the effects of entering into agreements for the use of surplus water from existing storage would render the project unable to meet its authorized project purposes, and where the environmental effects of surplus M&I water use would exceed the environmental effects of structural modifications.

These considerations indicate that structural modifications would not be an effective measure for the Garrison Dam / Lake Sakakawea Project. The amount of water being requested, 100,000 acre-feet/year, is only 0.7 percent of the net system yield of 15.2 million acre-feet. As described in Section 3.7.1, use of this small portion of total system yield will have negligible impacts on current authorized purposes and on environmental conditions at the project, or in upstream or downstream reaches of the Missouri River.

Structural measures to add additional storage at Garrison Dam / Lake Sakakawea are also not efficient given the temporary nature of the industrial water needs of the oil and gas industry. In order to meet Corps design criteria, structural measures would need to be designed and built to last for the remaining design life of the project, which is well in excess of the term of the temporary water needs of the industry.

¹⁷ ER 1105-2-100, Planning Guidance Notebook, 22 April 2000, Paragraph 3-8.a.

¹⁸ EM 1110-2-2300, General Design and Construction Considerations for Earth and Rock-Fill Dams, 30 July 2004

Based on this assessment, structural measures involving modifications to the Garrison Dam / Lake Sakakawea Project to increase storage capacity have been eliminated from further consideration (screened out) for reasons of efficiency, effectiveness, and considerations of adverse effects on the environment.

Groundwater Withdrawals

Water users in North Dakota require a permit from the State for groundwater withdrawals for industrial use, irrigation of more than five acres and domestic or livestock use in excess of 12.5 acre-feet. In executing its permit decision making process, the State closely monitors water usage and impacts on aquifers to protect groundwater resources and avoid damage to critical aquifers. The State of North Dakota has recently completed a detailed study of state water resources that contains its assessment of the ability of groundwater resources to meet the water needs of the oil and gas industry in North Dakota (North Dakota State Water Commission, August 2010). The study is incorporated by reference and the summary conclusion of the assessment of groundwater resources is provided below:

“Groundwater supplies in western North Dakota are limited. Glaciofluvial and other shallow aquifers and the Fox Hills – Hell Creek bedrock aquifer are insufficient to supply the requirements of the B-S-TF play at the proposed rate of development. It is critical that ground-water supplies be conserved for the use and sustenance of towns, homes, local industries, and farms and ranches, after the completion of oil development. As of December of 2009 there were 28 water depots, for a total allocation of 2,340 acre-feet per year serving the oil industry in western North Dakota. Thirty more water permits for water depots are pending, for an additional 5,534 acre-feet per year. Not all of these will likely be approved. Even if all were approved, water supplies from groundwater would fall far short of needs for the B-S-TF play. The only plentiful and dependable supply of water for the oil industry in western North Dakota, at projected rates of extraction, is the Missouri River system, including Lake Sakakawea.” (p. ES-7)¹⁹

Comparisons of total groundwater usage in western North Dakota provided previously in Section 2.7, Existing Water Uses, shows that existing groundwater withdrawals for all uses in the 11-county study area total less than 19,000 acre-feet annually, and are already being stressed. It is unreasonable to expect these limited groundwater resources to meet the water needs of the oil and gas industry, which are expected to exceed total existing groundwater use by over 50 percent (27,000 acre-feet).

Also, North Dakota state water law is based on the doctrine of prior appropriations, which allocates water rights according to the date the Office of the State Engineer receives the permit application (senior rights) and the priority of the water use as established by state law. New applications for significant quantities of groundwater for industrial purposes would be considered subordinate under state water law to more senior water rights. They would also be considered subordinate to higher priority uses, which include domestic, municipal, livestock, and irrigation – the purposes to which the vast majority of the limited groundwater resources of the

19 Water Appropriation Requirements, Current Water Use, & Water Availability for Energy Industries in North Dakota: A 2010 Summary, Response to House Bill 1322, Section 2 of the 61st Legislative Assembly of North Dakota prepared by W. M. Schuh Water Resources Investigation No. 49 North Dakota State Water Commission August 2010

study area are already committed. Priority of use is invoked when competing applications (those filed within 90 days of each other) from the same source are received and that source is insufficient to supply the competing applicants.

Therefore, requests for groundwater permits for the oil and gas industry would only be granted in conditions where enough excess water was available that withdrawals would not affect senior and higher priority appropriations. This is most certainly not the case with western North Dakota's limited and stressed groundwater resources.

Based on this assessment, structural measures involving additional groundwater withdrawals have been eliminated from further consideration (screened out) for reasons of lack of completeness and lack of public acceptability.

Temporary Use of Surplus Water

Temporary use of surplus water in Garrison Dam / Lake Sakakawea Project is considered a structural measure. In order to meet the completeness criterion, this measure includes the necessary investments by non-Federal entities to construct water intakes, pipelines, and water depots necessary to deliver the purchased water to the oil and gas industry.

The four reservoir zones, as described in Section 2.5 and displayed in Figure 2-3, are: the permanent pool, the carryover multiple use zone, the annual flood control and multiple use zone, and the exclusive flood control zone.

At Lake Sakakawea the permanent pool provides 5.15 million acre foot (MAF) of storage. Storage within this zone is the minimum necessary to maintain project operations (sediment storage) and to meet minimum head requirements needed to support hydropower operations. As described in section 3.2 of this report the current sediment deposition rate is less than the expected sediment deposition rate.

Above the permanent pool is the 13.1 MAF carryover multiple use zone. This intermediate zone provides a storage reserve for irrigation, navigation, power production, and other beneficial conservation uses. This zone also provides carryover storage for maintaining downstream flows through a succession of years in which runoff is below normal. Similar to the Fort Peck and Oahe Projects, storage originally planned for the irrigation purpose has not been fully utilized since the project was placed in operation, which has enabled the mainstem system to provide additional benefits to other authorized project purposes in extended droughts. As shown in this report, the mainstem system will continue to provide substantially for this additional benefit even with a water surplus determination of 100,000 acre-feet.

The third zone is the 4.2 MAF annual flood control and multiple use zone. This is the desired operating zone. Water stored in this zone is normally evacuated by March 1 of each year to provide adequate storage capacity for the flood season. During the flood period, water is impounded in this zone as required. Because of the annual operational fluctuations of water levels in this zone it is not considered a reliable source of water to meet M&I water needs on a consistent basis throughout the year, however this zone, together with the other operational zones of the reservoir, have the capability to provide 100,000 acre-feet of surplus water for Municipal and Industrial purposes on a temporary basis without unreasonably impairing the efficiency of the reservoirs other purposes.

Finally, the fourth zone, or exclusive flood control zone, consists of 1.5 MAF of storage between elevations 1850.0 and 1854.0 feet msl. This zone is used only during periods of extreme floods and is evacuated as soon as downstream conditions permit. For this reason, water is very infrequently stored in this zone and so does not contain surplus water except under the most extreme and infrequent, conditions. However, to the extent surplus water withdrawals are made during the evacuation period from this zone for municipal and industrial needs it does represent a source of surplus water during that time period.

The temporary use of surplus water in the foregoing zones can be scaled to meet the entire water needs of the oil and gas industry, and so fully meets the effectiveness criterion.

The costs of surplus water to the industry will include the prorated share of updated project costs, plus the full cost of all necessary infrastructure investments on and off project lands. These costs, when compared to the costs of purchasing water from multiple locations that are more distant from the oil and gas industry, may prove to be the most cost effective means of achieving project objectives, and is therefore tentatively considered to meet the efficiency criterion, subject to more detailed analysis in the comparison of alternative plans.

Provision of water from Lake Sakakawea is the preferred alternative of the State of North Dakota (as stated in public documents), the oil and gas industry (as evidenced by easement applications and state permit requests), and many members of the general public in North Dakota (as expressed in news publications). Therefore, it is tentatively considered to meet the criterion of acceptability, subject to further analysis.

Consistent with the criteria of completeness, effectiveness, efficiency, and acceptability, the structural measure of temporary use of surplus water in the Garrison Dam / Lake Sakakawea Project is carried forward for further consideration into the formulation of alternative plans.

Surface Water Withdrawals From Free-Flowing Reaches Of The Missouri River

Withdrawal of water from the surface waters of North Dakota to serve the needs of the oil and gas industry is a potentially viable structural measure. The State of North Dakota recognizes this potential in its analysis of water availability for the oil and gas industry²⁰:

“Surface-Water Storage and Use

Except for the Missouri River system, most of the state’s surface waters are heavily appropriated and are not good prospects for large-scale long-term sustainable water supplies. For many of the state’s rivers, however, there are seasonal flows that are not being captured and used. With appropriate capture and storage these waters could be retained and used. Possible storage techniques would include surface storage and aquifer recharge and recovery.” (p. ES-16)

A sovereign lands permit is required from the state for withdrawals from free-flowing reaches of the Missouri River. If channel alterations are necessary, then a regulatory permit must also be obtained from the Corps of Engineers. However, no surplus water agreement is required from the Corps of Engineers for water obtained from river reaches not contained within a Corps reservoir or on Corps project lands, provided the Corps does not operate the system to meet the

²⁰ W. M. Shuh, op.cit.

needs of the intake. Water allocation decisions for free-flowing river reaches within North Dakota, depending on the scope of such a withdrawal, are generally under the purview of the State or the Three Affiliated Tribes. The State of North Dakota has identified the Missouri River as the best available source of water for the oil and gas industry (after Lake Sakakawea).

An example of a proposal to provide water from a free-flowing reach of the Missouri River upstream of Lake Sakakawea is collaboration of northwest North Dakota water stakeholders (including the BDW Rural Water District, the City of Crosby, the McKenzie County Commission, the McKenzie County Water Resources District, R&T Water Supply Association, the Williams Rural Water District, and the City of Williston). This group has developed a regional water development plan that proposes delivery of Missouri River water from the Williston Regional Water Treatment Plant to the northwest North Dakota region. This plan includes a series of water supply and transmission infrastructure projects which could provide up to 11,200 acre-feet of water for regional water demands, principally focusing on the water needs of the oil and gas industry.²¹ The Williston project, as proposed, would be a shallow groundwater array that would be constructed adjacent to the Missouri River in the alluvium. While this depletion would not be from an intake in the Missouri River surface water and the withdrawal would be off Corps lands, the water would be immediately hydrologically connected to the river. The project would replace the existing intake with a possible horizontal collector well (20 MGD). Horizontal collector wells incorporate a vertical shaft, but then utilize horizontal screen laterals to collect and filter the groundwater. Typically, they are installed close to a dependable surface water source (i.e., the Missouri River), and these wells take advantage of a natural filtering process called Riverbank Infiltration (RBI). For this reason, the State does not consider the request with a groundwater evaluation since it would not be from a surficial groundwater aquifer. The withdrawal would result in a depletion to the Missouri River and is considered as such.

Evaluation of this proposal has determined that it includes all the necessary investments by non-Federal entities to construct water intakes, pipelines, and water depots necessary to deliver the purchased water to the oil and gas industry, and therefore meets the completeness criterion.

This measure can be scaled upwards to meet a significant portion of the water needs of the oil and gas industry, and so at least partially meets the effectiveness criterion.

The cost estimate presented in this collaborative proposal includes estimates of the full cost of all necessary infrastructure investments necessary to extract, transmit, store, and distribute water extracted from the Missouri River. These costs, when compared to the costs of surplus water from the Garrison Dam / Lake Sakakawea Project, may prove to be a cost effective means of achieving study objectives, and is therefore tentatively considered to meet the efficiency criterion, subject to more detailed analysis in the comparison of alternative plans.

Provision of water from the Missouri River is the second-most preferred alternative of the State of North Dakota (as stated in public documents) if temporary use of surplus water from Lake Sakakawea is not available. The oil and gas industry (as evidenced by easement applications and state permit requests) and many members of the public (as expressed in the referenced letter to

²¹ Letter to Honorable John Hoeven, Governor of North Dakota, RE: Northwest North Dakota Water Development & Management Plan, June 30, 2010, signed by the President, McKenzie County Water Resource District; President, R&T Water Supply Association; President, Williams Rural Water District; and Mayor, City of Williston.

the Governor of North Dakota) also consider this to be a potentially feasible alternative. Therefore, it is tentatively considered to meet the criterion of acceptability.

Consistent with the criteria of completeness, effectiveness, efficiency, and acceptability, the structural measure of withdrawal of surface waters from free-flowing reaches of the Missouri River is carried forward for further consideration into the formulation of alternative plans.

3.5.2.2 Non-Structural Measures (Activities)

Three non-structural measures are considered below. Two non-structural measures are screened out from further consideration (i.e., conservation / incentive programs and water reuse / recycling). One non-structural measure is carried forward into formulation of alternative plans (i.e., temporary State permits to convert irrigation water to industrial use).

Conservation / Incentive Programs / Regulations / Public Education / Drought Contingency Planning

Water conservation, incentive programs, regulations, public education, and drought contingency planning are not viable options for reducing the water demands of the oil and gas industry in western North Dakota. Water reuse / recycling programs are being explored as water reducing options for the industry and are addressed in the next non-structural measure.

As described previously, extracting oil from the Bakken Formation is an extremely water intensive activity, requiring between 2.6 and 13.2 acre-feet of water per well for hydrofracing, casing, de-brining and other maintenance activities. The cost of only the water required to develop a well ranges from over \$10,000 to over \$100,000 per well²². Recently, average water requirements per well have been increasing due to new drilling technologies.

These technologies allow for horizontal drilling that greatly increases the productivity of oil wells. The value of the increased oil production more than offsets the increased water (and other production) costs, resulting in increasing industry water demand. Industry efforts to reduce water demands have focused on recycling and reuse efforts, since there is currently no practical conservation method for decreasing water use while still employing the hydrofracing technology that makes extraction of oil from the Bakken Formation economically viable. Incentives work in the opposite direction of increasing (not decreasing) water use, since new drilling technologies require more water per well (not less), and produce significantly greater economic returns, even considering the high cost of water needed for well production. Similarly, State regulatory efforts have been directed towards increasing, not decreasing, water availability to the oil and gas industry, through temporary State permits allowing industrial use of irrigation water (see temporary State water permits for industrial usage - the third non-structural measure described below).

The current estimate of the total water demands of the oil and gas industry (27,000 acre-feet) is nearly one third of the total water usage in the 11-county study area (97,000 acre-feet) and nearly three times the historic average of all industrial users (10,000 acre-feet). Given the significant amounts of industrial water required relative to total supply, water conservation, incentive programs, regulations, public education, and drought contingency planning measures simply

²² Estimate based on range of reported sales costs by ND water providers of \$0.50-\$1.05 per barrel, multiplied by 2.6-13.2 acre feet of water per well (as estimated in Section 3.3.1).

cannot successfully reduce usage to any meaningful degree necessary to meet the effectiveness criterion.

The State of North Dakota recognizes the vital economic importance of the oil and gas industry to the State's economy. A 2009 study²³ of the economic impact of the oil and gas industry by the North Dakota Petroleum Council calculated that North Dakota's oil and gas industry generated \$8.22 billion in total business activity for 2007; \$3.1 billion in direct impacts, and \$5.1 billion in secondary impacts. The industry paid \$520 million in state and local taxes and provided direct employment for 7,719 people and indirect employment for nearly 38,500 people, making it one of the state's largest industries. According to a study by PricewaterhouseCoopers, the oil and gas industry directly and indirectly supported 5.7% of the State's employment, contributed 7.6% of the State's labor income, and represented 9.6% of the value added contribution to the State's economy.²⁴ As a direct result of the oil and gas industry, North Dakota has one of the lowest unemployment rates in the U.S. (3% in September, 2010), and is one of the few states with a significant budget surplus (\$800 million anticipated for 2010).

For these reasons, any non-structural measure predicated on reducing water consumption by the industry (other than through water reuse / recycling) will also reduce industry productivity and the economic benefits the industry provides to the State of North Dakota. Therefore, this measure does not meet the acceptability criterion.

For reasons of lack of completeness, effectiveness, efficiency, and acceptability, water conservation, incentive programs, regulations, public education, and drought contingency planning measures are eliminated (screened out) from further consideration in the formulation of alternative plans.

Water Reuse / Recycling

The potential for water reuse / recycling in the oil and gas industry is being actively evaluated by the industry and government / public partnerships. The Energy & Environmental Research Center (EERC) of the University of North Dakota (Grand Forks) has entered into a partnership with the U.S. Department of Energy (DOE) and key energy-producing entities in the northern Great Plains to identify and evaluate opportunities for water reuse and recycling in the oil and gas industry. The purpose of the partnership is:

“...to address issues related to water availability, reducing freshwater use, and minimizing the impacts of facility and industry operations on water quality. The key goals of this partnership, called the Northern Great Plains Water Consortium (NGPWC), are:

- *To evaluate water demand and consumption from competing users in the northern Great Plains region, including energy production, agriculture, industry, and domestic/municipal users.*
- *To assess, develop, and demonstrate technologies and methodologies that minimize water use and reduce wastewater discharge from energy production and agricultural processing facilities.*

²³ North Dakota Petroleum Council's 2007 Economic Impact Study, Ron Ness, February 20, 2009

²⁴ The Economic Impacts of the Oil and Natural Gas Industry on the U.S. Economy: Employment, Labor Income and Value Added, PricewaterhouseCoopers prepared for the American Petroleum Institute, September 8, 2009

- *To identify nontraditional water supply sources and innovative options for water reuse.”²⁵*

Potential opportunities for reuse or recycling in the oil and gas industry include using waste water from other industries as frac water in the drilling process, or alternatively recycling frac waste water (called ‘produced water’ or ‘flowback’ water) for use in other industries. Research is currently underway by the EERC, with sponsorship from U.S. DOE, the North Dakota Petroleum Council, and the North Dakota Industrial Commission Oil & Gas Research Council to assess the economic potential to recycle flowback water for reuse in the Bakken Formation²⁶.

Research activities include: inventorying industry freshwater use, assessing the water quality of flowback water, evaluating water handling costs, evaluating the technical and economic feasibility of recycling and reuse technologies, and making recommendations regarding potential recycling and reuse opportunities in the industry. Preliminary results to date indicate water recovery rates of flowback water of less than 50% in the first 10 days, with extremely high salinity levels, and lower but still significant levels of calcium, potassium, and sulfate. Preliminary study results show significant challenges to extensive application of recycling and reuse in the oil and gas industry due to slow flowback rates, low initial recovery volumes, extremely high dissolved salt levels, and challenging treatment technologies – all of which result in limited cost effectiveness for frac water recycling / reuse at this stage of treatment technology development.

Various pilot recycling projects for flowback water and recovering fracing fluids have been initiated in the Barnett Shale play in Texas²⁷. To date, none of these pilot projects have proven to be economically feasible, and significant technical issues remain in ensuring the recycled water is reusable for future well fracing.

A potentially more economically feasible recycling / reuse application at this phase of technological development could involve treatment and use of non-potable groundwater for well fracing (rather than recycling and reuse of frac / produced water). This alternative has perhaps greater near-term potential due to the relative abundance of non-potable groundwater and lack of competing demand. Its viability for use in oil and gas production requires additional analysis and research and will be in large part determined by the costs of pre-treatment (water for fracing must meet certain water quality standards to not damage well production equipment or cause difficulties in the oil extraction process), as well as the relative cost of other available sources of fracing water.

Unresolved issues related to the technological feasibility of recycling / reuse of flowback water renders it an incomplete solution to meeting the near-term water needs of the oil and gas industry.

Effectiveness is also suspect at this stage of technological development. Slow flowback rates and low initial recovery volumes limit the quantity of water that would be available for reuse, and therefore reduce its ability to meet a significant portion of industry water requirements.

²⁵ EERC Fact Sheet BK32526.INDD, Final Draft 11/08, www.ndoil.org/image/cache/Water_Assessment.pdf

²⁶ Bakken Water Opportunities Assessment, Northern Great Plains Water Consortium (NGPWC), Presentation by EERC to the North Dakota Petroleum Council Annual Meeting, September 2009

²⁷ Water Use in the Barnett Shale, Railroad Commission of Texas, 10/11/10, op. cit.

The most significant factor limiting recycling / reuse as a viable non-structural measure at this time is effectiveness. None of the reported pilot projects have been found to be economically viable to date, and all have been abandoned after the initial pilot project (i.e., subsidized) stage. Use of non-potable groundwater may hold some future promise, but additional research is required to identify the conditions (water quality, location, pre-treatment requirements) necessary to determine whether - and to what extent - this measure could meet a significant portion of industry water needs.

Recycling / reuse meets the criteria of public acceptability, as government, various industry stakeholders, and the general public appear to strongly support efforts to reduce the competition of the oil and gas industry for scarce water resources through recycling and reuse of produced water, as well as to minimize potential for environmental degradation by reducing the total volume of produced water in the waste stream.

Recycling / reuse of water as a non-structural measure to meet the water demands of the oil and gas industry does hold some future promise, but does not meet evaluation criteria for a technologically feasible and economically viable measure for meeting the near-term (10-11 year) water needs of the industry. Effectiveness (i.e., the extent of industry demand met by this measure) also cannot be demonstrated until technical and economic issues are better understood. For these reasons, recycling / reuse are eliminated (screened out) from further consideration in the formulation of alternative plans.

Temporary State Permits to Convert Irrigation Water to Industrial Use

The North Dakota State Water Commission is currently granting temporary water permits to holders of existing irrigation water permits to use their water for industrial purposes, allowing farmers to sell their irrigation water to the oil and gas industry.

“To facilitate more efficient distribution of water for the oil industry, the State Engineer has developed a new policy granting temporary authorization for holders of existing irrigation water permits to use water for industrial purposes...If significant problems persist with the efficient distribution of water for oil field use, the State Engineer will consider continuing this policy beyond 2011 on a year-by-year basis.”²⁸

Unless the permit holder’s allocation is from the Missouri River or Lake Sakakawea, sale of irrigation water is currently limited to approximately 100% of the permit holder’s average annual use (not their total allocation), in order to guarantee no net increase in the quantity of the water withdrawn from groundwater or highly allocated surface water sources by the permit holder. State permit holders for irrigation withdrawals from Lake Sakakawea or the Missouri River may sell their entire allocation, irrespective of past use levels.

The average annual usage limit is applied to all non-Missouri River / Lake Sakakawea irrigation State permit holders in an effort to mitigate for potential losses of water from the overall aquifer system as well as protect from severe groundwater overdraft. This is because there is some percolation and aquifer recharge when water is used for irrigation. However, when that water is transferred from irrigation to industrial use, the percolation and aquifer recharge is eliminated,

28 Policy for Obtaining a Temporary Water Permit for Industrial Usage, In Lieu of Irrigation, North Dakota State Water Commission, September 2010

resulting in a net increase in water "use", or net decrease in aquifer water availability. The uncertainty regarding percolation and aquifer recharge is another factor that contributes to the tenuous estimate of the total volume of water from this measure that will be available for industrial use.

These temporary State permits to convert irrigation water to industrial use are only granted for the calendar year (January 1 – December 31) in which the permit is issued. No permanent industrial water right is created by the State's issuance of a temporary water permit, and the temporary permits are not guaranteed to be reissued in the following year. All temporary State permits to convert irrigation water to industrial use require installation of meters on discharge pipes and annual reporting to the State of the quantity of irrigation water sold to industry by each permit holder.

It is difficult to estimate the total amount of oil and gas industry water demand that can be met over the next 10 years through this non-structural measure, because: temporary industrial water permit requests are initiated by the individual irrigation permit holder; this is a new State policy without historic usage data; and continuation of the program and reissuance of temporary State permits are not guaranteed from year to year. However, since this State program is underway and water is currently being sold from irrigation to industrial use, this non-structural measure meets the criteria of completeness.

Effectiveness (i.e., the proportion of the need that can be met through this measure) is very hard to determine this early in the implementation phase of the new State policy, but at this stage of the temporary program appears to be relatively low. A total of 391.7 acre-feet of State permits were approved by the State for irrigation to industrial water conversions for 2010 (1.5% of the 27,000 acre-feet of oil and gas industry requirements). A total of 526.6 acre-feet of State permits have been approved thus far for conversions for 2011 (2.0% of 27,000 acre-feet). Average State permit size for 2010/2011 is 106.35 acre-feet.

This measure appears to be efficient, as evidenced by the fact that water providers to the oil and gas industry are purchasing irrigation water from the temporary State permit holders in lieu of buying water from other available sources. State permit holders are not required to report the price at which they sell their water to the industry so only anecdotal information is available, which indicates a selling price of \$0.02/gallon (\$0.84/barrel). This compares favorably to the price of water purchased by the industry from water depots, which ranges from \$0.50/barrel to \$1.05/barrel, depending on the water depot and the purchaser.

This measure also appears to meet the criterion of acceptability, since there are willing sellers, willing buyers, State permit approvals, and a lack of public opposition within North Dakota to the practice thus far.

Temporary State permits to convert irrigation water to industrial use by the oil and gas industry is a non-structural measure that meets the criteria of completeness, efficiency, and acceptability, and to a much lesser (but somewhat unknown) degree, effectiveness. For these reasons, this non-structural measure is carried forward into the formulation of alternative plans. However, because of its low (and unreliable) effectiveness, it will only be considered in combination with other measures and cannot function as a stand-alone alternative.

3.6 Most Likely Future Without Project Condition

The most likely future without project condition (No Action) consists of a combination of the structural and non-structural measures that survived the screening process described above, with the exception of the proposed action (use of surplus water in the Garrison Dam / Lake Sakakawea Project). The future without project condition consists of a combination of the following measures anticipated to be used to meet existing water needs, as well as the growing municipal and industrial (M&I) water demands of the study area:

- surface water withdrawals from free-flowing reaches of the Missouri River up-stream of the Garrison Dam / Lake Sakakawea Project
- temporary State permits to convert irrigation water to industrial use, and
- continuation of existing Garrison Dam / Lake Sakakawea intake easements.

Water demand from the oil and gas industry is highly decentralized, as is decision making, with each individual oil producer making their own decision about where to get the water needed to develop their well. Thousands of these discrete decisions are made by scores of oil producers in any given year. Obviously it is not possible to predict the outcomes of each of these decisions individually. Because they are profit maximizing producers however, oil and gas companies typically choose the least costly water source that will provide them the required volume and quality of water they need for well production, so long as the water can be delivered reliably (i.e., in the quantities needed, when needed). For this reason, the most likely future without project condition (No Action) is defined as the least costly combination of feasible measures for providing the quantity of water sufficient to meet the demands of the oil and gas industry from the multiple water sources currently available, excluding Lake Sakakawea.

3.7 Alternatives Studied in Detail

The alternatives studied in detail include the No Action (Next Least Costly Alternative) and the Proposed Action. For comparison purposes, both alternatives describe the most likely means of providing 100,000 acre feet of water to meet the current and future water needs of the study area. The No Action is a combination of:

- development of new, non-Project water sources (e.g., expansion of the Williston Regional Water Treatment Plant),
- continued use of existing Garrison Dam / Lake Sakakawea M&I water easements
- temporary State permits to convert irrigation water to industrial use, and
- continued use of existing water depots.

The Proposed Action includes temporary use of 100,000 acre-feet/year of surplus water in the Garrison Dam / Lake Sakakawea Project. The Proposed Action also includes the infrastructure development required to access the surplus water. Table 3-7 summarizes the sources of demand for both without project (no action – next least costly) and with project (proposed action) conditions.

**Table 3-7
Water Demand for Without and With Project Conditions**

Sources of Water Demand	Without Project Condition (acre-feet)	With Project Condition (acre-feet)
Small GD/LS Water Users with Expiring Easements	23,754	23,754
Large Institutional GD/LS Water Users	2,083	2,083
Subtotal GD/LS Easement Water Use	25,837	25,837
Oil & Gas Industry Demand	27,000	27,000
Remaining Unidentified Future Users Demand	47,163	47,163
Subtotal Additional Water Use	74,163	74,163
Total Required Yield	100,000	100,000

Under both without and with project conditions it is expected that existing Garrison Dam / Lake Sakakawea M&I water users will continue to withdraw water from the Project to meet their current water needs. The only difference between without and with project conditions for these users (and the only reason Project M&I water users' water needs are quantified in the analysis) is that an administrative action may be required under with project conditions to execute surplus water agreements or water storage agreements with these users, pursuant to policy. These users represent 25,837 acre-feet of the 100,000 acre-feet of water yield evaluated in this analysis.

The remaining 74,163 of the 100,000 acre-feet/year of water needs evaluated in this analysis is for the oil and gas industry and other (as yet unidentified) M&I water uses that may arise over the 10-year study period. Oil and gas industry demand was previously estimated to be 27,000 acre-feet of water per year over the 10-year study period. The remaining 47,163 acre-feet of water will be reserved to meet potential demand from prospective future users during the 10-year study period.

3.7.1 No Action Alternative (Next Least Costly Alternative)

As stated in the previous section, 25,837 acre-feet of the 100,000 acre-feet/year of water yield evaluated in this analysis will still come from existing intake easements at the Garrison Dam / Lake Sakakawea Project under the no action alternative. Water sources to meet the remaining 74,163 acre-feet of water needs in the no action / without project future condition include:

- Temporary State permits to convert irrigation water to industrial use
- Existing water depots
- Missouri River - Williston, ND Treatment Plant Expansion
- Missouri River – Other sources

The acre-feet of water estimated to be obtained from each of these sources is summarized in Table 3-8. Following the summary table, subsequent tables display the water obtained from each source, sub-divided into water obtained from groundwater and surface water sources. Surface

water sources are further sub-divided into waters obtained from free-flowing reaches of the Missouri River, water obtained from the Garrison Dam / Lake Sakakawea Project, and water obtained from other (non-Missouri River) surface sources.

**Table 3-8
Water Sources – No Action Alternative**

No Action Alternative Water Sources	Acre-Feet
Temporary State permits to convert irrigation water to industrial use	527
Water Depots	5,813
Missouri River - Williston Treatment Plant Expansion	11,200
Missouri River - Other unidentified sources	56,623
Total Supply	74,163

3.7.1.1 Temporary State Permits to Convert Irrigation Water to Industrial Use

The process for obtaining temporary State permits to convert irrigation water to industrial use is discussed in Section 3.4.2.2 Non-Structural Measures. It is estimated that 527 acre-feet of demand can be met through these agricultural to industrial water conversions, based on 2011 conversion application approvals granted by the State of North Dakota. To date, all conversions have been from ground water sources (Table 3-9). Table 3-10 provides additional detail on all conversions that had been approved as of the time this Surplus Water Report was prepared.

**Table 3-9
Sources Of Water For Temporary State Permits to Convert Irrigation Water to Industrial Use**

Source	Acre-Feet
From Ground Water	527
From Surface Water	0
From Missouri River	0
From GD/LS Existing Intakes	0
From free-flowing reaches of Missouri River	0
From other surface waters	0
Total All Sources	527

Table 3-10
Temporary State Permits to Convert Irrigation Water to Industrial Use
(2010 and 2011)

Aquifer Source	Acre-feet	Year
Tobacco Garden	151	2010
Tobacco Garden	128	2010
Little Muddy	45.2	2010
Little Muddy	67.5	2010
Total - 2010	391.7	2010
West Wildrose	111.8	2011
Little Muddy	113.5	2011
Little Muddy	89	2011
Hofflund	114.8	2011
Little Muddy	67.5	2011
Total - 2011	526.6	2011

3.7.1.2 Water Depots

It is estimated that 5,813 acre-feet of water demand can be met from existing water depots. This estimate is based on permitted allocations, as shown in Table 3-11 which displays the total volume of water, by source, for water depots in the study area.

Table 3-11
Sources of Water for Water Depots

Source	Acre-Feet
From Ground Water	3,384
From Surface Water	2,429
From Missouri River	2,300
From GD/LS Existing Intakes	2,300
From free-flowing reaches of Missouri River	0
From other surface waters	129
Total, all Sources	5,813

There are currently 38 groundwater depots and 4 surface water depots operating in the study area. The number of water depots and acre-feet of allocations, by county, are shown in Table 3-12. There are no permitted water depots in four of the study area's eleven counties: Bottineau, Stark, Burke, and Ward.

**Table 3-12
Permitted Water Depots in Northwest North Dakota**

County	Acre-Feet Permits	Groundwater	Surface Water	Total
Mountrail	Acre-Feet	932	1,170	2,102
	# Depots	11	2	13
Mercer	Acre-Feet	0	1,130	1,130
	# Depots	0	1	1
Dunn	Acre-Feet	902	0	902
	# Depots	10	0	10
Williams	Acre-Feet	770	0	770
	# Depots	6	0	6
McKenzie	Acre-Feet	440	129	569
	# Depots	7	1	8
McLean	Acre-Feet	250	0	250
	# Depots	1	0	1
Divide	Acre-Feet	90	0	90
	# Depots	3	0	3
Total Acre-Feet		3,384	2,429	5,813
Total Water Depots		38	4	42

3.7.1.3 Missouri River - Williston Treatment Plant Capacity Upgrade

One component of the No Action Alternative is the Williston Regional Water Treatment Plant capacity upgrade. The Williston Treatment Plant obtains water from intakes on a free-flowing reach of the Missouri River upstream from Lake Sakakawea. The proposed capacity upgrade would increase plant capacity from the current 10 MGD to 20 MGD. The upgrade would provide the equivalent of 11,200 acre feet per year. The expansion would be conducted in two phases. The first phase would be an upgrade to 14 MGD, which would take approximately two years to complete. The second phase would bring plant capacity to 20 MGD and would take an additional two years to complete. The expansion to 20 MGD would be supported by a new set of horizontal wells, which would source water from the Missouri River Alluvium. The source of water for the Williston Treatment Plant Capacity Upgrade is shown in Table 3-13.

Table 3-13
Sources of Water for Williston Treatment Plant Capacity Upgrade

Source	Acre-Feet
From Ground Water	0
From Surface Water	11,200
From Missouri River	11,200
From GD/LS Existing Intakes	0
From free-flowing reaches of Missouri River	11,200
From other surface waters	0
Total, all Sources	11,200

The estimated cost of the Williston Regional Water Treatment Plant upgrade is \$45 million (Table 3-14). The costs for the Williston Regional Water Treatment Plant upgrade do not include the costs of pipeline transmission to various towns and rural water districts throughout the northwest counties of North Dakota. The additional costs of pipelines, reservoirs, and other transmission infrastructure, which would not necessarily be in service to the oil and gas industry, total more than \$80 million.

Table 3-14
Williston Regional Water Treatment Plant Capacity Upgrade Cost

Project	Start Date	End Date	Cost ²⁹
Upgrade existing treatment plant to 14 MGD	01/01/2011	12/31/2012	\$5,000,000
Upgrade treatment plant capacity to 20 MGD	01/01/2012	12/31/2013	\$25,000,000
Replace existing intake with horizontal collector well	01/01/2012	01/01/2014	\$15,000,000
Total Cost			\$45,000,000

²⁹ Source: Northwest North Dakota Oil Country Water Systems Proposed Projects, an attachment to a letter to Governor Hoeven from regional water stakeholder leaders dated 30 June 2010.

3.7.1.4 Missouri River – Other Sources

The previous paragraphs have identified and described sources of water that will be available under without project conditions to meet the 100,000 acre-feet/year of water needs evaluated in this study. Existing easements within the Garrison Dam / Lake Sakakawea Project providing 25,837 acre-feet of yield are assumed to remain available under without project conditions. Of the remaining 74,163 acre-feet of water requirements, 17,540 acre-feet will be provided by a combination of temporary state permits to convert irrigation water to industrial use, existing water depots, and the planned Williston Treatment Plant Capacity Expansion. This leaves a remaining 56,623 acre-feet of water that must be obtained from other sources under without project conditions to provide a valid comparison to the proposed action.

As discussed previously in this report, the State of North Dakota has conducted detailed evaluations of water availability in western North Dakota and has identified that groundwater sources and surface waters other than the Missouri River are nearly fully allocated and are not capable of providing the significant quantities of water needed to meet the growing industrial water needs in the state. The North Dakota State Water Commission has been directing applicants for state water permits to the Missouri River and the Garrison Dam / Lake Sakakawea Project as the only remaining sources of significant quantities of available water in the state. Because new allocations from the Garrison Dam / Lake Sakakawea Project are not available under the no action condition, the Missouri River remains the only viable source of providing the remaining 56,623 acre-feet of water.

Withdrawing water from free-flowing reaches of the Missouri River does not require a Corps of Engineers easement. Withdrawals from the free-flowing reaches of the Missouri River require either a State water permit, or a permit from the Three Affiliated Tribes for any intakes located on tribal lands.

Lake Sakakawea bisects the portion of the Missouri River that flows through North Dakota. Due to the size of the Lake, the reaches of the river that are upstream and downstream of the Lake are over 100 miles apart. As such they are analyzed separately below.

State Water Permits - Upstream Missouri River

Existing ND State water permits for withdrawals from the free-flowing reaches of the Missouri River upstream of Lake Sakakawea are summarized in Table 3-15. This shows that there is an average excess capacity of 71,544 acre-feet in unused state allocations to existing permit holders in the Missouri River upstream of Lake Sakakawea. New permit applications have also been received, which total an additional 11,950 acre-feet.

Table 3-15
North Dakota State Water Permits for Missouri River Withdrawals - Upstream

Upstream	Permit Count	Acre-Feet	Average Use 1989-2009	Utilization Rate	Max Use 1965-2009	Maximum Rate	Average Excess Capacity
Permits							
City of Williston	1	40,325	2,376	6%	3,121	8%	37,949
Buford-Trenton Irrigation District	1	44,000	14,392	33%	44,384	101%	29,608
Others	36	6,527	2,540	39%	5,522	85%	3,987
Total Permits	38	90,852	19,308	21%	53,027	58%	71,544
Total Applications*	3	11,950	-	-	-	-	11,950

*Includes applications for water depots only, not other uses

State Water Permits - Downstream Missouri River

This reach consists of the portion of the Missouri River south of Garrison Dam within Mercer and McLean Counties. Data for reaches further south may be attainable; however, their relevance decreases significantly proportional to their distance further south and east of the Bakken Formation. Any permits further downstream would be at least 50 miles from the closest oilfield, and as such, would not be good candidates for supplying water to the oil and gas industry. Along this reach there are thirty-seven (37) active water permits, as shown in Table 3-16. This shows that there is an average excess capacity of 29,612 acre-feet in unused state allocations to existing permit holders in the Missouri River downstream of Lake Sakakawea.

Table 3-16
North Dakota State Water Permits for Missouri River Withdrawals - Downstream

Downstream	Permit Count	Acre-Feet	Average Use 1989-2009	Utilization Rate	Max Use 1965-2009	Maximum Rate	Average Excess Capacity
Permits*							
Great River Energy	1	15,000	12,547	84%	15,997	107%	2,453
Otter Tail Power Company	1	11,000	4,459	41%	6,972	63%	6,541
Bureau of Reclamation	1	8,600	898	10%	11,000	128%	7,702
Others	34	15,415	2,499	16%	7,818	51%	12,916
Total Permits	37	50,015	20,403	41%	41,787	84%	29,612
Total Applications	0						0

*Includes data from Mercer & McLean Counties only

The 37 active water permits are for a total of 50,015 acre-feet; 34,600 acre-feet from three permits: Great River Energy (15,000), Otter Tail Power Company (11,000), and the Bureau of Reclamation (8,600). The remaining 34 downstream permits total 15,415 acre feet. There are no pending permit applications for new water depots along this reach of the Missouri river. On average, small permit holders utilize 16% of their allocations, though they have used up to 51% in a single year. Great River Energy has used 84% on average and 107% at maximum. The Otter Tail Power Company has used 41% on average and 63% at maximum. The Bureau of Reclamation has used 10% on average and 128% at maximum. All of these figures are for consumptive use only. On average there are excess allowances of 2,453 at Great River, 6,541 at Otter Tail, 7,702 at the Bureau of Reclamation and 12,916 from other users. All of these sources are at least 25 miles from the closest oilfield and at least 50 miles from the primary areas of oilfield development. As such, they are not ideal candidates for supplying water to the oil & gas industry.

State Water Permits – Missouri River Total

There are 84,253 acre-feet of excess capacity from five (5) large institutional users and 16,903 acre-feet of excess capacity from 70 different individual permit holders (Table 3-17). Total applications provide an additional 11,950 acre-feet in capacity. In total, these under-utilized existing state permits and applications for withdrawals from the Missouri River provide almost double the capacity needed to meet the 56,623 acre-feet of water requirements from unidentified sources.

**Table 3-17
Total North Dakota State Water Permits for Missouri River**

Total Missouri River ND Water Permits	Permit Count	Acre-Foot	Average Use 1989-2009	Utilization Rate	Max Use 1965-2009	Maximum Rate	Average Excess Capacity
Large Institutional Users	5	118,925	34,672	29%	81,474	69%	84,253
Other Users	70	21,942	5,039	23%	13,340	61%	16,903
Total Permits	75	140,867	39,711	28%	94,814	67%	101,156

3.7.1.5 Summary of Water Sources for the No Action Alternative

Table 3-18 summarizes the water sources that will be used to meet the identified 100,000 acre-foot/year of water yield for the No Action Alternative.

**Table 3-18
All Sources of Water for No Action Alternative**

Water Source	Acre-Feet
From Ground Water	3,911
From Surface Water	96,089
From Missouri River	95,960
From GD/LS Existing Intakes*	25,837
From free-flowing reaches of Missouri River	70,123
From other surface waters	129
Total All Sources	100,000

* Includes both existing easements and the portion of Water Depot water coming from the Garrison Dam / Lake Sakakawea Project

3.7.2 Proposed Action –Use of Surplus Water

The Proposed Action will allow for the use of surplus water from 100,000 acre-feet/year of yield (257,000 acre-feet of storage) and the subsequent execution of surplus water agreements and easements with the three applicants considered in the Environmental Assessment (Appendix A in Volume 2), identified in Table 3-19. The Proposed Action would also allow for the execution of surplus water agreements and easements for the six (6) other applicants identified in Table 3-19, as well as other future applicants. The Proposed Action would also allow for the execution of surplus water agreements with holders of current easements for existing water intakes at Lake Sakakawea, pursuant to current policy.

If surplus water agreements and easements are executed for the three applicants, the applicants would construct intakes at Lake Sakakawea and associated transmission infrastructure. The endpoint of the intake and transmission infrastructure would be in either a new water depot, an existing water depot, or (for the International Western intakes) in a new retention pond (Table 3-19). Typical construction of water supply intakes includes:

- Excavation and placement of a length of intake pipe and electrical supply line,
- Site preparation and construction (i.e., directional drilling for submerged pumps and pump placement in the reservoir),
- Construction of any features at the terminus of the raw water pipe (e.g., water depot, retention pond), and
- Re-establishing vegetation from ground-disturbing actions during the excavation and placement of pipe, utilities, intake, or pumps.

Typically, the proposed water depot site would consist of a 2-acre tract with a 24-foot roadway being constructed to each site for truck access.

From the water depot or retention pond, an 8" to 12" PVC pipe would be placed by typical surface excavation to approximately seven feet below grade from the terminus to approximately the high water mark of Lake Sakakawea (elevation 1854 msl). The length of this section of pipe would vary by intake from approximately 1,000 feet to more than five miles. Open trenching would typically be dug by tracked hoe, side casting the material, and backfilling in place when completed. Disturbances from the open trenching could consist of a 75-foot wide path from the high water mark to the terminus. To the extent feasible, the trenched water/utility line would be constructed adjacent to an existing utility or road corridor and all areas of soil disturbance would be stabilized and re-planted with native vegetation after construction.

**Table 3-19
Proposed Intake Information**

Intake Name	County	Volume In AC-FT (Yield)	Nearest Major Road	Length of Transfer Pipe (Feet)	Length Of Transfer Pipe (Miles)	Terminus
Element Solutions (ES)						
Mandaree	Dunn	1,000	Immediately Adjacent to Hwy 22 near Hwy 73 intersection	30,000	5.7	New Depot
International Western (IW)						
Charlson	McKenzie	6,000	5.5 mil to the NE terminus of State Hwy 1806	1,000	0.2	Retention Pond
Iverson	McKenzie	2,000	3mi. to Federal Hwy 85 near the south shore	1,000	0.2	Existing Depot
Thompson	Williams	4,950	0.8 mi. to State Hwy 1804 - 24 mi E of Williston	1,400	0.3	Retention Pond
Lake Sakakawea & Associates (LS&A)						
#3	Dunn	1,600	Over 20 mi. to Hwy 22 south of intersection Hwy 73	1,700	0.3	New Depot
#5	Dunn	1,600	Over 20 mi. to Hwy 22 south of intersection Hwy 73	1,200	0.2	New Depot
#8	McKenzie	1,600	3.5 mi. to the NE terminus of State Hwy 1806	1,800	0.3	New Depot
Total Yield		18,750				

Intake and associated infrastructure construction costs vary depending on the type of water supply service provided. Construction costs are similar for intakes terminating at a water depot, and variations are typically a function of distance from the raw water intake at the Lake. Intakes terminating at retention ponds are typically more expensive due to additional real estate and pumping requirements. The retention pond system provides water directly to the drilling site through a system of temporary piping, thereby avoiding the need for water trucks and trucking costs. The avoidance of trucking costs makes the more capital intensive retention pond system competitive with the lower cost water depot system.

3.8 Alternative Evaluation – Economic Analysis

The no action / least costly alternative plan (CC2010) and temporary use of surplus water plan (Proposed Action, or GAR100) are evaluated and compared in this section of the Report. Specifically, this section provides discussions on project economic effects, calculates the cost of storage, and concludes with the identification of the least cost method of meeting the water supply needs of the project area.

3.8.1 Impacts on Authorized Project Purposes

The Garrison Dam/Lake Sakakawea Project provides benefits to the Nation as a component of the comprehensive Pick-Sloan Plan for development in the Missouri River Basin. The authorized purposes of the upper Missouri River's six mainstem reservoirs and the lower Missouri River's levees and navigation channel are flood control, navigation, irrigation, hydropower, municipal and industrial water supply, fish and wildlife, water quality, and recreation. In order to evaluate the effects of temporary use of surplus water in Lake Sakakawea it is necessary to determine whether the depletions associated with the proposed use of surplus water would impact authorized project purposes through effects on reservoir water surface elevations and outflows.

Table 3-20 provides a comparison of the sources of water used to provide the 100,000 acre-foot/year of water under the no action alternative and the proposed action. The proposed action will result in a reduction in groundwater withdrawals of 527 acre-feet per year due to the expected cessation of the State emergency program to allow temporary state permits to convert irrigation water to industrial use. The need for this program will no longer exist if surplus water is made available from the Garrison Dam / Lake Sakakawea Project.

The no action plan requires withdrawals of an additional 70,123 acre-feet from free-flowing reaches of the Missouri River upstream of Lake Sakakawea. The proposed action includes 70,650 acre feet of surplus water yield from the Garrison Dam / Lake Sakakawea Project. Both the no action plan's withdrawal from free-flowing reaches of the Missouri River and the proposed action's withdrawal from Lake Sakakawea involve depletions from the Missouri River system (just at different locations). As described in Section 2.5, the six Missouri River mainstem reservoirs are operated as an integrated system to achieve the authorized project purposes. Therefore, the net impact on the Missouri River System from the use of surplus storage in the Garrison Dam / Lake Sakakawea Project is an increase in depletions of 527 acre-feet per year.

Table 3-20
Sources of Water Withdrawals for No Action and Proposed Action Alternatives

Water Source	No Action (Acre- Feet)	Proposed Action (Acre-Feet)	Difference (Proposed Action minus No Action)
From Ground Water	3,911	3,384	-527
From Surface Water	96,089	96,616	527
From Missouri River	95,960	96,487	527
From GD/LS Existing Intakes	25,837	25,837	0
From free-flowing reaches of Missouri River	70,123	0	- 70,123
From GD/LS surplus water		70,650	70,650
From other surface waters	129	129	0
Total All Sources	100,000	100,000	0

3.8.1.1 Use of the Daily Routing Model (DRM) to Predict Hydrologic Impacts

The Daily Routing Model (DRM) was used as an analytical tool in this study to estimate the hydrologic effects that additional depletions would have at Lake Sakakawea, the other system reservoirs, and free-flowing reaches of the Missouri River. Modeling of the movement of the water through the entire Missouri River Reservoir System was accomplished using the DRM, which was developed during the 1990's as part of the Master Manual Review and Update Study. An 80-year period was selected as the period of analysis for each of the alternatives because this is the period that daily data are available on Missouri River inflows and flows. Daily records are available for the six dams since their respective dates of closure, and daily flow data are available for the majority of gaging stations since 1930 (USACE, 1998). The depletion and capacity curve data (computed using the sedimentation rate data) were the input files that were used to project elevation and flow for without and with project conditions.

The DRM was developed to simulate and evaluate alternative System regulation for all authorized purposes under a widely varying, long-term hydrologic record. The DRM is a water accounting model that consists of 20 nodes, including the six System dams and 14 gaging stations. In the DRM, each of the six System reservoirs was modeled, and the DRM provides output at locations (nodes) along river reaches between System projects: Wolf Point and Culbertson, Montana, and Williston and Bismarck, North Dakota; and ten locations along river reaches below the System: Sioux City, Iowa; Omaha, Nebraska City and Rulo, Nebraska; St.

Joseph, Kansas City, Waverly, Boonville, and Hermann, Missouri on the Missouri River and St. Louis, Missouri on the Mississippi River.

The DRM performs a time-series analysis that simulates hydrologic output on a daily basis for each of the 80 years modeled from 1930 through 2009, assuming that the entire System was in place and fully operational for the full 80-year period. As the depletion and capacity curve data are varied between the evaluation years for this analysis (i.e., 2010 and 2020), the DRM computes System storage, reservoir elevation, reservoir release, reservoir evaporation, and river flow data for each day of the modeling period. Hydraulic impacts (changes to water surface elevations (WSE) in riverine reaches of the Missouri River) were estimated externally to the DRM model by combining DRM hydrologic output on streamflow with stage-discharge relationships provided at the DRM-modeled riverine nodes by the Omaha District.

Each DRM run provides 29,220 simulated values (80 years of daily values) for each parameter (i.e., water surface elevation, reservoir volume, and streamflow) at the 20 locations/model nodes in the system. These data should not be considered as estimates of actual calendar day values, but rather as simulation output values under the full range of climatological conditions existing over the 80-year period. To evaluate differences between two alternatives, the differences between each of the 29,220 daily values were determined and then sorted to establish a frequency distribution of modeled values. The distributions of the differences from the current conditions (without the additional depletions) for various DRM outputs (water surface elevation, reservoir volume, and streamflow) were then examined. Comparing the data distributions in this manner provides insight as to how the increased depletion scenario impacts the likelihood of occurrence of a given water surface elevation, reservoir volume, and streamflow over the entire 80-year period. Similarly, it can provide an estimate of the likelihood of a given magnitude of change in each parameter between No Action and with project conditions.

To examine the effects of just the additional depletions directly from System reservoirs, the simulations for one study year (2010) were completed under three separate planning scenarios: 1) baseline depletions (without project current condition), 2) 527 acre-feet of depletions at Lake Sakakawea (with project condition), and 3) 50,527 acre-feet of depletions (including 527 acre-feet at Lake Sakakawea and 10,000 acre-feet each at the other five system reservoirs) to evaluate the cumulative effects of removing an additional 50,527 acre-feet of water from all six System reservoirs. The model assumes that the historic System inflow data, adjusted assuming the depletions associated with current development in the basin, occurred over the 80-year modeling period.

The source of the actual System inflow data is the U.S. Geological Survey, which began acquiring daily data beginning in late 1929. The DRM adjusts these inflow data by the difference for depletions that have been estimated to occur between each year and 2002. The Bureau of Reclamation provided the monthly depletions, and these monthly data were further separated to daily values for use in the DRM. Inflow and depletion data are available for each of the DRM modeling reaches. The 2002 depletion data are assumed to remain constant through 2010 (assumes no change in system depletions from 2002 to 2010).

The required analyses were initially based on a comparison of the releases from four of the System dams (Fort Peck, Garrison, Oahe, and Gavins Point dams) and water surface elevations on the upper three, larger reservoirs (Fort Peck Lake, Lake Sakakawea, and Lake Oahe). Figures comparing the differences between the No Action and Proposed Action alternatives are located

in the Environmental Assessment, which is Appendix A to this report; therefore, they will not be presented in the Surplus Water Report. The DRM output shows that the removal of 527 acre-feet of water from Lake Sakakawea on an annual basis will have essentially no effect on the releases from the reservoirs (average daily change of about 1 cubic feet per second from Garrison Dam and less than 0.1 cfs from the other dams) or on the water surface elevations of the upper three reservoirs (-0.002 to -0.009 feet on an average daily basis). Because these changes are extremely small when compared to the average daily releases or the daily water surface elevations, they result in essentially no economic impacts.

To address economic impacts, models were developed to quantify economic impacts of scenarios run in the Missouri River Daily Routing Model (DRM). The economic impacts models were developed by Corps of Engineers Northwest Division (NWD) to evaluate impacts to basin resources in support of the EIS for the Missouri River Master Water Control Manual Review and Update Study in the 1990s. The economic models accept the output file from a DRM model run and quantify impacts in order to make relative comparisons between alternative scenarios. In accordance with Engineering Circular 1105-2-412 and the project’s model review plan, the Water Supply Planning Center of Expertise (PCX) organized a model review team to perform a level 4 review of the model documentation.

Based on this model review, the PCX recommended approval for use of the flood control, hydropower, navigation, water supply and recreation benefits models in this study within the context of plan formulation and H&H that show the impacts of the proposed action were minimized to the point where the updated cost of storage is orders of magnitude greater than benefits or revenues foregone. Based on the plan formulation showing a very small difference between the without and with-project conditions and because the model is being used for a surplus water report rather than a reallocation study the HQUSACE Model Certification Panel concurred with the recommendation by the PCX and the economic modules were approved for use in this study.

Table 3-21 presents the National Economic Development (NED) benefits for the No Action and Proposed Action alternatives. This table shows that the removal of 527 acre-feet of water from Lake Sakakawea will result in a net gain of \$9,000 of NED benefits, which is an increase of 0.001 percent in average annual NED benefits (based on the 80-year period of analysis). The breakdown of the impact on NED benefits among the individual project purposes is also presented.

**Table 3-21
Annual NED Benefits for the No Action and Proposed Action
Alternatives**

Authorized Purpose	No Action	Proposed Action	Change (millions)	Change (percent)
	CC2010 (millions)	GAR100 (millions)		
Flood Control	\$415.433	\$415.440	\$0.007	0.002
Navigation	\$6.766	\$6.763	-\$0.003	-0.044
Water Supply	\$606.305	\$606.308	\$0.003	0.001

Recreation	\$85.500	\$85.489	-\$0.011	-0.013
Hydropower	\$639.479	\$639.492	\$0.013	0.002
Total	\$1,753.484	\$1,753.493	\$0.009	0.001

The goal of a model is to show differences between alternatives, even if they are very slight. The numbers computed by the DRM were carried out to a thousandth of a percent in an effort to show these very small differences. The DRM and the economic modules are very complicated and rarely can results be simplified into an easy explanation. Brief clarifications of the numbers computed by the model in table 3-21 are shown below.

Flood Control - Either downstream flow was reduced very, very slightly, which caused a reduction of flood damages or the lake level was reduced just enough to result in lower damages to one or more recreation sites during a high reservoir pool condition.

Navigation - A season length was likely reduced a day or two in one or more years to cause the navigation benefits to be reduced in that year or several years (in only drought periods).

Hydropower - One would expect minor reductions in one or more years, but a "major" change in Garrison releases caused redistribution in releases in 1980, resulting in an increase in benefits (not expected for such a small change in depletions).

Water supply - Benefits apparently increased in one or more years, most likely due to very small increase in a minimum release in a drought year. The impact likely reduced an impact to powerplants in the Garrison downstream reach (one would expect the water supply benefits to decrease very very slightly). Irrigation benefits are computed as part of the water supply module of the Economic Impacts Model.

Recreation - Benefits decreased very slightly in one or more years due to a very small lowering in reservoir levels (likely Garrison) in a drought year.

3.8.2 Derivation of User Cost

The cost to entities executing surplus water agreements for the capital investment of storage in a Corps of Engineers' reservoir is calculated as the highest of:

- benefits foregone by the use of surplus water;
- revenues foregone by the use of surplus water;
- replacement cost of the storage necessary to provide the surplus water; or
- updated cost of storage in the Federal project.

The update cost of storage and any associated operations and maintenance costs are based on the proportion of the project's usable storage required to provide a yield of 100,000 acre feet of water. The relationship between reservoir storage and yield is described in Section 3.7.2.1 Water Storage-Yield Analysis.

3.8.2.1 Water Storage-Yield Analysis

The sequential reservoir routing method was used to calculate the storage-yield ratio used in the computation of updated costs of storage. This is the same method that was used to calculate the storage-yield ratio for the Basin Electric water supply agreement in January 2005. The storage-

yield ratio was determined for this analysis from simulations conducted using the Daily Routing Model (DRM), which applied the reservoir system operational rules as described in the Missouri River Master Water Control Manual (Revised March 2006). Depletion (water demand or use) analyses in the upper Missouri River basin were conducted for this study and used in the DRM. These analyses determined that the ultimate depletion level would be approximately 8.1 million acre-feet. The 1930 to 1941 drought was the limiting drought in these analyses. As determined in these analyses, 39 million acre-feet of carryover multiple use storage in the Missouri River Mainstem Reservoir system would be required to support a depletion level of 8.1 million acre-feet per year, and a minimum annual flow of 8.8 million acre-feet per year at Sioux City, Iowa. The total yield in the analysis is 16.9 million acre-feet per year (8.1 + 8.8 million acre-feet). Dividing the carry over multiple use storage (39 million acre-feet) by the total yield (16.9 million acre-feet) results in a storage-yield ratio of 2.31.

This ratio is lower than the value of 2.59 computed for the Basin Electric water supply agreement. The difference is due to a slight increase in basin depletions since the previous studies were completed and changes to the Master Manual water control plan (a change in the system storage level at which navigation is not supported that year and increased seasonal non-navigation period releases). The navigation support change increased the simulated number of non-navigation years during the 1930s drought from 1 year under the former Master Manual to 3 years under the current Master Manual. Because of the effect of the navigation support change, another method for computing the storage-yield ratio was used to calculate an alternative value and confirm the results of the sequential reservoir routing.

This second method utilized a Rippl diagram to determine the yield that could be expected with a system carryover storage capacity of 39 million acre-feet. A Rippl diagram is a mass curve of accumulated system inflows. Tangents are drawn to the high points of the mass curve in such a manner that the maximum departure does not exceed the system storage capacity. The slope of the resulting line indicates the annual yield or demands that can be attained with the specified storage capacity. The critical drawdown period begins at the tangent and ends with the maximum departure between the inflow and demand curve. The point at which the demand curve intersects the inflow curve indicates that the system storage has refilled. System inflows for 2002 development conditions were accumulated over the period of 1930-2009 and used to determine the yield that could be supplied during the critical period, which extended from December 1930 to February 1942, as shown on Figure 3-4.

Results of this analysis indicate that the system yield is 17.0 million acre-feet per year. Based on results of the DRM simulations, average annual evaporation during the critical period is 1.8 million acre-feet per year. Subtracting evaporation from the system yield results in a net yield of 15.2 million acre-feet per year. Dividing the carryover multiple use storage (39 million acre-feet) by the net yield (15.2 million acre-feet) results in a storage-yield ratio of 2.57. A comparison of the storage-yield computations is shown in Table 3-22. It is recommended that a value of 2.57 be used for this analysis since it is close to what was previously used for the Basin Electric water supply agreement and can be supported by the Rippl diagram.

Figure 3-4
Rippl Diagram for Missouri River Reservoir System

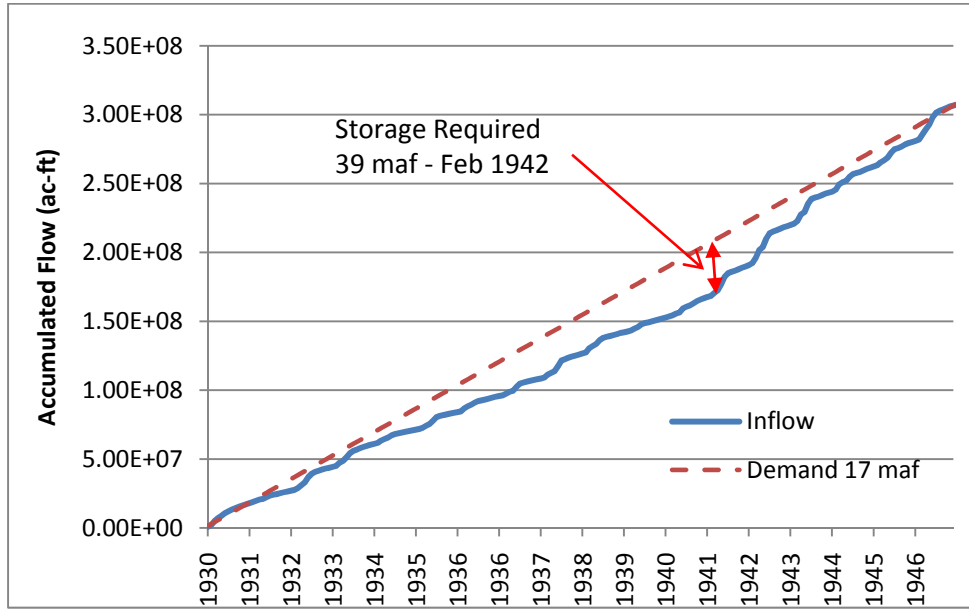


Table 3-22
Storage-Yield Ratios

Method	Storage (maf)	Yield (maf/yr)	Storage-Yield Ratio
Sequential Reservoir Routing (Basin Electric)	39	15.1	2.59
Sequential Reservoir Routing (DRM revised)	39	16.9	2.31
Rippl Diagram (Recommended)	39	15.2	2.57

3.8.2.2 Benefits Foregone

The Garrison Dam/Lake Sakakawea Project provides benefits to the Nation as a component of the comprehensive Pick-Sloan Plan for development in the Missouri River Basin. The authorized purposes of the upper Missouri River’s six mainstem reservoirs and the lower Missouri River’s levees and navigation channel are flood control, navigation, irrigation, hydropower, municipal and industrial water supply, fish and wildlife, water quality and recreation. The Garrison Dam/Lake Sakakawea beneficial contributions to authorized project purposes are identified in Chapter 2.4 Authorized Project Purposes.

Chapter 3.7.1 Impacts to Other Project Purposes identifies that use of 527 acre-feet of surplus water from sediment and irrigation storage of Lake Sakakawea would result in a positive NED impact to authorized project purposes of \$0.009 million per year.

Based on the 100,000 acre-feet/year of water yield for potential surplus water agreements (net change of 527 acre feet in System depletions) and the yield ratio of 2.57, 257,000 acre-feet of storage would be required for the proposed action. Because there is no net loss of NED benefits for the proposed action, the benefits foregone per acre-foot of storage would be \$0.00.

3.8.2.3 Revenues Foregone

Revenues foregone are defined as the reduction in revenues accruing to the U.S. Treasury based upon any existing payment agreements related to the project. Revenues foregone to hydropower would be based upon the projected reduction in hydropower output due to depletions associated with the use of surplus water or modified release schedule. Hydropower generated at Garrison Dam is marketed through the Western Area Power Administration (Western), which is a Federal agency under the Department of Energy. Revenues from the sale of hydropower generated at the Garrison Dam are paid to the U.S. Treasury to recover the Federal investment in the power generating facilities (with interest) and other costs assigned to power for repayment, such as aid to irrigation development (Western Area Power Administration, Annual Report, 2009).

Western provided a spreadsheet for this analysis with its most recent economic values for what it pays on an average monthly basis for power it purchases to meet its firm commitments to its customers, and a corresponding value for the revenue it receives for the power marketed in excess of its firm commitments. The net difference in energy revenues for the 527 acre-feet of water to be removed on a temporary basis from Lake Sakakawea is \$0.010 million. Using the 257,000 acre-feet of required storage for the 100,000 acre-feet/year, the corresponding value per acre-foot of storage is \$0.010 million divided by 257,000 acre-feet, or \$0.04 for the proposed action.

3.8.2.4 Replacement Costs

Since there is storage space in Lake Sakakawea that is currently not being used to store sediment inflows that will enter in years to come, there is no need to provide replacement storage for the 257,000 acre-feet of storage space that will be needed from the permanent pool of the reservoir. Therefore, there are no replacement costs required for the proposed action.

3.8.2.5 Updated Cost of Storage

The surplus water identified for M&I use is surplus located within the sediment and irrigation storage of Lake Sakakawea. The carryover multiple use zone of the reservoir is designed to serve all project purposes, though at reduced levels, through a severe drought like that of the 1930's. The updated cost of storage is calculated based on available capacity within all four system zones: permanent pool, carryover multiple use, annual flood control & multiple use, and exclusive flood control. In a permanent reallocation, the portion of the permanent pool assigned to sediment storage would be excluded from the available capacity in computing the updated cost of storage. However, for a surplus water study, it is appropriate to include this capacity if evaluation of sediment surveys indicate that the portion of the zone assigned to sediment storage will not be full during the 10-year study period.

Sediment surveys are conducted periodically for each of the six reservoirs comprising the Missouri River system. As these surveys are completed, the sedimentation rates are available for various studies, including the system modeling. When sediments accumulate in each reservoir, the amount of storage available at a given water surface elevation diminishes. The water surface elevation versus storage volume capacity relationship in the system model is updated following the sediment survey of each reservoir.

The last two sediment surveys indicate that there is sufficient capacity within the permanent pool of Lake Sakakawea to provide 257,000 acre-feet of surplus water storage over the 10-year planning period. Sediment storage is an purpose of the project, so M&I use of the water identified as surplus to that purpose clearly fits within the existing policies for surplus water and is considered to be within the existing usable storage that can be used.

Usable Storage Calculations

The 2009 – 2010 Annual Operating Plan (AOP) presents the storage allocations and capacities based on the latest available storage data³⁰. Usable storage includes the exclusive flood control pool, the flood control and multiple use zone, the carryover multiple use zone, and the permanent pool (Table 3-23). Total usable storage is 23,821,000 acre-feet. The surplus water needs of 100,000 acre feet of yield requires 257,000 acre-feet of storage, which is 1.079% of total usable storage (257,000/23,821,000 = 1.079%).

**Table 3-23
Usable Storage Calculations (acre-feet)**

Exclusive Flood Control	1,489,000
Flood Control & Multiple Use	4,222,000
Carryover Multiple Use	13,130,000
Permanent	4,980,000
Total	23,821,000
Net System Yield	15,200,000
Required Storage to Provide Surplus Water Yield of 100,000 acre-feet	257,000
Proportion of Usable Storage	1.079%

Updated Construction Cost Calculations

Construction costs were updated using the Engineering News Record (ENR) construction cost index and the Corps of Engineers Civil Works Construction Cost Index System (CWCCIS) as identified in EM 1110-2-1304, revised 31 March 2010. The value of lands is updated by the

³⁰ See note 6 of Plate 2, AOP

weighted average update of all other project features, as per the Water Supply Handbook, revised IWR Report 96-PS-4, December 1998. Since the CWCCIS dates back only to 1967, the ENR construction cost index was used to update project costs to 1967. The ENR construction cost index values are presented in the Water Supply Handbook.

The costs to be assigned to surplus M&I water use include joint use costs and are exclusive of specific costs. Examples of specific costs excluded from the updated cost of storage include the specific construction costs of:

- Recreation facilities;
- Flood control outlet works;
- Power intake works;
- Powerhouse;
- Turbines; and
- Generators.

The period of expenditure for each project feature is 1946 – 1953 (mid-point 1949) as identified in the 2009 – 2010 AOP. Table 3-24 shows the cost update calculations from the mid-point of expenditures (1949) to 1967, using the ENR construction cost index. Note that interest during construction is not included in this updating procedure. Table 3-25 shows the cost update calculations from 1967 to the first quarter of Fiscal Year 2011 using the CWCCIS, revised 31 March 2010. Note that the cost of lands and damages (Table 3-26) are updated based on the ratio of total FY11 updated costs (excluding lands and damages) to the total original 1949 costs (excluding lands and damages), as per the Water Supply Handbook (page 4-10).

Table 3-24
Updated Cost of Construction 1949 – 1967

Joint Use Cost Category	Original Cost (\$)	ENR Index 1949	ENR Index 1967	Update Factor	1967 Cost (\$)
Main Dam	90,060,716	477	1074	2.252	202,778,216
Outlet Works	25,227,424	477	1074	2.252	56,801,371
Reservoirs	1,662,775	477	1074	2.252	3,743,858
Power Intake Works	11,614,999	477	1074	2.252	26,152,010
Fish & Wildlife	317,638	477	1074	2.252	715,186
Levees & Floodwalls	2,524,796	477	1074	2.252	5,684,760
Pumping Plant	380,497	477	1074	2.252	856,716
Roads & Bridges	2,393,967	477	1074	2.252	5,390,190
Buildings & Grounds	9,240,426	477	1074	2.252	20,805,487
Perm Operating Equip	854,087	477	1074	2.252	1,923,039
Relocations	28,038,563	477	1074	2.252	63,130,852

Table 3-25
Updated Cost of Construction 1967 – FY 2011

Joint Use Cost Category	1967 Cost (\$)	1967 CWCCIS	FY11 CWCCIS	Update Factor	FY11 Cost (\$)
Main Dam	202,778,216	100	716.21	7.1621	1,452,317,857
Outlet Works	56,801,371	100	705.36	7.0536	400,654,148
Reservoirs	3,743,858	100	786.05	7.8605	29,428,597
Power Intake Works	26,152,010	100	716.21	7.1621	187,303,307
Fish & Wildlife	715,186	100	705.36	7.0536	5,044,632
Levees & Floodwalls	5,684,760	100	734.64	7.3464	41,762,521
Pumping Plant	856,716	100	713.79	7.1379	6,115,153
Roads & Bridges	5,390,190	100	723.44	7.2344	38,994,792
Buildings & Grounds	20,805,487	100	713.79	7.1379	148,507,484
Perm Operating Equip	1,923,039	100	713.79	7.1379	13,726,461
Relocations	63,130,852	100	723.44	7.2344	456,713,834
Lands and Damages	30,926,840*			16.136	499,049,787
Total					3,279,618,574

*Original 1949 cost without interest during construction

Table 3-26
Updated Costs of Lands and Damages

Total 1949 Cost Exclusive of Lands and Damages	\$ 172,315,887
Total FY11 Cost Exclusive of Lands and Damages	\$ 2,780,568,787
Ratio of Total FY11 Cost to Total 1949 Cost	16.136
1949 Cost of Lands and Damages	\$ 30,926,840
Updated FY11 Cost of Lands and Damages	\$ 499,049,787

The updated FY 2011 total cost of construction is \$3,279,618,574 (excluding interest during construction). The proportion of usable storage for the 257,000 acre-feet recommended for surplus water use is 1.079%. At FY 2011 price levels, the updated cost of storage for the 257,000 acre-feet is \$35,383,148 ($\$3,279,618,574 * 1.079\% = \$35,383,148$). This equates to a total cost per acre-foot of storage of \$137.68.

The total annual cost of surplus M&I water use to water users is calculated as the sum of annual payments to the Federal Government for the surplus water plus the proportional annual operation

and maintenance costs. Annual payments are based on a 30-year payment schedule and the repayment rate identified in EGM 11-01 Federal Interest Rates for Corps of Engineers Projects for Fiscal Year 2011. The appropriate interest rate is the Water Supply Interest Rate based on PL 85-500, which is the interest rate used for water supply storage space in projects completed or under construction prior to enactment of PL 99-662 (17 Nov 1986). The FY11 interest rate is 4.25%. The annual payment for the updated cost of storage (\$35,383,000) over a 30-year period at an interest rate of 4.25% is \$2,022,804.

3.8.2.6 Annual Operations and Maintenance Costs

The updated cost of storage will be used as the cost to the surplus water users for the capital investment of surplus water use, as it is the highest cost out of the four cost calculation methods. The surplus water users are also responsible for a proportional share of operation and maintenance costs, the cost of updating the project’s water management plan, and any costs specific to the provision of surplus water, such as environmental mitigation costs. As the provision of surplus water does not require an update to the project’s management plan and does not require environmental mitigation, the surplus water users will be responsible for the proportional share of joint use operations and maintenance costs.

The operation and maintenance costs to be assigned to the provision of surplus water are based on the most recent 10-year average of joint use operation and maintenance costs at Lake Sakakawea updated to FY11 dollars using CWCCIS (Table 3-27).

**Table 3-27
Joint Use Operations and Maintenance Costs**

Year	Joint Use O&M Costs (\$)	FY CWCCIS	Update Factor	FY11 Cost (\$)
FY01	5,118,863	503.32	1.433	7,336,169
FY02	3,802,922	517.46	1.394	5,301,279
FY03	4,736,562	529.95	1.361	6,447,159
FY04	4,479,694	571.29	1.262	5,656,291
FY05	6,993,579	608.36	1.185	8,292,374
FY06	5,223,285	641.91	1.123	5,869,614
FY07	4,166,942	673.52	1.071	4,462,795
FY08	6,253,065	716.54	1.006	6,294,954
FY09	5,457,577	703	1.026	5,599,955
FY10	7,471,318	716.68	1.006	7,519,898
1QFY11		721.34	Average	6,278,049

The average joint use operations and maintenance costs for the most recent ten-year period are \$6,278,049 in FY 2011 dollars (Table 3-14). The proposed proportion of usable storage for

257,000 acre-feet is 1.079% (Table 3-10). For 2011, the annual operations and maintenance for the 257,000 acre-feet of storage is \$67,733 ($\$6,278,049 * 1.079\% = \$67,733$).

3.8.2.7 Annual Payment for Use of Surplus Water

The total annual cost of surplus water for 257,000 acre-feet of storage is \$2,090,537 based on FY 2011 price levels. Payment required from each user will be calculated proportionate to the amount of required storage need to support the requested yield, using an annual cost of \$20.91 per acre-foot of yield (equivalent to \$8.13 per acre-foot of storage) at FY 2011 price levels (Table 3-28).

Table 3-28
Annual Payment for Use of Surplus Water
(FY 2011 price levels)

Updated Cost of Storage	\$ 35,383,148
Repayment Period	30 years
Repayment Rate	4.25%
Annual Payment	\$ 2,022,804
Annual O&M Cost	\$67,733
Total Annual Payment	\$ 2,090,537
Acre-Feet of Storage	257,000
Annual Cost per Acre-foot of Storage	\$ 8.13
Acre-Feet of Yield	100,000
Annual Cost per Acre-foot of Yield	\$ 20.91

For example, if a water user had requested a surplus water agreement for 10 acre foot per year of water yield (equivalent to .00893 MGD), based on current Corps' policy, they would have a required payment of \$200.91 per year (10 AF/Yr multiplied by \$20.91 annual cost per AF).

3.8.2.8 Summary of the User Cost of Storage Calculations

The four methods of determining the cost of storage in Lake Sakakawea have been discussed in the previous subsections. Table 3-29 presents these results. The updated cost of storage is the highest value at \$8.13 per acre-foot of storage (FY 2011 price levels).

**Table 3-29
Annual Cost of Storage Computation Methods**

Cost Calculation Method	Annual Cost per Acre foot of Storage
Benefits foregone	\$0.00
Revenues forgone	\$0.04
Replacement costs	\$0.00
Updated cost of storage	\$8.13

3.8.3 Test of Financial Feasibility

The test of financial feasibility compares the annual cost to surplus water user(s) under the proposed action to the annual cost of the most likely, least costly water supply alternative to meet projected water supply needs in the absence of the Federal action. The no action - next least costly alternative must be able to provide an equivalent quality and quantity of water which non-Federal interests could obtain in the absence of utilizing surplus water from the Federal project. The purpose of the test of financial feasibility is to demonstrate that provision of surplus water from the Federal project is the most efficient water supply alternative.

Table 3-30 displays the estimated cost to provide an equivalent yield of 100,000 acre-feet per year for the most likely, least costly water supply alternative to meet projected water supply needs in the absence of the Federal action.

Ground water sources consist of a combination of the sub-set of water depots that draw on groundwater sources, and temporary State water permits that allow holders of existing irrigation water permits to use their water for industrial purposes. Water from both of these sources is sold to the oil and gas industry on a per barrel basis. Water sold from water depots ranges in cost from \$0.50 to \$1.05 per barrel. Average costs of water sold from holders of existing irrigation water permits to the oil and gas industry has been \$0.84 per barrel. These reported sales costs are very compatible; therefore \$0.84 per barrel (\$6,517.03 per acre-foot of yield) has been used in the analysis for 3,911 acre-feet of the required 100,000 acre-feet/year of yield.

An assumption used in the analysis is that existing Garrison Dam / Lake Sakakawea Project easements will continue to be available in the future to existing easement holders at current usage levels. It is also assumed that the cost of this portion of the 100,000 acre-feet per year of yield would be the same under without and with project conditions. Therefore, \$20.91 per acre-foot of yield has been used in the analysis for 25,837 acre-feet of the required 100,000 acre-feet/year of yield.

**Table 3-30
Cost of the Next Least Costly Alternative**

Water Source	Acre-Feet	Cost Per Acre-Foot	Cost
From Ground Water (Agriculture-Industrial Conversions & Ground Water Depots)	3,911	\$6,517.03	\$25,488,099
From GD/LS Existing Intakes	25,837	\$20.91	\$540,252
From free-flowing reaches of Missouri River	70,123	\$229.70	\$16,107,253
From other surface waters	129	*	*
Total All Sources	100,000	n/a	\$42,135,604
Average Cost Per Acre-Foot of Yield		\$421.90	
Average Cost Per Acre-Foot of Storage Equivalent		\$164.16	

The cost of providing water from free-flowing reaches of the Missouri River has been estimated based on a proposal made by a collaboration of northwest North Dakota water stakeholders including the BDW Rural Water District, the City of Crosby, the McKenzie County Commission, the McKenzie County Water Resources District, R&T Water Supply Association, the Williams Rural Water District, and the City of Williston, ND.

This group has developed a regional water development plan that delivers Missouri River water from the Williston Regional Water Treatment Plant to the northwest North Dakota region. This plan includes a series of water supply and transmission infrastructure projects which could be constructed over a period of five years at a cost of \$127.5 million. The focal point of this multi-project plan is the capacity increase for the Williston Regional Water Treatment Plant, including intake infrastructure, from 10MGD to 20 MGD, which is the equivalent of an annual increase of 11,200 acre-feet. The cost of the Williston Regional Water Treatment Plant capacity increase is \$45 million. The project would take three years to complete. The average annual cost of the project amortized over 30 years at 4.25% is \$2,572.586, which is equivalent to an annual cost of \$229.7 per acre-foot. In the absence of specific proposal for the remaining acre-feet of yield from the free-flowing reaches of the Missouri River, the average annual cost of \$229.7 per acre-foot yield for the 11,200 acre-foot Williston Treatment Plant capacity increase has been applied to all 70,123 acre-feet of the required 100,000 acre-feet/year of yield in this category.

Costs were not able to be obtained for the 129 acre-feet of yield obtained from other surface waters in the State. Given that this water source represents only 0.1 percent of the 100,000 acre-feet/year of required yield, it was eliminated in the estimate of average costs per acre-feet of yield with minimal effect on the accuracy of the overall estimate.

The weighted average of all of these sources results in an average cost per acre-foot of yield of \$421.90. This was converted to an equivalent average cost per acre-foot of storage of \$164.16

per acre-foot using the storage-yield ratio of 2.57 to allow for a valid comparison to the cost of the proposed action.

The average annual cost of surplus water from 257,000 acre-feet of storage in the Garrison Dam / Lake Sakakawea Project (required to provide 100,000 acre-feet/year of yield) is based on the updated cost of storage method and is \$2,090,537, which is \$20.91 per acre-foot of yield (equivalent to \$8.13 per acre-foot of storage) (FY 2011 price levels). The test of financial feasibility, comparing the cost of the next least costly alternative (\$164.16 per acre-foot of storage) to the cost of the proposed action (\$8.13 per acre-foot of storage), clearly demonstrates that temporary provision of surplus water from the Garrison Dam / Lake Sakakawea Project is the most efficient water supply alternative.

3.9 Environmental Considerations

Because of the small magnitude of the predicted changes to discharges and water surface elevations of Lake Sakakawea, the remaining five System reservoirs, and the riverine reaches of the Upper Missouri River as a result of the Proposed Action, the following environmental resources (as discussed in Section 5.3 of the accompanying Environmental Assessment (Volume 2)) would not be expected to have any measurable change over the existing condition: soils, groundwater, water quality (including cold water habitat), air quality, demographics, socioeconomics, environmental justice, recreation, aesthetics, noise, cultural resources, vegetation and protected plants, fish and wildlife and protected animals. In addition, there would be no effects to project purposes anticipated (Section 3.7.1 Impacts on Project Purposes).

The Environmental Assessment (Appendix A in Volume 2) identifies localized and temporary construction-related effects (noise, dust, minor earth-moving), which would be expected during construction at the new intake sites. Significant environmental and cultural resources of Lake Sakakawea would be avoided with good planning and continued coordination with resource agencies as designs are finalized. No significant effects would be expected in association with intake, transfer pipe, or depot/retention pond construction and operation. An increase in localized truck traffic (on access roads) would be expected leading to/from new water depots; however, there would likely be a cumulative beneficial effect from the concomitant decrease in total truck miles traveled for the water supply aspect of the oil/gas industry as a whole.

The expected environmental consequences of entering into agreements for the use of 100,000 acre-feet/year of surplus water from 257,000 acre-feet of storage (the Proposed Action) would not be expected to be significant and would not require the preparation of an Environmental Impact Statement.

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4. PLAN IMPLEMENTATION

4.1 Parties to Surplus Water Agreements

In accordance with ER 1105-2-100 (22 April 2000), the cost allocated to the surplus water user, i.e., the price to be charged for the capital investment for the storage required to provide the surplus water, will normally be established as the highest of the benefits or revenues foregone, the replacement cost, or the updated cost of storage in the federal project. As identified in Table 3-29 above, the costs to be assigned to M&I water supply storage are calculated as the updated cost of storage.

The repayment rate used to calculate annual payment for storage is the yield rate defined in Section 932 of the Water Resources Development Act of 1986. EGM 11-01 Federal Interest Rates for Corps of Engineers Projects for Fiscal Year 2011 identifies the appropriate interest rate as 4.25%. Payment amounts are recalculated based upon appropriate interest rate for the year an agreement or renewal is signed. The annual payment for the updated cost of storage is calculated over a 30-year period. The duration of the surplus water agreement shall be for a period not to exceed five (5) years. Upon expiration, the agreement may be extended for an additional period not to exceed five (5) years. Extensions shall be subject to recalculation of reimbursement. A surplus water agreement does not imply a permanent right to utilize the storage space.

4.2 Agency Coordination

Letters to each of the 29 tribes in the basin were sent on 24 August 2010 informing them of the Omaha District's intent to prepare the Surplus Water Report and requesting their review once the draft Report had been completed. An Omaha District representative also made a presentation on the study at the Tribal Programmatic Agreement meeting in Pierre, SD on 18 November 2010.

Letters to the Governors of each of the affected States in the basin, and to State and Federal agencies within North Dakota, were sent on 21 September 2010 informing them of the Omaha District's intent to prepare the Surplus Water Report and requesting their review once the draft Report had been completed.

On 29 September 2010, the Corps of Engineers hosted an Agency Coordination Meeting at the North Dakota State Water Commission's- offices in Bismarck, ND. The purpose of the meeting was two-fold: to share information between the Corps of Engineers and the state/federal agencies and to receive input from the respective agencies regarding their concerns. The meeting was held to ensure transparency and understanding of current Corps of Engineers Surplus Water Supply Studies that are currently under way, with specific focus on Lake Sakakawea. Agencies and individuals that were in attendance include:

- U.S. Army Corps of Engineers-Omaha District;
- U.S. Army Corps of Engineers-Regulatory Office;
- U.S. Department of the Interior-Bureau of Reclamation;
- N.D. Department of Agriculture;
- N.D. Industrial Commission-Mineral Resources-Oil & Gas Division;
- N.D. State Water Commission;

- N.D. State Historic Preservation Office;
- N.D. Game & Fish Department;
- N.D. Governor's Office;
- N.D. Parks and Recreation Division; and
- S.D. Department of Environment and Natural Resources.

4.3 Public Participation

A public comment period was scheduled from 16 December 2010 through 17 January 2011. In response to several requests for additional review time, a fifteen day extension was granted and comments were collected through 1 February 2011. A public meeting was held on 6 January 2011 in Bismarck, ND.

Over 75 comment letters totaling more than 400 pages were received from States, Agencies, Tribes and individuals (see Appendix B). A matrix that categorizes each commenter's concerns is shown in Table 16 of the EA (Appendix A). In general there were 34 categories of concern in the comments that were received. These categories were further reviewed and it was determined that the concerns fell into themes. Nine themes resulted from this review and are as follows: hydropower, water rights, cost, irrigation, NEPA, tribal consultation, cultural resources, municipal & industrial water supply, and other. To provide structure, thematic responses to comments were developed and are provided in Table 17 of the EA (Appendix A). This table illustrates how a majority of the comments were addressed.

Each comment was carefully considered and several resulted in revisions to the document. Revisions to the report as a result of the public comments were principally intended to provide additional clarity and did not ultimately affect the determination that surplus water is available or the determination that there are no significant environmental impacts associated with implementing the proposed action. Comments that are not addressed in Table 17 of the EA (Appendix A) were considered, but determined to be either outside the scope of this study or they would not have an impact on the decision being made.

5. CONCLUSIONS

The purpose of the Garrison Dam / Lake Sakakawea, ND, Surplus Water Report is to identify and quantify whether surplus water is available in the Project, as defined in Section 6 of the 1944 Flood Control Act that the Secretary of the Army can use to execute surplus water supply agreements with water users, and to determine whether use of surplus water is the most efficient method for meeting regional municipal and industrial (M&I) water needs.

This Surplus Water Report and attached Environmental Assessment investigate the engineering and economic feasibility and environmental effects of entering into agreements for the use of surplus water from 100,000 acre-feet/year of yield (equivalent to 257,000 acre-feet of storage) from the sediment and irrigation storage in the Garrison Dam / Lake Sakakawea Project to meet existing and projected near-term municipal and industrial (M&I) water supply needs in the region.

This report:

- identifies temporary surplus water in the Garrison Dam / Lake Sakakawea Project associated with storage originally planned for mainstem system irrigation that has not yet developed to its original capacity as well as available storage within the sediment storage area of the permanent pool;
- establishes the need for additional water supply in Northwest North Dakota based on increased industrial activity and limited groundwater and surface water resources;
- assesses structural and non-structural alternative water supply measures;
- assesses potential impacts to project purposes using the DRM developed as part of the Master Manual Review and Update Study;
- assesses potential environmental impacts also using the DRM developed as part of the Master Manual Review and Update Study;
- uses the updated cost of storage method to calculate user costs;
- conducts a test of financial feasibility indicating that provision of surplus water is the least cost water supply alternative; and
- identifies three prospective partners to engage in Surplus Water Agreements for the temporary use of surplus water from the Garrison Dam / Lake Sakakawea Project.

The engineering and environmental analyses contained in this report indicate that there are no impacts to project purposes and no significant impacts to environmental resources due to the proposed action. The economic analysis of alternatives identifies the proposed action as the least cost water supply alternative.

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6. RECOMMENDATIONS

I have carefully reviewed the water supply problems of the study area and the proposed solution documented in this report. There is a current and future need for additional municipal and industrial water supply in western North Dakota. Furthermore, it is evident through the analysis conducted for this surplus water report that surplus water is available in the Garrison Dam / Lake Sakakawea Project that can meet these M&I water demands and increase the benefits provided by the Federal project.

Based on the findings of this study and the appended Environmental Assessment, it is recommended that surplus water associated with 100,000 acre-feet/year of yield (equivalent to 257,000 acre-feet of storage) in the Garrison Dam / Lake Sakakawea Project be made available for temporary use for municipal and industrial water supply and that authority be granted to execute surplus water agreements with easement applicants for a period of five (5) years, with an option to renew for an additional five (5) years.

The use of surplus water discussed in this report is economically justified and will not affect the authorized purposes of Garrison Dam / Lake Sakakawea Project.

Therefore, the Omaha District recommends that:

1. Use of surplus water from 100,000 acre-feet/year of yield (257,000 acre-feet of storage) by municipal and industrial water supply be approved for implementation; and
2. The annual payment for surplus water storage would be \$20.91 per acre-foot of yield (equivalent to \$8.13 per acre-foot of storage) at FY 2011 price levels. All cost figures are based on the WSA of 1958 interest rates and will need to be recalculated at the appropriate time, using the current Water Supply Interest Rate based on PL 99-662.

The recommendations contained herein reflect the information available at this time and current Departmental policies governing formulation of individual projects. They do not reflect program and budgeting priorities inherent in the formulation of a national Civil Works construction program nor the perspective of higher review levels within the Executive Branch. Consequently, the recommendations may be modified before they are transmitted to higher authority for approval.

Robert J. Ruch
Colonel, Corps of Engineers
District Engineer



**US Army Corps
of Engineers
Omaha District**

Garrison Dam/Lake Sakakawea Project North Dakota

Surplus Water Report

Appendix A

Environmental Assessment



March 2011

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1. Introduction

1.1. *Purpose of the Surplus Water Report and Environmental Assessment*

The purpose of the Garrison Dam/Lake Sakakawea, ND, Surplus Water Report is to identify and quantify whether surplus water is available in the Project, as defined in Section 6 of the 1944 Flood Control Act, that the Secretary of the Army can use to execute surplus water supply agreements with water users, and to determine whether use of surplus water is the most efficient method for meeting regional municipal and industrial (M&I) water needs. This Environmental Assessment presents and provides an evaluation of the direct, indirect, and cumulative environmental impacts of the proposed action and the “no action” alternatives pursuant to the requirements of the National Environmental Policy Act of 1969 (NEPA) as implemented by the Council on Environmental regulations (40 CFR 1500, et seq.).

This Surplus Water Report (Report) and this Environmental Assessment (EA) investigate the engineering and economic feasibility and environmental effects of temporary use of up to 100,000 acre-feet of yield per year (257,000 acre-feet of storage) from the Garrison Dam / Lake Sakakawea Project to meet municipal and industrial (M&I) water supply needs in the region over the 10-year study period. This Report has been prepared by the Omaha District, U.S. Army Corps of Engineers (Corps) under the Operation & Maintenance Program. The water supply agreements derived from this process would be executed with potential easement applicants upon approval of this Report by the Assistant Secretary of the Army (Civil Works) and completion of required NEPA coordination. The term of surplus water agreement is for a five (5) year period, renewable for an additional five (5) year period, subject to recalculation of reimbursement after the initial five (5) year period.

A 10-year study period has been established for the surplus water study and EA. The length of the study period was selected for several reasons. First, surplus water agreements may be executed for a five (5) year period, renewable for an additional five (5) year period. Second, prior to the end of the 10-year study period, the Corps recommends that a comprehensive strategy to address long-term regional water needs be developed that may involve the Administration, Congress and stakeholders. Third, the primary water demand driving regional water needs at this time is the North Dakota oil and gas industry. Industry and state estimates indicate that demand from this industry is temporary and will decrease significantly after 10 years. The surplus water agreements executed upon the approval of the Report and EA serve as measures to address temporary water needs of the region during the 10-year study period.

The temporary use of a total of 100,000 acre-feet of yield (257,000 acre-feet of storage) being analyzed is in excess of the total amount for which easements have currently been requested, and was selected based on potential future demand over the 10-year study period. The amount in excess of intake easement requests received to date has been included for the purposes of efficiency and responsiveness and so that expected requests over the period of analysis can be evaluated and approved.

1.2. Authority for the Proposed Action

The Garrison Dam / Lake Sakakawea, ND, Surplus Water Report study is being conducted under the authority of Section 6 of Public Law 78-534, the 1944 Flood Control Act. Under Section 6, the Secretary of the Army is authorized to enter into agreements for surplus water with states, municipalities, private concerns, or individuals at any reservoir under the control of the Department of the Army. Specifically, Section 6 states that:

“[T]he Secretary of War is authorized to make contracts with States, municipalities, private concerns, or individuals, at such prices and on such terms as he may deem reasonable, for domestic and industrial uses for surplus water that may be available at any reservoir under the control of the War Department: Provided, That no contracts for such water shall adversely affect then existing lawful uses of such water. All moneys received from such contracts shall be deposited in the Treasury of the United States as miscellaneous receipts.”

The Corps of Engineers’ Planning Guidance Notebook, ER 1105-2-100, page 3-32, paragraph 3-8a states:

“The Secretary of the Army can also enter into agreements with states, municipalities, private entities or individuals for the use of surplus water as defined in, and under the conditions described in, Paragraph 3-8b(4). Surplus water can also be used to respond to droughts and other emergencies affecting municipal and industrial water supplies.”

ER 1105-2-100, paragraph 3-8b(4), entitled, “Surplus Water” states:

“Under Section 6 of the Flood Control Act of 1944, the Secretary of the Army is authorized to make agreements with states, municipalities, private concerns, or individuals for surplus water that may be available at any reservoir under the control of the Department. These agreements may be for domestic, municipal, and industrial uses, but not for crop irrigation.

ER 1105-2-100, paragraph E-57b(2) states:

(2) Classification.

(a) Surplus Water will be classified as either:

(1) water stored in a Department of Army reservoir that is not required because the authorized use for the water never developed or the need was reduced by changes that occurred since authorization or construction; or

(2) water that would be more beneficially used as a municipal and industrial water than for the authorized purpose and which, when withdrawn, would not significantly affect authorized purposes over some specified time period.

(b) An Army General Counsel opinion of March 13, 1986, states that Section 6 of the 1944 Flood Control Act empowers the Secretary of the Army to make reasonable reallocations between different project purposes. Thus, water stored for purposes no longer necessary can be considered surplus. In addition, the Secretary may use his broad

discretionary authority to reduce project outputs, envisioned at the time of authorization and construction, if it is believed that the municipal and industrial use of the water is a higher and more beneficial use....

(3) Requirements and Restrictions. Surplus water declarations will only be made when related withdrawals would not significantly affect authorized purposes. Surplus water agreements shall be accompanied by a brief letter Report similar to reallocation Reports and shall include how and why the storage is determined surplus. Surplus water agreements will normally be for small amounts of water and/or for temporary use as opposed to storage reallocations and a permanent right to that storage. Normally, surplus water agreements will be limited to 5 year periods. Use of the Section 6 authority should be encouraged only where non-Federal sponsors do not want to buy storage because the need of the water is short term or the use is temporary pending the development of the authorized use. The views of the affected state(s) will be obtained, as appropriate, prior to entering into any agreement under Section 6. The annual price deemed reasonable for this use of surplus water is determined by the same procedure used to determine the annual payment for an equivalent amount of reallocated storage plus an estimated annual cost for operation and maintenance, repair, replacement, and rehabilitation. The total annual price is to be limited to the annual costs of the least cost alternative, but never less than the benefits foregone (in the case of hydropower, revenues foregone).

1.3. Garrison Project Background and Overview

1.3.1. Project Location

Garrison Dam and Lake Sakakawea, the impoundment created by Garrison Dam, is the third largest man-made lake in the United States. Authorized for flood control, navigation, irrigation, hydropower, municipal and industrial water supply, fish and wildlife, recreation and water quality, the Garrison Dam/Lake Sakakawea Project creates an approximately 178-mile long and up to 6-mile wide pool on the main stem of the Missouri River from near Williston, ND to near Riverdale, ND (see Figures 1 and 2). The reservoir covers approximately 380,000 acres, with more than 1,500 miles of shoreline, and 23.8 million acre-feet of water storage at full pool, which is nearly one-third of the total storage capacity of the Missouri River reservoir system. As shown in Figure 2, about 220,840 surface acres of Lake Sakakawea and about 600 miles of its shoreline are included within the boundaries of the Fort Berthold Reservation. Within the Fort Berthold Reservation are the Mandan, Hidatsa, and Arikara Nations. The Reservation includes portions of six counties in North Dakota: Mountrail, McLean, Dunn, McKenzie, Mercer, and Ward.

1.3.2. Project Authorization

The Garrison Dam/Lake Sakakawea project was authorized on December 22, 1944, by the Flood Control Act of 1944, Public Law (P.L.) 534, 78th Congress, 2nd session, along with four other Missouri River main stem projects -- Gavins Point, Fort Randall, Big Bend, and Oahe. These five main stem reservoirs are elements of the comprehensive development program in the Missouri River Basin, known as the Pick-Sloan Plan. This comprehensive plan became known as the Pick-Sloan Missouri Basin Program. Fort Peck Dam, located in northern Montana, was constructed before the Pick-Sloan Plan, but is operated as part of the Missouri River System.

Figure 1
Omaha District Civil Works Boundary and Mainstem Projects

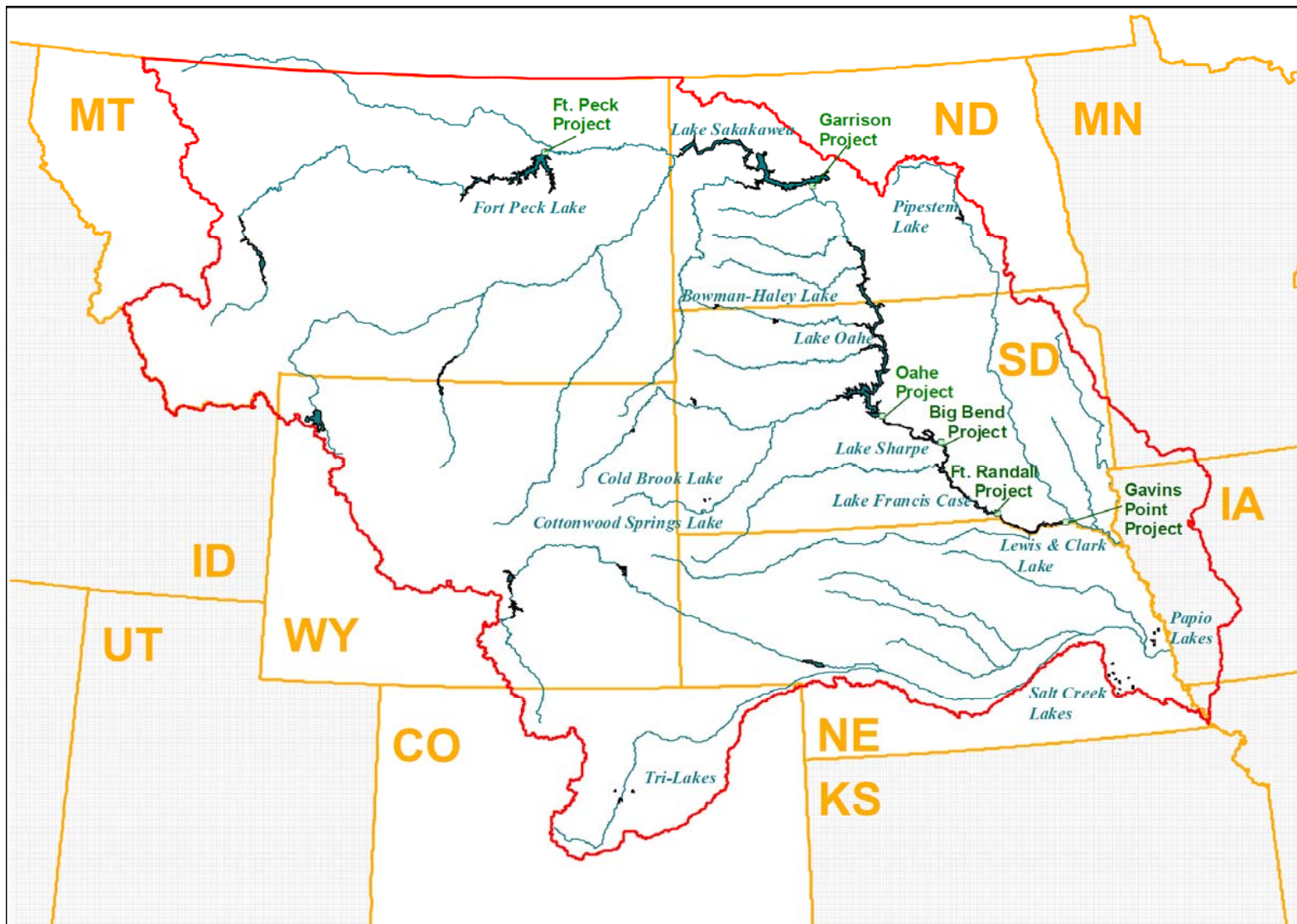
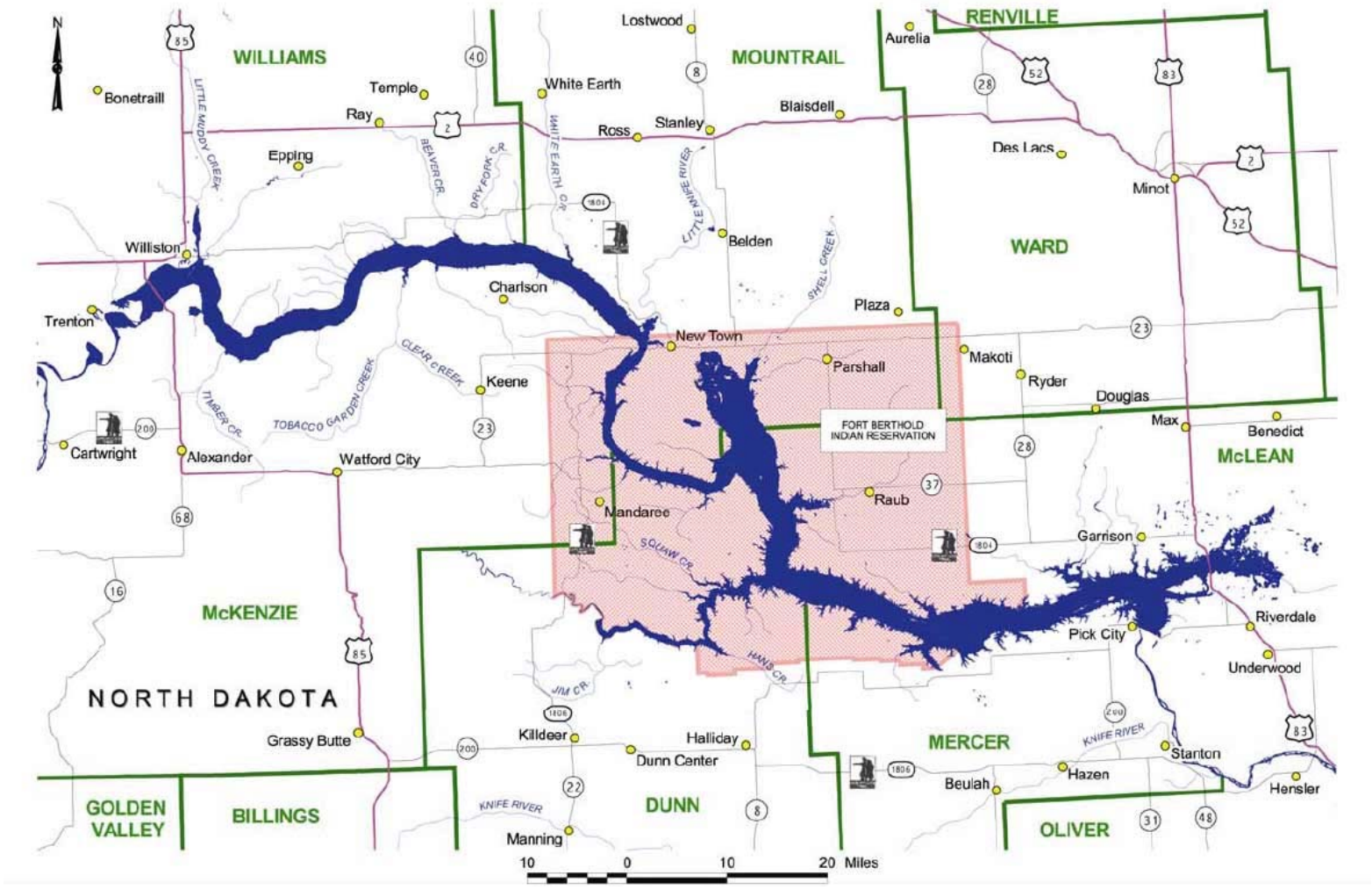


Figure 2
Garrison Dam/Lake Sakakawea Project, North Dakota



1.3.3. Authorized Project Purposes

The Garrison Dam/Lake Sakakawea project is a unit of the comprehensive Pick-Sloan Plan for development in the Missouri River Basin. The operation of the upper Missouri River's six main stem reservoirs and the lower Missouri River's levees and navigation channel provides for flood control, navigation, irrigation, hydropower, municipal and industrial water supply, fish and wildlife, and recreation.

The Missouri River begins at the junction of the Jefferson, Madison, and Gallatin Rivers, near Three Forks in the Rocky Mountains of south-central Montana. Figure 1 illustrates the Upper Missouri River Basin. The Garrison Dam/Lake Sakakawea Project is operated as an integral component of the Missouri River Mainstem Reservoir System. To achieve full coordination within the entire Missouri River basin and to meet all of the authorized project purposes, operation of all six mainstem reservoirs is directed by the Missouri River Basin Reservoir Control Center located in Omaha, Nebraska, part of the Corps' Northwestern Division.

The six mainstem reservoirs operated by the Corps are listed in Table 1. Lake Sakakawea provides a significant storage contribution to the mainstem system of reservoirs. It is the largest of the six reservoirs, with a storage capacity of approximately 23.8 million acre-feet (MAF), which comprises nearly one third percent of the total 73.3 MAF storage capacity in the mainstem system.

Table 1
Missouri River Mainstem Flood Control Reservoirs

Project (Dam and Reservoir)	Incremental Drainage Area (Square Miles)	Year of Closure	Flood Control and Multiple Use Storage in Acre-Feet (AF)	Total Storage in Acre-Feet (AF)
Fort Peck Dam/ Fort Peck Lake	57,500	1937	2,717,000	18,688,000
Garrison Dam/ Lake Sakakawea	123,900	1953	4,222,000	23,821,000
Oahe Dam/ Lake Oahe	62,090	1958	3,201,000	23,137,000
Big Bend Dam/ Lake Sharpe	5,840	1963	117,000	1,798,000
Fort Randall Dam/ Lake Francis Case	14,150	1952	1,309,000	5,418,000
Gavins Point Dam/ Lewis & Clark Lake	16,000	1955	90,000	470,000

1.4. Prior Reports and NEPA Documents

The Army Corps of Engineers and other federal and non-federal entities have prepared a number of documents on the upper Missouri River system. The previous federal and non-federal studies have established an extensive database on the environment in the upper Missouri River system. These references are listed below, and are hereby incorporated-by-reference (40 CFR 1502.21).

- In March 2003, the Kansas City District and the Omaha District published a Final Environmental Impact Statement entitled, “Final Supplemental Environmental Impact Statement for the Missouri River Fish and Wildlife Mitigation Project.” The project study area is located along 735 miles of the Missouri River from Sioux City, Iowa to the mouth of the river near St. Louis, Missouri. The purpose of this program was to restore fish and wildlife habitat losses resulting from construction, operation, and maintenance of the Missouri River Bank Stabilization and Navigation Project that provided a navigation channel from Sioux City to the mouth.
- In October 2003, the Omaha District published a Master Plan entitled, “Big Bend Dam/Lake Sharpe Master Plan with Integrated Programmatic Environmental Assessment Missouri River, South Dakota Update of Design Memorandum MB-90.” The document was prepared to describe the operational plan and existing environmental conditions for the Big Bend Project in South Dakota.
- In October 2003, the Omaha District published a Master Plan entitled, “Gavins Point Dam/Lewis and Clark Lake Master Plan Missouri River, Nebraska and South Dakota, Update of Design Memorandum MG-123.” The document was prepared to describe the operational plan and existing environmental conditions for the Gavins Point Dam/Lewis and Clark Lake in Nebraska and South Dakota.
- In December 2003, the U.S. Fish and Wildlife Service published an amendment to their 2000 Biological Opinion entitled “U.S. Fish and Wildlife Service Amendment to the 2000 Biological Opinion on the Operation of the Missouri River Main Stem Reservoir System, Operation and Maintenance of the Missouri River Bank Stabilization and Navigation Project, and Operation of the Kansas River Reservoir System.”
- In March 2004, the Northwestern Division of the Army Corps of Engineers published the Final Environmental Impact Statement for the Missouri River Master Water Control Manual entitled, “Missouri River Final Environmental Impact Statement, Master Water Control Manual Review and Update.”
- In February 2006, the Northwestern Division of the Army Corps of Engineers published an Environmental Assessment entitled, “Environmental Assessment for the Inclusion of Technical Criteria for Spring Pulse Releases from Gavins Point Dam.” The analysis in the document compares the impacts of the bimodal spring pulse technical criteria with the impacts of the spring pulse alternatives evaluated in the Master Water Control Manual FEIS (USACE, 2004).
- In December 2007, the Omaha District published the Master Plan and integrated Finding of No Significant Impact entitled, “Garrison Dam/Lake Sakakawea Master Plan with

Integrated Programmatic Environmental Assessment Missouri River, North Dakota Update of Design Memorandum MGR-107D.” The document was prepared to evaluate the environmental impacts associated with management of the Garrison Project in North Dakota.

- In August 2008, the Omaha District published the Master Plan and integrated Finding of No Significant Impact entitled, “Fort Peck Dam/Fort Peck Lake Master Plan with Integrated Programmatic Environmental Assessment Missouri River, Montana Update of Design Memorandum MFP-105D.” The document was prepared to evaluate the environmental impacts associated with management of the Fort Peck Project in Montana.
- In September 2010, the Omaha District published the Final Master Plan and integrated Finding of No Significant Impact entitled, “Final Oahe Dam/Lake Oahe Master Plan Missouri River, South Dakota and North Dakota Design Memorandum MO-224.” The document was prepared to evaluate the environmental impacts associated with management of the Lake Oahe Project in North and South Dakota.
- In April 2010, the Omaha District published an Environmental Assessment entitled, “Missouri River Recovery Program, Emergent Sandbar Habitat Complexes in the Missouri River, Nebraska and South Dakota, Draft Project Implementation Report (PIR) With Integrated Environmental Assessment.” These actions are being undertaken to address endangered species needs and mitigate for the loss of habitat that resulted from construction, operation, and maintenance of the Missouri River Bank Stabilization and Navigation Project (BSNP).
- In September 2010, the Omaha District published document entitled, Missouri River Mainstem System, 2010-2011 Draft Annual Operating Plan. The Annual Operating Plan (AOP) presents pertinent information and plans for regulating the Missouri River Mainstem Reservoir System (System) through December 2011 under widely varying water supply conditions. It provides a framework for the development of detailed monthly, weekly, and daily regulation schedules for the System's six individual dams during the coming year to serve the Congressionally authorized project purposes.
- In October 2010, the Omaha District published an Environmental Impact Statement entitled, “Draft Programmatic Environmental Impact Statement for the Mechanical Creation and Maintenance of Emergent Sandbar Habitat in the Riverine Segments of the Upper Missouri River.” This Draft Programmatic Environmental Impact Statement (PEIS) evaluates the potential environmental consequences of implementing the Emergent Sandbar Habitat (ESH) program on the upper Missouri River.

2. Purpose and Need for the USACE Action

2.1. Purpose and Need for the Surplus Water

As stated in Section 1, the purpose of this study is to identify whether there is a quantity of surplus water, as defined in Section 6 of the 1944 Flood Control Act, which the Secretary of the Army can make available to execute surplus water supply agreements with prospective Lake Sakakawea M&I water users. The Omaha District, U.S. Army Corps of Engineers has received requests for new water supply easements from suppliers to the oil and gas industry. Based on Corps policy, none of the easement requests can be processed until a determination is made by the Secretary of the Army that surplus water is available in the Garrison Dam/Lake Sakakawea Project and that use of the surplus water would not significantly affect existing lawful uses of Lake Sakakawea water.

In addition to the water needs of the oil and gas industry, 110 of the 142 existing easements for water intakes at Garrison Dam/Lake Sakakawea will expire over the 10-year period of analysis, and may require surplus water agreements prior to renewal. Corps guidance¹ states “*no easement that supports any type of water supply agreement will be executed prior to the water supply agreement being executed by all parties.*” An analysis of total demand for surplus water storage at Garrison Dam / Lake Sakakawea over the 10-year planning period is provided below.

Because of uncertainty in the rate of oil and gas development, and resulting water demand over the 10-year planning period, temporary use of 100,000 acre-feet of surplus water (equivalent to 257,000 acre-feet of storage) has been evaluated. This is somewhat in excess of the amount of new easements requests and total estimated demand. The 100,000 acre-feet of surplus water was selected by the Omaha District based on the potential for growth in future M&I water demand over the 10-year planning period. Demand for water from Lake Sakakawea has grown rapidly just over the last 18 months, as exemplified by the fact that six new easement applications have been received just during the short period of time that this study has been underway. Therefore, a surplus water determination in excess of current easement applications received to date has been evaluated for the purposes of efficiency and responsiveness, so that the storage volume associated with all reasonably foreseeable future surplus water needs over the period of analysis could be evaluated and approved in one single action by the Assistant Secretary. Should resource impacts from temporary use of 100,000 acre-feet of surplus water (equivalent to 257,000 acre-feet of storage) prove significant, then lesser amounts could be evaluated.

The problem of cost effective municipal and industrial (M&I) water supply to support the oil and gas industry in North Dakota, and the need for surplus water from Garrison Dam/Lake Sakakawea Project to meet expected demand is quantified in the following demand analysis.

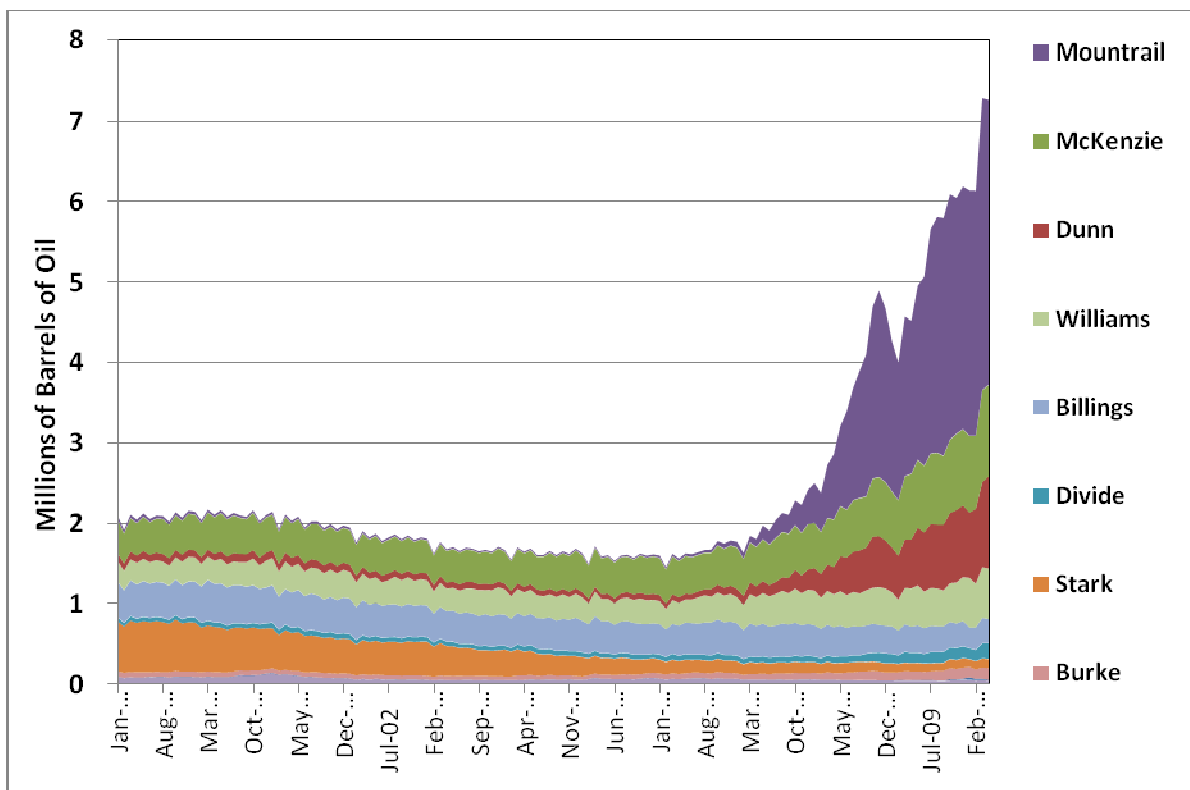
2.1.1. Oil and Gas Industry Water Supply Demand

A major new source of water demand in western North Dakota is due to the recent boom in oil and gas development in the region. Figure 3 depicts the rapid increase in oil production in oil-

¹ Real Estate Policy Guidance Letter No. 26, Easements to Support Water Supply Storage Agreements and Surplus Water Agreements, 10 June 2008.

producing counties of western North Dakota. The boom in oil and gas production in western North Dakota is in large part due to the recent advancements in the application of horizontal drilling and hydraulic fracturing ('hydro-fracing' or 'fracing') technology, which allows for cost-effective extraction of oil and gas from previously unviable formations. This technology is critically dependent on large volumes of high quality, fresh water. During hydrofracing, water, in combination with sand and proprietary chemical gelling mixtures, is forced under high pressure into the formation surrounding a well in order to fracture the surrounding rock, allowing the oil and gas to travel through the fractures into the well. The quantity of water required to hydrofrac a well varies widely, and can range from less than 2-acre-feet to more than 12-acre-feet per well (NDSWC, 2010).

Figure 3
Oil Production in the Lake Sakakawea Area, by County



In addition to water used for fracing, there is also a large quantity of water required for drilling and casing each newly drilled well. The drilling process uses large quantities of drilling 'mud', which is a mud-like mixture that is pumped past the drill head to both cool the drill bit and collect drilled material and transport it to the surface as the mud is circulated. Wells are commonly drilled thousands of feet deep, and then subsequently drilled several thousands of feet horizontally through the oil-bearing formations. This extensive drilling requires large quantities of drilling mud and, as such, large quantities of water are used to mix the mud.

Each well must also be 'cased', i.e., the well shaft (vertical section) must be encased in a solid tube of concrete so that neither fracing chemicals nor oil permeate into other geological layers, many of which contain fresh water aquifers. The concrete used to case such deep wells also

requires a large quantity of water. The amount of water required for drilling and casing a single well has increased from approximately 0.04 of an acre-foot to 0.4 of an acre-foot (a 10-fold increase), in large part due to technological advances in horizontal drilling techniques that have resulted in much longer drilling runs and therefore more casing required (NDSWC, 2010).

In addition to water used for fracing, drilling, and casing of wells, there is additional water required for maintenance of existing wells. Maintenance of existing wells may include another water-intensive activity known as ‘de-brining’. De-brining is a process in which water is used to dilute salt brines that have a tendency to form in and throughout the well shaft due to high concentrations of salts. During de-brining, fresh water is used to reduce the overall salinity of the well and to dissolve obstructive salt brine formations in order to prevent clogging. The ND State Water Commission estimates that 10% of existing wells require de-brining on an annual basis, using approximately 1.6 acre-feet of water per well (NDSWC, 2010).

Between fracing, drilling and casing, and de-brining, each new well in western North Dakota is estimated to require between 2.6 acre-feet and 13.2 acre-feet of water per well. Low end estimates are based on reported water-use data; however new drilling technologies (i.e., horizontal drilling) requires higher volumes of fracing water, and wells using these technologies are not yet fully represented in water-use data statistics. Therefore, total required water volumes have been calculated under a range of water requirements per well. Depending on which estimates are used for each of the aforementioned parameters, the potential for water supply demand from the oil and gas industry varies significantly. Demand could be as low as 7,000 acre-feet per year or as high as 27,000 acre-feet per year (NDSE, 2010).

2.1.2. Existing Lake Sakakawea Water Users

The Corps has issued 142 water intake easements around Lake Sakakawea, only one of which has a water supply agreement (Basin Electric Power Cooperative). Of these 142 water intake easements, approximately 77% (110) will expire during the 10-year study period. According to Corps policy, holders of these easements may be required to execute surplus water agreements with the Corps of Engineers as a pre-condition of re-issuance of their current easements.

The quantities of water being withdrawn through these easements are difficult to determine from the available data. The Corps keeps records on easement allocations, but does not collect data on actual water usage. The North Dakota State Water Commission does keep detailed data on permitted water usage, and all Corps easements also require a North Dakota or Tribal water permit. However, there is no data set that allows direct correlation of State water use permits with Corps easements. An analysis of all ND state water permits for surface water withdrawals within one mile of Lake Sakakawea shows that there are 115 permits totaling 30,664 acre-feet of allocations for small users². From 1989-2009, average reported water use for these 115 small permit holders was 6,384 acre-feet (21% of total allocation) in total.

² Small users exclude the 15 largest permits, which are all institutional users. Most of these 15 institutional easements have not been used for decades and are therefore not deemed to be representative of ‘typical’ water permits.

There are also 15 State surface water permits within one mile of Lake Sakakawea held by large, institutional users. The permitted allocations for these 15 State surface water permit holders total 3,344,589 acre-feet, but many allocations date back to the 1950s - 1960s and have never been utilized. From 1989-2009, average reported water use for these 15 large institutional permit holders was only 23,612 acre-feet (0.7% of total allocation), and water use was reported for only 6 of the 15 large institutional users. Maximum water usage over this 21-year period was 27,362 acre-feet (see Section 3.2.2 of the Surplus Water Report, Volume 1).

2.1.3. Total Water Supply Demand

Existing water demand in areas surrounding Lake Sakakawea has been relatively steady over the last 20 year period and is not expected to change significantly over the 10-year study period, resulting in no new net demand for the region. Water demand from the oil and gas industry has developed rapidly since 2008 and is expected to result in an increase in demand ranging from 7,000 acre-feet to 27,000 acre-feet annually for the next 10-11 years, and then decrease abruptly thereafter as the Bakken Formation is fully developed. The upper range of the estimate 27,000 acre-feet annually, has been used in this estimate of surplus water needs for the 10-year study period.

Water demand represented by Lake Sakakawea water intake small easement holders whose easements will expire within the 10-year study period has been estimated to be approximately 23,754 acre-feet per year, and has been used in this estimate of surplus water demand for this group of users. The maximum water usage by Lake Sakakawea large institutional easement holders over the 21-year period of 1989-2009 is 27,362 acre-feet per year. Reclamation projects that have been specifically authorized by Congress do not require a water agreement from the Corps, therefore Reclamation projects are not considered in the demand analysis. Likewise, the Basin Electric/ Dakota Gasification intake already has a water storage agreement in place so they are not considered in the demand analysis. Future water demand for the remaining large institutional easement holders over the 10-year planning period is 2,083 acre-feet. The existing and potential users of Lake Sakakawea may require use of surplus water from within the Garrison Dam/Lake Sakakawea Project during the 10-year study period.

For the reasons stated previously, there is a significant amount of uncertainty associated with this estimate of total demand. Therefore, the Omaha District determined at the initiation of this study to request the authority to identify as surplus 100,000 acre-feet of yield (equivalent to 257,000 acre-feet of storage) to be able to address Garrison Dam/Lake Sakakawea Project water intake easement requests that could reasonably be expected to arise over the proposed 10-year study period. Based the estimate of identified demand, a surplus declaration of 100,000 acre-feet of yield (equivalent to 257,000 acre-feet of storage) would provide an allowance of more than 45,000 acre-feet of additional yield that would be available to meet as yet unidentified M&I water demand that could arise during the 10-year study period.

3. Alternatives Formulation

3.1. Planning Goals and Objectives

The goal of the Surplus Water Report is to determine whether there is surplus water available in the Garrison Dam/Lake Sakakawea Project and to evaluate whether entering into agreements for the use of surplus water from the Project is the most cost effective means of meeting the near-term (10-year) water needs of the study area. The study area is defined as the 11-county area surrounding Lake Sakakawea in western North Dakota.

National water policy states that the primary responsibility for water supply rests with states and local entities, not the Federal government. However, the Corps can participate and cooperate with state and local entities in developing water supplies in connection with the construction, operation, or modification of Federal navigation, flood damage reduction, or multipurpose projects. Specifically, the Corps is authorized to provide storage in new or existing multipurpose reservoirs for municipal and industrial water supply. However, since water supply is a state and local responsibility, the cost of water supply storage and associated facilities in a Corps project must be paid for entirely by a non-Federal entity.

The Secretary of the Army is authorized to make agreements with states, municipalities and other non-Federal entities for the rights to utilize water supply storage in Corps reservoirs. The Secretary of the Army can enter into agreements with states, municipalities, private entities or individuals for the use of 'surplus water'. Under Section 6 of the Flood Control Act of 1944, the Secretary of the Army is authorized to make agreements with states, municipalities, private concerns, or individuals for surplus water that may be available at any Corps reservoir. Surplus agreements may be for domestic, municipal, and industrial uses.

Planning objectives for this study were developed to be consistent with Federal, State and local laws and policies, and technical, economic, environmental, regional, social, and institutional considerations. The planning objectives were used to help formulate and evaluate plans to avoid, minimize, and mitigate (if necessary), any adverse project impacts to the environment. Planning objectives also provide a decision framework to identify the least cost water supply alternative, avoid adverse social impacts, and meet local preferences to the fullest extent possible.

In pursuit of the project goal, the following Federal planning objectives were established:

- Determine if surplus water is available at the Garrison Dam / Lake Sakakawea Project and determine the storage amount to be evaluated for potential impacts, over the next 10 years
- Anticipate demand and requests for temporary surplus water agreements at the Project over the 10-year study period, including requests identified within this report and a forecast of additional requests.
- Determine repayment unit costs to apply to surplus water agreements

Also in pursuit of the project goal, the following regional planning objectives were established:

- Provide sufficient water to meet the needs of existing and prospective applicants for new surplus water agreements at Garrison Dam / Lake Sakakawea for the next 10 years by the most efficient means;
- Provide sufficient water to meet the needs of current Garrison Dam/Lake Sakakawea water supply users whose existing easements will expire within the next 10 years.

This study develops and evaluates alternatives to determine how best to meet the easement applicants' water needs within the constraints described below. The impacts of entering into agreements for the use of surplus water on other project purposes are assessed so that an optimal alternative that provides needed water supply and does not negatively impact other project purposes may be identified. The impacts assessed in this analysis include effects on: flood control, navigation, irrigation, hydropower, municipal and industrial water supply, fish and wildlife, recreation, water quality, and any associated environmental and economic effects.

3.2. Planning Constraints

Planning constraints related to reservoir operations include maintenance of the project's ability to support currently authorized project purposes and to support other incidental uses. Currently authorized project purposes are: flood control, navigation, irrigation, hydropower, municipal and industrial (M&I) water supply, fish and wildlife, recreation, and water quality.

A second planning constraint relates to the requirements of Section 6 of the Flood Control Act of 1944. Under Section 6, the Secretary of the Army is authorized to make agreements with states, municipalities, private concerns, or individuals for surplus water that may be available at any Corps reservoir. The formulation and evaluation of alternative plans is constrained by the limitations imposed by Congress and Corps policy for temporary reallocation of surplus water. These constraints/limitations include:

- No surplus water agreement can adversely affect then existing lawful uses of such water;
- No temporary surplus water agreement can be made for crop irrigation;
- Surplus water agreements can only be granted if the Secretary can classify surplus water as either: 1) water stored that is not required because the authorized use for the water was never developed or if the need for the authorized use was reduced or eliminated by changes in water demand that occurred since authorization or construction of the project; or 2) water that would be more beneficially used as municipal and industrial water than for the authorized project purposes and which, when withdrawn, would not significantly affect authorized purposes over some specified period of time; and
- Temporary surplus water reallocations are time limited and can only be granted for a period of up to 5 years, with one 5-year renewal option (for a total period of 10 years).

3.3. Management Measures

A management measure is a feature (i.e., a structural element that requires construction or assembly on-site), or an activity (i.e., a nonstructural action) that can either work alone or be combined with other management measures to form alternative plans. Management measures were developed to address study area problems and to capitalize upon study area opportunities. Management measures for this study were derived from a variety of sources including prior studies, agency and public input, and the project delivery team (PDT).

3.3.1. Identification of Management Measures

The following management measures were identified for initial consideration:

Structural Measures (Features)

- Structural modifications to the project to increase storage capacity
- Provision of surplus water from the sediment storage portion of the permanent pool to M&I water supply for up to 10 years, including associated infrastructure (i.e., intakes, pipelines, storage and distribution facilities)
- Groundwater withdrawals, including associated infrastructure
- Surface water withdrawals from the Missouri River upstream of Lake Sakakawea, including associated infrastructure

Non-Structural Measures (Activities)

- Conservation / incentive programs / regulations / public education / drought contingency planning
- Water reuse / recycling
- Temporary State permits to convert irrigation water to industrial use.

3.3.2. Screening of Management Measures

The following sub-sections evaluate and screen each of the structural and non-structural measures identified above to determine which measures should be carried forward in the planning process and included in the formulation of alternatives. The Corps of Engineers Principles and Guidelines³ identify four criteria to be used in the formulation and evaluation of alternative plans: completeness, effectiveness, efficiency, and acceptability. At this phase of the planning process, management measures are screened, using these four criteria, to determine whether they have the potential to make meaningful contributions to achieving the goals and objectives of the project. While none of these criteria are absolute, it is clearly reasonable to screen out from further consideration any management measure that: 1) does not contribute to meeting study goals and objectives to any significant extent (completeness), 2) is not effective in resolving study area problems and needs (effectiveness), 3) is not an efficient means of solving the problem when compared to other potential measures (efficiency), or 4) is not an acceptable solution to other Federal and non-Federal agencies and affected publics (acceptability).

This is not to imply that some management measures that are screened out from further consideration may not be beneficial public policies or effective solutions to other legitimate

³ Economic and Environmental Principles for Water and Related Land Resources Implementation Studies and The Economic and Environmental Guidelines for Water and Related Land Resources Implementation Studies, U.S. Water Resources Council, February 1983

problems of the study area. Rather, management measures are screened out from further consideration when it can be reasonably determined that they will not meaningfully contribute to meeting study goals and objectives or resolving the problems and needs that the study was initiated to address.

3.3.2.1. Structural Measures

Four structural measures are considered below. Two structural measures are screened out from further consideration (i.e., structural modifications to the project and groundwater withdrawals). Two structural measures are carried forward into formulation of alternative plans: 1) temporary provision of surplus water from Lake Sakakawea, and 2) surface water withdrawals from free-flowing reaches of the Missouri River).

Structural Modifications to the Project to Increase Storage Capacity

Corps of Engineers guidance (USACE, 2000) states that existing Corps projects may be modified to add storage for municipal and industrial water supply. Structural measures to increase the storage capacity of an existing dam typically include: auxiliary spillways, lined overflow sections, raising the dam, modifications to the existing spillway, and combinations of these measures. Environmental criteria that must be assessed when considering structural measures to increase storage capacity include: avoiding adverse impacts to the environment, mitigating any unavoidable environmental impacts, maintaining water quality and ecosystem functions during and after the modification, and achieving no net loss in environmental values and functions (USACE, 2004c).

The advantages of structural measures to increase storage capacity is that the needs of municipal and industrial water supply can be met without the negative effects on project users associated with taking water storage away from other authorized project purposes. The disadvantages of structural measures to increase storage capacity is that the studies necessary to design such modifications are lengthy and costly; and construction activities are similarly costly, time consuming, and can have significant impacts on the physical and natural environment. As a result, structural modifications to increase storage capacity are typically only considered when municipal and industrial water needs are so significant relative to total existing storage capacity that the effects of reallocating existing storage would render the project unable to meet its authorized project purposes, and where the environmental effects of surplus M&I water use would exceed the environmental effects of structural modifications.

These considerations indicate that structural modifications would not be an effective measure for the Garrison Dam / Lake Sakakawea Project. The amount of water being requested, 100,000 acre-feet, is only 0.7 percent of the net system yield of 15.2 million acre-feet. Use of this small portion of total system yield would have negligible impacts on current authorized purposes and on environmental conditions at the project, or in upstream or downstream reaches of the Missouri River.

Structural measures to add additional storage at Garrison Dam / Lake Sakakawea are also not efficient given the temporary nature of the industrial water needs of the oil and gas industry. In order to meet Corps design criteria, structural measures would need to be designed and built to

last for the remaining design life of the project, which is well in excess of the term of the temporary water needs of the industry.

Based on this assessment, structural measures involving modifications to the Garrison Dam/Lake Sakakawea Project to increase storage capacity have been eliminated from further consideration (screened out) for reasons of efficiency, effectiveness, and considerations of adverse effects on the environment.

Groundwater Withdrawals

Water users in North Dakota require a permit from the State for groundwater withdrawals for industrial use, irrigation of more than five acres and domestic or livestock use in excess of 12.5 acre-feet. In executing its permit decision making process, the State closely monitors water usage and impacts on aquifers to protect groundwater resources and avoid damage to critical aquifers. The State of North Dakota has recently completed a detailed study of state water resources that contains its assessment of the ability of groundwater resources to meet the water needs of the oil and gas industry in North Dakota (NDSWC, 2010). The study is incorporated by reference and the summary conclusion of the assessment of groundwater resources is provided below:

“Groundwater supplies in western North Dakota are limited. Glaciofluvial and other shallow aquifers and the Fox Hills – Hell Creek bedrock aquifer are insufficient to supply the requirements of the B-S-TF play at the proposed rate of development. It is critical that ground-water supplies be conserved for the use and sustenance of towns, homes, local industries, and farms and ranches, after the completion of oil development. As of December of 2009 there were 28 water depots, for a total allocation of 2,340 acre-feet per year serving the oil industry in western North Dakota. Thirty more water permits for water depots are pending, for an additional 5,534 acre-feet per year. Not all of these will likely be approved. Even if all were approved, water supplies from groundwater would fall far short of needs for the B-S-TF play. The only plentiful and dependable supply of water for the oil industry in western North Dakota, at projected rates of extraction, is the Missouri River system, including Lake Sakakawea.” (NDSWC, 2010)

Comparisons of total groundwater usage in western North Dakota shows that existing groundwater withdrawals for all uses in the study area total less than 19,000 acre-feet annually, and are already being stressed. It is unreasonable to expect these limited groundwater resources to meet the water needs of the oil and gas industry, which are projected to exceed total existing groundwater use by over 50 percent (27,000 acre-feet).

Also, North Dakota state water law is based on the doctrine of prior appropriations, which allocates water rights according to the date the Office of the State Engineer receives the permit application (senior rights) and the priority of the water use as established by state law. New applications for significant quantities of groundwater for industrial purposes would be considered subordinate under state water law to more senior water rights. They would also be considered subordinate to higher priority uses, which include domestic, municipal, livestock, and irrigation – the purposes to which the vast majority of the limited groundwater resources of the study area are already committed. Priority of use is invoked when competing applications (those

filed within 90 days of each other) from the same source are received and that source is insufficient to supply the competing applicants.

Therefore, requests for groundwater permits for the oil and gas industry would only be granted in conditions where enough excess water was available that withdrawals would not affect senior and higher priority appropriations. This is most certainly not the case with western North Dakota's limited and stressed groundwater resources.

Based on this assessment, structural measures involving additional groundwater withdrawals have been eliminated from further consideration (screened out) for reasons of lack of completeness and lack of public acceptability.

Temporary Use of Surplus Water

Temporary use of surplus water in the permanent storage portion of the Garrison Dam/Lake Sakakawea Project is considered a structural measure. In order to meet the completeness criterion, this measure includes the necessary investments by non-Federal entities to construct water intakes, pipelines, and water depots necessary to deliver the purchased water to the oil and gas industry.

The structural measure of temporary use of surplus water in the permanent zone can be scaled to meet the entire water needs of the oil and gas industry, and so fully meets the effectiveness criterion.

The costs of surplus water to the industry would include the prorated share of updated project costs, plus the full cost of all necessary infrastructure investments on and off project lands. These costs, when compared to the costs of purchasing water from multiple locations that are more distant from the oil and gas industry needs, may prove to be the most cost effective means of achieving project objectives, and is therefore tentatively considered to meet the efficiency criterion, subject to more detailed analysis in the comparison of alternative plans.

Provision of water from Lake Sakakawea is the preferred alternative of the State of North Dakota (as stated in public documents), the oil and gas industry (as evidenced by easement applications and state permit requests), and many members of the general public in North Dakota (as expressed in news publications). Therefore, it is tentatively considered to meet the criterion of acceptability, subject to further analysis.

Consistent with the criteria of completeness, effectiveness, efficiency, and acceptability, the structural measure of temporary use of surplus water in the Garrison Dam / Lake Sakakawea Project is carried forward for further consideration into the formulation of alternative plans.

Surface Water Withdrawals From Free-Flowing Reaches Of The Missouri River

Withdrawal of water from the surface waters of North Dakota to serve the needs of the oil and gas industry is a potentially viable structural measure. The State of North Dakota recognizes this potential in its analysis of water availability for the oil and gas industry (NDSWC, 2010):

“Surface-Water Storage and Use

Except for the Missouri River system, most of the state's surface waters are heavily appropriated and are not good prospects for large-scale long-term sustainable water supplies. For many of the state's rivers, however, there are seasonal flows that are not being captured and used. With appropriate capture and storage these waters could be retained and used. Possible storage techniques would include surface storage and aquifer recharge and recovery.” (p. ES-16)

A sovereign lands permit is required from the state for withdrawals from free-flowing reaches of the Missouri River. If channel alterations are necessary, then a regulatory permit must also be obtained from the Corps of Engineers. However, no water supply agreement or easement would be required from the Corps of Engineers for water obtained from river reaches not contained within a Corps reservoir or on Corps project lands, provided the Corps does not operate the system to meet the needs of an intake. Water allocation decisions for free-flowing river reaches, depending on the scope of such a withdrawal, are generally under the purview of the State or the Three Affiliated Tribes. The State of North Dakota has identified the free-flowing section of the Missouri River as the best available source of water for the oil and gas industry (after Lake Sakakawea).

An example of a proposal to provide water from a free-flowing reach of the Missouri River upstream of Lake Sakakawea is collaboration of northwest North Dakota water stakeholders (including the BDW Rural Water District, the City of Crosby, the McKenzie County Commission, the McKenzie County Water Resources District, R&T Water Supply Association, the Williams Rural Water District, and the City of Williston) (NNDWD&M, 2010). This group has developed a regional water development plan that proposes delivery of Missouri River water from the Williston Regional Water Treatment Plant to the northwest North Dakota region. This plan includes a series of water supply and transmission infrastructure projects that could provide up to 11,200 acre-feet of water for regional water demands, principally focusing on the water needs of the oil and gas industry (NNDWD&M, 2010). The Williston project, as proposed, would actually be a shallow groundwater array that would be constructed adjacent to the Missouri River in the alluvium. While this depletion would not be from an intake in the Missouri River surface water and the withdrawal would be off Corps lands, the water would be immediately hydrologically connected to the river. The project would replace the existing intake with a possible horizontal collector well (20 MGD). Horizontal collector wells incorporate a vertical shaft, but then utilize horizontal screen laterals to collect and filter the groundwater. Typically, they are installed close to a dependable surface water source (i.e., the Missouri River), and these wells take advantage of a natural filtering process called riverbank infiltration (RBI). For this reason, the State does not consider the request with a groundwater evaluation because it would not be from a surficial groundwater aquifer. The withdrawal would result in depletion from to the Missouri River and is considered as such.

Evaluation of this proposal has determined that it includes all the necessary investments by non-Federal entities to construct water intakes, pipelines, and water depots necessary to deliver the purchased water to the oil and gas industry, and therefore meets the completeness criterion.

This measure can be scaled upwards to meet a significant portion of the water needs of the oil and gas industry, and so at least partially meets the effectiveness criterion.

The cost estimate presented in this collaborative proposal includes estimates of the full cost of all necessary infrastructure investments necessary to extract, transmit, store, and distribute water extracted from the Missouri River. These costs, when compared to the costs of surplus water from the Garrison Dam / Lake Sakakawea Project, may prove to be a cost effective means of achieving study objectives, and is therefore tentatively considered to meet the efficiency criterion, subject to more detailed analysis in the comparison of alternative plans.

Provision of water from the Missouri River is the second-most preferred alternative of the State of North Dakota (as stated in public documents) if temporary use of surplus water from Lake Sakakawea is not available. The oil and gas industry (as evidenced by easement applications and state permit requests) and many members of the public (as expressed in the referenced letter to the Governor of North Dakota) also consider this to be a potentially feasible alternative. Therefore, it is tentatively considered to meet the criterion of acceptability.

Consistent with the criteria of completeness, effectiveness, efficiency, and acceptability, the structural measure of withdrawal of surface waters from free-flowing reaches of the Missouri River is carried forward for further consideration into the formulation of alternative plans.

3.3.2.2. Non-Structural Measures (Activities)

Three non-structural measures are considered below. Two non-structural measures are screened out from further consideration (i.e., conservation/incentive programs and water reuse/recycling). One non-structural measure is carried forward into formulation of alternative plans (i.e., temporary water permits for industrial usage).

Conservation, Incentive Programs, Regulations, Public Education, Drought Contingency Planning

Water conservation, incentive programs, regulations, public education, and drought contingency planning are not viable options for reducing the water demands of the oil and gas industry in western North Dakota. Water reuse/recycling programs are being explored as water reducing options for the industry and are addressed in the next non-structural measure.

As described previously, extracting oil from the Bakken formation is an extremely water intensive activity requiring large quantities of water per well for hydrofracing, casing, de-brining and other maintenance activities. The cost of only the water required to develop a well ranges from over \$400,000 to over \$4.5 million each. Even in the face of these extremely high water costs, the average water requirements per well have been increasing, rather than decreasing, due to new drilling technologies that allow for horizontal drilling that greatly increases the productivity of oil wells. The value of the increased oil production more than offsets the increased water (and other production) costs, resulting in increasing industry water demand.

Industry efforts to reduce water demands have focused on recycling and reuse efforts, since there is no practical conservation method for decreasing water use and still employing the hydrofracing technology that makes extraction of oil economically viable. Incentives work in the opposite direction of increasing (not decreasing) water use, since new drilling technologies require more water per well (not less), and produce significantly greater economic returns, even considering the high cost of water needed for well production. Similarly, State regulatory efforts

have been directed towards increasing, not decreasing, water availability to the oil and gas industry, through temporary State permits allowing industrial use of irrigation water (see temporary water permits for industrial usage - the third non-structural measure described below).

The current estimate of the total water demands of the oil and gas industry (27,000 acre-feet) is nearly one third of the total water usage in the 11-county study area (97,000 acre-feet) and nearly three times the historic average of all industrial users (10,000 acre-feet). Given the massive amounts of industrial water required relative to total supply, water conservation, incentive programs, regulations, public education, and drought contingency planning measures could not be expected to successfully reduce usage to any meaningful degree necessary to meet the effectiveness criterion.

The State of North Dakota recognizes the vital economic importance of the oil and gas industry to the State's economy. A study of the economic impact of the oil and gas industry by the North Dakota Petroleum Council (NDPC, 2007) calculated that North Dakota's oil and gas industry generated \$8.22 billion in total business activity for 2007; \$3.1 billion in direct impacts, and \$5.1 billion in secondary impacts. The industry paid \$520 million in state and local taxes and provided direct employment for 7,719 people and indirect employment for nearly 38,500 people, making it one of the state's largest industries. According to a study by PricewaterhouseCoopers, the oil and gas industry directly and indirectly supported 5.7% of the State's employment, contributed 7.6% of the State's labor income, and represented 9.6% of the value added contribution to the State's economy (PWC, 2008). As a direct result of the oil and gas industry, North Dakota has the lowest unemployment rates in the U.S. and is one of the few states with a significant budget surplus (\$800 million anticipated for 2010).

For these reasons, any non-structural measure predicated on reducing water consumption by the industry (other than through water reuse / recycling) would also reduce industry productivity and the economic benefits the industry provides to the State of North Dakota. Therefore, this measure does not pass the acceptability criterion.

In summary, for reasons of lack of completeness, effectiveness, efficiency, and acceptability, water conservation, incentive programs, regulations, public education, and drought contingency planning measures are eliminated (screened out) from further consideration in the formulation of alternative plans.

Water Reuse/Recycling

The potential for water reuse / recycling in the oil and gas industry is being actively evaluated by the industry and government / public partnerships. The Energy & Environmental Research Center (EERC) of the University of North Dakota (Grand Forks) has entered into a partnership with the U.S. Department of Energy (DOE) and key energy-producing entities in the northern Great Plains to identify and evaluate opportunities for water reuse and recycling in the oil and gas industry (NDIC, 2010a). The purpose of the partnership is:

“...to address issues related to water availability, reducing freshwater use, and minimizing the impacts of facility and industry operations on water quality. The key goals of this partnership, called the Northern Great Plains Water Consortium (NGPWC), are:

- *To evaluate water demand and consumption from competing users in the northern Great Plains region, including energy production, agriculture, industry, and domestic/municipal users.*
- *To assess, develop, and demonstrate technologies and methodologies that minimize water use and reduce wastewater discharge from energy production and agricultural processing facilities.*
- *To identify nontraditional water supply sources and innovative options for water reuse” (NDIC, 2010a).*

Potential opportunities for reuse or recycling in the oil and gas industry include using wastewater from other industries as frac water in the drilling process, or alternatively recycling frac wastewater (called ‘produced water’ or ‘flowback’ water) for use in other industries. Research is currently underway by the EERC, with sponsorship from U.S. DOE, the North Dakota Petroleum Council, and the North Dakota Industrial Commission Oil & Gas Research Council to assess the economic potential to recycle flowback water for reuse in the Bakken formation.

Research activities include: inventorying industry freshwater use, assessing the water quality of flowback water, evaluating water handling costs, evaluating the technical and economic feasibility of recycling and reuse technologies, and making recommendations regarding potential recycling and reuse opportunities in the industry. Preliminary results to date indicate water recovery rates of flowback water of less than 50-percent in the first 10 days, with extremely high salinity levels, and lower but still significant levels of calcium, potassium, and sulfate. Preliminary study results show significant challenges to extensive application of recycling and reuse in the oil and gas industry due to slow flowback rates, low initial recovery volumes, extremely high dissolved salt levels, and challenging treatment technologies – all resulting in limited cost effectiveness for frac water recycling/reuse at this stage of treatment technology development.

Various pilot recycling projects for flowback water and recovering fracturing fluids have been initiated in the Barnett Shale play in Texas. To date, none of these pilot projects have proven to be economically feasible, and significant technical issues remain in ensuring the recycled water is reusable for future well fracturing.

A potentially more economically feasible recycling/reuse application at this phase of technological development could involve treatment and use of non-potable groundwater for well fracturing (rather than recycling and reuse of frac / produced water). This alternative has perhaps greater near-term potential due to the relative abundance of non-potable groundwater and lack of competing demand. Its viability for use in oil and gas production requires additional analysis and research and will be in large part determined by the costs of pre-treatment (water for fracturing must meet certain water quality standards to not damage well production equipment or cause difficulties in the oil extraction process), as well as the relative cost of other available sources of fracturing water.

Unresolved issues related to the technological feasibility of recycling / reuse of flowback water renders it an incomplete solution to meeting the near-term water needs of the oil and gas industry. Effectiveness is also suspect at this stage of technological development. Slow flowback rates and low initial recovery volumes limit the quantity of water that would be

available for reuse, and therefore reduce its ability to meet a significant portion of industry water requirements.

The most significant factor limiting recycling/reuse as a viable non-structural measure at this time is efficiency. None of the reported pilot projects have been found to be economically viable to date, and have been abandoned after the initial pilot project (i.e., subsidized) stage. Use of non-potable groundwater may hold some near-term future promise, but additional research is required to identify the conditions (water quality, location, pre-treatment requirements) necessary to determine whether - and to what extent - this measure could meet a significant portion of industry water needs.

Recycling/reuse definitely meets the criteria of public acceptability, as government, various industry stakeholders, and the general public appear to strongly support efforts to reduce the competition of the oil and gas industry for scarce water resources through recycling and reuse of produced water, as well as to minimize potential for environmental degradation by reducing the total volume of produced water in the waste stream.

Recycling/reuse of water as a non-structural measure to meet the water demands of the oil and gas industry does hold some future promise, but does not meet evaluation criteria for a technologically feasible and economically viable measure for meeting the near-term (10-year) water needs of the industry. Effectiveness (i.e., the extent of industry demand met by this measure) also cannot be demonstrated until technical and economic issues are better understood. For these reasons, recycling / reuse were eliminated (screened out) from further consideration in the formulation of alternative plans.

Temporary Water Permits for Industrial Usage

The North Dakota State Water Commission is currently granting temporary water permits to holders of existing irrigation water permits to use their water for industrial purposes – allowing farmers to sell their irrigation water to the oil and gas industry (NDSWC, 2010a).

“To facilitate more efficient distribution of water for the oil industry, the State Engineer has developed a new policy granting temporary authorization for holders of existing irrigation water permits to use water for industrial purposes...If significant problems persist with the efficient distribution of water for oil field use, the State Engineer will consider continuing this policy beyond 2011 on a year-by-year basis.” (NDSWC, 2010a)

Unless the permit holder’s allocation is from the Missouri River or Lake Sakakawea, sale of irrigation water is currently limited to approximately 100-percent of the permit holder’s average annual use (not their total allocation), in order to guarantee no net increase in the quantity of the water withdrawn from groundwater or highly allocated surface water sources by the permit holder. State permit holders in Lake Sakakawea or the Missouri River may sell their entire allocation irrespective of past use levels.

The average annual usage limit applied to all non- Missouri River/Lake Sakakawea irrigation State permit holders in an effort to avoid substantial increases in groundwater use from the overall aquifer system as well as protect from severe groundwater overdraft. This is because there is some percolation and aquifer recharge when water is used for irrigation. However, when

that water is transferred from irrigation to industrial use, the percolation and aquifer recharge is eliminated, resulting in a net increase in water "use", or net decrease in aquifer water availability. The uncertainty regarding percolation and aquifer recharge is another factor that contributes to the tenuous estimate of the total volume of water from this measure that will be available for industrial use.

These temporary State permits are only granted for the calendar year (January 1 – December 31) in which the permit is issued. No permanent industrial water right is created by the State's issuance of a temporary permit, and the temporary permits are not guaranteed to be reissued in the following year. All temporary State permits require installation of meters on discharge pipes and annual reporting to the State of the quantity of irrigation water sold to industry by each permit holder.

It is extremely difficult to estimate the total amount of oil and gas industry water demand that can be met over the next 10 years through this non-structural measure because: temporary industrial water permit requests are initiated by the individual irrigation permit holder, this is a new State policy without historic usage data, and continuation of the program and re-issuance of temporary permits are not guaranteed from year to year. However, since this State program is actually underway and water is currently being sold from irrigation to industrial use, this non-structural measure meets the criteria of completeness.

Effectiveness (i.e., the proportion of the need that can be met through this measure) is very hard to determine this early in the implementation phase of the new State policy, but at this stage of the temporary program appears to be relatively low. A total of 391.7 acre-feet of State permits were approved by the State for irrigation to industrial water conversions for 2010 (1.5% of the 27,000 acre-feet of oil and gas industry requirements). A total of 526.6 acre-feet of State permits have been approved thus far for conversions for 2011 (2.0% of 27,000 acre-feet). Average State permit size for 2010/2011 is 106.35 acre-feet.

This measure appears to be efficient, as evidenced by the fact that water providers to the oil and gas industry are purchasing irrigation water from the temporary State permit holders in lieu of buying water from other available sources. State permit holders are not required to report the price at which they sell their water to the industry so only anecdotal information is available, which indicates a selling price of \$0.02/gallon (\$0.84/barrel). This compares favorably to the price of water purchased by the industry from water depots, which ranges from \$0.50/barrel to \$1.05/barrel, depending on the water depot and the purchaser.

This measure also appears to meet the criterion of acceptability, since there are willing sellers, willing buyers, State permit approvals, and a lack of public opposition within North Dakota to the practice thus far.

Temporary State permits to convert irrigation water to industrial use by the oil and gas industry is a non-structural measure that meets the criteria of completeness, efficiency, and acceptability, and to a much lesser (but somewhat unknown) degree, effectiveness. For these reasons, the non-structural measure, temporary permits for industrial water usage, is carried forward into the formulation of alternative plans. However, because of its low (and unreliable) effectiveness, it

will only be considered in combination with other measures and cannot function as a stand-alone alternative.

4. Alternatives Including the Proposed Action

The alternatives evaluated in detail within this Environmental Assessment include the No Action – Next Least Costly Alternative and the Proposed Action. For comparison purposes, both alternatives describe the most likely means of providing 100,000 acre feet of water to meet the current and future water needs of the study area. The Proposed Action would be the temporary use of up to 100,000 acre-feet of yield (257,000 acre-feet of storage) in the Garrison Dam/Lake Sakakawea Project, including the infrastructure development required to access the surplus water.

Because the only plentiful and dependable supply of water for M&I development in western North Dakota is the Missouri River system, including Lake Sakakawea, (NDSWC, 2010), the No Action alternative assumes a significant portion of the demand for water would be met by the Missouri River, but not within Garrison Dam/Lake Sakakawea Project. The other difference between the No Action and the Proposed Action is that the No Action alternative utilizes 527 AF of groundwater rather than surface water. The remainder of Section 4 provides additional detail on the No Action and Proposed Action alternatives.

Table 2 summarizes the sources of demand for both No Action and with Proposed Action.

Table 2
Water Demand for No Action and the Proposed Action

Sources of M&I Water Demand	No Action (acre-feet)	Proposed Action (acre-feet)
Small GD/LS Water Users with Expiring Easements	23,754	23,754
Large Institutional GD/LS Water Users	2,083	2,083
Subtotal GD/LS Easement Water Use	25,837	25,837
Oil & Gas Industry Demand	27,000	27,000
Remaining Unidentified Future Users Demand	47,163	47,163
Subtotal Additional Water Use	74,163	74,163
Total Required Yield	100,000	100,000

4.1. Most Likely Future Without Project Condition - No Action Alternative

The most likely future without project condition consists of a combination of the structural and non-structural measures that survived the screening process described above, with the exception

of the proposed action (temporary use of surplus water in the Garrison Dam/Lake Sakakawea Project). The future without project condition would be a combination of the following measures anticipated to be used to meet existing water needs, as well as the growing municipal and industrial (M&I) water demands of the study area:

- Development of new water withdrawals from free-flowing reaches of the Missouri River up-stream of the Garrison Dam/Lake Sakakawea Project or other non-Garrison Project sources (e.g., expansion of the Williston Regional Water Treatment Plant),
- Continued use of existing Garrison Dam/Lake Sakakawea M&I water intakes,
- Temporary conversion of irrigation water permits to industrial usage (agricultural to M&I), and
- Continued use of all other available sources of existing water depots.

Water demand from the oil and gas industry is highly decentralized, as is decision making, with each individual oil producer making their own decision about where to get the water needed to develop their well. Thousands of these discrete decisions are made by scores of oil producers in any given year. Obviously it is not possible to predict the outcomes of each of these decisions individually. Because they are profit maximizing producers however, oil and gas companies typically choose the least costly water source that will provide them the required volume and quality of water they need for well production, so long as the water can be delivered reliably (i.e., in the quantities needed, when needed). For this reason, the most likely future without project condition is defined as the least costly combination of feasible measures for providing the quantity of water sufficient to meet the demands of the oil and gas industry from the multiple water sources currently available, excluding Lake Sakakawea.

4.2. Proposed Action

The proposed action for the Army Corps of Engineers would include decision making associated with three different administrative actions:

1. Programmatic decision making to identify surplus water, as defined in Section 6 of the 1944 Flood Control Act, which the Secretary of the Army can make available to execute surplus water supply agreements with prospective M&I water users for up to of up to 100,000 acre-feet of yield (257,000 acre-feet of storage) from Lake Sakakawea,
2. Project level decision making to execute surplus water supply agreements with the three applicants and grant them new water supply easements, and
3. Project level decision making to execute surplus water supply agreements with holders of current easements for existing water intakes at Lake Sakakawea if their current easements expire during the 10-year planning period.

Because these are administrative actions, USACE actions to implement them would not result in environmental effects. However, USACE decision making to implement the proposed actions are *connected* (40 CFR 1508.25(a)(1)) to other actions that would be reasonably foreseeable and are the focus of the environmental analysis.

4.2.1. Intake Site Selection

As of 2010, there were more than 140 existing water intake easements across Corps land at Lake Sakakawea. The site selection, construction, operation, and monitoring of water intakes on Lake Sakakawea is an ongoing program addressed by multi-disciplinary consideration of environmental factors in planning the site selection and construction of intakes to avoid and minimize environmental consequences. None of the environmental evaluations for the existing intakes resulted in a determination that significant environmental impacts would occur, nor did the decision to grant any of the easements require the preparation of an Environmental Impact Statement. When recent drought-driven changes to water surface elevations necessitated modification of existing intakes; these actions were reviewed with an Environmental Assessment and resulted in a Finding of No Significant Impact (USACE, 2004b).

The existing environmental and cultural or historic resources at any proposed intake site affect the conditions for approval that would be required by the Corps regulatory or real estate review, North Dakota state sovereign lands permits, and/or coordination with resource agencies responsible for the protection of other resources would be expected to avoid significant resources. These conditions typically address specifications on methods of construction, placement of intakes, limitations on construction time, noise during operation, and limitations on pumping. All currently proposed intakes, or those that could be proposed in the future, require this detailed evaluation to address environmental approvals and regulatory considerations.

In an effort to improve the coordination and environmental evaluation of water intakes in Lake Sakakawea/Missouri River in North Dakota, the North Dakota State Water Commission developed a shapefile in GIS characterizing the shore of the Missouri River and its reservoirs in North Dakota for the level of “difficulty of access” as a preliminary indication of the possible difficulty and delays in obtaining permits. Departments consulted for map development and review included the Corps of Engineers (Both Lake Sakakawea and Lake Oahe Project Offices), the North Dakota State Water Commission, the North Dakota Department of Game and Fish, the North Dakota Historical Society, the U.S. Fish and Wildlife Service, and the North Dakota Department of Parks and Recreation. Both the Standing Rock Sioux and the Three Affiliated Tribes cultural offices were invited to participate, but declined.

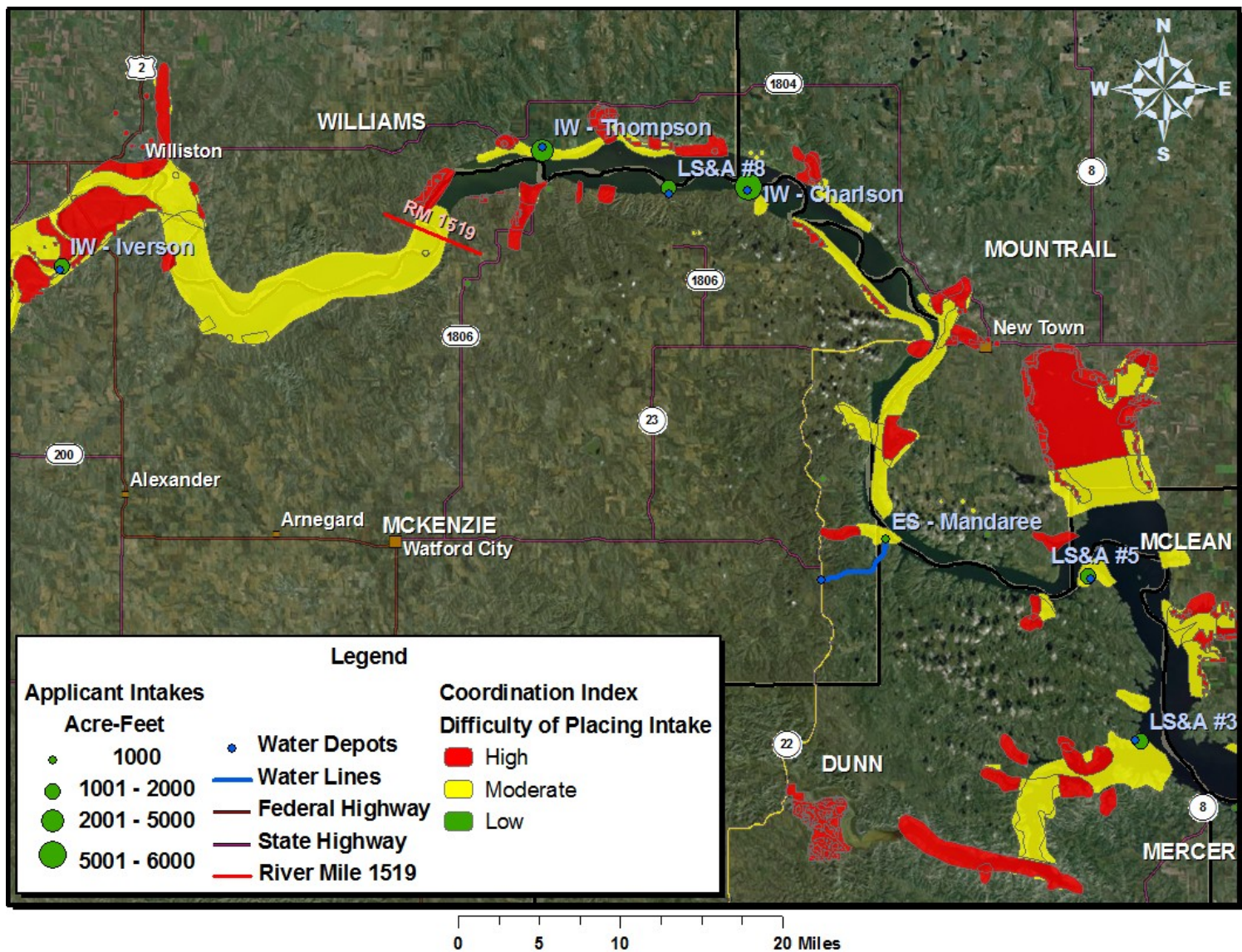
The end product was a GIS shapefile of the Missouri River system. The Water Commission cautioned, “To avoid misinterpretation, it is important to understand how the map was derived, what it represents, and what it does not represent.” The map key content consists of three general groupings. These are:

1. River system reaches, shorelines and near-shore areas where existing resources are most likely to cause prolonged or difficult delays in permitting (red);
2. River reaches, shorelines and near-shore areas where existing resources are somewhat likely to cause delays in permitting (yellow);
3. River reaches, shorelines and near-shore areas where critical resources are least likely to cause prolonged or difficult delays in permitting (green/no color).

The sole purpose of the map was to provide a “first cut” level of guidance for potential water users who were considering locations to propose an intake. Cultural, historical, park and recreation, and fish and wildlife resources are not differentiated on the map. Some resources, particularly fish and wildlife, are mobile and areas of concern may change. The U.S. Fish and Wildlife Service, in particular, consider that the locations of critical habitat for some endangered species may change with lake elevations and consider the entire Missouri River system to be “sensitive.”

The map was intended as an initial screening tool only and in all cases, regulatory agencies are charged with due diligence and must carefully examine proposed points of diversion and their impact. Designation as an area of least concern does not guarantee that a given location would be acceptable or that permits would be processed quickly – only that the chances are better. Designation as an area of highest concern does not guarantee that placement of an intake would be prohibited or excessively delayed – only that the chances of refusal or delay were higher. Figure 4 depicts the base map illustrating the seven proposed intakes and includes the Water Commission “difficulty of access” designations. Application of resource avoidance and best management practices during planning and construction (see Section 4.2.5) would be expected to avoid potentially significant environmental effects from construction and operation of new intakes at the Garrison Project. As such, the Proposed Action would be not likely to affect listed species or critical habitat in association with construction and operation of the intakes.

Figure 4
Coordination Index – Difficulty of Placing an Intake



4.2.2. Description of Typical Intake, Pipeline, and Water Depot Construction

At the time of completion of this Environmental Assessment, engineering and design had not been completed for the proposed intakes, pipelines and water supply depots, and construction details were not finalized. Final specification of the engineering details (e.g., exact location of intake; size of pumps, pipes, utilities; method for trenching to bury the water line and power supply; etc.) of the proposed intake construction and operations had not been completed. As such, this analysis has been performed before final design review and approval and is based on concept level design and reasonable assumptions regarding the proposed actions. While the actions described in this evaluation are preliminary, the basic function of their features and the footprint for their construction should remain substantially the same as each of these proposed intakes proceed through the administrative and regulatory review and approval process. Future intakes proposed would be expected to also be substantially similar in design and construction.

Estimates of materials necessary to construct the project were developed from best professional judgment and analyses for similar, previously reviewed and approved intakes on Lake Sakakawea. As such, the features and associated descriptions developed were used to quantify the magnitude of the proposed actions and not to prescribe detailed materials, quantities, or final design specifications.

The estimated environmental impacts have been assessed to characterize an envelope of effects within which design may proceed without compromising the integrity of the assessment. As such, the description of the features does not represent any formal commitment to final design, equipment for use, vendors for supply of materials, or methods of construction, but gives an approximation of how the features could be constructed and the associated impacts thereof. Substantial changes to the proposed actions that could result in unforeseen impact to the natural or human environment would require the preparation of a supplemental NEPA analysis.

There are four typical activities associated with construction of water supply intakes:

- Excavation and placement of a length of intake pipe and electrical supply line,
- Site preparation and construction (i.e., directional drilling for submerged pumps and pump placement in the lake),
- Construction of any features at the terminus of the raw water pipe (e.g., water depot, retention pond), and
- Re-establishing vegetation from ground-disturbing actions during the excavation and placement of pipe, utilities, intake, or pumps.

The endpoint of the intake would be in either a new water depot or (for the International Western intakes) in a new retention pond. Typically, the proposed water depot site would consist of a 2-acre tract with a 24-foot roadway being constructed to each site for truck access. Figure 5 showing an existing water depot near Red Mike Hill, ND on the north side of Lake Sakakawea. At least one, but potentially more 20-foot x 20-foot building(s) would be constructed for distribution and to meter the water. The small white building in Figure H is a water depot.

Retention ponds would typically be less than two acres in size and hold six to eight acre-feet of water.

Figure 5
Water Depot Near Red Mike Hill, ND



From the water depot or retention pond, an 8" to 12" PVC pipe would be placed by typical surface excavation to approximately seven feet below grade from the terminus to approximately the high water mark of Lake Sakakawea (elevation 1854 msl). The length of this section of pipe would vary by intake from approximately 1,000 feet to more than five miles. Open trenching would typically be dug by tracked hoe, side casting the material, and backfilling in place when completed. Disturbances from the open trenching could consist of a 75-foot wide path from the high water mark to the terminus. To the extent feasible, the trenched water/utility line would be constructed adjacent to an existing utility or road corridor and all areas of soil disturbance would be stabilized and re-planted with native vegetation after construction.

From the high water mark of Lake Sakakawea, either: 1) the supply line from the intake to the buried supply line would run above ground to accommodate a floating intake or 2) would be horizontally/directionally bored beneath the lakebed and “daylighting” under water for a submerged system. Intake construction would typically utilize directional drilling to minimize disturbances to the aquatic environment. An electric power supply would run in conjunction with the water line for each intake. Figure 6 shows an existing intake to the east of Whitetail Bay on the north shore of Lake Sakakawea. Signage warning boaters, recreationists, and swimmers about the intake would be installed as required.

Figure 6
Existing Water Intake East of Whitetail Bay



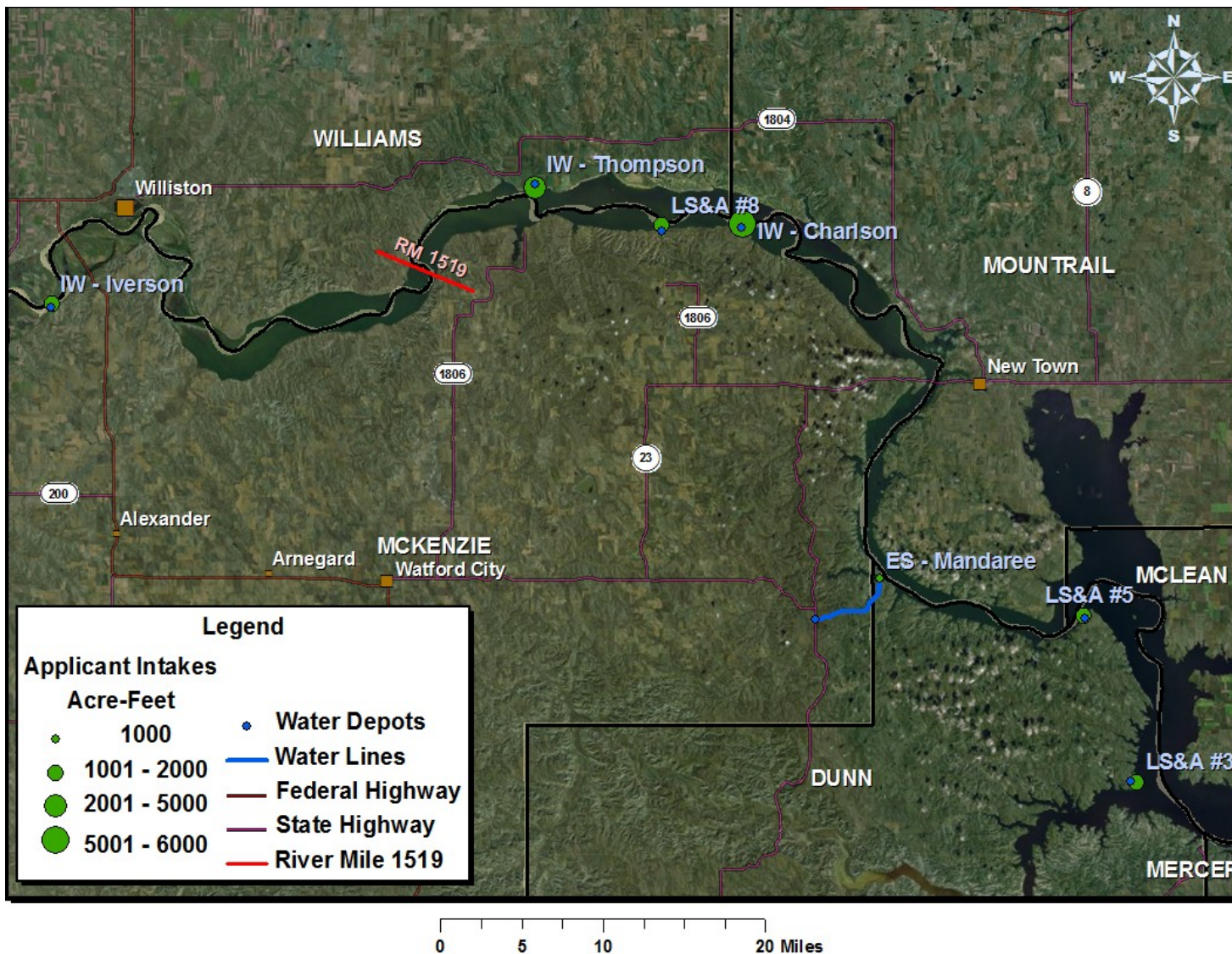
4.2.3. Site-Specific Intake Easement Requests

In response to the increase in demand for water in the oil and gas fields, several companies and individuals, and one state agency, have submitted applications for water intake easements across Corps lands. More may be submitted to the Corps in the future. The Corps has determined that nine of these applications are from serious applicants and have a reasonable chance of being granted, if all conditions are met. The nine credible applications identify seventeen different intake sites ranging and from 600 to 8,000 acre-feet of annual water withdrawal. The nine applications that have been initiated sum to a total of less than 30,000 acre-feet.

While all of nine of these applications have been considered in the needs and demand analysis, only the three applications (for a total of seven new intakes) have been characterized as mature enough to be described in sufficient detail to be evaluated within this Environmental Assessment. The other applications are well within the 100,000 acre-feet depletion for the overall effects assessment, but would require separate, independent NEPA review if and when their applications have matured for consideration. The seven intake locations are depicted in Figure 7 and a summary of the applications considered in detail is provided in Table 3.

As stated in Section 4.2.1, final specification of the engineering details of the proposed intake construction and operations had not been finalized. Prior to the final decision regarding the conditions of approval for the proposed intakes, all applications would be reviewed for acceptability by federal and state resource agencies (e.g., U.S. Fish and Wildlife Service, U.S. Army Corps of Engineers North Dakota State Regulatory Office, U.S. Army Corps of Engineers Garrison Dam/Lake Sakakawea Project, North Dakota Game and Fish Department, North Dakota State Historical Society, North Dakota State Parks and Recreation Department). This final regulatory review process would be completed for all currently-proposed as well as any future applications for additional water supply intake easements.

Figure 7
Proposed Intake Locations on Lake Sakakawea



**Table 3
Proposed Intake Information**

Intake Name	County	Volume In AC-FT	Nearest Major Road	Length of Transfer Pipe (Feet)	Length Of Transfer Pipe (Miles)	Terminus
Element Solutions (ES)						
Mandaree	Dunn	1,000	Immediately Adjacent to Hwy 22 near Hwy 73 intersection	30,000	5.7	New Depot
International Western (IW)						
Charlson	McKenzie	6,000	5.5 mil to the NE terminus of State Hwy 1806	1,000	0.2	Retention Pond
Iverson	McKenzie	2,000	3mi. to Federal Hwy 85 near the south shore	1,000	0.2	Existing Retention Pond
Thompson	Williams	4,950	0.8 mi. to State Hwy 1804 - 24 mi E of Williston	1,400	0.3	Retention Pond
Lake Sakakawea & Associates (LS&A)						
#3	Dunn	1,600	Over 20 mi. to Hwy 22 south of intersection Hwy 73	1,700	0.3	New Depot
#5	Dunn	1,600	Over 20 mi. to Hwy 22 south of intersection Hwy 73	1,200	0.2	New Depot
#8	McKenzie	1,600	3.5 mi. to the NE terminus of State Hwy 1806	1,800	0.3	New Depot

4.2.4. Intake-Specific Information

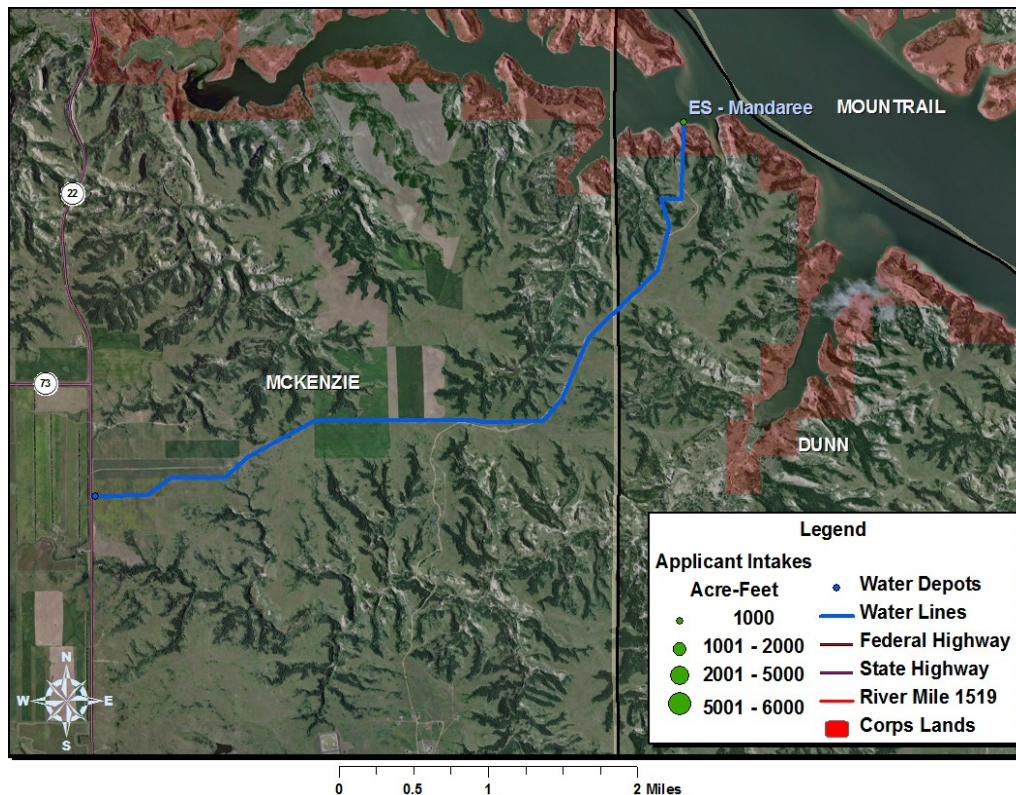
Specific information concerning the proposed intakes from each of the three applicants is provided below.

4.2.4.1. Element Solutions – Mandaree Intake

Element Solutions has an application for a single intake; figure 8 shows the proposed location. Their application requests an easement for industrial purposes over Corps land in Section 19, Township 150 North, and Range 93 West, in Dunn County. The water line would be installed with a direct bury to approximately seven feet (below frost line) as much as feasible within an existing utility corridor or road side. The line would be approximately 350 feet in length across Corps lands and would continue for an additional 5.6 miles to a new water depot; the area of disturbance would be approximately 52 acres⁴ for the pipeline and an additional 2 acres for the water depot within a previously disturbed grassland corridor.

The intake would use electric submersible pumps. The approximately 10-inch pipe connection to the intake would be constructed below the ground surface by directionally drilling from elevation 1,865 to the 1,800-foot elevation. Maintenance would be performed on a monthly basis and access to the lake would be needed for repairs and spring/fall pump setup. Pumping would occur at approximately 1,200 gpm for the duration of the year, as the water was needed.

Figure 8
Element Solutions Proposed Mandaree Intakes



⁴ 5.7 miles x 75 foot width of corridor = 52 acres.

4.2.4.2. International Western - Charlson, Iverson, Thompson Intakes

International Western has an application for three separate intakes (Charlson, Iverson, and Thompson) at three different locations as show in Figures 10, 11, and 12. Their application requests an easement for industrial purposes over Corps land as follows: Charlson in Section 31, Township 154 North, and Range 94 West, in McKenzie County; Iverson in Section 30, Township 153 North, and Range 101 West, in McKenzie County; and Thompson in Section 24, Township 154 North, and Range 97 West, in Williams County.

The Charlson and Thompson intakes would utilize directional drilling to construct the intake with the intake pipeline daylighted on the lake bottom. The Iverson intake would utilize the pre-existing infrastructure from an irrigation pump facility. All other infrastructure associated with the depot would be located off USACE lands. Each intake would consist of two 16-inch diameter steel casing each holding a 150-200 HP submersible pumps capable of pumping approximately 2,100 GPM. The placement of the actual intake structure would require the use of a floating barge and a diver. Once installed, the intakes would extend approximately 3-4 feet into the water column above the lake bottom.

The pipelines for the Charlson and Thompson intakes would be approximately 1,000 and 1,400 feet in length and constructed within a previously disturbed grassland corridor. The area of disturbance for pipeline, utility and road access would be approximately 1.7⁵ and 2.4⁶ acres respectively and 4.1 acres in total.

The Iverson intake would terminate at an existing retention pond and would not require new construction. For the other two intakes, the terminus of the water supply line would be new retention ponds. The applicant proposes to construct a series of retention ponds, typically less than two acres in size, spaced three to four miles apart that would each be capable of holding 6-8 acre-feet of water. Figure 9 shows a similar retention pond in use near Killdeer, ND.

The purpose of the pipeline and retention ponds would be to place water from the lake within convenient access to the oil fields. Using overland water transfer, the applicant proposes to pump the water from the ponds directly to the oil and gas wells, obviating the need for trucks. Assuming three ponds for each intake, an additional 12-acres⁷ would be necessary for construction of retention ponds for both intakes. For all three intakes, the area of potential footprint of construction would be approximately 16.1 acres.⁸ At this time, International Western has not identified the specific locations for construction of retention ponds associated with these intakes, but would be responsible to develop these sites in compliance with all appropriate state and federal resource protection laws.

⁵ 1,000 foot length x 75 foot width of corridor = 1.7 acres.

⁶ 1,400 foot length x 75 foot width of corridor = 2.4 acres.

⁷ 2 intakes x 3 retention ponds x 2 acres each = 12 acres total.

⁸ 12 acres for retention ponds + 4.1 acres for pipeline corridors = 16.1 acres.

Figure 9
Retention Pond Near Killdeer, ND



Figure 10
International Western's Charlson Site

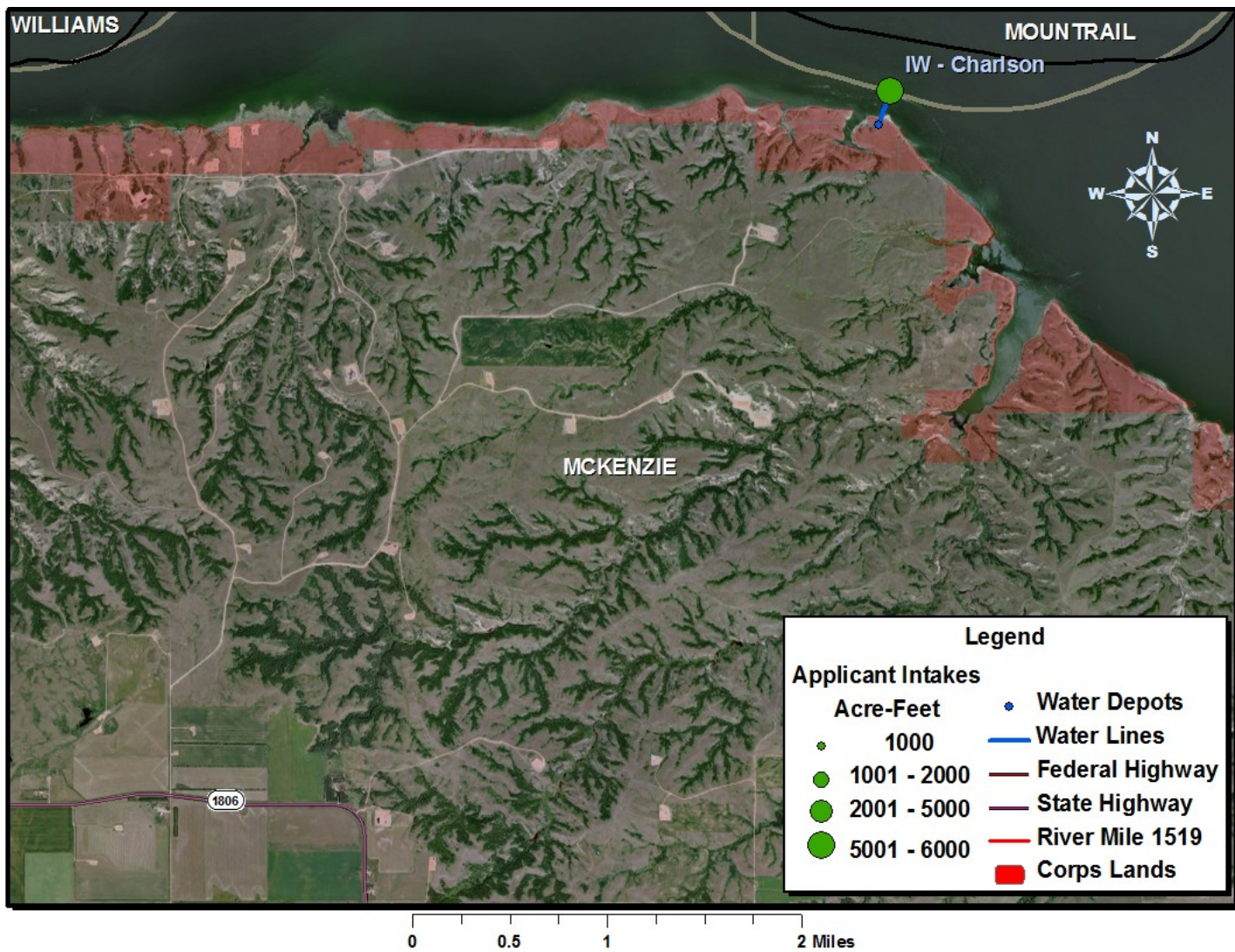


Figure 11
International Western's Iverson Site

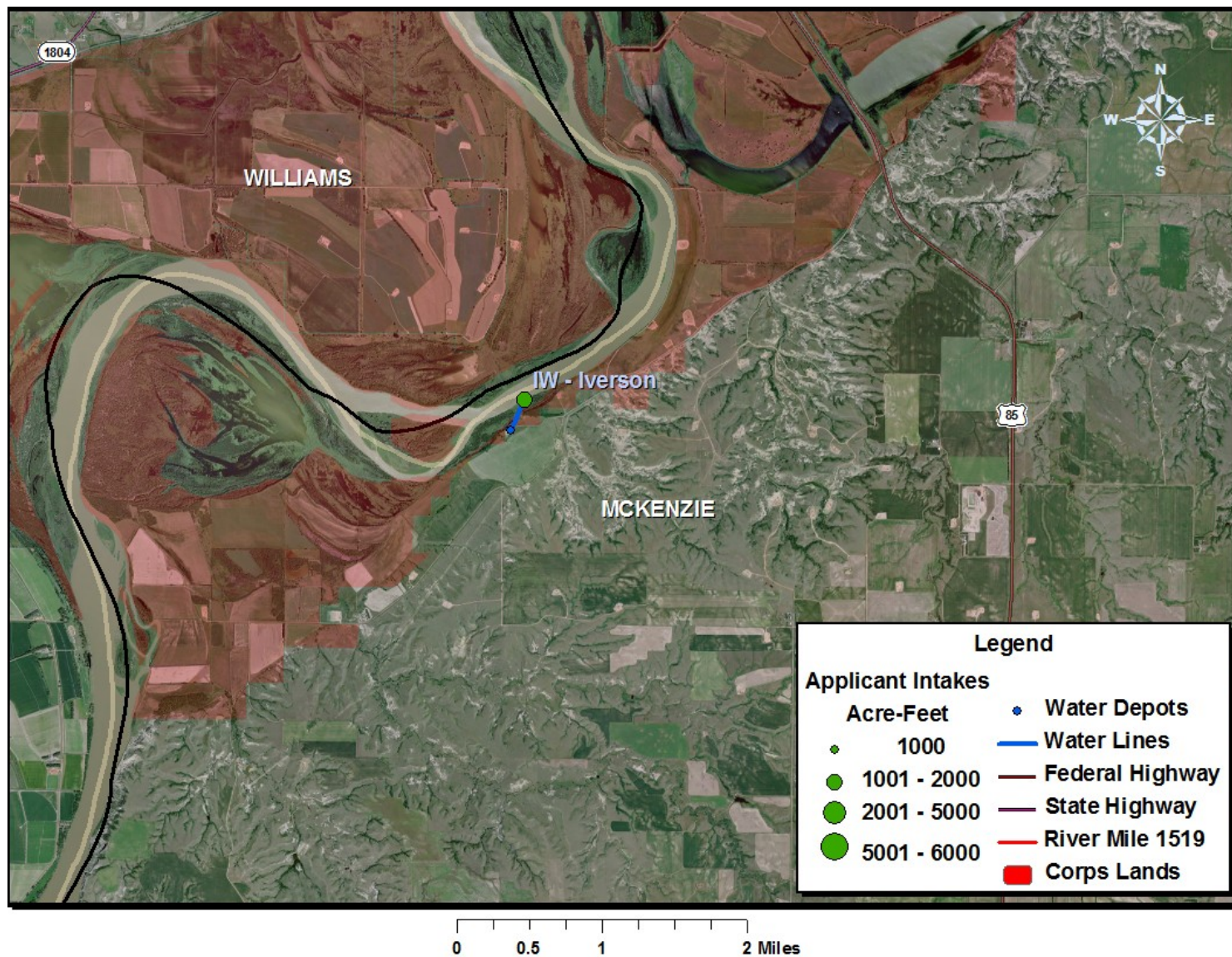
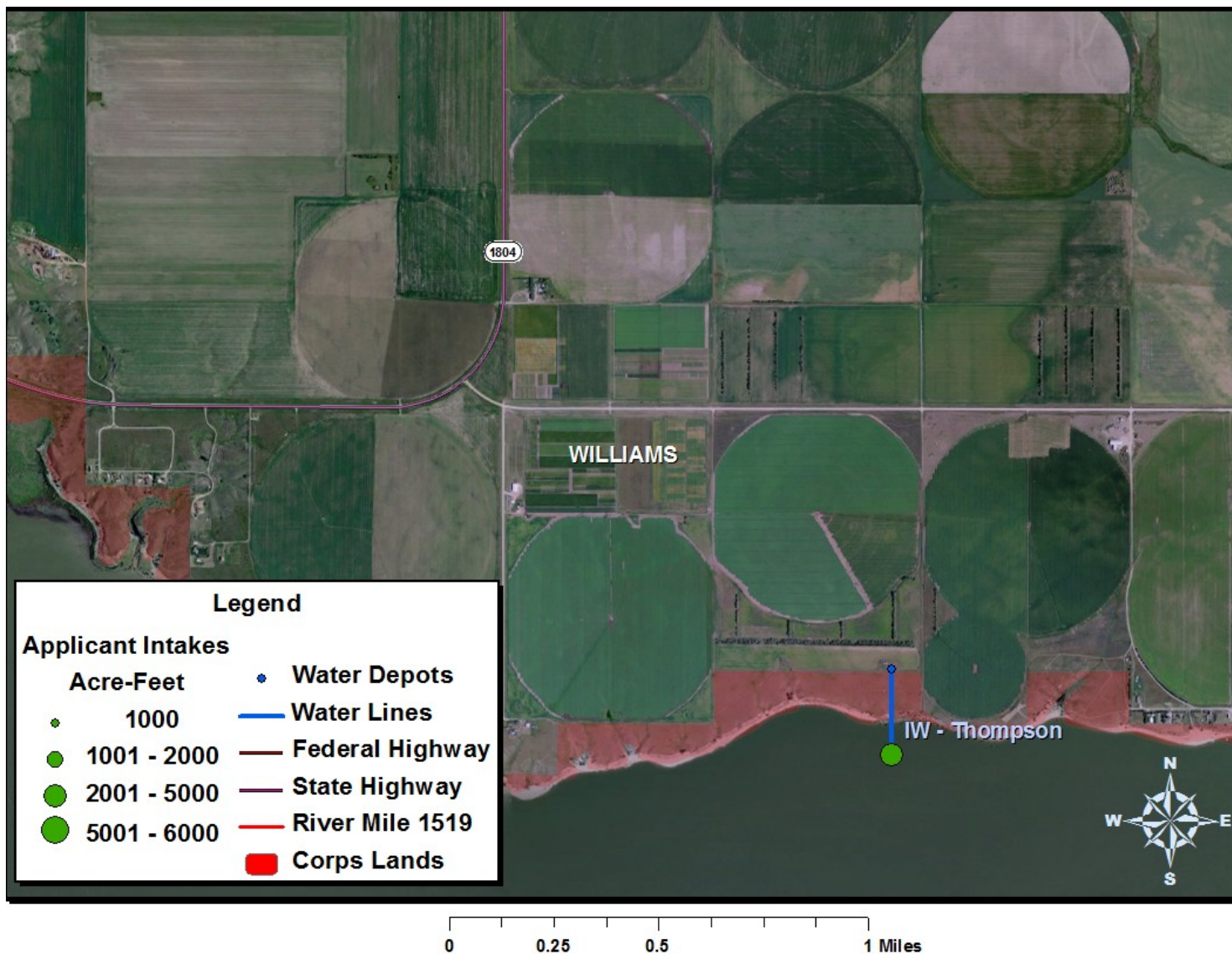


Figure 12
International Western's Thompson Site



4.2.4.3. Lake Sakakawea & Associates - Intakes #3, #5, and #8

Lake Sakakawea and Associates has an application for three separate intakes (#3, #5, and #8) at three different locations as shown in Figures 13, 14, and 15. Their application requests an easement for industrial purposes over Corps land as follows: #3 in Section 20, Township 148 North, and Range 91 West, in Dunn County; #5 in Section 32, Township 150 North, and Range 91 West, in Dunn County; and #8 in Section 32, Township 154 North, and Range 95 West, in McKenzie County.

Road access to the intakes would be from established roads and would be constructed to the proposed sites. These newly constructed roadways to the intakes would be approximately 24 feet wide and constructed of available local materials, such as gravel, scoria, etc. Culverts would be installed where needed to facilitate runoff. The proposed water depots would be of typical design, with a 2-acre gravel pad and a 20-foot x 20-foot building for water distribution.

A buried 8" to 12" PVC pipe would be installed to a non-frost depth by open trench method, from the water depot to the high water mark (1854 msl) of Lake Sakakawea. Assuming a 75-foot width of disturbance, the pipelines for intakes #3, #5, and #8 would have areas of disturbance of approximately 2.9⁹, 2.1¹⁰, and 3.1¹¹ acres respectively and sum to approximately 8.1 acres in total. Each of these intakes would terminate at new water depots requiring an additional two acres each for a total of approximately 14.1 acres of potential disturbance from the infrastructure associated with these intakes.

All proposed intakes would be submerged pump units. Intakes #5 and #8 would be submersible pumps while intake #3 would utilize a floating type pump that would be removed from the lake prior to freeze up and re-deployed each spring after ice-out. The 8 to 12-inch PVC pipe from the water depot would enter into a concrete manhole to be located above the high water mark. The concrete manhole would contain the pumps. Piping from the concrete manhole to the intake would be constructed by horizontal directional boring as described in the general overview. This construction method would minimize the physical disturbance below the high water mark.

⁹ 1,700 foot length x 75 foot width of corridor = 2.9 acres.

¹⁰ 1,200 foot length x 75 foot width of corridor = 2.1 acres.

¹¹ 1,800 foot length x 75 foot width of corridor = 3.1 acres.

Figure 13
Lake Sakakawea & Associates #3

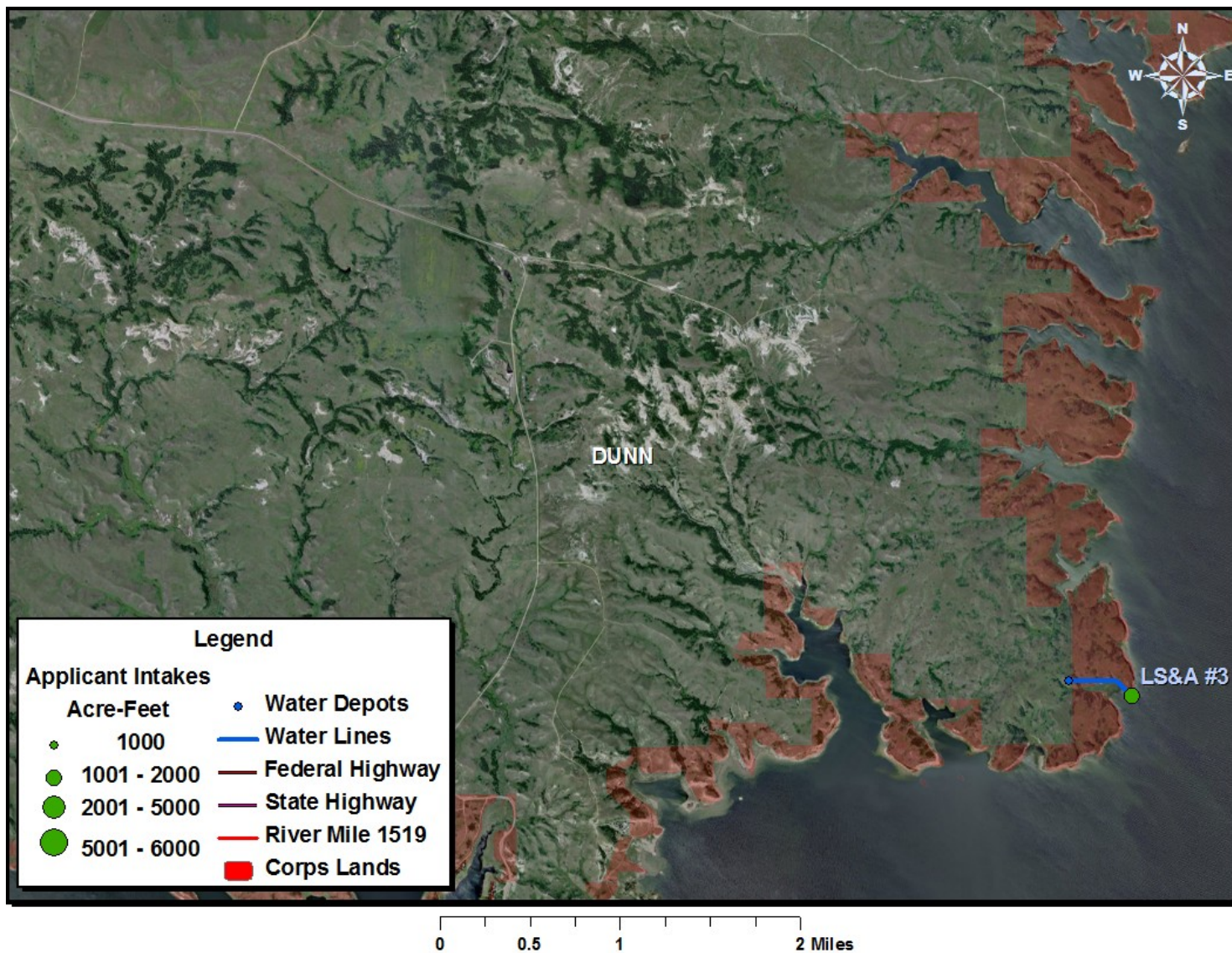


Figure 14
Lake Sakakawea & Associates #5

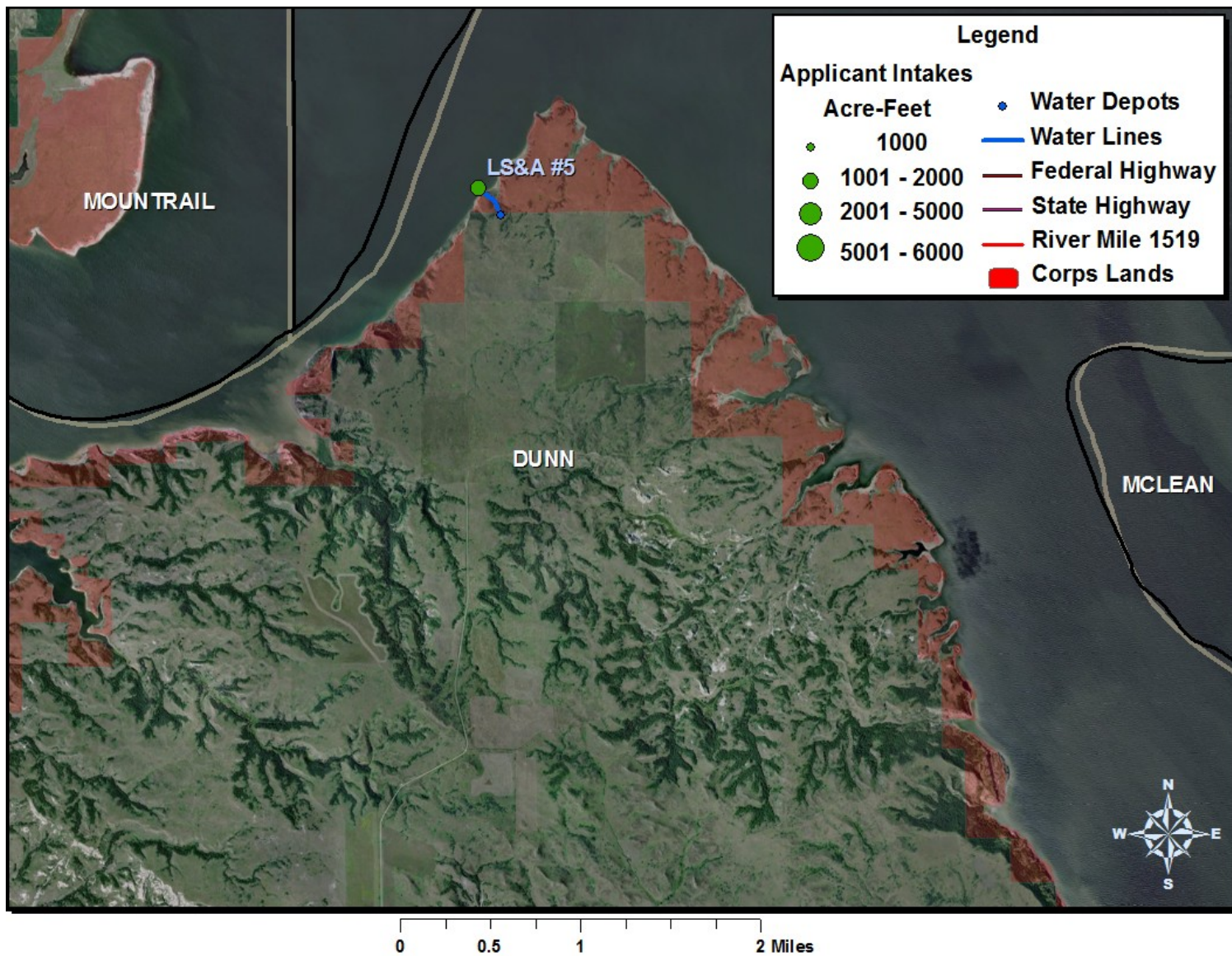
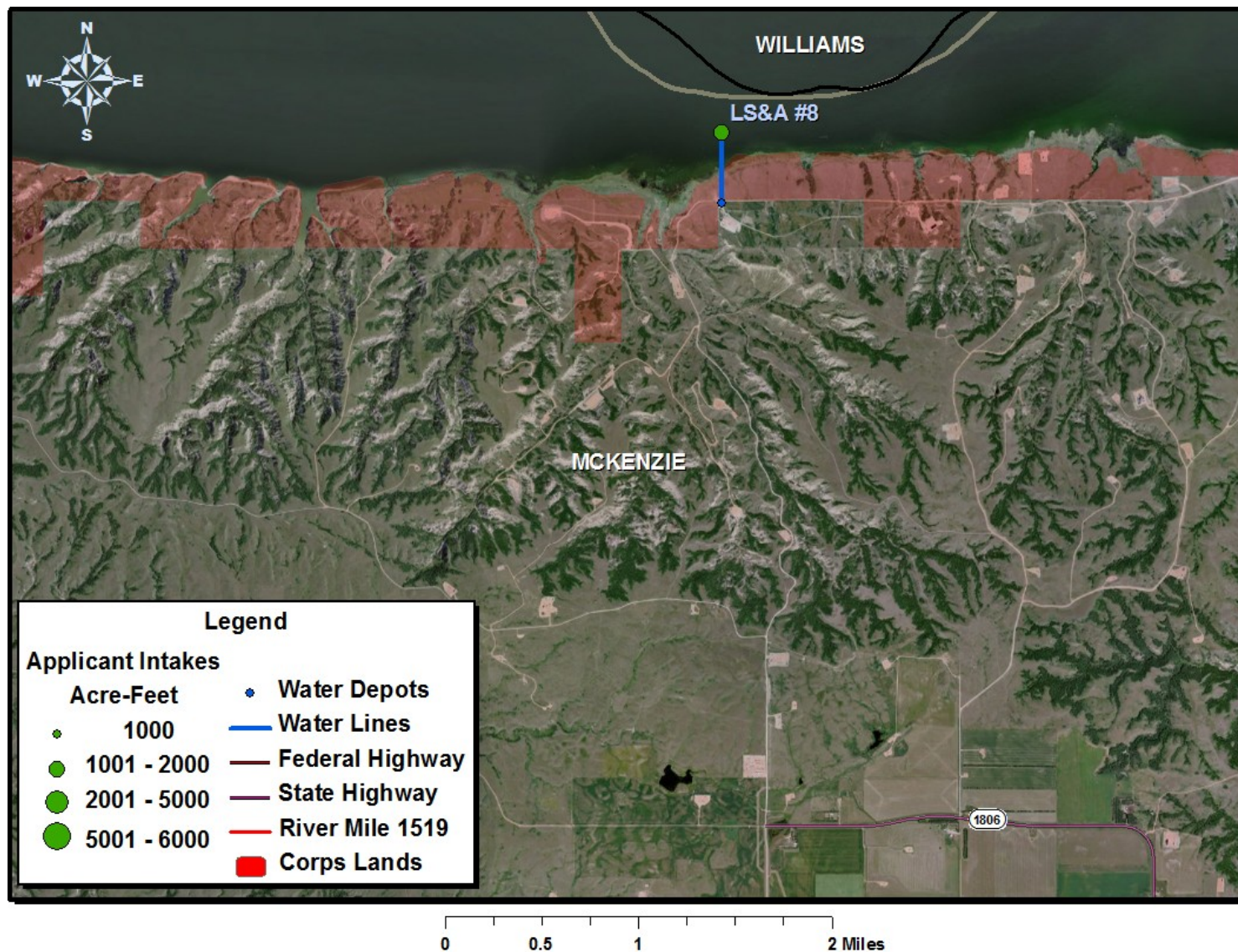


Figure 15
Lake Sakakawea & Associates #8



4.2.5. Typical USACE, NDG&F and USFWS Conditions for Intake Easements

The following provides a list of typical easement requirements stipulated by the Garrison Project Office in association with the final site selection, construction, and operation of a water intake. These requirements are based on existing Corps regulations, and input provided by the U.S. Fish and Wildlife Service and North Dakota Game and Fish Department. Stipulations addressing the trust resources under U.S. Fish and Wildlife Service authorities are tailored to address protective measures for a variety of species. As such, recommended timing restrictions are not identical and the federal action agency or project proponent should evaluate the trust resources that may be affected by the proposed project and use the protective timing restriction accordingly.

Typical USACE Application Requirements

General Requirements: Requests for easements for industrial intakes shall be considered on a case by case basis.

Placement of industrial intakes shall only be considered in areas that are zoned “Vegetation Management” and “Lake Easement”. (Garrison Dam/Lake Sakakawea

Industrial intakes shall not be allowed in areas zoned “Project Operations”, “Recreation – Intensive and Low Density Use”, “Wildlife Management”, and “Environmentally Sensitive”. (Garrison Dam/Lake Sakakawea Master Plan dated December 14, 2007)

Requests to convert existing irrigation intakes to industrial intakes shall be considered on a case by case basis and shall not exceed the original footprint of the existing easement.

Any existing irrigation intake must meet current regulations, design and construction standards prior to them being authorized to convert to industrial systems.

There shall be no less than a 25-mile radius between industrial intakes that are authorized on Lake Sakakawea.

Applicant(s) shall provide the current status of existing water depots, to include municipal and private, supplies within the region of industrial supply need.

Applicant(s) shall be required to conduct a market study to develop an inventory of the supply of existing water depots, to include water sources on private land, i.e. municipal, tribal, and private depots, within a 25-mile radius of proposed intake, as well as an industry demand analysis within the same region.

Existing infrastructure (existing State, county and BIA main roads and utilities to a proposed area) as well as the proposed means of transporting the water, i.e. trucking vs. piping (reduction in truck traffic if piped versus trucked) will be taken into consideration and may be a deciding factor.

The placement of water filling/truck depots shall not be authorized on the COE lands. Intake lines, pumps, utility lines and preferably two-track trails to access for initial installation and maintenance will be considered.

Applicant(s) shall be required to complete an Environmental Assessment for the proposed intake.

The appropriate water permit/allocation must be obtained from the North Dakota State Water Commission (NDSWC). If within the boundaries of the Fort Berthold Reservation, a Tribal Water Permit/Allocation may be required. It is the Applicant's responsibility to coordinate with the NDSWC and the Three Affiliated Tribes (TAT) to get the appropriate permit.

A sovereign lands permit may be required. Applicant must coordinate with the NDSWC and provide written documentation that it is not needed.

The grantee shall not install erosion control devices around the intake of the system without prior written approval.

Environmentally Sensitive Requirements:

Cultural Resource Sites

The grantee shall not remove, disturb, or cause or allow to be removed or disturbed, any historical, archeological, architectural, or other cultural artifacts, relics, vestiges, remains, or objects of antiquity. In the event such items are discovered on the premises, the grantee shall immediately notify the District Engineer, Omaha District, and the site and the material shall be protected by the grantee from further disturbance until a professional examination can be made or until clearance to proceed is authorized by the District Engineer.

Tern and Plover and Plover Critical Habitat

Pre-project Surveys – Within 5 days prior to construction or any surface disturbance activities planned to occur between April 15th and August 31st, the shoreline and nearby islands shall be surveyed by a qualified biologist, hired by the grantee and approved by the Corps, for the presence of piping plover and interior least terns. All surface disturbing and construction activities shall be seasonally restricted from April 15 to August 31 within 0.50 mile of any active piping plover and interior least tern nests. If any terns or plovers are found to be active outside of these dates within the 0.50 mile restriction area during construction of the project, then all project related activities will be stopped immediately until the Corps can consult with the U.S. Fish and Wildlife Service to determine appropriate steps to avoid any effects to the species.

Once an intake and associated infrastructure is in place, overland access to these sites during the piping plover and interior least tern breeding season (April 1 – August 31) shall be restricted. Grantees shall either access the intakes from the water only, or coordinate with the Corps' Garrison Project Office and the U.S. Fish and Wildlife Service to ensure that the area affected is surveyed 24 hours prior to overland access. All surveys will be conducted by a qualified biologist hired by the grantee. The Corps will require that the grantee provide the

qualifications of the biologist(s) conducting the survey, method of survey, and results of the survey to the Corps and the U.S. Fish and Wildlife Service. In addition, in accessing the site, the grantee will avoid leaving ruts or other ground disturbances behind. If surface disturbances occur, the grantee shall be required to restore the site back to its previous condition.

Critical Habitat - Proposed intakes will be directional bored with limited facilities/structures on the Corps managed lands. Earth disturbance on the shoreline will be minimal. If there is some earth disturbance, the grantee shall be required to restore to like condition.

Pallid Sturgeon/Important Fisheries

Any existing irrigation intakes must meet current regulations/standards prior to them being authorized as industrial systems. Some of the existing irrigation intakes have been in place for many years and do not meet current regulations.

Intake screens with a mesh opening of $\frac{1}{4}$ inch or less shall be installed, inspected annually, and maintained,

Water velocity at the intake screen shall not exceed $\frac{1}{2}$ foot per second,

Only floating intakes shall be installed above river mile 1519 in Williams and McKenzie Counties to minimize potential impacts to larval pallid sturgeon,

For floating intakes, they shall be installed over water with a minimum depth of 20 feet, but if the 20-foot depth is not attainable, the intake shall be located over the deepest water available. If the water depth falls below six feet, the intake shall be moved to deeper water or the maximum intake velocity shall be limited to $\frac{1}{4}$ foot per second.

Intakes below river mile 1519 shall be submerged, placed at least 20 vertical feet below the existing water level, with the intake elevated 2 to 4 feet off the bottom. If the 20-foot depth is not attainable, then the intake velocity shall be limited to $\frac{1}{4}$ foot per second, with intake placed at maximum practicable attainable depth.

Any work within the waterway shall not occur from April 15 to June 1 to protect the fishery resource.

Any disruption or displacement of the lakebed or banks must be restored to pre-project conditions.

Whooping Crane

If a whooping crane is sighted within one mile of the proposed projects' construction, that all work cease within one mile of that part of the project (i.e. that intake) and the U.S. Fish and Wildlife Service be contacted immediately.

Bald and Golden Eagles

A survey for bald and golden eagle nests shall be conducted by the applicant prior to final site selection in order to avoid initial selection of a site that has a high probability for impacting bald or golden eagles. Should a nest be located in this initial assessment, the Corps and the U.S. Fish and Wildlife Service shall coordinate with the applicant to determine if approaches to construction or sighting of the project would be available to allow the site to be utilized. For any construction required between February 1 and August 15 a survey shall be conducted to ensure that there are no active bald or golden eagle nests within one-half mile of the proposed project site and associated facilities. A buffer of at least 1/2 mile should be maintained for golden and bald eagle nests. All surveys will be conducted by a qualified biologist hired by the grantee. The Corps will require that the grantee provide the qualifications of the biologist(s) conducting the survey, method of survey, and results of the survey to the Corps and the U.S. Fish and Wildlife Service.

Sprague's Pipit

To avoid fragmentation of Sprague's pipit habitat, the Corps will require the grantee to place the intake, engine, and all appurtenances on previously disturbed land when construction is planned in areas of native prairie. Should previously disturbed sites not be available in the vicinity, the Corps and U.S. Fish and Wildlife Service will work with the applicant to determine if acceptable approaches to construction would be available at the site. All construction activities will be required to occur outside the dates of April 15 to August 15 if Sprague's Pipits have been shown to occur in the area as a result of migratory bird surveys (see Migratory Bird Treaty Act stipulations below).

Dakota Skipper

Due to its short flight window, and difficulties associated with identifying them in the field, the U.S. Fish and Wildlife Service does not recommend surveying for Dakota skippers. Rather, the applicant should survey the habitat to determine if potentially suitable grassland habitat exists on the site. The project area shall be surveyed by a qualified biologist, hired by the grantee and approved by the Corps and U.S. Fish and Wildlife Service. If suitable habitat for skippers is found to exist, avoidance of construction within this habitat will be required. In cases where alternative sites may not be available to the applicant, and high quality habitat is unavoidable, the Corps and the U.S. Fish and Wildlife Service will work with the applicant to determine if acceptable approaches to construction exist at the site.

Migratory Bird Treaty Act

Construction shall be scheduled for late summer or fall/early winter so as not to disrupt waterfowl or other migratory birds during the breeding season (February 1 to July 15).

If construction will occur within the migratory bird nesting season of February 1 to July 15, surveys will be conducted for migratory birds and their active nests (nests containing eggs or young) within five days of commencement of construction activities. If birds and/or their nests are found during surveys, the grantee shall contact the Corps and U.S. Fish and Wildlife Service with a proposal for realigning the work or maintaining adequate buffers to prevent the take of migratory birds. All surveys for migratory birds shall be conducted by a qualified biologist hired by the applicant. The Corps will require that the applicant provide the qualifications of the biologist(s) conducting the survey, method of survey, and results of the survey to the Corps and the U.S. Fish and Wildlife Service.

High Value Habitat Avoidance

Construction in native prairie will be avoided if at all possible. All disturbed native prairie shall be reseeded with a comparable native grass/forb seed mixture. The seed source should be as local as possible, preferably collected from the nearby native prairie. Obtain seed stock from nurseries within 250 miles of the project area to insure the particular cultivars are well adapted to the local climate.

The construction of intakes/pipelines on COE lands will not be allowed to alter stream channels or create changes in drainage patterns,

Placement of fill in wetlands will be avoided as much as possible. Unavoidable loss of wetland habitat will be replaced with functionally equivalent wetlands.

Any unavoidable losses of native forest or riparian forest shall be replaced with similar species on a 2:1 basis by incorporating a mitigation planting into the impacted forest to complement the existing woody vegetation.

Install and maintain appropriate erosion control measures to reduce sediment transport to adjacent wetlands and stream channels.

Pumping plant sound levels shall not exceed 75 decibels at 50 feet, and

The project area shall be kept clean and free from discarded material.

Typical USACE Easement Conditions:

The grantee shall comply with all applicable Federal laws and regulations and with all applicable laws, and ordinances, and regulations of the state and county wherein the premises are located.

This easement is granted for the exercise of water rights granted by the State of North Dakota and does not create any right to use water from the Lake Sakakawea Project.

Granting of this easement does not preclude the Secretary of the Army from requiring the grantee to enter into an appropriate water service agreement in consideration of such (irrigation) benefits as may, in the opinion of the Secretary, be derived from the withdrawal of (irrigation) water from the Lake Sakakawea Project.

All electrical equipment will be installed, operated and maintained in compliance with all applicable Federal, state, county and municipal laws, ordinances and regulations wherein the premises are located, including, but not limited to, the provisions of the latest edition of the National Electric Safety Code (NESC) and the Environmental Protection Agency regulations on Polychlorinated Biphenyls (PCB's).

Electrical service to electrical motors submerged under water or located above water shall be by means of a sealed, waterproof, multiple conductor cable with controls and switches located on land. The location of such motors and the electrical feeders shall be clearly marked so as to be visible to boaters and swimmers. Additionally, signs warning "DANGER - HIGH VOLTAGE - Unauthorized Access" shall be erected to be visible from the water and land approaches to the equipment.

Additional site specific conditions may be added to an easement document to address use of the premises, protection of the environment, safety and mitigation requirements.

Each intake shall include a meter to record the volume of water pumped. The grantee shall report all usage to the Corps on a monthly basis.

The grantee shall not pump or discharge water back into the lake.

5. Scope of Analysis and Missouri System Overview

5.1. Scope of the Analysis

5.1.1. Context and Intensity

The National Environmental Policy Act (NEPA) and the Council on Environmental Quality's Implementing Regulations require that an Environmental Assessment identify the likely environmental effects of a proposed project and that the agency determine whether those impacts may be significant. The determination of whether an impact significantly affects the quality of the human environment must consider the *context* of an action and the *intensity* of the impacts (40 CFR 1508.27).

The term *context* refers to the affected environment in which the proposed action would take place and is based on the specific location of the proposed action, taking into account the entire affected region, the affected interests, and the locality. The term *intensity* refers to the magnitude of change that would result if the proposed action were implemented.

Determining whether an effect significantly affects the quality of the human environment also requires an examination of the relationship between *context* and *intensity*. In general, the more sensitive the context (i.e., the specific resource in the proposed action's affected area), the less intense an impact needs to be in order for the action to be considered significant. Conversely, the less intense of an impact, the less scrutiny even sensitive resources need because of the overt inability of an action to effect change to the physical environment. The consideration of context and intensity also must account for the indirect and cumulative effects from a proposed action.

5.1.2. Indirect, Cumulative, and Growth-Inducing Effects

Direct effects are caused by the action and would occur at the same time and place (40 CFR 1508.8) (e.g., actions involving construction and operation of the new intakes and pipes). Indirect effects are caused by the action, but typically occur later in time or are farther removed in distance, but are still reasonably foreseeable (40 CFR 1508.8). For example, the indirect effect of the determination of surplus water in Lake Sakakawea would include the granting of easements for intake construction and the construction and use of water supply intakes. The indirect effect of these actions would include changes to the water surface elevation in Lake Sakakawea and changes to the releases from the Garrison Dam. Indirect effects may also include growth-inducing effects and other effects related to induced changes in the pattern of land use, population density, or the growth rate of an industry.

A cumulative impact is defined as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions" (40 CFR§1508.7). Cumulative impacts can result from individually minor, but collectively significant actions taking place over a period of time. These actions include on-site or off-site projects conducted by government agencies, businesses, or individuals that are affecting or would affect the same environmental resources as would be affected by the proposed action.

5.1.3. Scope of the Analysis

The scope of the analysis in this EA evaluates the reasonably foreseeable direct, indirect, and cumulative effects of the proposed action. For the proposed action, the area of potential influence for the analysis of effects consists of:

- The proposed locations for new intakes and associated infrastructure with Garrison Dam / Lake Sakakawea Project lands;
- All mainstem Missouri River Reservoirs and the riverine reaches between the reservoirs,
- Downstream of the mainstem Missouri River Reservoirs in the Missouri River, and
- Western North Dakota, where the provision of water via new water supply could influence the oil and gas industry.

From a practical standpoint, environmental effects could occur:

- Within the footprint of disturbance and area of influence where water intakes and associated infrastructure (e.g., pumps, pipelines, water depots, etc.) would be constructed, operated, and maintained;
- Where depletions from Lake Sakakawea would result in changes to the water surface elevation in Lake Sakakawea;
- Where depletions from Lake Sakakawea would result in changes to the releases from Garrison Dam;
- Where depletions from Lake Sakakawea would result in changes to the releases from, and water surface elevations in, the other Missouri River System reservoirs (Fort Peck, Oahe, Big Bend, Fort Randall, and Gavins Point);
- Where the depletions from Lake Sakakawea would result in changes to flow and water surface elevations in downstream reaches of the Missouri River; and
- Where the availability of water supply from Lake Sakakawea would change the location of water supply infrastructure and water transportation patterns for water delivery to the oil and gas industry in western North Dakota.

These represent the largest area of *potential* influence where effects might be observed. However, effects must be traceable through a chain-of-causation. Only effects that are reasonably foreseeable need be addressed in a NEPA analysis; impacts that are speculative and that depend on actions that are remote or hypothetical need not be considered.

The proposed action being evaluated in this EA is the identification of surplus water in the Garrison Dam/Lake Sakakawea project in order to provide surplus water to M&I users in western North Dakota. If this determination of surplus water markedly changed the rate at which the oil and gas industry grows, or facilitated an even more rapid increase in production, then the changes in the industry's rate of growth and the associated environmental consequences would be an indirect effect of the Corps' action and would need to be quantified in the EA. However, according to the Bruce Hicks, Assistant Director of the North Dakota Industrial Commission's Department of Mineral Resources Oil and Gas Division, water supply--while necessary to oil and gas production--is not the limiting factor on the rate of drilling or hydrofracing in North Dakota. Rather, the availability of drill rigs and hydrofracing crews are the critical factors limiting the

rate at which industry grows within the region. This observation is supported by the growth of drilling and production in 2009-2010 without any Federal action affecting the availability of water by the Corps of Engineers (see Section 6.7.1).

The demand for hydrofracing can be considered inelastic to the price of water within a reasonable range. Water is a small part of the cost of a hydrofracing operation. There are millions of dollars of equipment, mineral rights, labor, fuel, chemicals, and associated costs required to develop an oil well utilizing this technology. A few hundred dollars is a negligible part of these costs. The driving force behind hydrofracing is the price of oil. This price which has spiked many times over recent decades is currently sufficiently high that private individuals and companies are willing to risk large amounts of capital on potential wells. The average North Dakota well produced 22 thousand barrels of oil in 2010. At a price of just \$50/barrel this would produce an income of about \$1.1 million annually. At the more recent price of \$90/barrel of oil the income would be over \$2 million. The price of oil is much more important to the demand for inputs to the hydrofracing process, such as water, than the cost of water or other minor inputs. Accordingly it is believed that the demand for hydrofracing can be considered inelastic to the price of water within any foreseeable range and will not decrease or increase the number of wells developed.

Additions to the supply of water for the industry from surplus water in Lake Sakakawea could affect the location of preferred water sources and how water is distributed and moved within the region; however, additional water availability is not expected to influence the rate of oil drilling or production.

Interviews with water-haulers and Wayne Biberdorf of the ND Petroleum Counsel's Water Committee Subgroup indicate that when a company is preparing to hydrofrac a well, they will travel extreme distances, if necessary, to obtain sufficient quantities of water. Round-trip water truck travel distances of 200-miles are not uncommon. Suppliers interviewed concerning their operations indicated that they would prefer to haul water from sources less than 20-miles one-way, but limited access to water supplies frequently requires that the oil company acquire water from substantially greater distances.

This is because the cost to haul water great distances, while substantial, is still minor when compared to the cost of delaying production. There is typically a 2-month wait for a hydrofrac crew. If the water necessary to hydrofrac the well is not present when the crew arrives, the crew will move on to their next assignment and will need to be rescheduled, leading to significant and costly delays in the production process. The net effect of improving the availability and distribution of water in the region by identifying surplus water in Lake Sakakawea and allowing new intakes would not be to change the growth rate of the industry, but rather to diminish the distance of transporting the water needed to support the industry's ongoing growth.

5.1.4. 100,000 Acre-Feet in Context

The Proposed Action for this EA is the temporary use of up to 100,000 acre-feet of yield (257,000 acre-feet of storage) from the Garrison Dam/Lake Sakakawea Project to meet municipal and industrial (M&I) water supply needs in the region over a 5-10 year period. As illustrated in Section 4 and Table 2, the No Action alternative similarly would result in 100,000 acre-feet of depletions from the Missouri River upstream from Lake Sakakawea. In both cases, the vast majority of water to meet demand would be from the Missouri River System, the

difference being where the water was removed. Under the Proposed Action water would be withdrawn from Lake Sakakawea from locations within the Garrison Project and in the case of the No Action alternative, the water would be withdrawn from the Missouri River upstream of the Garrison Project and not on Corps of Engineers land. The only differential between the alternatives involves 527 acre feet of water that under the Proposed Action would be removed from Lake Sakakawea and under the No Action alternative would be provided by continued conversion of agricultural permits to M&I under a State program.

This section is included to provide the reader with a context within which to understand the relative magnitude of the changes in the Missouri River and the Garrison Dam/Lake Sakakawea that are being proposed. The proposed temporary use of 100,000 acre-feet of water from Lake Sakakawea would be a total depletion allowance that the easement holders would be allowed to remove over the span of a year. Daily (and yearly) withdrawals from the various intakes would be extremely small relative to the total storage in the reservoir. To put 100,000 acre-feet of yield per year into a daily context, a withdrawal of 138.1 cubic feet per second, every day for an entire year, would yield 100,000 acre-feet of water. So, if water withdrawals were uniformly removed from Lake Sakakawea throughout the year, there would be 138.1 fewer cubic feet per second less water available for discharge at any given moment from the Garrison Dam as a result of the proposed action.

The summary of historical pool elevations and releases, by month, (Table 4) shows the daily maximum, daily minimum, and mean releases from Garrison Dam. If the water depletions resulted in 138.1 cfs less being available for discharge from Garrison Dam every day over the course of the year, the potential decrease in the maximum daily release would never be more than one half of one percent (0.5%), the percent decrease in flow for the lowest daily release would be less than 3.5 percent, and the mean release would be diminished by less than one percent.

This is the most conservative case in that it assumes that no changes would be made in reservoir operations to adjust for this 100,000 acre-foot depletion. In fact, adjustments would not need to be made in the vast majority of cases, because the 100,000 acre-foot depletion represents approximately 0.6-percent of total yield in a reservoir that holds nearly 24,000,000 acre-feet. As the proposed 100,000 acre feet in depletions represent a small change relative to the scale of the normal operations of the Garrison Dam and the entire reservoir system, where actual operational changes in release rates are typically made in thousands of cubic feet per second, the effects on pool levels and reservoir outflow are very small, and nearly immeasurable.

Table 4
Garrison Releases by Month,
and Percent Change with 138.1 CFS Less From Release

Month	Daily Release (CFS)			Daily Percent Change		
	Max	Min	Mean	Max	Mini	Mean
Jan	34,200	12,500	23,200	0.40%	1.11%	0.60%
Feb	36,000	11,000	24,400	0.38%	1.26%	0.57%
Mar	37,800	4,100	19,700	0.37%	3.37%	0.70%
Apr	39,100	8,700	19,300	0.35%	1.59%	0.72%
May	41,200	9,100	21,400	0.34%	1.52%	0.65%
Jun	50,100	9,500	23,300	0.28%	1.45%	0.59%
Jul	65,200	9,500	24,700	0.21%	1.45%	0.56%
Aug	65,100	12,100	24,500	0.21%	1.14%	0.56%
Sep	50,100	6,000	20,900	0.28%	2.30%	0.66%
Oct	49,700	9,200	19,300	0.28%	1.50%	0.72%
Nov	50,100	9,300	20,200	0.28%	1.49%	0.68%
Dec	39,100	12,500	20,500	0.35%	1.11%	0.67%

Source: USACE, 2007 data from June 1967 - December 2006, including drought years.

5.2. Missouri River System Description and Operation

The Missouri River System, including Lake Sakakawea, is operated such that depletions could result in changes to all reservoirs and riverine sections. In other words, because of how the system is managed, water withdrawn from Lake Sakakawea results in changes throughout the system. Understanding the routine aspects of System operation is important in order better understand the predicted effects from the removal of water from Lake Sakakawea. The rest of this section contains detailed information on the entire System and System operations. It has been included in order provide a basis for understanding how the system is operated so that the consequence assessment, where depletions from Lake Sakakawea have system-wide consequences, can be understood.

As originally shown in Figure 1, the six Corps dams spanning the Missouri River control runoff from approximately half of the basin. Those six dams, from the upper three giants of Fort Peck in eastern Montana, Garrison in central North Dakota and Oahe in central South Dakota, to the lower three smaller reservoirs of Big Bend and Fort Randall in South Dakota, and Gavins Point along the Nebraska-South Dakota border, comprise the largest system of reservoirs in the United States (USACE, 2007c).

As shown in Table 5, the storage capacity of the six reservoirs ranges from over 23 MAF at Garrison and Oahe, to less than 0.5 MAF at Gavins Point. The System is also unique in the fact that 88 percent of the combined storage capacity is in the upper three reservoirs of Fort Peck, Garrison, and Oahe (USACE, 2007c). The lower three projects, Big Bend, Fort Randall, and

Gavins Point, are regulated in much the same manner year after year regardless of the runoff conditions (USACE, 2007c).

The entire System's storage capacity is divided into four unique storage zones for regulation purposes; information on the unique storage zones for each of the six individual reservoirs is provided on Table 5. The bottom 25 percent of the total System storage capacity comprises the permanent pool designed for sediment storage, minimum fisheries, and minimum hydropower heads (USACE, 2007c). The largest zone, comprising 53 percent of the total storage capacity, is the carryover-multiple use zone which is designed to serve all project purposes, though at reduced levels, through a severe drought like that of the 1930's (USACE, 2007c).

**Table 5
Reservoir Storage Zones**

Project	Top of Permanent		Top of Carryover Multiple Use		Top of Flood Control & Multiple Use		Top of Exclusive Flood Control	
	Cumul Storage (MAF)	Elev (ft MSL)	Cumul Storage (MAF)	Elev (ft MSL)	Cumul Storage (MAF)	Elev (ft MSL)	Cumul Storage (MAF)	Elev (ft MSL)
Fort Peck	4.2	2160.0	15.0	2234.0	17.7	2246	18.7	2250
Garrison	5.0	1775.0	18.1	1837.5	22.3	1850	23.8	1854
Oahe	5.4	1540.0	18.8	1607.5	22.0	1617	23.1	1620
Big Bend	1.6	1420.0	1.6	1420.0	1.7	1422	1.8	1423
Randall	1.5	1320.0	3.1	1350.0	4.4	1365	5.4	1375
Gavins Point	0.3	1204.5	0.3	1204.5	0.4	1208	0.5	1210
Total System	18.0		56.9		68.7		73.3	

The annual flood control and multiple use zone, occupying 16 percent of the total storage capacity, is the desired operating zone of the System (USACE, 2007c). Ideally the System is at the base of this zone at the start of the spring runoff season (March 1st of each year). Spring and summer runoff is captured in this zone and then metered out throughout the remainder of the year to serve the other project purposes, returning the reservoirs to the base of this zone by the start of the next runoff season (USACE, 2007c). The top 6 percent of the System storage capacity is the exclusive flood control zone. This zone is used only during extreme floods, and evacuation of this zone is initiated as soon as downstream conditions permit (USACE, 2007c).

Overall System regulation follows the "water control plan" presented in the Master Water Control Manual (USACE, 2007b). Each of the six System dams also has an individual water control manual that presents more detailed information on its regulation. System regulation is in many ways a repetitive annual cycle; most of the year's water supply is produced by runoff from winter snows and spring and summer rains which increase System storage. After reaching a

peak, usually during July, System storage declines until late in the winter when the cycle begins anew. A similar pattern may be found in releases from the System, with the higher releases from mid-March to late-November, followed by low rates of winter discharge from late-November until mid-March, after which the cycle repeats (USACE, 2007c).

The water control plan is designed to achieve the multipurpose objectives of the System given these cyclical events. The two primary high-risk flood seasons are the plains snowmelt season, (late February through April) and the mountain snowmelt period (May through July). Runoff during both of these periods may be augmented by rainfall. The winter ice-jam flood period extends from mid-December through February. The highest average power generation period extends from mid-April to mid-October, with high peaking loads during the winter heating season (mid-December to mid-February) and the summer air conditioning season (mid-June to mid-August).

The major maintenance periods for the System hydropower facilities extend from March through mid-May and September through November, which normally are the lower demand and off-peak energy periods. The normal 8-month navigation season extends from April 1st through November 30th during which time System releases are scheduled, in combination with downstream tributary flows, to meet downstream target flows. Winter releases after the close of navigation season are much lower, and vary depending on the need to conserve or evacuate System storage while managing downstream river stages for water supply given ice conditions (USACE, 2007c). Minimum release restrictions and pool fluctuations for fish spawning management generally occur from April through June. Gavins Point spring pulses, which are designed to cue spawning of the endangered pallid sturgeon, are provided in March and May with the flow magnitude, duration, and timing based on System storage, runoff forecast, and other criteria (USACE, 2007c). Nesting of the two Federally protected bird species, the endangered interior least tern and the threatened piping plover, occurs from early May through mid-August.

Other factors may vary widely from year to year, such as the amount of water in storage and the magnitude and distribution of inflow received during the coming year. All of these factors affect the timing and magnitude of releases throughout the System. The gain or loss in the water stored at each reservoir must also be considered in scheduling the amount of water transferred between reservoirs to achieve the desired storage levels and to generate power. These items are continually reviewed as they occur and are appraised with respect to the expected range of operations (USACE, 2007c).

5.2.1. Intrasystem Regulation

Intrasystem regulation is an important tool in the management of water in the System to meet the authorized purposes. It is used to regulate individual reservoir levels in the System to balance or unbalance the water in storage at each project, to smooth the annual System regulation by anticipating unusual snowmelt runoff, to maintain the seasonal capability of the hydropower system, and to improve conditions for the reservoir fish spawn and recruitment. It also can be used to maintain stages on the open river reaches between projects at desirable levels. Intrasystem adjustments may also be used to meet emergencies, including the protection of human health and safety, protection of significant historic and cultural properties, or to meet the provisions of applicable laws including the Endangered Species Act (USACE, 2007c). These

adjustments are made to the extent reasonably possible after evaluating impacts to other System uses, are generally short term in nature, and continue only until the issue is resolved (USACE, 2007c).

The presence of large reservoirs in the System increases intrasystem regulation flexibility. A small reservoir such as Gavins Point with storage of less than one-half million acre-feet can only tolerate a large difference between inflow and release for less than a day. Big Bend is in this category as well. To a lesser extent, so is Fort Randall, although its carryover-multiple use and annual flood control and multiple use storage of nearly 3 MAF make possible significant storage transfers and flow differentials extending a month or more (USACE, 2007c). But it is the upper three large reservoirs of Fort Peck, Garrison, and Oahe, with their combined 37.4 MAF of carryover multiple-use storage plus an additional 10.1 MAF of annual flood control multiple-use storage, that provide the flexibility to adjust intrasystem regulation to better serve authorized purposes (USACE, 2007c).

5.2.1.1. Seasonal Intrasystem Regulation Patterns.

Intrasystem regulation to meet the needs of power generation follows a regular seasonal cycle. Releases from Gavins Point are generally at their highest during the navigation season when downstream flow requirements are highest. Since Gavins Point reservoir is small, these releases must be backed up with similar magnitude releases from Fort Randall, and Fort Randall, in turn, requires similar support flows from Oahe via Big Bend. Here the chain can be interrupted; Oahe is large enough to support high releases for extended periods without high inflows. Generation at Fort Peck and Garrison are held to lower levels during the summer to allow more winter hydropower production unless the evacuation of water accumulated in the flood control zones or the desire to balance or unbalance storage among the upper three projects becomes an overriding consideration (USACE, 2007c).

5.2.1.2. Winter Release Patterns

With the onset of the non-navigation season, conditions are reversed. Gavins Point releases drop to about one-third to slightly greater than half of summer levels and the chain reaction proceeds upstream, curtailing daily average discharges from Fort Randall, Big Bend, and Oahe (USACE, 2007c). During the winter release pattern, Fort Peck and Garrison daily releases are usually maintained at relatively high levels (within the limits imposed by downstream ice cover) to partially compensate for the reduction of generation downstream where high winter releases could result in significant flood damages in urban areas when the formation of ice impedes the flow (USACE, 2007c).

5.2.1.3. Balancing/Unbalancing the Upper Three Reservoirs

In the past, the volume of water stored in each of the upper three reservoirs was balanced by the first of March of every year (USACE, 2007c). However, intentionally unbalancing the water stored in the upper three reservoirs can benefit the reservoir fisheries and increase tern and plover habitat. All Annual Operating Plans since the 2000-2001 report have stated that unbalancing would be pursued during years when the reservoirs were at or near the base of their annual flood control pools on March 1st and when runoff forecasts were for median or greater annual runoff. However, drought conditions have prevented implementation of reservoir unbalancing to date (USACE, 2007c).

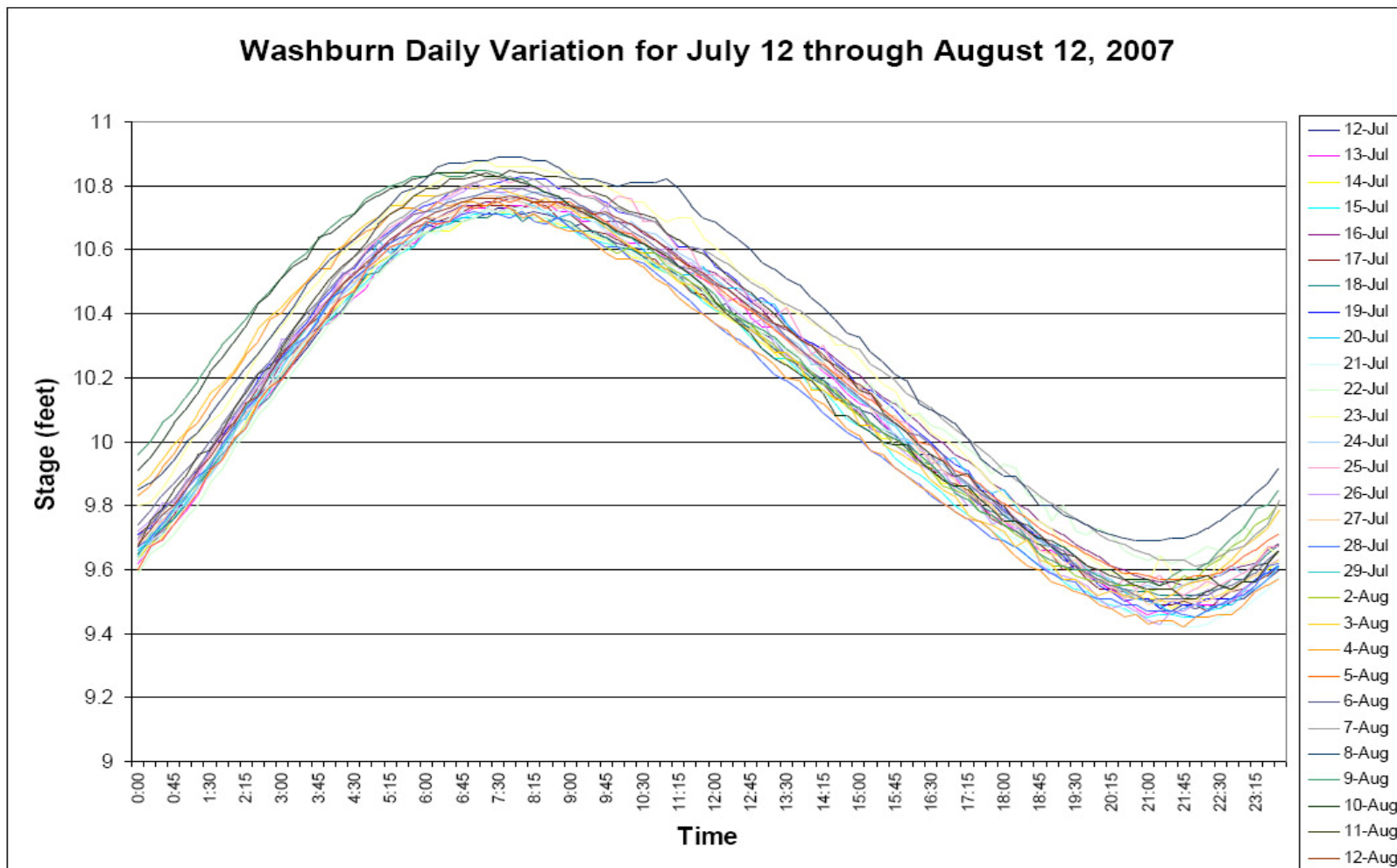
5.2.1.4. Short Term Intrasystem Adjustments.

The interaction among projects described above, repeated as it is year after year, might make intrasystem regulation appear to be a routine and rigid procedure. However, routine regulation is often disrupted by the short-term extremes of nature. For example, heavy rains may raise river stages near the flood level, necessitating a release reduction at one project and a corresponding increase at others. Very hot or very cold weather may create sharp increases in the demand for power. Inflows for a week or for a season may concentrate disproportionately in one segment of the System, causing abrupt shifts in regulating objectives. In addition, short-term intrasystem adjustments are occasionally required to meet emergencies, including the protection of human health and safety, protection of significant historic and cultural properties, or to meet the provisions of applicable laws, including the Endangered Species Act. These adjustments are made to the extent possible after evaluating impacts to other System uses, are generally short term in nature, and continue only until the issue is resolved (USACE, 2007c). However, meeting the needs for short term intrasystem adjustments lead to great variability in releases and pool elevations year-to-year.

5.2.1.5. Hourly Fluctuation of Release Rates

With the exception of the Gavins Point Project, hourly release rates may vary widely as necessary to meet fluctuating power loads (USACE, 2007c) at all of the other projects (Fort Peck, Garrison, Oahe, Big Bend, and Fort Randall). Known as “power pulsing,” this daily practice for the upstream System reservoirs produces predictable, daily, and distinct changes to releases and the associated water surface elevations in the riverine reaches between power pulsed reservoirs. Figure 16 shows the daily stage variation at the Washburn, ND river gage, downstream of the Garrison Dam, for a one-month period between July 12 and August 12, 2007 (USACE, 2010). This figure shows the daily fluctuation in water surface elevation at the Washburn gage with daily highs around 10.7 feet and daily lows of approximately 9.5 feet. The daily effect to river stage of power pulsing at this gage shows a 1.2-foot up-and-down differential in the water surface elevation due to the changes to releases from Garrison Dam. The amplitude of these changes varies by reach, power pulsing result in substantial daily variation in both flow and water surface elevation in the riverine reaches.

Figure 16
Daily Stage Variation for a 31-Day Period Downstream of Garrison Dam



Source: USACE, 2010.

6. Affected Environment and Environmental Consequences

Use of the Daily Routing Model (DRM) to Predict Hydrologic Changes

The Daily Routing Model (DRM) (USACE, 1998) was used as an analytical tool in this assessment to estimate the hydrologic effects that an additional 527 acre-feet of depletions would have at Lake Sakakawea, the other system reservoirs, and free-flowing reaches of the Missouri River. Modeling of the movement of the water through the entire Missouri River Reservoir System was accomplished using the DRM, which was developed during the 1990s as part of the Master Manual Review and Update Study. An 80-year period was selected as the period of analysis because this is the period that daily data are available on Missouri River inflows and flows. Daily records are available for the six dams since their respective dates of closure, and daily flow data are available for the majority of gaging stations since 1930 (USACE, 1998). The depletion and capacity curve data (computed using the sedimentation rate data) were the input files that were used to project elevation and flow for without and with project conditions.

The DRM was developed to simulate and evaluate alternative System regulation for all authorized purposes under a widely varying, long-term hydrologic record. The DRM is a water accounting model that consists of 20 nodes, including the six System dams and 14 gaging stations as shown in Figure 17. In the DRM, each of the six System reservoirs was modeled and the DRM provides output at locations (nodes) along river reaches between System projects: Wolf Point and Culbertson, Montana, and Williston and Bismarck, North Dakota; and ten locations along river reaches below the System: Sioux City, Iowa; Omaha, Nebraska City and Rulo, Nebraska; St. Joseph, Kansas City, Waverly, Boonville, and Hermann, Missouri on the Missouri River and St. Louis, Missouri on the Mississippi River.

The DRM is a time-series analysis that simulates hydrologic output on a daily basis for each of the 80 years modeled from 1930 through 2009, assuming that the entire System was in place and fully operational for the full 80-year period. As the depletion and capacity curve data are varied between the evaluation years for this analysis (i.e., 2010 and 2020), the DRM computes system storage, reservoir elevation, reservoir release, reservoir evaporation, and river flow data for each day of the modeling period. Hydraulic impacts (changes to water surface elevations (WSE) in riverine reaches of the Missouri River) were estimated externally to the DRM model by combining DRM hydrologic output on streamflow with stage-discharge relationships provided at the DRM-modeled riverine nodes by the Omaha District.

Figure 17
Model Node Locations for the Daily Routing Model



Each DRM run provides 29,220 simulated values (80 years of daily values) for each parameter (i.e., water surface elevation, reservoir volume, and streamflow) at the 20 locations/model nodes in the system. These data should not be considered as estimates of actual calendar day values, but rather as simulation output values under the full range of climatological conditions existing over the 80-year period.

To evaluate differences between two alternatives, the differences between each of the 29,220 daily values were determined and then sorted to establish a frequency distribution of modeled values. The distributions of the differences from the current conditions (without the additional depletions) for various DRM outputs (water surface elevation, reservoir volume, and streamflow) were then examined. Comparing the data distributions in this manner provides insight as to how the increased depletion scenario impacts the likelihood of occurrence of a given water surface elevation, reservoir volume, and streamflow over the entire 80-year period. Similarly, it can provide an estimate of the likelihood of a given magnitude of change in each parameter between No Action and with project conditions. It should be noted that the x axis on all of the distribution plots are percent of the days, where 10 percent represents 2,922 days of the full 29,220 days of the 80-year period of analysis.

To examine the effects of just the additional depletions directly from System reservoirs, the simulations for one study year (2010) were completed under three separate planning scenarios: 1) baseline depletions (without project current condition), 2) 527 acre-feet of depletions at Lake Sakakawea (with project condition), and 3) 50,527 acre-feet of depletions (including 527 acre-feet at Lake Sakakawea and 10,000 acre-feet each at the other five system reservoirs) to evaluate the cumulative effects of removing an additional 50,527 acre-feet of water from all six System reservoirs. The model assumes that the historic System inflow data, adjusted assuming the depletions associated with current development in the basin, occurred over the 80-year modeling period.

The source of the actual System inflow data is the U.S. Geological Survey, which began acquiring daily data beginning in late 1929. The DRM adjusts these inflow data by the difference for depletions that have been estimated to occur between each year and 2002. The Bureau of Reclamation provided the monthly depletions, and these monthly data were further separated to daily values for use in the DRM. The 2002 depletion data are assumed to remain constant through 2010 (assumes no change from 2002 to 2010). The depletion data are adjusted upwards to 2020 by including other forecasted depletions (basin projects, population/M&I growth, and the Northwest Area Water Supply (NAWS) project). Simulations including these projected additional system depletions for 2020 were used in the assessment of cumulative effects analysis.

The Daily Routing Model (DRM) has been evaluated and approved under the Science and Engineering Technology (SET) initiative managed by the Engineering and Construction Community of Practice.

Modeled Differences: Depletions from Lake Sakakawea

Because the Missouri River reservoirs are operated as an integrated system, 100,000 acre-feet of yield (257,000 acre-feet of storage) from Lake Sakakawea could conceivably reduce outflows and water surface elevations not just in Lake Sakakawea, but also in the other five System

reservoirs. Changes in water surface elevations have the potential to affect environmental resources throughout the system and the magnitude of predicted environmental consequences is proportional to the predicted changes. However, as stated in Section 5.1.1, the determination of whether an impact significantly affects the quality of the human environment must consider the *context* of an action and the *intensity* of the impacts (40 CFR 1508.27). The less intense of an impact, the less scrutiny even sensitive resources need because of the overt inability of an action to effect change to the physical environment.

Figures 18, 19, and 20, present the distributions (daily differences redistributed from minimum to maximum over the 29,220 daily values) of the differences in releases (cfs) between No Action (CC2010) and the Proposed Action (GAR100) (527 acre-foot depletion from Lake Sakakawea) for Ft. Peck, Garrison, and Oahe Dams, respectively. DRM simulated discharge differences appear to be essentially unaffected from these three dams for about 95 percent of the days. The differences at each end of the distribution are dramatically larger; however, they are for a very small part of the 80-year period of analysis. Many of those for Fort Peck and Garrison Dams are due to the DRM selecting a release change at a slightly different time, resulting in a large difference of a day or two, or due to the selection of a different release for a short period because there is less or more water to move to balance the amount of water in storage among these three reservoirs. The difference at the ends of the distribution of the Oahe Dam figure are for only a few days, indicating that releases to the three lower reservoirs and the lower Missouri River are relatively unaffected by the removal of 527 acre-feet of water from Lake Sakakawea over the year on an annual basis.

Figure 18
Fort Peck: Release-Difference Distribution - Proposed Action Minus No Action

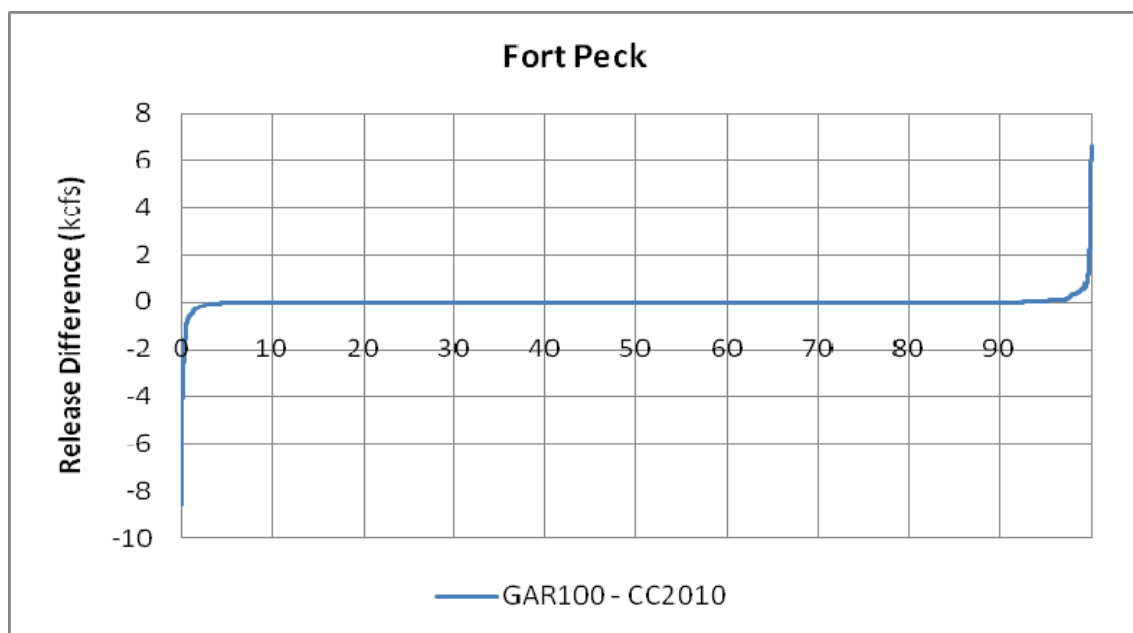


Figure 19
Garrison: Release-Difference Distribution - Proposed Action Minus No Action

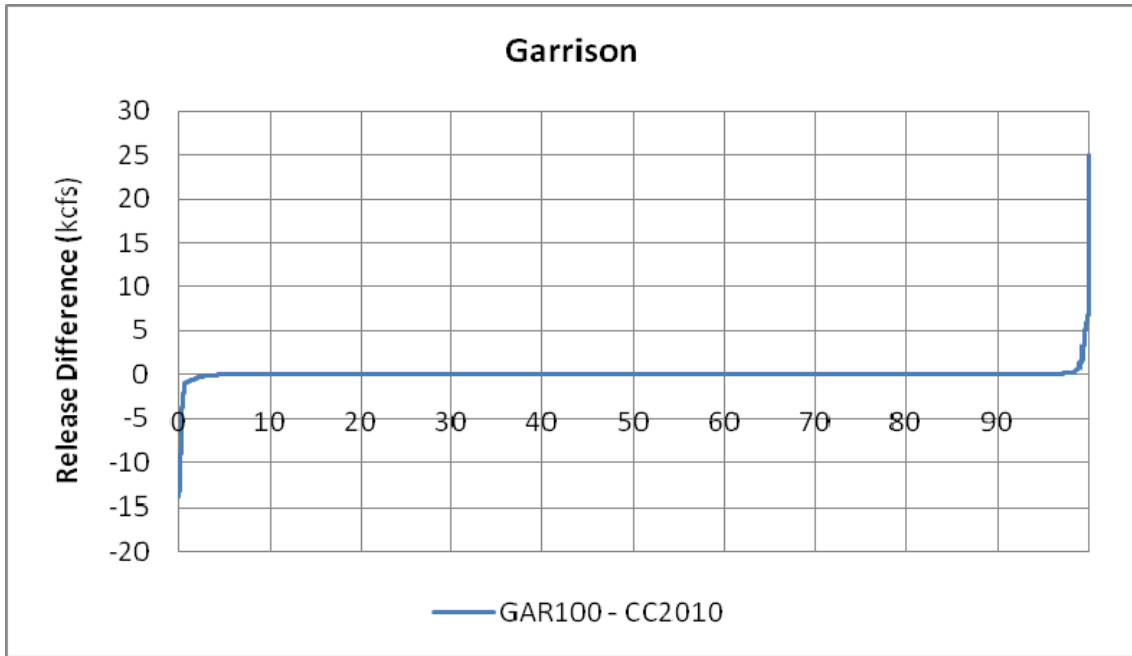
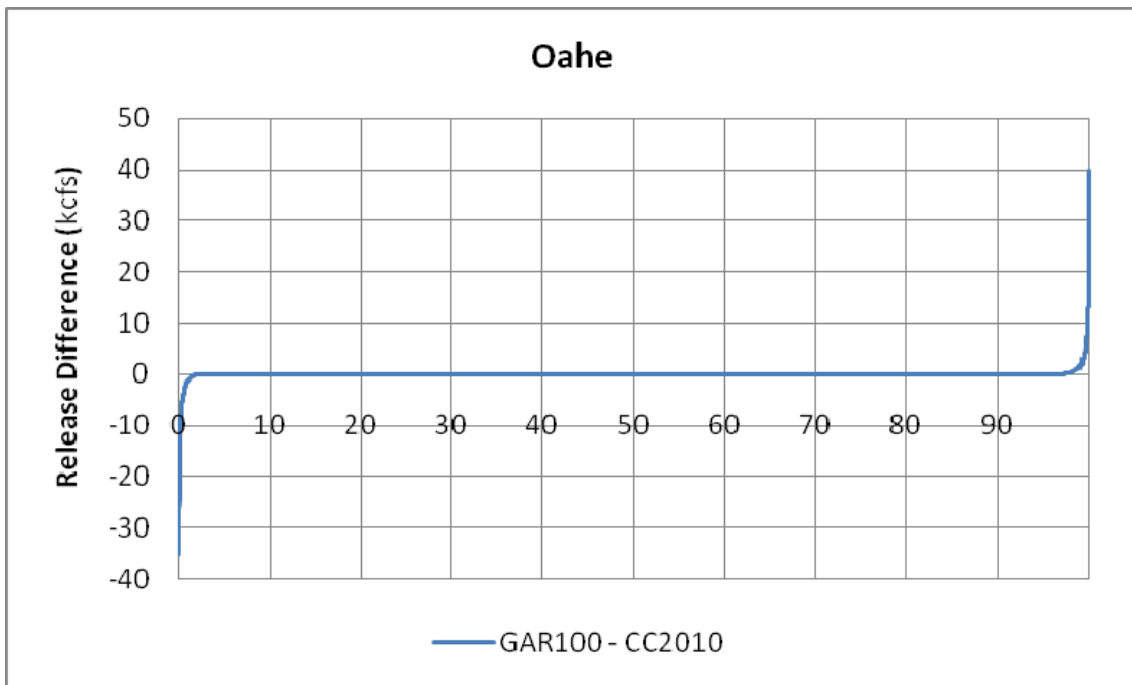


Figure 20
Oahe: Release-Difference Distribution - Proposed Action Minus No Action



Figures 21, 22, and 23 present the reservoir stage distributions for the differences in the reservoir water surface elevations (WSE) between the No Action and the Proposed Action alternatives for the three upper reservoirs of Ft. Peck, Garrison, and Oahe, respectively. The differences in the three lower reservoirs, Big Bend, Fort Randall, and Gavins Point are essentially unaffected by changes at the upper three reservoirs; therefore, no figures are presented for these three lower reservoirs. All three figures show that the levels for the three larger reservoirs are unaffected about 90 to 95 percent of the time. The larger differences are at each end of the distribution plot, and these differences are for relatively short periods in several of the years of the 80-year period of analysis.

Figure 21

Fort Peck Lake: WSE Difference Distribution - Proposed Action Minus No Action

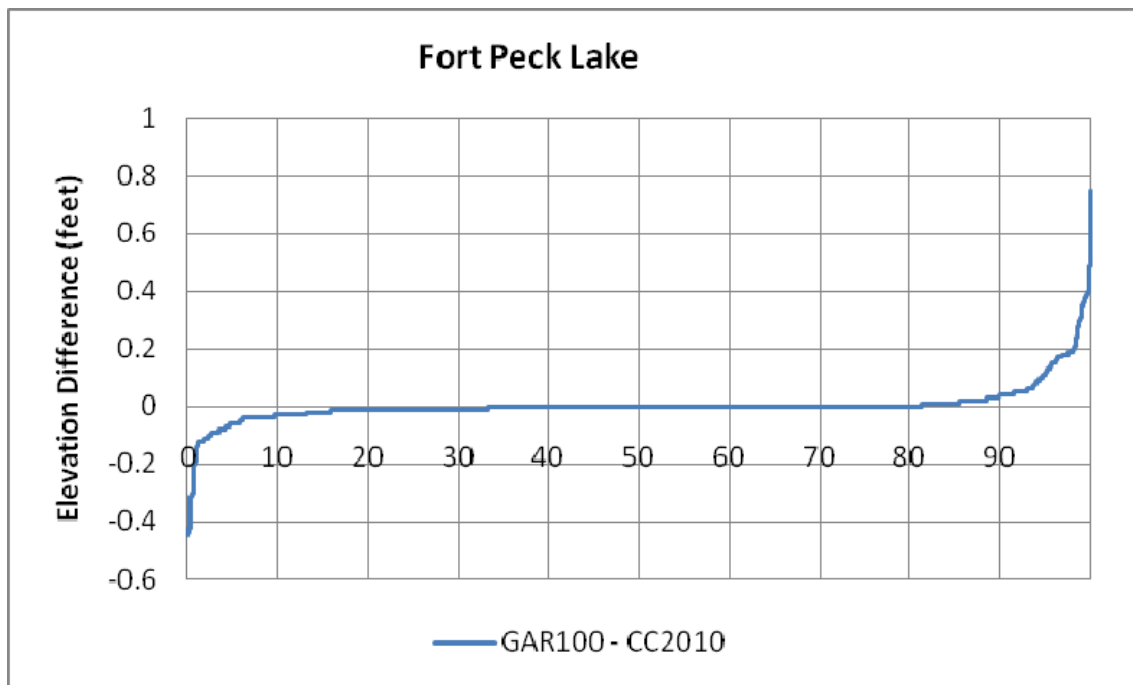


Figure 22
Garrison: WSE Difference Distribution - Proposed Action Minus No Action

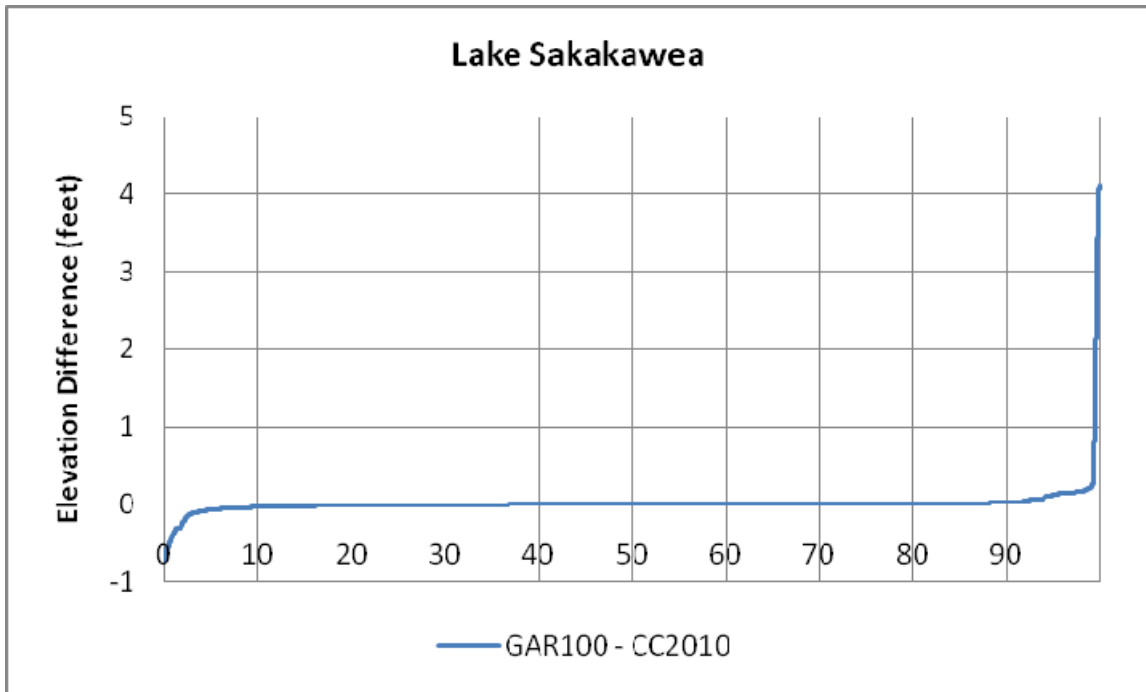
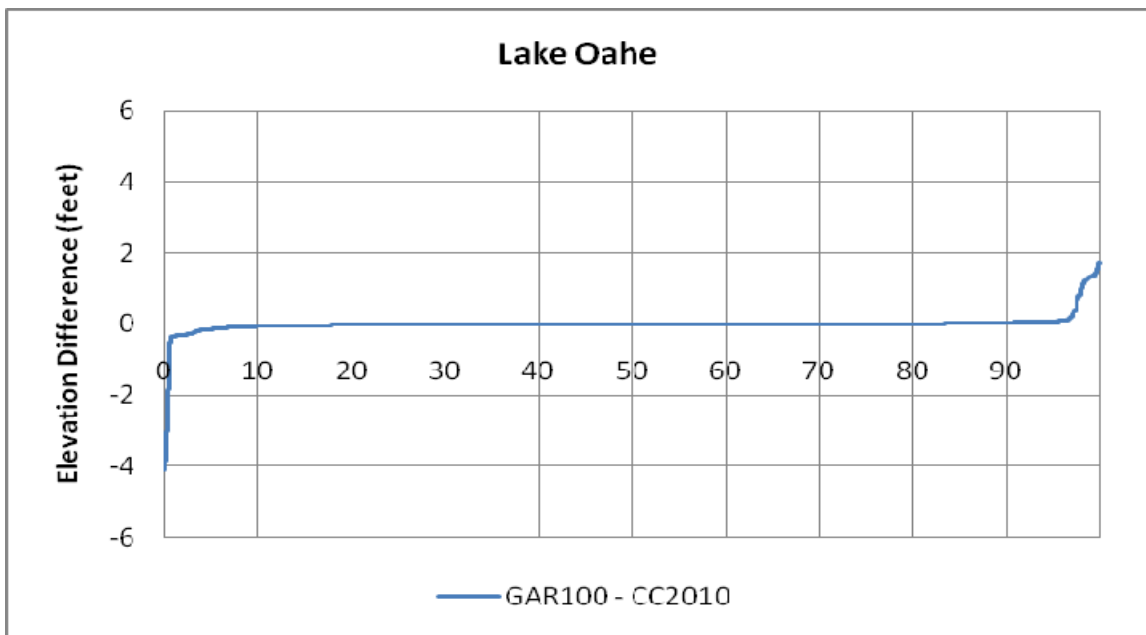
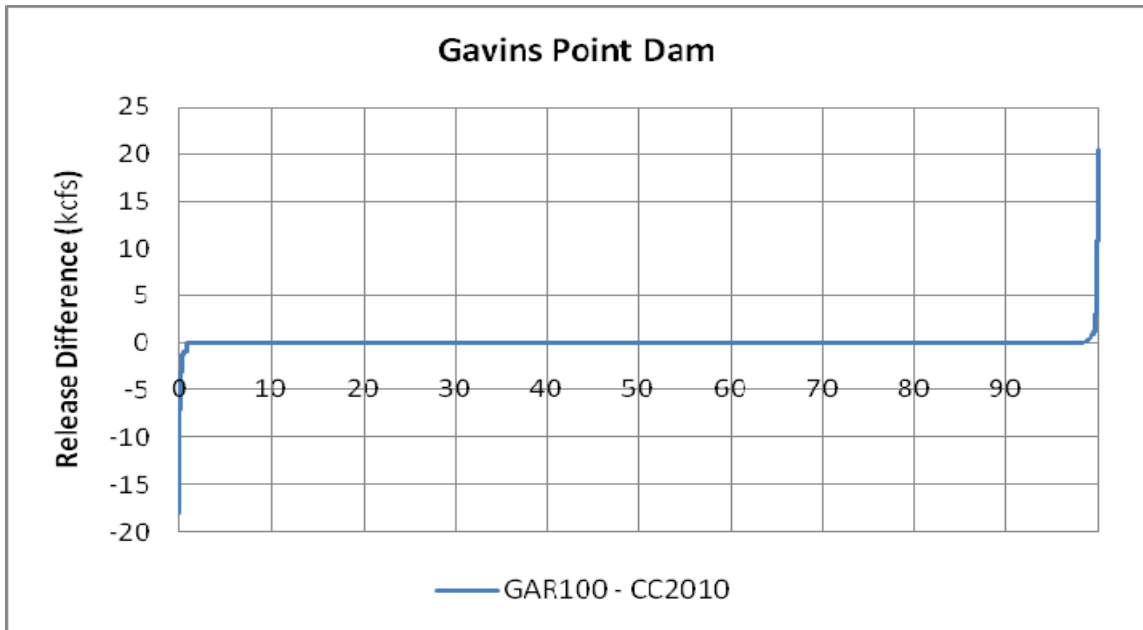


Figure 23
Garrison: WSE Difference Distribution - Proposed Action Minus No Action



Releases from Gavins Point Dam were plotted to examine any potential differences between the No Action and Proposed Action alternatives. Figure 24 is the release distribution plot for Gavins Point Dam releases to the lower Missouri River. This figure shows that there are essentially no differences between these two alternatives for about 95 percent of the years. The differences at each end of the distribution plot are likely due to small changes in navigation service levels and season lengths on the lower Missouri River.

Figure 24
Gavins Point: Release Difference Distribution - Proposed Action Minus No Action



6.1. Topography

6.1.1. Existing Condition

The topography of North Dakota defined by contrast with the Missouri River defining the boundary. The advance and retreat of the Laurentide Ice Sheet during last glacial period is largely responsible for the present terrain and drainage. The mile-wide Missouri River valley separates the Missouri Plateau of the west from the glaciated Missouri Coteau of eastern North Dakota. Most of western North Dakota is characterized by the Missouri Plateau of the Great Plains extending from the western side of the Missouri River valley down to north-central South Dakota. The topography of this area typifies the "American West" with its rolling wide-open spaces and shortgrass prairie. To the west of this plateau, the landscape transitions into the Little Missouri badlands where conical hills were formed when the Little Missouri River was displaced by Pleistocene glacial activity. Ephemeral streams that remove the soft silt and clays of the hills have further shaped the badlands. Overall, western North Dakota is characterized by its moderately dissected level topography, stream carved terrain, and rolling plains that are a patchwork of prairie, steppe, and grassland, interspersed with buttes and badlands. Elevations in western North Dakota range from 1,750 to 3,300 feet above sea level (NPWRC, 2010).

The topography surrounding Lake Sakakawea is an open, expansive, stream-dissected prairie. Lake Sakakawea is long and sinuous, with a highly serrated shoreline due to the inundation of valleys of tributaries to the Missouri River. Rugged topography due to stream downcutting (dissection) is most extensive near Lake Sakakawea and to the southwest, particularly along the Little Missouri River valley. Here, elevations often differ by more than 800 feet within a few miles, in areas where buttes, badlands, and large coulees (drainageways) formed in association with Pleistocene (ice age) glacial advances and retreats.

6.1.2. Environmental Consequences

No Action

Under the No Action alternative, there would be none of the ground-disturbing effects associated with construction of the water depots, retention ponds, road access, utility lines, or the water supply intakes on lands surrounding Lake Sakakawea. However, under the No Action alternative, similar infrastructure to access the water from riverine reaches would likely be constructed upstream or downstream of Lake Sakakawea to meet the water demand. None of these actions under the No Action alternative would be expected to significantly affect topography.

Proposed Action

As described in Section 4.4.2, construction of water depots, retention ponds, utility lines and roadways for all of the water supply intakes would typically disturb a 75-foot width of disturbance from the high water mark to the terminus and water depots/retention ponds would be approximately two acres each. However, to the extent feasible, the trenched water/utility line and water depots/retention ponds would be constructed within or adjacent to an existing utility or road corridor thereby minimizing the changes to topography from the proposed actions.

6.2. Geology, Stratigraphy, and Seismology

6.2.1. Existing Condition

Geology

North Dakota is situated in the Northern Great Plains region and is geologically, one of the least complicated parts of North America. For most of the half billion years from 570 million until about 70 million years ago, the Great Plains was inundated by shallow seas. About 70 million years ago, the seas were displaced from the continental interior by slow uplift of the continent. The landscape that appeared, presently the Northern Great Plains, was the expansive, nearly flat, floor of the former sea. The many layers of sediments deposited onto the subsiding floor of the interior ocean, now consolidated into rock, rest on ancient Pre-Cambrian basement rocks (Trans-Hudson Orogenic Belt) of the North American Craton.¹²

Within the North American Craton, the Williston Basin is a large, sedimentary basin covering approximately 300,000 square miles across parts of North and South Dakota, Montana, and the Canadian provinces of Manitoba and Saskatchewan. The geographic center of the basin lies about 16,000 feet below the ground surface near Williston, ND (Heck et al., 2007).

Overlying the geologic structures of the Williston Basin are poorly consolidated sediments and lignite (soft coal) beds of the Tertiary-age Fort Union Formation. This formation mainly consists of alternating beds of moderately to well compacted, gray to brown, stiff to hard clay shale, with moderately to well compacted silt and fine sand, and numerous lignite beds. Overlying the Fort Union Formation are Pleistocene glacial till and alluvial deposits (sands, gravels, and alluvial clays) that hold surficial groundwater aquifers.

Stratigraphy

Stratigraphy is the description of the sequence, spacing, composition, and spatial distribution of geologic formations of sedimentary deposits and rocks in a given area. The stratigraphic column, or layers of rock of the Williston Basin, spans a discontinuous sequence from weathered Precambrian crystalline basement rocks approximately 2.5 billion years old to Tertiary rocks deposited 2.5 million years ago. Unconsolidated glacial sediments of Quaternary age (2.5 million years ago to approximately 12,000 years ago) overly the consolidated basin strata. There are a large number of oil-bearing formations in the Williston Basin including the Bakken, Sanish, and Three-Forks Formations that are the focus of current oil and natural gas drilling activities in western North Dakota (NDSWC, 2010).

Seismology

Most earthquakes that originate in North Dakota are likely related to deeply buried structures in the Precambrian basement (Bluemle, 2002). Most of the structural deformation during the Paleozoic Eon in North Dakota probably resulted from the subsidence of the Williston Basin. The main evidences of structural deformation in the basin are folding and faulting and the best evidence of folding in North Dakota is the anticlinal and synclinal structures that were formed.

¹² A craton is a stable part of the earth's continental crust that has not been deformed significantly for many millions or hundreds of millions of years.

In structural geology, an anticline is a fold that is convex up and has its oldest beds at its core and a syncline is a downward-curving fold, with layers that dip toward the center of the structure. Anticlines are favored locations for oil and natural gas drilling because the low density of petroleum causes it to buoyantly migrate upward to the highest parts of the fold. In North Dakota, some of these structures, like the Nesson, Cedar Creek, Little Knife, and Billings anticlines, produce oil (Heck et al., 2007).

The Nesson Anticline is the most prominent surface structure in the North Dakota portion of the Williston Basin. It is a subterranean crustal flexure extending from Williams County and western Mountrail County generally southward for approximately 75 miles into McKenzie and Dunn counties.

6.2.2. Environmental Consequences

No Action

Taking no action would not have any effect on the geology, stratigraphy, or seismology of the Garrison Project, Lake Sakakawea, or the region.

Proposed Action

Implementing the Proposed Action would not have any effect on the geology, stratigraphy, or seismology of the Garrison Project, Lake Sakakawea, or the region.

6.3. Soils

6.3.1. Existing Condition

Soil in this region has been forming since the last glacier receded approximately 10,000 years ago. Residue was left from the last glacial period in the form of glacial till, outwash plains, alluvium, loess materials, or weathered bedrock. Soils were developed in a semiarid to subhumid, continental climate with hot summers, cold winters, and modest precipitation.

Western North Dakota soils are principally Mollisols of the dominant sub-order Udolls. Mollisols are characterized as dark mineral soils common to the subhumid to semiarid plains of North America. These soils are typically found in grasslands and are rich in organic materials making them very suitable for agriculture. Udolls specifically are predominant in the Great Plains region where they support tall grass prairie, cropland, pasture or rangeland.

The badlands of southwest North Dakota are characterized by Entisols of the dominant sub-order Orthents. These soils, which have little to no diagnostic horizons, are the result of erosional processes and glacial outwash. The lack of horizons indicates soils that exist on steep, eroding slopes where soil material does not stay long enough to develop distinct layers. Orthents typically support rangeland, pasture, and wildlife habitat (USACE, 2007).

Along the Missouri River, Aridisols and Inceptisols are also found; Aridisols are soils that are unable to hold onto moisture for long periods of time limiting the growth of vegetation and many contain salts as a result of high evapotranspiration. Inceptisols are widely varying soils that are generally found in active landscapes where deposition or erosion regularly occurs. As a result,

Inceptisols are often located on mountain slopes or along river valleys and many of the Inceptisols were a result of the late-Pleistocene glacial drift (USACE, 2007).

Within NEPA evaluations, the USACE must consider the protection of the nations' significant/important agricultural lands from irreversible conversion to uses that result in their loss as an environmental or essential food production resource. The Farmland Protection Policy Act (FPPA), 7 USC 4201 et seq., and the U.S. Department of Agriculture's (USDA) implementing procedures (7 CFR § 658) require Federal agencies to evaluate the adverse effects of their actions on prime and unique farmland, including farmland of statewide and local importance.

6.3.2. Environmental Consequences

No Action

Under the No Action alternative, there would be no soil-disturbing activities for water depot, retention pond, water intake, utility, and access road construction on Garrison Project lands. However, taking No Action would likely require new water intake infrastructure be developed up-river from Lake Sakakawea that could require the conversion of Prime or Unique Farmland or farmland of statewide and local importance, depending on the intake location selected.

Proposed Action

Element Solutions:

Mandaree Site – proposed pipeline would be constructed within a previously disturbed corridor with current ground cover of grass adjacent to an existing roadway and an existing utility corridor. According to Figure 2.5.1 in the Garrison Dam/Lake Sakakawea Project Master Plan (USACE, 2007), the proposed area for pipeline, utility, and road construction has not been designated as prime farmland or farmland of statewide importance (USACE, 2007).

International Western:

Iverson Site – According to Figure 2.5.1 in the Garrison Dam/Lake Sakakawea Project Master Plan (USACE, 2007), the proposed area for pipeline, utility, and road construction has not been designated as prime farmland or farmland of statewide importance (USACE, 2007). In addition, this location would utilize an existing intake and existing storage pond and would not result in new construction. As such, there would be no concerns about affects to protected farmland.

Thompson Site – The proposed intake pipe would be constructed within a grassed area between access roads and the high-water mark. According to Figure 2.5.1 in the Garrison Dam/Lake Sakakawea Project Master Plan (USACE, 2007), the proposed area for pipeline, utility, and road construction has not been designated as prime farmland or farmland of statewide importance (USACE, 2007).

Charlson Site – The proposed intake pipe would be constructed within a grassed area between the existing two-track access roads and the high-water mark. According to Figure 2.5.1 in the Garrison Dam/Lake Sakakawea Project Master Plan (USACE, 2007), the proposed area for

pipeline, utility, and road construction has not been designated as prime farmland or farmland of statewide importance (USACE, 2007).

Lake Sakakawea & Associates:

#3 – The area for the proposed water depot and the pipeline from the water depot to the ordinary high water mark would be constructed within a predominantly grassed area with adjacent vegetated coulees. According to Figure 2.5.1 in the Garrison Dam/Lake Sakakawea Project Master Plan (USACE, 2007), the proposed area for the water depot, pipeline, utility, and road construction has not been designated as prime farmland or farmland of statewide importance (USACE, 2007).

#5 - The area for the proposed water depot and the pipeline to the ordinary high water mark would be constructed within a grassed area between access roads and the high-water mark. No trees or woody vegetation or wetlands are within the proposed access. According to Figure 2.5.1 in the Garrison Dam/Lake Sakakawea Project Master Plan (USACE, 2007), the proposed area for pipeline, utility, and road construction has not been designated as prime farmland or farmland of statewide importance (USACE, 2007).

#8 – The area for the proposed water depot and the pipeline to the ordinary high water mark would be constructed within a previously disturbed corridor with current ground cover of grass adjacent to an existing roadway and an existing utility corridor. According to Figure 2.5.1 in the Garrison Dam/Lake Sakakawea Project Master Plan (USACE, 2007), the proposed area for pipeline, utility, and road construction has not been designated as prime farmland or farmland of statewide importance (USACE, 2007).

6.4. Groundwater

6.4.1. Existing Condition

Groundwater supplies approximately 60% of North Dakota's drinking water and 97% of the rural population's drinking water (USACE, 2007). Groundwater in western North Dakota occurs in glacial deposits (drift) and in bedrock sediments (see Figure 25). The unconsolidated glacial sediments include sorted outwash deposits and glaciofluvial valley-fills that are typically less than one mile wide. Though highly transmissive, glacial aquifers are commonly too small to store sufficient quantities of water to supply large industrial users.

Groundwater in bedrock aquifers in western North Dakota occur in fine-grained and lenticular sediments deposited on an aggrading continental landmass of Tertiary and late Cretaceous age, or in the underlying beach/delta deposits of the Fox Hills-Hell Creek aquifer. The bedrock sediments overlying the Fox Hills Formation are usually too clayey and lenticular to supply more than five or ten gallons per minute to individual wells. The Fox Hills Formation, occurring between about 1,000 and 2,000 feet below land surface in much of the central Williston basin, is the deepest fresh water aquifer in western North Dakota and can yield 100 or more gallons per minute to wells, but recharge to the aquifer is very low. The Fox Hills-Hell Creek aquifer is laterally continuous, extending southwest to higher elevations, which gives the aquifer a pressure head above land surface in low-lying parts of the Missouri and its tributary river valleys. The flowing pressure head is a valuable asset to ranchers in that electrical power does not have to be

provided in remote pasture locations. The large number of Fox Hills wells and the low recharge rate has resulted in a declining pressure head of one to two feet per year in the central Williston basin. Eventually the wells will stop flowing as the pressure head declines below land surface. So as to not increase the rate of pressure head decline, water users in the central Williston basin that require a permit are now directed to other sources.

According to the North Dakota State Water Commission, glaciofluvial and other shallow aquifers and the Fox Hills bedrock aquifer are insufficient to supply the requirements of the oil and gas industry at the proposed rate of development (NDSWC, 2010). In addition, “it is critical that ground-water supplies be conserved for the use and sustenance of towns, homes, local industries, and farms and ranches, after the completion of oil development” (NDSWC, 2010). As of December of 2009 there were 28 groundwater-based water depots, for a total allocation of 2,340 acre-feet per year serving the oil industry in western North Dakota (NDSWC, 2010). Thirty more water permits for water depots are pending, for an additional 5,534 acre-feet per year, but not all of these would likely be approved (NDSWC, 2010). Even if all were approved, water supplies from ground water would fall far short of needs for the oil and gas industry and risk long-term effects from depleting the bedrock groundwater resources (NDSWC, 2010).

6.4.2. Environmental Consequences

No Action

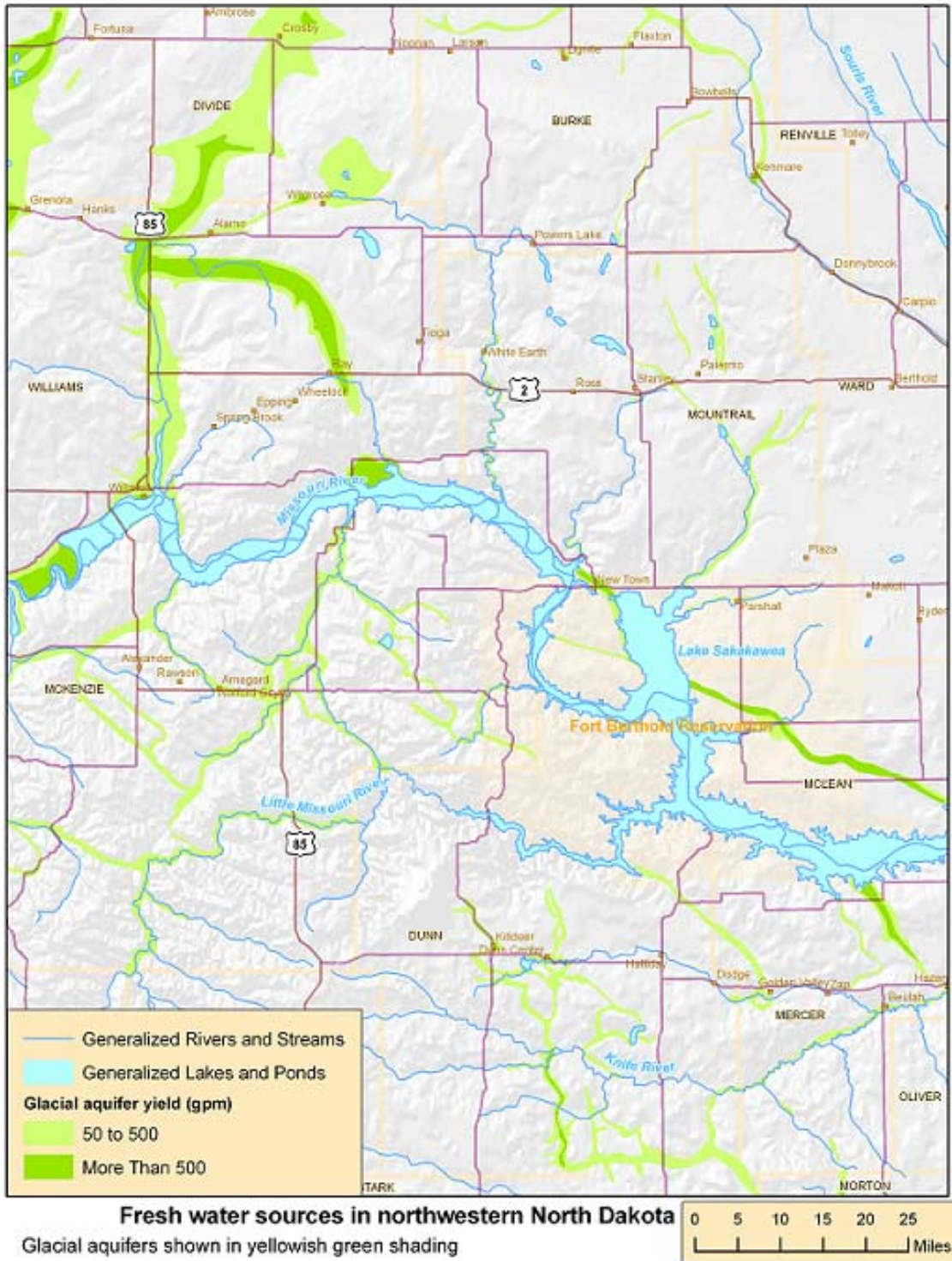
As described in Section 4.1, under the no action alternative, the Corps of Engineers would not make a determination of surplus water, there would be no change to the water supply, there would be no water supply agreements, and no new water supply intakes would be constructed. Without these new water supply intakes, there would be no new depletions from Lake Sakakawea from within Garrison Project lands. The majority of water to supply the industry’s needs would likely be provided by Missouri River water upstream or downstream of Lake Sakakawea. Groundwater resources (both surficial and bedrock sources) within the area are not sufficient to supply the quantity of water needed for M&I purposes.

Therefore, minimal effects to groundwater would be predicted as a consequence of taking No Action because groundwater resources are insufficient to supply the oil and gas industry and the State of North Dakota would not overexploit the groundwater resource. As quoted in Section 3.3.2.1, “*Groundwater supplies in western North Dakota are limited. Glaciofluvial and other shallow aquifers and the Fox Hills – Hell Creek bedrock aquifer are insufficient to supply the requirements ... at the proposed rate of development. It is critical that ground-water supplies be conserved for the use and sustenance of towns, homes, local industries, and farms and ranches, after the completion of oil development*” (NDSWC, 2010).

Proposed Action

For the same reasons that implementing the No Action alternative would not be expected to have an effect on groundwater, implementing the Proposed Action would likewise not be expected to significantly affect groundwater resources. Implementing the proposed action could reduce the demand for groundwater sources, but as stated above, groundwater resources are insufficient to meet the industry’s needs and therefore would not be affected by implementing the Proposed Action.

Figure 25
Surficial Aquifers in Western North Dakota



6.5. Water Quality

6.5.1. Existing Condition

The Clean Water Act (CWA) requires states to report on the quality of their waters including Section 305(b) (State Water Quality Assessment Report) and Section 303(d) identifying a list of a state's water quality-limited waters needing total maximum daily loads (TMDLs). The primary purpose of the Section 305(b) State Water Quality Assessment Report is to assess and report on the extent to which beneficial uses of the state's rivers, streams, lakes, reservoirs and wetlands are met (NDDoH, 2010). The NDDoH's Ambient Water Quality Monitoring Network for Rivers and Streams currently consists of 34 fixed-station ambient monitoring sites located on 19 rivers to provide data for trend analysis, general water quality characterization, and pollutant loading calculations (NDDoH, 2010).

Samples are collected and analyzed for water chemistry and bacteria at each of these sites every six weeks during the open-water period (generally from early April through November) and once during the winter under ice cover (generally in late January or early February). Parameters include major ions, trace elements, total suspended solids, total and dissolved nutrients (phosphorus, nitrogen, ammonia, nitrate-nitrite, Total Kjeldahl Nitrogen), total and dissolved organic carbon, and fecal coliform and E. coli bacteria (NDDoH, 2010).

Table 6 shows the designated use, impairment status, and the basis for listing for impaired waterbodies tributary to, and including, Lake Sakakawea in North Dakota. These classifications are based on the 2010 List of Section 303(d) TMDL Waters for the Missouri River Basin (NDDoH, 2010). The State of North Dakota has designated Lake Sakakawea as a Class I lake in the State's water quality standards.¹³ As such, the lake is to be suitable for a coldwater fishery (e.g., salmonid fishes and associated aquatic life); swimming, boating, and other water recreation; irrigation; stock watering; wildlife; and water for municipal or domestic use after appropriate treatment.

Lake Sakakawea undergoes an annual water temperature cycle, based on the four seasons and the transition between seasons. During the summer, a thermocline becomes established in the deeper area of the reservoir towards the dam. Because the thickness of the upper (warm water) layer tends to remain the same from year to year due to mixing by wind, the higher the surface elevation of the lake, the farther upstream the boundary of the hypolimnion (and the coldwater fishery) extends. The shallower upper reaches of Lake Sakakawea do not vary much in temperature by depth during mid to late summer because wind action completely mixes the water (USACE, 2007).

¹³ www.legis.nd.gov/information/acdata/pdf/33-16-02.1.pdf

Table 6
Surface Waters on 303(d) TMDL List in the Project Area

Description	Assessment Unit ID	Designated Use	Use Support	Impairment
Lake Sakakawea	ND-10110101-021_00	Fish Consumption	Not Supporting	Methyl mercury
Little Muddy River from East Fork Tributary to Lake Sakakawea	ND-10110102-001-S_00	Recreation	Not Supporting	Fecal coliform
Little Missouri River from Little Beaver Creek to Lake Sakakawea	ND-10110203-003-S_00	Recreation	Fully Supporting, but Threatened	Fecal coliform
Little Knife River from Stanley Reservoir to Lake Sakakawea	ND-10110101-080-S_00	Recreation	Not Supporting	Fecal coliform

Dissolved oxygen concentrations in Lake Sakakawea vary in association with water depth because more oxygen can remain dissolved (and available for fish respiration) in cold water. Dissolved oxygen levels ≥ 5 mg/l (milligrams per liter) are required for fishery habitat. Maintaining summer pool levels above 1825 msl in Lake Sakakawea is considered necessary to maintain sufficiently oxygenated habitat (USACE, 2009).

The State of North Dakota “Standards of Quality for Waters of the State” (Chapter 33-16-02.1) defines Lake Sakakawea as a Class 1 Lake: cold water fishery capable of supporting growth of cold water fish species (e.g., salmonids) and associated biota. Water temperature and dissolved oxygen levels are primary water quality factors that determine the suitability of water for coldwater aquatic life. As such, the water quality standards applied to Lake Sakakawea are that the lake must maintain at least 500,000 acre-feet of water at all times with a temperature less than or equal to 15° C, and dissolved oxygen greater than or equal to 5 mg/l. The State of North Dakota has placed Lake Sakakawea on their 303(d) impaired waterbody list citing impairment to the coldwater fishery due to water temperature and dissolved oxygen concerns.

6.5.2. Environmental Consequences

No Action

As described in Section 4.1, under the no action alternative, the Corps of Engineers would not make a determination of surplus water, there would be no change to the water supply, there would be no water supply agreements, and no new water supply intakes would be constructed. Without these new water supply intakes, there would be no new depletions from Lake Sakakawea from within Garrison Project lands. However, as a result of taking No Action, the majority of water to supply the industry’s needs would likely be provided by Missouri River water upstream or downstream of Lake Sakakawea. These depletions from the riverine reaches above Lake Sakakawea would effectively result in the same changes to water surface elevations and the quantity of water available for discharge as with the Proposed Action. The only difference would be where the water was withdrawn. Therefore, implementing the No Action

alternative would result in effects to water quality of the surface waters of Lake Sakakawea that were substantially the same as with the Proposed Action.

Proposed Action

Intake Construction

The expected impacts of intake construction (e.g., conventional excavation and directional drilling) on the water quality of Lake Sakakawea would be temporary and minor disturbances during the construction process. The construction methods selected for these projects were chosen, in part, because they eliminate the need for suspension of organic lake sediment, and the handling of such, in an aquatic environment. Thus, no detrimental effects to the water quality are expected to occur from the temporary impacts of the localized increased turbidity, the release of possible contaminants, or release of nutrients and associated impacts to dissolved oxygen levels.

Depletions

The Omaha District utilized the most current model available (CE-QUAL-W2) to model the potential changes to the Class 1 Cold Water Fishery water quality conditions in Lake Sakakawea (USACE, 2010a). The CE-QUAL-W2 model predicts temperature and dissolved oxygen depth-profiles in modeled lakes based on model inputs (e.g., meteorological conditions, inflows, outflows, etc.) and was used to quantify the volume of Lake Sakakawea that meets the CWFH temperature and dissolved oxygen standards under the existing and proposed action conditions. The CE-QUAL-W2 model has been evaluated and approved under the Science and Engineering Technology (SET) initiative managed by the Corps of Engineers Engineering and Construction Community of Practice. CE-QUAL-W2 is listed as a preferred model for water quality analyses.

The QUAL2 model has been applied and calibrated for only a five-year period for Lake Sakakawea, 2003 through 2007 (as opposed to the 1930-present for the DRM). Reservoir models were developed for each year based on the meteorological, inflow, outflow, and inflow water quality conditions that occurred during the year. To identify which year best characterized “most-normal” and “worst-case-drought” conditions, yearly pool elevations, mid-summer thermal stratification, and estimated coldwater habitat in Lake Sakakawea were reviewed. Based on that review, 2003 was selected as the year that best represented most-normal conditions, and 2006 was selected as the year that best represented drought conditions.

As an extremely conservative approach to the analysis, the maximum change to the water surface elevation of Lake Sakakawea from a system-wide depletion of 150,000 acre-feet (including of up to 100,000 acre-feet of yield (257,000 acre-feet of storage from Lake Sakakawea) was modeled and indicated a lowering of less than one foot for the typically wet (2003) year and approximately two feet for the typical dry (2006) year. However, to better understand the utility of these results in predicting changes to the areal extent of cold-water habitat in Lake Sakakawea, root mean square errors (RMSE) were calculated.

Root Mean Square Error (RMSE) is a frequently used measure of the differences between values predicted by a model and the values actually observed. The RMSE is the square root of the variance, also known as the standard error. The standard error of a method of measurement or estimation is the standard deviation of the sampling distribution associated with the estimation

method. These standard errors are typically reported as a value, plus or minus the reported value.

As shown in Table 7, the standard error for modeling the depth to 15° C water temperature are approximately 6.6 feet and 11.5 feet for 2003 and 2006 respectively. The standard errors for modeling the depth to 5 mg/l dissolved oxygen were approximately 11 feet and 16 feet for 2003 and 2006 respectively. As such, the standard error associated with estimating the depths to the 15° C and 5 mg/l isopleths were appreciably larger than the predicted changes in Lake Sakakawea pool elevations (maximally two feet or less) from the extremely conservative assumptions used for modeled depletions. Thus, the uncertainty associated with the model predictions exceed the values predicted from the proposed action. These standard errors indicate that the model does not have the sensitivity to predict effects at the magnitude of the estimated pool elevation changes. Given the difference between the No Action and Proposed Action model results from DRM, there would be no significant effects to the cold water habitat predicted as a result of implementing the Proposed Action.

Table 7
Standard Error Estimation for Modeled Effects

Parameter	Standard Error +/- (Feet)	
	Typically Wet Year (2003)	Typically Dry Year (2006)
Change to Depth of 15-Degrees C	6.6	11.5
Change to Depth of 5 mg/l Dissolved Oxygen	11.1	16

6.6. Air Quality

6.6.1. Existing Condition

The U.S. Environmental Protection Agency (USEPA) Office of Air Quality Planning and Standards has set National Ambient Air Quality Standards (NAAQS) for six principal pollutants, called “criteria” pollutants. They are carbon monoxide, nitrogen dioxide, ozone, lead, particulates of 10 microns or less in size (PM-10 and PM-2.5), and sulfur dioxide. Ozone is the only parameter not directly emitted into the air but forms in the atmosphere when three atoms of oxygen (O₃) are combined by a chemical reaction between oxides of nitrogen (NO_x) and volatile organic compounds (VOC) in the presence of sunlight. Motor vehicle exhaust and industrial emissions, gasoline vapors, and chemical solvents are some of the major sources of NO_x and VOC, also known as ozone precursors. Strong sunlight and hot weather can cause ground-level ozone to form in harmful concentrations in the air.

The Clean Air Act General Conformity Rule (58 FR 63214, November 30, 1993, Final Rule, Determining Conformity of General Federal Actions to State or Federal Implementation Plans) dictates that a conformity review be performed when a Federal action generates air pollutants in a region that has been designated a non-attainment or maintenance area for one or more NAAQS. A conformity assessment would require quantifying the direct and indirect emissions of criteria

pollutants caused by the Federal action to determine whether the proposed action conforms to Clean Air Act requirements and any State Implementation Plan (SIP).

The general conformity rule was designed to ensure that Federal actions do not impede local efforts to control air pollution. It is called a conformity rule because Federal agencies are required to demonstrate that their actions “conform with” (i.e., do not undermine) the approved State Implementation Plan (SIP) for their geographic area. The purpose of conformity is to (1) ensure Federal activities do not interfere with the air quality budgets in the SIPs; (2) ensure actions do not cause or contribute to new violations, and (3) ensure attainment and maintenance of the NAAQS. Federal agencies make this demonstration by performing a conformity review when the actions they are planning to carry out will be conducted in an area designated as a non-attainment or maintenance area for one of the criteria pollutants.

If one or more of the priority pollutants was not in attainment, then the proposed action would be subject to detailed conformity determinations unless these actions are clearly de minimus emissions. Use of the de minimus levels assures that the conformity rule covers only major Federal actions (USEPA, 1993). A conformity review requires consideration of both direct and indirect air emissions associated with the proposed action. Sources that would contribute to direct emissions from this project would include demolition or construction activities associated with the proposed action and equipment used to facilitate the action (e.g., construction vehicles). To be counted as an indirect emission, the Federal proponent for the action must have continuing control over the source of the indirect emissions. Sources of indirect emissions include commuter activity to and from the construction site (e.g., employee vehicle emissions). Both stationary and mobile sources must be included when calculating the total of direct and indirect emissions, but this project would involve only mobile sources.

For each of the counties of western North Dakota, all six criteria pollutants are in attainment of the air quality standards (USEPA, 2010). The Clean Air Act Amendments of 1977 state that national parks which exceed six thousand acres in size be classified as "Class I" areas. "Class I" areas have set restrictions on the allowable increase in emissions of particulate matter and sulfur dioxide beyond a baseline year. Theodore Roosevelt National Park, located in the badlands of western North Dakota, covers 70,467 acres of land, deeming it a "Class I" area (Clean Water Act). Sulfur dioxide levels have been monitored at the Park, but not at park boundary areas (NPS, 2010).

The North Dakota Department of Health is the state agency designated to administer and coordinate a statewide program of air pollution control, has general legal authority under North Dakota Century Code Sections 23-25-03 and 28-32-02 to adopt and enforce rules for visibility protection including regional haze visibility impairment. In February 2010, the state prepared a submittal to address the State Implementation Plan requirements for the State of North Dakota Regional Haze Program Requirements, of 40 CFR Part 51 Subpart P - Protection of Visibility (NDDOH, 2010a).

The evaluation identified seven steam electric generating units in North Dakota as being subject to the best available retrofit technology (BART) requirements of 40 CFR 51.308(e). The installation of BART on these sources will result in a reduction of 98,618 tons per year of sulfur dioxide emissions and a reduction of 21,137 tons per year of nitrogen oxides emissions from the 2000-2004 average emissions (NDDOH, 2010a). These reductions will significantly improve

visibility in North Dakota's Class I areas¹⁴ as well as those in surrounding states (NDDOH, 2010a).

6.6.2. Environmental Consequences

No Action

Under the No Action alternative, the Corps of Engineers would not make a determination of surplus water, there would be no change to the water supply, there would be no water supply agreements, and no new water supply intakes would be constructed. Without these new water supply intakes, there would be no new depletions from Lake Sakakawea from within Garrison Project lands. However, as a result of taking No Action, the majority of water to supply the industry's needs would likely be provided by Missouri River water upstream or downstream of Lake Sakakawea.

Emissions and fugitive dust related to the construction of the water supply infrastructure would still be necessary, but these emissions and the associated effects would occur at locations upstream or downstream from Lake Sakakawea as opposed to within Garrison Project lands. Obtaining water up or down river from Lake Sakakawea would also lead to a substantial increase in water truck travel distance when compared to the Proposed Action. The associated diesel emissions and fugitive dust (i.e., road dust) would be greater than with the Proposed Action as well. Under the No Action alternative, the oil and gas industry would continue to obtain the necessary water to support the oil and gas industry and the regional effects to air quality, including visibility impairment, would not be predicted to change substantially from the existing conditions.

Proposed Action

Probable effects to air quality would include emissions from the operation of construction equipment for intake, roadway, water depot, retention pond, and pipeline installation. Emissions would be earthen particles (i.e., fugitive dust) as well as diesel emissions from equipment operation. These impacts would be localized and temporary. Other indirect effects to air quality would be from the emissions from transportation of personnel and equipment to and from the job sites on a daily basis until the completion of construction.

The other effect to air quality from implementing the Proposed Action would be associated with the decrease in total miles traveled to supply water from the source to the end users in the oil field. The No Action alternative would require longer per-trip travel than the Proposed Action, so implementing the Proposed Action would result in a decrease in diesel emissions associated with providing water to the oil and gas industry throughout the region.

¹⁴ The Clean Air Act Amendments of 1977 state that national parks that exceed six thousand acres in size be classified as "Class I" areas. "Class I" areas have set restrictions on the allowable increase in emissions of particulate matter and sulfur dioxide beyond a baseline year.

6.7. Oil and Natural Gas

6.7.1. Existing Condition

The recent U.S. Geological Service (USGS) Assessment for the Bakken Formation estimated mean undiscovered volumes of 3.65 billion barrels of oil, 1.85 trillion cubic feet of associated/dissolved natural gas, and 148 million barrels of natural gas liquids in the Williston Basin Province, Montana and North Dakota (USGS, 2008).

However, much of the Bakken Formation was considered a marginal to sub-marginal resource because the oil and gas were locked in a rock formation with a low permeability. Beginning in late-2008, successful wells were drilled into the Bakken Formation using a newly developed horizontal drilling technology and a long-used method of accessing the oil from the formation called hydrofracing. The application of these techniques allowed access to significant oil reserves that had been previously inaccessible.

As a result, crude oil production in North Dakota has nearly doubled from approximately 45 million barrels in 2007 to just under 80 million barrels in 2009 (NDIC, 2010). The number of producing wells and the associated oil production continue to grow; data from June 2010 set new state records for the number of producing wells (4,979), oil production in a month (9,458,349 barrels), and total production in the first six months of 2010 equaled the entire 2009 production (Helms, 2010). The number of active drill rigs in North Dakota has nearly doubled during 2010; from 83 in January 2010, to 125 in June 2010, to 154 drill rigs active in November, to 162 in early December 2010 (NDIC, 2010).

6.7.2. Environmental Consequences

No Action

Under the No Action alternative, the oil and gas industry would continue to obtain the water necessary to sustain the industry, but would not access the water from Lake Sakakawea within the Garrison Project. The water necessary for the industry would likely be accessed up or downstream of Lake Sakakawea. As such there would be no predicted change to the oil and gas industry as a result of implementing the No Action alternative.

Proposed Action

As stated in Section 5.1.3, water supply--while necessary to oil and gas production--is not the limiting factor on the rate of drilling or hydrofracing in North Dakota. Rather, the availability of drill rigs and hydrofracing crews are the critical factors limiting the rate at which industry grows within the region. This observation is supported by the growth of drilling and production in 2009-2010 without any Federal action affecting the availability of water by the Corps of Engineers. Additions to the supply of water for the industry from surplus water in Lake Sakakawea could affect the location of preferred water sources and how water is distributed and moved within the region; however, additional water availability is not expected to influence the rate of oil drilling or production.

6.8. Solid and Hazardous Waste

6.8.1. Existing Condition

As companies explore for and produce oil and gas, they generate various hazardous and non-hazardous liquid, semisolid, and solid wastes. Non-hazardous oil field wastes¹⁵ can be assigned to several categories: drilling wastes, produced water, and associated wastes. Produced water typically hydrofrac water that is brought to the surface at the beginning of production.

When hydrocarbons are produced, they are brought to the surface as a produced fluid mixture. The composition of this produced fluid generally includes a mixture of either liquid or gaseous hydrocarbons, produced water, dissolved or suspended solids, produced solids such as sand or silt, and injected fluids and additives that may have been placed in the formation as a result of exploration and production activities. Most produced waters contain a mixture of:

- Dissolved inorganic salts,
- Dispersed oil droplets,
- Dissolved organic compounds (i.e., oil),
- Treatment and workover chemicals,
- Dissolved gases (particularly hydrogen sulfide and carbon dioxide),
- Bacteria and other living organisms, and
- Dispersed solid particles.

The salinity in these produced waters typically range from 60,000-200,000 parts per million (ppm) and values around 100,000 ppm are typical (NDIC, 2010a). The produced water is typically stored in tanks at the well site and transported by truck to a North Dakota approved disposal well location. These are throughout western North Dakota and a photograph of a location on Route 8 south of Stanley, North Dakota is shown in Figure 26. The North Dakota State Department of Health (ND DOH) oversees the hydrofrac water disposal in North Dakota under the Underground Injection Control Program.¹⁶ As part of the regulatory oversight for the industry, ND DOH maintains a 24-hour emergency incident reporting program.¹⁷

6.8.2. Environmental Consequences

No Action

Under the No Action alternative, the oil and gas industry would continue to obtain the water necessary to sustain the industry's growth, would continue to utilize the water for the purpose of hydrofracing, and would continue to dispose of the produced waters in accordance with the

¹⁵ In the Solid Waste Disposal Act Amendments of 1980 (Pub. L. 94-580), Congress amended the Resource Conservation and Recovery Act (RCRA) to add sections 3001 (b)(2)(A), and 8002 (m). Section 3001(b)(2)(A) exempted drilling fluids, produced waters, and other wastes associated with exploration, development, and production of crude oil, natural gas and geothermal energy from regulation as hazardous wastes (58 FR 15284, 1993). Therefore, most oil field wastes that arise from, or are associated with, oil and gas exploration and production are considered nonhazardous because they are specifically exempted from federal hazardous waste requirements.

¹⁶ <http://www.ndhealth.gov/WQ/GW/uic.htm>

¹⁷ <http://www.ndhealth.gov/wm/EnvironmentalIncidentReporting.htm>

State's ongoing program. However, the water to supply the industry would not be from Lake Sakakawea within the Garrison Project. The water necessary for the industry would likely be accessed from the Missouri River upstream from Lake Sakakawea. Construction of the infrastructure necessary to access the water from upstream or downstream locations (outside the Garrison Project) would likely result in the same risk of creating HTRW materials as with the Proposed Action.

Proposed Action

Constructing the water intakes and associated infrastructure via conventional excavation and directional drilling techniques would not be expected to generate any HTRW concerns. While the potential to create HTRW materials as a result of equipment malfunction or failure during the construction process exists (e.g., fluid leaks from heavy equipment), best management practices and regular equipment maintenance reduce these risks. Storage, fueling, and lubrication of equipment and motor vehicles associated with the construction process would be conducted in a manner that affords the maximum protection against spill and evaporation. The construction methods selected for these projects were chosen, in part, because they eliminate the need for suspension of organic lake sediment, and the handling of such, in an aquatic environment.

Figure 26
Produced Water Collection and Disposal Site South of Stanley, ND



6.9. Traffic, Truck Traffic, and Accidents

6.9.1. Existing Condition

Two US highways, U.S. 83 and U.S. 85, and one interstate highway, Interstate 94, are the largest capacity roads in Western North Dakota. Interstate 94, proceeds east-west through southern North Dakota, connecting Fargo, Jamestown, Bismarck, and Dickinson. U.S. Highway 83 and 85 run north-south to the west and east of Lake Sakakawea respectively. To the north of Lake Sakakawea, U.S. 2 is an east-west road that connects U.S. 83 and 85. Similarly, to the south of Lake Sakakawea, State Route 200 is an east-west state road that connects U.S. 83 and 85. State Route 23 approximately bisects Lake Sakakawea via the Four Bears/New Town Bridge and is an east-west state road that connecting U.S. 83 and 85 midway between U.S. 2 and State Route 200. With so few bridge crossings, vehicles might have to drive up to 100 miles one-way to get from one side of the Lake Sakakawea to the other by road.

The area surrounding Lake Sakakawea is an extremely remote area of the United States, with associated low population densities and low levels of traffic. These smaller state and local roads provide access to the residences, ranches, and small communities within the region. The most recently published traffic count data from the North Dakota Department of traffic counter data provide an indication of the effect the booming oil and gas industry has had on traffic, especially the increase in truck traffic. Table 6 shows average daily traffic (AADT) and the number of vehicles within the AADT counts that were trucks. These data are collected from many locations within the state of North Dakota, but are reported here for select locations surrounding Lake Sakakawea from 2007 and 2009. At the locations for which data are presented, the increases in all traffic and truck traffic are noteworthy. Table 8 shows average increases in AADT of 23-percent and a larger percentage increase in the proportion of traffic from large trucks. The number of trucks per day at these locations had increased by between 16-percent and more than 80-percent between 2007 and 2009. The only location presented in Table 6 for which truck traffic declined is S.R. 1804 west of Williston, where truck traffic had declined approximately 19-percent between 2007 and 2009. The decrease in truck traffic seen at this location is more typical for many of roads outside the area of influence of the oil and gas industry during this three year period.

Table 9 shows the number of fatalities, by county, as a result of vehicle accidents in the area of influence in western North Dakota. In 2009, of the 169 vehicle crash fatalities in the State, 28 of them involved large trucks (e.g., Single Unit Trucks greater than 19,500 lbs GVWR, truck tractors, and medium/heavy pickup trucks) (FARS, 2010). For 2009, Mountrail, Ward, and McKenzie had the first, second, and fourth-most vehicle-related fatalities in North Dakota (NNDOT, 2009).

A study by the North Dakota Department of Transportation has shown that truck traffic in western counties impacted by oil development has grown by approximately 200 percent in one year (2008-09) (NDPC, 2010). Annual freshwater truckloads have grown from approximately 118,900 in 2008 to approximately 224,900 truckloads in 2009 (NDPC, 2010).

Table 8
2007-2009 Changes in Regional Traffic on Selected Western North Dakota Routes

Route	County and Intersection	2007 AADT	2009 AADT	Change AADT	Percent AADT Change	2007 Truck Traffic	2009 Truck Traffic	Change Truck Traffic	Percent Truck Traffic Change
US 2	Williams (Rt. 40 and Rt. 2)	1,700	1,340	(360)	-27%	320	1,015	695	68%
	Mountrail (Rt. 8 and Rt. 2)	2,080	3,370	1,290	38%	300	725	425	59%
SR 8	Mountrail (North of Rt. 2)	1,800	3,985	2,185	55%	330	1,115	785	70%
	Burke (Intersection with Rt. 50)	500	685	185	27%	70	385	315	82%
US 85	McKenzie (btw Rt. 200 & Williston)	2,600	2,670	70	3%	570	675	105	16%
	McKenzie (btw Rt. 68 and Rt. 23)	2,450	3,030	580	19%	455	750	295	39%
	Williams (US 85/US 2 in Williston)	8,800	11,340	2,540	22%	1,280	2,640	1,360	52%
SR 23	New Town Bridge	3,450	5,575	2,125	38%	285	830	545	66%
	McKenzie (btw Rt.1806 and Rt. 73)	700	1,360	660	49%	160	590	430	73%
	Mountrail (intersection w/ Rt. 1804)	5,300	6,460	1,160	18%	355	880	525	60%
SR 1804	Mountrail (North of Rt. 23)	800	995	195	20%	150	250	100	40%
	Williams (West of Williston)	2,100	2,445	345	14%	430	360	(70)	-19%
	Williams (East of Williston)	2,650	3,250	600	18%	550	1,435	885	62%
Average Percent Change in AADT					+23%	Average Percent Change in Truck Traffic		+51%	

AADT – Average Annual Daily Traffic (Total Vehicle Count)

Source: www.dot.nd.gov/road-map/traffic/index.htm (NDDOT, 2007; 2009)

Table 9
Traffic Fatalities in North Dakota By County

County	2004	2005	2006	2007	2008	2009
Burke	0	0	1	1	1	3
Divide	0	0	0	0	1	0
Dunn	3	0	2	3	3	1
McKenzie	2	4	6	4	7	8
McLean	3	2	5	4	3	5
Mountrail	5	2	2	5	6	13
Ward	6	6	5	7	8	13
Williams	4	2	2	4	1	4
TOTALS	23	16	23	28	30	47

Source: FARS, 2010

6.9.2. Environmental Consequences

No Action

As stated in Section 2.1.3, the water demand for the oil and gas industry is estimated at between 7,000-27,000 acre-feet per year for the next 10-years. It takes approximately 41 8,000-gallon tanker truckloads to move each acre-foot of water.¹⁸ Using the highest estimate as a conservative (i.e., higher) value, 27,000 acre-feet of water would need to be moved annually to meet the demand, there would be over 1.1 million water truck trips per year.¹⁹ Over the next 10 years, assuming consistent growth of the industry, the water trucking would sum to over 11 million water truck trips that would occur to meet the industry's upper estimate of water needed. These truck trips would occur under both the No Action and the Proposed Action, the difference being where the water was made available for use by the industry.

Under the no action alternative, a substantial portion of the demand would be met by getting access to the water upstream of the Garrison Project/Lake Sakakawea. This would result in a substantial transportation burden for the No Action alternative compared to the Proposed Action. The No Action alternative would result in increasing the number of miles driven per truck-trip resulting in increased diesel emissions, infrastructure deterioration, and increased risks of property damage, injury, and fatality-causing accidents compared to the Proposed Action.

Proposed Action

The effect of implementing the Proposed Action on traffic, truck traffic, and accidents within the region would be expected to be a reduction in the total number of water truck miles driven, but no substantial decrease in the number of truck trips necessary to meet the industry's needs. The

¹⁸ One acre-foot equals approximately 325,851 gallons. Using an 8,000-gallon tanker truck, it takes approximately 41 truck trips to move an acre-foot of water.

¹⁹ 41 truckloads per acre-foot x 27,000 acre-feet per year = 1,107,000 truck trips per year.

Proposed Action would allow the development of water supply sources on both the North and South sides of Lake Sakakawea and reduce the distance well developers would need to travel to access the water necessary to meet the industry's need. If these reductions in total miles were realized by implementing the Proposed Action, then there would be associated decreases in the effects to infrastructure and the risks of accidents involving water trucks when compared to the No Action alternative.

6.10. Demographics

6.10.1. Existing Condition

At the time of the 2000 census, North Dakota had a total population of 642,200 people. This total ranks North Dakota 47th of the 50 States and District of Columbia. With 68,976 square miles of area, the population density in 2000 was 9.3 persons per square mile. By comparison, the 2000 population density for the entire United States was 79.6 persons per square mile. The demographics data presented in Table 10 are limited to the contiguous eight counties (i.e., first tier counties) that contact Lake Sakakawea. The data are historical counts as well as county projections through 2020. Although the population of the eight counties declined by 10-percent from 1980 to 2000, and were projected to decline an additional 6.4-percent from 2000 to 2020 (from 70,778 in 1980 to 49,829 projected for 2020) the effect of the increased activities for oil and gas extraction would be expected to increase the population within these eight counties of the western North Dakota. The extent of these increases has not been measured formally, but would be better understood with the receipt of the 2010 Census Data.

Table 10
Historical and Projected Population for Eight North Dakota Counties

County	1980	1990	2000	Percent Change 1990 to 2000	2010	2020	Percent Change 2000 to 2020
Burke	3,822	3,002	2,242	-25.3%	1,908	1,686	-11.6%
Divide	3,494	2,899	2,283	-21.2%	1,796	1,420	-20.9%
Dunn	4,627	4,005	3,600	-10.1%	3,283	2,927	-18.7%
McKenzie	7,132	6,383	5,737	-10.1%	5,197	4,924	-14.2%
McLean	12,383	10,457	9,311	-11.0%	8,820	8,423	-9.5%
Mercer	9,404	9,808	8,644	-11.9%	7,751	7,267	-15.9%
Mountrail	7,679	7,021	6,629	-5.6%	6,518	6,503	-1.9%
Williams	22,237	21,129	19,761	-6.5%	17,959	16,679	-15.6%
Totals:	70,778	64,704	58,207	-10.0%	53,232	49,829	-6.4%

Source: U.S. Census Bureau, 2000 Decennial Census
Population projections: ND State Data Center at ND State University, Fargo, ND, 2002

For the Master Plan (USACE, 2007), the seasonal population was estimated by multiplying the average household size in the county by the number of homes vacant on April 1, 2000 (when the

U.S. Census was taken) that were recorded as being for occasional, seasonal, or recreational use. Seasonal residents in the counties contiguous to Lake Sakakawea were assumed to not be permanent residents of these counties (USACE, 2007). The estimated seasonal population and total (permanent plus seasonal) population of the counties contiguous to Lake Sakakawea in 2000 are shown in Table 11.

In 2000, 55.8 percent of the North Dakota population was classified as urban, while 44.2 percent was classified as rural. This compares to an average of 79.0 percent classified as urban and 21.0 percent rural for the United States as a whole (USACE, 2007). Although nearly all the growth in North Dakota's population has occurred in the largest cities, the cities are small by national standards. The two largest cities near the Garrison Project are Bismarck (approximately 70 miles south) with a 2000 Census population of 55,532, and Minot (approximately 60 miles north), with a population of 36,567. Table 12 shows the 20-year population trend (1980-2000) for several North Dakota municipalities close to Lake Sakakawea.

Efforts to quantify the extent of growth in population from the influx of oil field workers in western North Dakota are incomplete ahead of the 2010 census data. However, some municipalities facing strains to infrastructure have conducted independent estimates. For example, current estimates of Williston's 2010 population are at 15,400 with the majority of the increase in the last three years (KXNet, 2010). This influx of workers has created a shortage of temporary and permanent housing throughout western North Dakota exemplified by the existence of temporary housing at various locations. These facilities provide temporary housing for workers that have come to the region seeking employment and examples are shown in Figure 27 from top to bottom: Williston, Stanley, Parshall, and Alexander, ND.

Table 11
Population Data in 2000

County	Vacant Housing Units	Seasonal Vacant Units ²⁰	Average Household Size	Estimated Seasonal Residents	Permanent Residents	Total Residents	Seasonal Percent Total
Burke	399	109	2.21	241	2,242	2,483	10 %
Divide	464	140	2.18	305	2,283	2,588	12 %
Dunn	587	263	2.57	676	3,600	4,276	16 %
McKenzie	568	162	2.64	428	5,737	6,165	7 %
McLean	1,449	923	2.40	2,215	9,311	11,526	19 %
Mercer	1,056	424	2.55	1,081	8,644	9,725	11 %
Mountrail	878	521	2.53	1,318	6,629	7,949	17%
Williams	1,585	426	2.38	1,014	19,761	20,775	5 %
TOTAL	6,986	2,968	-----	7,278	58,207	65,487	11 %

Sources: U.S. Census Bureau, 2000 Decennial Census.

Table 12
Population Trends for Municipalities in the Lake Sakakawea Area

Municipality	County	Census 1980	Census 1990	Census 2000	2008 Estimate	Percent Change 1990-2000
Beulah	Mercer	2,908	3,363	3,152	2,863	-6.3%
Garrison	McLean	1,830	1,530	1,318	1,173	-13.9%
Hazen	Mercer	2,365	2,818	2,457	2,206	-12.8%
New Town	Mountrail	1,335	1,388	1,367	1,712	-1.5%
Parshall	Mountrail	1,059	943	981	1,055	4.0%
Riverdale	McLean	unincorp	283	273	264	-3.5 %
Stanley	Mountrail	1,631	1,371	1,279	1,218	-6.7 %
Tioga	Williams	1,597	1,278	1,125	1,096	-12.0 %
Watford City	McKenzie	2,119	1,784	1,435	1,386	-19.6 %
Williston	Williams	13,336	13,131	12,512	12,641	-4.7 %

Source: (U.S. Census Bureau, 2000).

²⁰ Includes housing units for seasonal, occasional, or recreational use. Does not include the following categories: for rent; for sale; rented or sold, not occupied; recreational vehicles; and other vacant.

Figure 27
Temporary Housing In Western North Dakota



6.10.2. Environmental Consequences

No Action

Under the No Action alternative, the trends of growth of population observed in the recent years in North Dakota would be expected to continue. The rate of growth of the oil and gas industry has not been controlled by the availability of water nor would it be expected change as a result of implementing the No Action alternative.

Proposed Action

The environmental consequences of implementing the Proposed Action on demographics of the regions would be minimal. The growth in population and associated stresses on the availability of housing seen in recent years in western North Dakota has occurred without any action on behalf of the Corps of Engineers and would be expected to remain controlled factors other than an improved availability of water associated with the Proposed Action.

6.11. Employment/Income

6.11.1. Existing Condition

The most recent year for which the US Bureau of the Census has published comprehensive income data is 1999 and the aggregate income for North Dakota was \$8.7 billion in that year. Table 13 shows the median household income, medium family income, and the per capita income reported by the 2000 Census (1999 data) for each of the eight first tier counties, the average of eight first tier counties, and the income figures for the state as a whole.

Table 13
Income Data for Lake Sakakawea Area of Influence and North Dakota (1999)

Area	Median Household Income	Median Family Income	Per Capita Income
Burke County	\$25,330	\$31,384	\$14,026
Divide	\$30,089	\$39,292	\$16,225
Dunn County	\$30,015	\$34,405	\$14,624
McKenzie County	\$29,342	\$34,091	\$14,732
McLean County	\$32,337	\$39,604	\$16,220
Mercer County	\$42,269	\$51,983	\$18,256
Mountrail County	\$27,098	\$31,064	\$13,422
Williams County	\$31,491	\$39,065	\$16,763
North Dakota	\$34,604	\$43,654	\$17,769

Source: U.S. Census Bureau, 2000 Decennial Census.

North Dakota's per capita income in 1999 was about 82-percent of the \$21,587 per capita income for the entire United States. The economy of North Dakota is highly dependent on agriculture, so median income in North Dakota tends to vary with agricultural yields (which vary

greatly with rainfall if not irrigated) and crop prices, which did not increase in the 1990s in proportion to the cost of most other goods and services.

The effect of the current oil boom has been profound on employment and income North Dakota. As of October 2010, North Dakota had the lowest unemployment rate in the nation at 3.8-percent (USDOL, 2010). This reflects a condition where all or nearly all persons willing and able to work at the prevailing wages and working conditions are able to work. According to the most recent data (2007-2008) from the U.S. Department of Commerce's Bureau of Economic Analysis (USDOC, 2010), North Dakota had the nation's largest increase in per capita personal income (8.7-percent). In addition, from 2005-2008, the per capita personal income in Williston, ND increased approximately \$14,000 from \$31,718 to \$45,801 (USDOC, 2010). These increases do not include changes from 2009-2010 because more recent data are not yet available.

Another indication of the employment climate is the number of job openings within the region. For example, a search of all jobs posted for "Williston, ND" at JobService North Dakota (www.ndworkforceconnection.com/) indicated there were more than 1,956 positions posted at this single web site. On the date of the search (2 December 2010) nearly 2,000 open jobs were associated with a municipality with a most recent population estimate of 15,400. According to this employment site, the number of job openings in Williston exceeds 10-percent of the entire population.

6.11.2. Environmental Consequences

No Action

Under the No Action alternative, the trends of growth of population and income observed in the recent years in North Dakota would be expected to continue. The rate of growth of the oil and gas industry has not been controlled by the availability of water nor would it be expected change as a result of implementing the No Action alternative.

Proposed Action

The environmental consequences of implementing the Proposed Action on employment and income would be minimal. The growth in employment and income seen in recent years in western North Dakota has occurred without any action on behalf of the Corps of Engineers and would be expected to continue based on factors other than an improved availability of water associated with the Proposed Action.

6.12. Environmental Justice

6.12.1. Existing Condition

Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Population and Low-Income Populations (Executive Order, 1994), directs Federal agencies to identify and address, as appropriate, disproportionately high and adverse human health or environmental effects of their programs, policies, and activities on minority population and low-income populations. When conducting NEPA evaluations, the USACE incorporates Environmental Justice (EJ) considerations into both the technical analyses and the public

involvement in accordance with the USEPA and the Council on Environmental Quality guidance (CEQ, 1997).

The CEQ guidance defines “minority” as individual(s) who are members of the following population groups: American Indian or Alaskan native, Asian or Pacific Islander, Black, not of Hispanic origin, and Hispanic (CEQ, 1997). The Council defines these groups as minority populations when either the minority population of the affected area exceeds 50 percent of the total population, or the percentage of minority population in the affected area is meaningfully greater than the minority population percentage in the general population or other appropriate unit of geographical analysis.

Low-income populations are identified using statistical poverty thresholds from the Bureau of the Census Current Population Reports, Series P-60 on Income and Poverty (U. S. Bureau of the Census, 2000). In identifying low-income populations, a community may be considered either as a group of individuals living in geographic proximity to one another, or a set of individuals (such as migrant workers or Native Americans), where either type of group experiences common conditions of environmental exposure or effect. The threshold for the 2000 census was an income of \$17,761 for a family of four (U.S. Bureau of the Census, 2000). This threshold is a weighted average based on family size and ages of the family members.

Executive Order 12898, “Federal Actions To Address Environmental Justice in Minority Populations and Low Income Populations,” issued in 1994, directs Federal and state agencies to incorporate environmental justice as part of their mission by identifying and addressing the effects of all programs, policies and activities on minority and low-income populations. The fundamental principles of EJ are as follows:

1. Ensure the full and fair participation by all potentially affected communities in the decision-making process;
2. Prevent the denial of, reduction in or significant delay in the receipt of benefits by minority and low-income populations; and
3. Avoid, minimize or mitigate disproportionately high and adverse human health and environmental effects, including social and economic effects, on minority populations and low-income populations.

In addition to Executive Order 12898, the Environmental Justice analysis is being developed per requirements of "Department of Defense's Strategy on Environmental Justice" (March 24, 1995).

Per the above directives, EJ analyses identify and address, as appropriate, disproportionately high and adverse human health or environmental effects of the project on minority and low-income populations. The methodology to accomplish this includes identifying low-income and minority populations within the study area, as well as community outreach activities such as stakeholder meetings with the affected population.

Table 14 shows the 2009-estimated population and the ethnic mix (as a percentage) for each of the eight first tier counties surrounding Lake Sakakawea. Table 15 is based on the 2000 Census counts and shows the percent race for ten of the population centers within the eight first tier counties. The higher percentage of Native Americans in Mountrail and McKenzie Counties relative to the other counties can be attributed to the location of Fort Berthold Reservation. The Fort Berthold Reservation lands include portions of six counties (McLean, Mountrail, Dunn, McKenzie, Mercer, and Ward).

Table 14
Percent Race by County

County	2009 Population Estimate	White	Black	American Indian	Asian	Hawaiian- Pacific Islander	Two or More Races	Hispanic
Burke	1,839	99.0	0.3	0.3	0.2	0.0	0.3	0.7
Divide	1,961	98.1	0.0	0.3	1.3	0.0	0.3	1.0
Dunn	3,365	85.3	0.1	13.6	0.1	0.0	0.9	1.0
McKenzie	5,799	76.7	0.2	21.5	0.1	0.0	1.4	1.8
McLean	8,310	91.2	0.2	7.1	0.2	Z	1.3	1.3
Mercer	7,873	95.3	0.1	2.9	0.3	0.4	1.0	0.8
Mountrail	6,791	62.7	0.5	35.1	0.2	Z	1.5	3.0
Williams	20,451	91.9	0.3	4.8	0.7	Z	2.4	1.7
ND	646,844	91.1	1.2	5.6	0.8	Z	1.2	2.3

Table 15
Percent Race by Population Center

City	County	2000 Pop	White	Black	American Indian	Asian	Hawaiian- Pacific Islander	Two or More Races	Hispanic
Beulah	Mercer	3,152	95.8	0.0	1.7	0.3	0.6	1.4	0.5
Garrison	McLean	1,318	95.4	0.0	2.4	0.2	0.0	1.8	0.8
Hazen	Mercer	2,457	97.1	0.1	1.8	0.3	0.2	0.5	0.4
New Town	Mountrail	1,367	30.0	0.1	66.9	0.3	0.1	2.9	1.5
Parshall	Mountrail	981	41.8	0.3	54.5	0.0	0.0	2.1	3.3
Riverdale	McLean	271	96.3	0.0	2.2	0.7	0.0	0.7	0.0
Stanley	Mountrail	1,279	99.0	0.0	0.5	0.3	0.1	0.1	0.5
Tioga	Williams	1,125	97.4	0.2	0.9	0.0	0.0	1.3	0.1
Watford City	McKenzie	1,435	94.9	0.2	3.8	0.1	0.0	1.0	1.1
Williston	Williams	12,512	93.7	0.2	3.7	0.2	0.0	2.1	1.2

Source: U.S. Bureau of the Census, 2000 Decennial Census

6.12.2. Environmental Consequences

No Action

There would be no disproportionate effects to minority or low-income communities as a result of implementing the No Action alternative.

Proposed Action

Compliance with Executive Order 12898 on Environmental Justice requires an evaluation of the nature of the proposed actions and the human context into which those actions would be undertaken. In order to have potential Environmental Justice impacts, a proposal must have potential for disproportionately high and adverse human health or environmental effects on low-income populations, minority populations, or Native American tribes. This action has been evaluated for potential disproportionately high environmental effects on minority or low-income populations and there would not be a high human health or environmental impact on minority or low-income populations. Implementation of the Proposed Action (including the construction of intakes as well as the subsequent depletions) would not result in measurable changes to environmental resources that individuals involved in subsistence fishing or hunting utilize. Also, construction and use of water supply intakes would not involve the release of hazardous, toxic, or radioactive materials to which minority or low-income populations could be exposed. As such, implementation of the Proposed Action would not create disproportionately high and adverse human health or environmental effects on low-income populations, minority populations, or Native American tribes.

6.13. Recreation

6.13.1. Existing Condition

The Lake Sakakawea region has an abundance of natural and scenic resources that make resource-based outdoor recreation activities, such as hunting and fishing, possible and add to the enjoyment of other outdoor recreation activities. Outdoor recreation activities common at Lake Sakakawea include camping, fishing, hunting, boating, sailing, scuba diving, sightseeing, swimming, and bird watching. There are 37 public recreation facilities located around the lake that support a variety of outdoors recreation.

Water levels are a key factor in recreational use of the reservoirs, but pool levels vary widely in response to routine operations and extended drought conditions. Periods of extended drought that result in significant lowering of reservoir levels and releases have a greater negative impact on recreational usage than high stages. At low reservoir levels, some boat ramps and recreational areas may not provide access to the reservoirs. During the two major droughts since the System first filled, many facilities made modifications to infrastructure (e.g., extending boat ramps) in an effort to maintain access. Figures 28 and 29 provide an example of the contrast in pool elevation and the potential effect extended drought has on recreation infrastructure. Figure 28 is of the boat ramp and marina at Lake Sakakawea's Lewis & Clark State Park taken in the summer of 2006 during extended drought conditions. The boatramp, marina, and entire bay are completely vegetated as an indication of how long these areas had been dry. For comparative purposes, Figure 29 shows a photograph of the same location taken in September 2010 when the pool elevations in Lake Sakakawea had returned to normal.

Figure 28
Lewis & Clark State Park Boat Ramp and Marina 2006

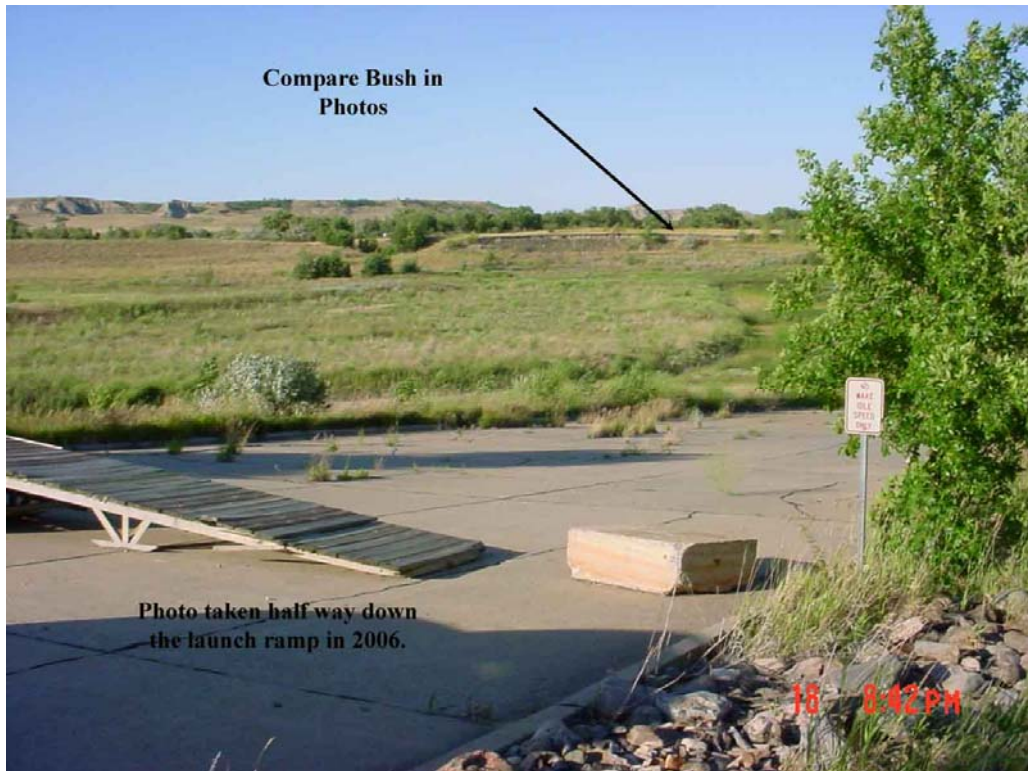
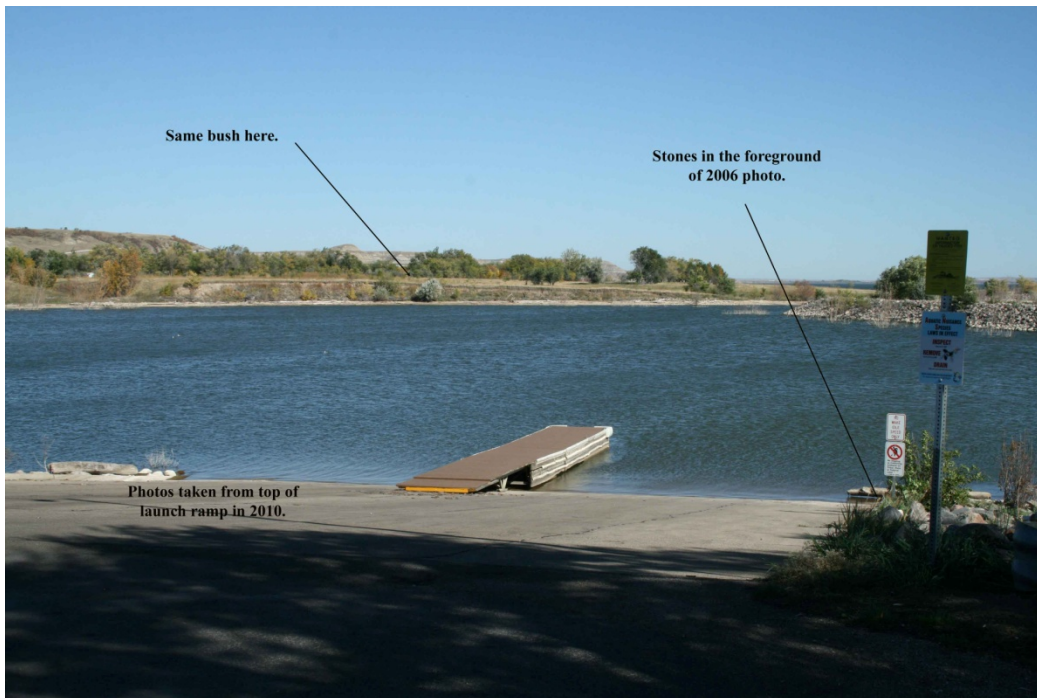


Figure 29
Lewis & Clark State Park Boat Ramp and Marina 2010



6.13.2. Environmental Consequences

No Action

Under the No Action alternative, there would be no construction of infrastructure and new water supply intakes within the Garrison Project lands. However, under the No Action alternative, a substantial portion of the demand would be met by constructing water supply intake infrastructure upstream or downstream of the Garrison Project/Lake Sakakawea and removing the water from the system's riverine reaches. This would result in little difference in the predicted depletions and associated changes to the water surface elevation from Lake Sakakawea between the Proposed Action and No Action.

Proposed Action

The expected effects to recreation from the construction and operation of the intakes would be related to the temporary and minor noise disturbances, emission releases, and land disturbance during construction. These temporary effects would be expected to have minimal effects on recreation. As described in Section 4.2.5, the electrical service to electrical motors submerged under water or located above water would be by means of a sealed, waterproof, multiple conductor cable with controls and switches located on land. The location of such motors and the electrical feeders would be clearly marked so as to be visible to boaters and swimmers. Additionally, signs warning "DANGER - HIGH VOLTAGE - Unauthorized Access" would be erected to be visible from the water and land approaches to the equipment to minimize the risk to recreational users.

Water levels are a key factor in recreational use of the reservoirs and river reaches. The modeled differences in water surface elevations between No Action and the Proposed Action in the DRM simulation output for Lake Sakakawea and all 18 model nodes were negligible. These modeled output show that at the 50th percent frequency (representing average conditions), all of the reservoirs would show virtually no difference in water surface elevation. In addition, the model predicted there would be nearly immeasurable changes in stages at all riverine (non-reservoir) model nodes. All of these simulated stage reduction estimates are too small to be distinguishable from the No Action alternative. Therefore, the change in water surface elevations between No Action and the Proposed Action conditions would not result in discernable effects to recreation.

6.14. Aesthetics and Visual Resources

6.14.1. Existing Condition

Visual qualities consist of natural and manmade features that give a particular environment its aesthetic qualities. Landscape character is evaluated to assess whether the project will appear compatible with the existing features or would contrast noticeably with the setting and appear out of place. Visual sensitivity includes public values, goals, awareness, and concerns regarding visual quality.

Western North Dakota is a rolling, hilly landscape of glaciated plains intersected by buttes, badlands and the Missouri River valley. This region supports grazing and farmland in addition to unique wildlife habitat. Manmade features that affect the natural aesthetics include the scattered

presence of cattle and other livestock, utility and transportation infrastructure (e.g., roads, bridges, railroads), industrial infrastructure (e.g., mining operations and oil and gas wells, tanks, and pads), fences, and visible residential and commercial development (e.g., homes, businesses, and recreation areas).

The initial visual impression of the prairie landscape surrounding most of Lake Sakakawea is one of open rolling plains and undulating rises. The horizon, horizontal line, and the expansive sky are dominant landscape elements defined by the surrounding wide-open spaces. At the western end of the project, the badlands of North Dakota are composed of tiered and multicolor buttes, stratified canyons, and hoodoos (tall thin spires of rock that protrude from the bottom of arid basins and badlands). These features present an extensive pattern of dramatic and rugged terrain with a stark, but exceptional natural beauty. The badlands emerge near the confluence of the Little Missouri and the Missouri River and continue westward to the Montana border. The term "badlands" attests to the intricate, deeply dissected nature of the land, with gullies, buttes, and a maze of short, steep ridges that make travel through such areas difficult (USACE, 2007).

In addition to the aesthetic sensitivity during daylight hours, the large distances from municipalities provide very little light interference (i.e., light pollution) to affect the night sky. Western North Dakota has only a few cities outside its typically rural landscape. The general lack of major roads and large residential communities accentuates the visually open landscape of the Great Plains (USACE, 2007). A 2001 analysis modeling light pollution in the United States showed that large areas of pristine dark skies can be viewed in North Dakota (Albers and Duriscoe, 2001). On clear nights, the Milky Way, planets, stars, and many constellations are visible. Occasionally, the Northern Lights or *aurora borealis*, may be visible, adding color and movement to the night sky. Municipal growth and oil and gas development produce light that threatens the relative darkness and aesthetic value of the night sky (USACE, 2007).

6.14.2. Environmental Consequences

No Action

Under the No Action alternative, there would be no construction of infrastructure and new water supply intakes within the Garrison Project lands. However, under the No Action alternative, a substantial portion of the demand would be met by constructing water supply intake infrastructure upstream or downstream of the Garrison Project/Lake Sakakawea and removing the water from the system's riverine reaches. The aesthetic effects to viewsheds related to the construction of the water supply infrastructure would still occur, but these actions and the associated effects would occur at locations upstream or downstream from Lake Sakakawea as opposed to within Garrison Project lands. This would result in little difference in the predicted aesthetic effects between the Proposed Action and No Action.

Proposed Action

The expected impacts of intake construction would include minor land disturbance and a change to the viewsheds during and immediately after construction. Intake locations were identified to (where possible) utilize existing roadway or utility corridors thereby diminishing the potential aesthetic effects as these areas had already been modified from undisturbed prairie. The construction methods selected for intake installation (e.g., directional drilling) were chosen, in

part, because they minimize the changes to the landscape below the normal high water mark and therefore minimize the aesthetic effect to the Lake Sakakawea shoreline.

The effects to aesthetics as a consequence of implementing the Proposed Action would be expected to be minimal. The explosive growth of the oil and gas industry in western North Dakota has occurred without any action on behalf of the Corps of Engineers. The associated effects on aesthetics as the panoramic vistas of western North Dakota now include extensive intrusion from the oil and gas industry's activity (e.g., drill rigs, pads, natural gas flares, etc.) would be expected to continue based on factors other than an improved availability of water associated with the Proposed Action.

6.15. Noise

6.15.1. Existing Condition

Western North Dakota contains very little residential, commercial, or recreational areas relative to the total area of undeveloped property. Other than in close proximity to recreation areas, municipalities, or major roadways, the characteristically wild, undeveloped landscape results in minimal background noise.

Changes in noise are typically measured and reported in units of dBA, a weighted measure of sound level. The primary sources of noise within the project area would include everyday vehicular traffic along roadways (typically between 50 and 60 dBA at 100 feet), maintenance of roadways, bridges, and the other structures (typically between 80 and 100 dBA at 50 feet), and seasonal recreational activities in Western North Dakota.

The U.S. Federal Transit Administration (FTA) has established noise impact criteria founded on well-documented research on community reaction to noise based on change in noise exposure using a sliding scale (USFTA, 1995). The FTA Noise Impact Criteria groups noise sensitive land uses into the following three categories:

- Category 1: Buildings or parks where quiet is an essential element of their purpose,
- Category 2: Residences and buildings where people normally sleep (e.g., residences, hospitals, and hotels with high nighttime sensitivity), and
- Category 3: Institutional buildings with primarily daytime and evening use (e.g., schools, libraries, and churches).

Even moderate noise caused by recreation activities such as picnicking and trail hiking can disturb nearby wildlife. Disturbance to wildlife can be reduced by vegetated buffer zones between recreation facilities and areas devoted to wildlife habitat, and by restrictions on vehicular use in portions of wildlife management areas.

Lake Sakakawea and the surrounding lands contain very little residential, commercial, or recreational areas relative to the total area of undeveloped property. Other than in close proximity to recreation areas, municipalities, or major roadways, the characteristically wild, undeveloped landscape results in minimal background noise.

Noise effects to the wildlife and human receptors within the project area are dominated by transportation sources such as trains, trucks, private vehicles, and recreational vehicles (e.g., boats, snowmobiles). Noise from occasional commercial aircraft crossing at high altitudes is

typically indistinguishable from the natural background noise of the area. Noise ranging from about 10 dBA for the rustling of leaves to as much as 115 dBA (the upper limit for unprotected hearing exposure established by the Occupational Safety and Health Administration) is common in areas where there are sources of recreational activities, construction activities, and vehicular traffic.

6.15.2. Environmental Consequences

No Action

Under the No Action alternative, the Corps of Engineers would not make a determination of surplus water, there would be no change to the water supply, there would be no water supply agreements, and no new water supply intakes would be constructed. Without these new water supply intakes, there would be no new depletions from Lake Sakakawea from within Garrison Project lands. However, as a result of taking No Action, the majority of water to supply the industry's needs would likely be provided by Missouri River water upstream or downstream of Lake Sakakawea.

Noise related to the construction of the water supply infrastructure would still occur, but the noise and the associated disturbance would occur at locations upstream or downstream from Lake Sakakawea as opposed to within Garrison Project lands.

Proposed Action

Construction of the water supply intakes and associated infrastructure would require the use of heavy equipment (e.g., backhoe) and trucks to haul materials to and from the site. However, the distance between these proposed intake construction locations and Category 2 (residences) adjacent to these locations are not less than approximately 250 feet and are frequently much greater because these sites are so remote. The expected effects of conventional excavation and directional drilling for the construction of the water supply intakes and associated infrastructure would be considered a temporary and minor noise disturbance during the construction process. Once completed, operation of the intake pumps would not exceed 75 decibels at 50 feet therefore not resulting in any significant noise concerns.

6.16. Cultural Resources

6.16.1. Existing Condition

The cultural history of western North Dakota is detailed in the Garrison Dam/Lake Sakakawea Master Plan (2007) and is herein incorporated-by-reference. Twelve large-scale cultural resource surveys have been conducted in the Lake Sakakawea/Garrison Dam project area (USACE, 2007). Five archaeological districts were defined during these investigations, with the strong possibility of more being defined as new surveys are conducted.

The Garrison Project lands contain 1,511 recorded cultural resource sites and 481 isolated finds including 1,493 archaeological sites and 18 historic architectural sites (USACE, 2007). Of these sites, none are listed on the National Register of Historic Places (NRHP) or are classified as a contributing part of a National Register District. In addition, 17 historic properties are considered eligible for listing on the NRHP, and 1,244 remain unevaluated against the NRHP

criteria; 242 sites have been determined not eligible. All un-evaluated sites are treated as potentially eligible for listing on the NRHP, and both eligible sites and unevaluated sites are taken into consideration when the Omaha District reviews undertakings.

6.16.2. Environmental Consequences

No Action

Under the No Action alternative, the Corps of Engineers would not make a determination of surplus water, there would be no change to the water supply, there would be no water supply agreements, and no new water supply intakes would be constructed. Without these new water supply intakes, there would be no new depletions from Lake Sakakawea from within Garrison Project lands. However, as a result of taking No Action, the majority of water to supply the industry's needs would likely be provided by Missouri River water upstream or downstream of Lake Sakakawea. The risk of disturbing cultural resources during the construction of water supply infrastructure upstream or downstream of Lake Sakakawea would be similar to the Proposed Action.

Proposed Action

No site-specific cultural resources investigations were performed at the proposed intake sites. However, the sites selected for proposed intakes were developed in coordination with Garrison Project staff with knowledge of existing cultural resources on project lands. The lack of sequential numbering for the Lake Sakakawea & Associates proposed intakes is an indication that many proposed locations were dismissed from consideration for a variety of environmental concerns, including the presence of or high likelihood of incurring cultural resources. Therefore, the sites selected for proposal were identified specifically to avoid the potential to affect known resources.

In addition, the construction methods selected for these projects were chosen, in part, because they minimize the area of surface disturbance thereby diminishing the risk of disturbing unknown cultural resources. Lastly, as described in Section 4.2.5, the easement grantee would not remove, disturb, or cause or allow to be removed or disturbed, any historical, archeological, architectural, or other cultural artifacts, relics, vestiges, remains, or objects of antiquity. In the event such items were discovered on the premises, the grantee would immediately notify the District Engineer, Omaha District, and the site and the material would be protected by the grantee from further disturbance until a professional examination could be made or until clearance to proceed was authorized by the District Engineer.

6.17. Vegetation and Listed Species

6.17.1. Existing Condition

The vegetation communities of western North Dakota are described in detail in the Garrison Dam/Lake Sakakawea Master Plan (2007) and are herein incorporated-by-reference.

Upland prairie habitat surrounds much of the perimeter of the Garrison Project land and perimeter boundary. These grasslands exist mainly on the plateaus and upland ridge tops extending from the high-water mark outward onto adjacent private lands (USACE, 2007). This

habitat is the dominant land cover within the areas that would be disturbed by construction of the intakes, pipelines, water depots, and retention ponds and an example is shown in Figure 30. In general, these plant communities are a mixture of short and mid-prairie grasses and forbs (USACE, 2007). The harsh environmental factors--particularly low precipitation--produce conditions to which grasses are best adapted, resulting in a grassland climax community (USACE, 2007).

Figure 30
Grassland Habitat of Lake Sakakawea



In undisturbed areas, native grasses include big bluestem (*Andropogon gerardii*), little bluestem (*Schizachyrium scoparium*), western wheatgrass (*Pascopyrum smithii*) and slender wheatgrass (*Agropyron trachycaulum*), prairie junegrass (*Koeleria cristata*), threadleaf sedge (*Carex filifolia*), and green needlegrass (*Stipa viridula*) are the dominant species (USACE, 2007).

Sites dominated with clay soils have scattered broomweed (*Amphiachyris dracunculoides*), rabbitbrush (*Ericameria nauseosa*), saltbrush (*Atriplex canescens*), sixweek fescue (*Vulpia octoflora*), saltgrass (*Distichlis spicata*), burning bush (*Euonymus atropurpureus*), and Pursh seepweed (*Suaeda calceoliformis*). The drier, generally southfacing slopes, support a plant community comprised primarily of purple sandgrass (*Triplasis purpurea*), soapweed yucca (*Yucca glauca*), plains prickly pear (*Opuntia polyacantha*) and occasionally various rose species. On more sandy soils, needle- and-thread grass (*Stipa comata*) and sideoats grama (*Bouteloua curtipendula*) dominate (USACE, 2007).

The areas identified for use to construct the proposed pipelines, utilities, road construction, were selected because they had been previously utilized by motor vehicles (either with actual roads or primitive two-track trails). In these disturbed areas, brome grass, various annual foxtail species, crested wheat grass, cheat grass and other exotics are commonly found these disturbed areas are of marginal value.

Protected Plant Species: Dakota Wild Buckwheat (Visher's Buckwheat)

The Dakota wild buckwheat or Visher's buckwheat (*Eriogonum visheri*) is found in the badlands of North and South Dakota and adjacent Montana. The plant is an annual (completes its life cycle in one year) and the Dakota wild buckwheat can occupy the constantly eroding badland habitat that otherwise provides unstable footing for longer-lived plants. *Eriogonum visheri* is rare to infrequent throughout its range. It appears to be concentrated in two areas, one primarily in the badlands of western South Dakota and a second from the Cheyenne River northward to just north of the Cannonball River area in south-central to western North Dakota.

The plant is a small, inconspicuous summer annual plant endemic to the badlands of North Dakota, South Dakota, and Montana. The Northern Region (Region 1) and the Rocky Mountain Region (Region 2) of the US Forest Service (USFS) have designated *E. visheri* a sensitive species. A USFS sensitive species is a plant or animal "species identified by a Regional Forester for which population viability is a concern, as evidenced by a significant current or predicted downward trend in population numbers or density [and/or] a significant current or predicted downward trends in habitat capability that would reduce a species' existing distribution."

Eriogonum visheri was designated a Category 2 candidate for listing as endangered or threatened under the federal Endangered Species Act (16 U.S.C. 1531 et seq.). However, it lost that status in 1996 when the USFWS eliminated the Category 2 designation; it remains a species of management concern for the USFWS. The species is designated between imperiled and vulnerable (S2S3) by the North Dakota Natural Heritage Inventory, and vulnerable (S3) by the South Dakota Natural Heritage Program. These state and global ranks indicate the rarity and vulnerability of a taxon, but they have no regulatory weight (Ladyman, 2006). Based on species' existing distribution in North Dakota primarily being just north of the Cannonball River in south-central to western North Dakota, this species would not be expected at any of the proposed intake construction sites.

Western Prairie Fringed Orchid

The western prairie fringed orchid (*Platanthera praeclara*) is a perennial which grows up to three feet high and is distinguished by large, white flowers that come from a single stem. The flowers are fringed on the margins giving them a feathery appearance.

Historically, the orchid was found throughout the tall grass regions of North America, but tall grass prairie has been reduced to less than two-percent of its former range. North Dakota has the largest population of Western prairie fringed orchid left in the world numbering over 7,000 individuals and is located in the Sheyenne National Grasslands in the southeastern corner of the state (USFWS, 2008). The plant has not been observed on the Garrison Project lands or in Western North Dakota (USFWS, 2008) and would therefore not be expected to occur at any of the proposed intake construction sites.

6.17.2. Environmental Consequences

No Action

Under the No Action alternative, there would be no soil-disturbing activities for water depot, retention pond, water intake, utility, and access road construction on or immediately adjacent to

Garrison Project lands. However, taking No Action would likely require new water intake infrastructure be developed up-river from Lake Sakakawea that could affect the terrestrial habitat depending on the intake location(s) selected.

Proposed Action

The expected impacts of conventional excavation and directional drilling include temporary and minor land disturbance for utility line infrastructure installation and permanent loss of habitat for road installation. The areas identified for use to construct the proposed water depots, retention ponds, pipelines, utilities, and road construction, were selected because they had been previously utilized by motor vehicles (either with actual roads or primitive two-track trails) or were already utility corridors. The methods selected for the construction of the intakes and associated infrastructure were chosen, in part, because they minimize the disturbance of riparian, wetland, and shoreline areas surrounding the lake and therefore limit the effects on the terrestrial and aquatic environment to the upland areas. Site-specific habitat effects are summarized below for the three current applications and any future sites would likely be constructed in similar locations.

In total, the footprint of disturbance from the three applicants and all seven of the proposed intakes and associated infrastructure (e.g., pipelines, utilities, roads, water depots, retention ponds) would be approximately 90 (88 acres) of disturbed upland prairie habitat. Of these 90 acres, 24 acres would be the footprint of construction of water depots and retention ponds and the remainder would be for pipelines, utilities, and roads to construct infrastructure from the intakes (approximately 66 acres).

Neither of the listed species identified in Section 6.17.1 would be likely to occur within the areas planned for construction and the effects to the small area of disturbed upland prairie within these areas of construction would not be considered significant.

Element Solutions:

Mandaree Site – The proposed pipeline would be constructed within a previously disturbed corridor of disturbed upland prairie habitat adjacent to an existing roadway and an existing utility corridor. As stated in Section 4.2.4.1, the footprint of disturbance would be approximately 350 feet in length across Corps lands and would continue for an additional 5.6 miles (total distance of 5.7 miles) to a new water depot. Assuming a 75-foot width of disturbance for all linear features being built, the area of disturbance would be approximately 52 acres²¹ plus an additional 2 acres for the water depot. In total, the Mandaree Site would be constructed over approximately 54 acres of previously disturbed upland prairie (i.e., grassland).

International Western:

Iverson Site – As stated in Section 4.2.4.2, this location would utilize an existing intake and would terminate at an existing storage pond and would therefore not require new ground-disturbing construction. Assuming two additional retention ponds were constructed in

²¹ 5.7 miles x 75 foot width of corridor = 51.65 acres.

association with this intake, then they would have a footprint of disturbance of approximately six acres total. At this time, International Western has not identified the specific locations for construction of any of the retention ponds associated with their application, but would be responsible to develop these sites in compliance with all appropriate state and federal resource protection laws.

Thompson Site – As described in Section 4.2.4.2, the proposed intake pipe for this site would be constructed within an area of previously disturbed upland prairie between access roads and the high-water mark. The pipelines for the Thompson intake would be approximately 1,400 feet in length. The area of disturbance for pipeline, utility and road access would be approximately 2.4²² acres. Assuming three two-acre retention ponds would be eventually developed to support this intake, an additional 6-acres would be necessary for construction of retention ponds for both intakes. Therefore, the area of potential construction would be approximately 8.4 acres of previously disturbed upland prairie.

Charlson Site – As described in Section 4.2.4.2, the intake pipe for this site would also be constructed within a previously disturbed upland prairie area between the existing two-track access roads and the high-water mark. The pipeline would be approximately 1,000 feet in length and the area of disturbance for pipeline, utility, and road access would be approximately 1.7²³ acres. Assuming three two-acre retention ponds would be eventually developed to support this intake, an additional 6-acres would be necessary for construction of retention ponds for both intakes. Therefore, the area of potential construction would be approximately 7.7 acres of previously disturbed upland prairie.

Lake Sakakawea & Associates #3 – As described in Section 4.2.4.3, the proposed area for construction of the proposed water depot and the pipeline from the water depot to the ordinary high water mark would be constructed within a predominantly grassed area with adjacent vegetated coulees. Assuming a 75-foot width of disturbance, the pipeline infrastructure (e.g., road, pipeline, utilities) for intake #3 would have areas of disturbance of approximately 2.9²⁴ acres. The water depot would be an additional two acres for a total footprint of construction of approximately 4.9 acres of previously disturbed upland prairie.

#5 - – As described in Section 4.2.4.3, the area for the proposed water depot and the pipeline to the ordinary high water mark would be constructed within a grassed area between access roads and the high-water mark. Assuming a 75-foot width of disturbance, the infrastructure (e.g., road, pipeline, utilities) for intake #5 would have areas of disturbance of approximately 2.1²⁵ acres. The water depot would be an additional two acres for a total footprint of construction of approximately 4.1 acres of previously disturbed upland prairie.

#8 – As described in Section 4.2.4.3, the area for the proposed water depot and the pipeline to the ordinary high water mark would be constructed within a previously disturbed corridor with current ground cover of grass adjacent to an existing roadway and an existing utility corridor.

²² 1400 foot length x 75 foot width of corridor = 2.4 acres.

²³ 1,000 foot length x 75 foot width of corridor = 1.7 acres.

²⁴ 1,700 foot length x 75 foot width of corridor = 2.9 acres.

²⁵ 1,200 foot length x 75 foot width of corridor = 2.1 acres.

Assuming a 75-foot width of disturbance, the infrastructure (e.g., road, pipeline, utilities) for intake #8 would have areas of disturbance of approximately 3.1²⁶ acres. The water depot would be an additional two acres for a total footprint of construction of approximately 5.1 acres of previously disturbed upland prairie.

6.18. Fish and Wildlife and Listed Species

The fish and wildlife of western North Dakota and the Garrison Project lands are detailed in the Garrison Dam/Lake Sakakawea Master Plan (2007) and are herein incorporated-by-reference.²⁷

6.18.1. Existing Conditions

Large mammals that occupy project lands and surrounding lands include white-tailed deer (*Odocoileus virginianus*), mule deer (*O. hemionus*), moose (*Alces alces americanus*), and pronghorn antelope (*Antilocapra americana*) (USACE, 2007). Small mammals known to utilize project and surrounding lands include beaver (*Castor canadensis*), muskrat (*Ondatra zibethicus*), raccoon (*Procyon lotor*), badger (*Taxidea taxus*), mink (*Mustela vison*), least weasel (*M. nivalis*), red fox (*Vulpes vulpes*), striped skunk (*Mephitis mephitis*), coyote (*Canis latrans*), and bobcat (*Felis rufus*) (USACE, 2007)

The diverse habitat on the Garrison Project provides year-round and seasonal use by a large variety of birds. Although there is no Breeding Bird Atlas for North Dakota, approximately 245 different bird species have been recorded within the Garrison Project (USACE, 2007). About 15-percent of the 245 bird species are permanent residents at Lake Sakakawea and the remainder are summer residents, migrants, or visitants (USACE, 2007). Avian populations and species diversity at the Garrison Project vary significantly from season to season because of bird migration habits and patterns.

Lake Sakakawea supports various cold-water fish species (e.g., rainbow smelt, *Osmerus mordax* and Chinook salmon, *Oncorhynchus tshawytscha*) and is primarily managed for sport fishing (USACE, 2007). The river fishery persists at the upper, riverine end of the lake (USACE, 2007) and the delta at the upstream end of the reservoir provides a nursery area for many river fish. These areas include fish species preferring warmer water such as shovelnose sturgeon (*Scaphirhynchus platorynchus*), pallid sturgeon (*S. albus*), paddlefish (*Polyodon spathula*), northern pike, catfish (*Ictalurus spp.*), burbot (*Lota lota*), yellow perch (*Perca flavescens*), sauger (*Sander canadense*), and walleye (*Sander vitreus*) (USACE, 2007).

Protected Species

Pallid Sturgeon (*Scaphirhynchus albus*) - Listed Endangered

Sturgeon (including the pallid sturgeon) and paddlefish are the only living descendants of an ancient group of Paleozoic fishes (USACE, 2007). The pallid sturgeon was listed as an endangered species in 1990 primarily due to the loss of habitat from alterations to the Missouri River and the construction of the extensive system of dams in the upper reaches (USACE, 2007).

²⁶ 1,800 foot length x 75 foot width of corridor = 3.1 acres.

²⁷ https://www.nwo.usace.army.mil/html/Lake_Proj/MasterPlan/GarrisonMP.pdf

Commercial fishing may have also played a role in the pallid sturgeon's decline (USACE, 2007). These species are adapted to large, turbid, warm-water rivers and fishermen occasionally catch pallid sturgeon in the Yellowstone and Missouri rivers in North Dakota (USACE, 2007).

Pallids spawning requirements are not well known, but spawning is believed to occur in May or June over gravel or other hard surfaces. Pallid sturgeon feed on aquatic insects, mollusks, and small fishes (USACE, 2007). Habitat requirements for the pallid sturgeon are still being determined; however, some clues to their habitat can be inferred from areas where most pallid sturgeon (and their close relative, the shovelnose sturgeon) have been captured, most often over a sandy substrate. Pallids have been captured most frequently in waters flowing with velocities between 0.33 and 0.98 feet per second in South Dakota (USACE, 2007) and between 1.3 and 2.9 feet per second in Montana (USACE, 2007).

Within the Missouri River basin, very few wild (naturally-occurring) pallid sturgeon persist (USACE, 2007). Population estimates are only available for existing pallid populations in a few reaches of the Missouri River. Approximately 35 adults are believed to exist in the Missouri River above Fort Peck Lake. About 180 adults are estimated to exist between the Fort Peck Dam and Lake Sakakawea, including the Yellowstone River up to approximately river mile 71.

A remnant population also exists in Lake Sharpe in South Dakota, but a reliable population estimate is not available. Between Fort Randall Dam and Gavins Point Dam, the wild population is believed to be nearly zero, although a wild pallid sturgeon was captured in this reach in November 2006 during standard Pallid Sturgeon Population Assessment sampling activities by the USFWS. From Gavins Point Dam to the mouth of the Missouri River, current data are inadequate for a reliable population estimate; however, the majority of pallid sturgeon captures are the result of stocking efforts since 2002. Pallid sturgeon captures are recorded in a permanent database by the USFWS in Bismarck, North Dakota.

The USFWS continues to improve the data regarding the distribution of pallid sturgeon in Lake Sakakawea through the Pallid Sturgeon Population Assessment sampling activities. Tracking efforts of radio-tagged pallid sturgeon indicate the presence of pallid sturgeon upriver from Lake Sakakawea and likely throughout Lake Sakakawea (Dixie Environmental Services, 2009). Best available information suggests that pallids stay in the remnant river thalweg, most likely responding to current (Dixie Environmental Services, 2009). As such, there is potential for the pallid sturgeon to be present within Lake Sakakawea when intakes were being constructed and during operations (Dixie Environmental Services, 2009).

Shovelnose Sturgeon (*Scaphirhynchus platyrhynchus*) – Listed Threatened

Effective October 1, 2010, the USFWS has listed the shovelnose sturgeon (*Scaphirhynchus platyrhynchus*) as threatened under the Similarity of Appearance clause of the Endangered Species Act²⁸ based on similarity to the endangered pallid sturgeon (*Scaphirhynchus albus*)

²⁸ Section 4(e) of the Endangered Species Act and implementing regulations (50 CFR 17.50–17.52) authorize the Secretary of the Interior to treat a species as an endangered or threatened species even though it is not itself listed if: (a) The species so closely resembles in appearance a listed endangered or threatened species that law enforcement personnel would have substantial difficulty in attempting to differentiate between the listed and unlisted species; (b) the effect of this substantial difficulty is an additional threat to an endangered or threatened species; and (c) such treatment of an unlisted species will substantially facilitate the enforcement and further the purposes of the Act.

(USFWS, 2010). The shovelnose sturgeon and the endangered pallid sturgeon are difficult to differentiate in the wild and inhabit overlapping portions of the Missouri and Mississippi River basins. Commercial harvest of shovelnose sturgeon in the four states where shovelnose and pallid sturgeon co-exist (IL, KY, MI, and TN) has resulted in the documented take of pallid sturgeon where the two species coexist and is a threat to the pallid sturgeon (USFWS, 2010).

Under this special rule, take of any shovelnose sturgeon, shovelnose-pallid sturgeon hybrids or the roe associated with or related to a commercial fishing activity is prohibited within the geographic areas set forth in the rule. The shovelnose and shovelnose-pallid sturgeon hybrid populations covered by the rule occur within Missouri River, including Lake Sakakawea, throughout all of North Dakota (USFWS, 2010).

Black-Footed Ferret (*Mustela nigripes*) – Listed Endangered

The black-footed ferret (*Mustela nigripes*) is one of the most endangered mammals in North America. The species was listed as endangered in 1967 under a precursor to the Endangered Species Act of 1973 (Volume 32 Federal Register [FR] 4001). Black-footed ferrets once ranged throughout the Great Plains. It has been calculated that if all suitable habitat had been used, as many as 5.6 million black-footed ferrets may have existed in the late 1800's (USFWS, 1995). Populations declined dramatically in the 1900's. The rapid decline of black-footed ferrets has been linked to the eradication of prairie dogs over a large portion of their historic range. Prairie dogs now occupy less than 1-percent of their historic range (USFWS, 1995). Threats to black-footed ferrets also include canine distemper. Black-footed ferrets are susceptible to predation by golden eagles, great-horned owls, and coyotes. They are also susceptible to road kills and trapping (USFWS, 1995). Of the reintroduction sites, only the Conata Basin site in South Dakota is considered to have a sizeable self-sustaining ferret population (USFWS, 2002).

The counties bordering Lake Sakakawea on the south (McKenzie, Dunn and Mercer) are all within the historic range of the black-footed ferret but have had no known sightings of the ferrets. As such, the black-footed ferret would not be likely to occur within the areas planned for construction of the intakes and associated infrastructure.

Gray Wolf (*Canis lupus*) – Listed Endangered

The gray wolf (*Canis lupus*) was historically found throughout North America, with the exception of parts of the southwestern and southeastern United States. The gray wolf was historically present throughout North Dakota, where it was known as the Plains wolf, the buffalo wolf, or the lobo wolf (USFWS, 1995). As of September 2009, the listing status of the gray wolf was expanded to endangered throughout all of North Dakota (USFWS, 2009a).

Given the density of roads in North Dakota and the large expanses of agricultural lands, wolves have not established any confirmed den sites in well over 20 years (USACE, 2007). Each year a small number of wolf sightings are reported by the public in North Dakota, and on average, the NDGFD, USDA's Wildlife Services, and the USFWS confirm one to four sightings per year (USACE, 2007). As such, the gray wolf would not be likely to occur within the areas planned for construction of the intakes and associated infrastructure and effects to the gray wolf would be highly unlikely.

Whooping Crane (*Grus americana*) – Listed Endangered

The whooping crane was listed as endangered in 1967 under a precursor to the Endangered Species Act of 1973 (Volume 32 Federal Register [FR] 4001). Unregulated hunting for sport and food combined with the loss of large expanses of wetlands habitat caused the massive decrease in numbers of whooping cranes. Breeding populations of the crane were extirpated from the U.S. portion of its historic breeding range by the early 1900's.

Because of intense conservation efforts and captive breeding programs, the whooping crane population now numbers more than 450 individuals. The whooping crane migrates through western and central counties of North Dakota during the spring (late April to mid-June) and the fall (late September to mid-October). Whooping cranes use open sand and gravel bars or very shallow water in rivers and lakes for nightly roosting. Cranes seen feeding during the migration are frequently within short flight distances of reservoirs, lakes, and large rivers that offer bare islands for nightly roosting (32 FR 4001). Whooping cranes do not readily tolerate disturbances to themselves or their habitat. A human on foot can quickly cause a crane to fly at distances of over a quarter mile (32 FR 4001).

Major food items for cranes during the migration period include insects, crayfish, frogs, small fish, and other small animals as well as some aquatic vegetation and some cereal crops in adjacent croplands (43 FR 36588). None of the designated critical habitat for whooping cranes is located at Lake Sakakawea (43 FR 36588). Most whooping crane sightings in North Dakota occur in the western two-thirds of the state, while the cranes are migrating from their winter home in and around Aransas National Wildlife Refuge on the Texas coast to their summer nesting grounds at Wood Buffalo National Park, which straddles the border between Alberta and the Northwest Territories in Canada. In 1988, a flock of eight whooping cranes was observed in a field in Mercer County just south of the project lands. In 2006, there were nine confirmed whooping crane sightings in North Dakota (USACE, 2007).

As such, other than a potential for brief stoppage during seasonal migration, the whooping crane would not be likely to occur within the areas planned for construction of the intakes and associated infrastructure.

Interior Least Tern (*Sterna antillarum athalassos*) – Listed Endangered

The interior population of the least tern uses several major river systems of the United States including the upper Missouri River and Lake Sakakawea in North Dakota. The stabilization of these river systems for navigation, flood control, hydropower generation, and irrigation has led to a loss of much of the sandbar habitat the species requires and led to the degradation of the remaining habitat. Consequently, in 1985, the interior population of the least tern was listed as endangered by the USFWS (50 FR 21792).

Least terns are migratory and arrive on Lake Sakakawea in late May and early June. The adults and juveniles depart the Lake Sakakawea breeding grounds by mid-August to migrate south to wintering grounds. Lake Sakakawea has never been a major nesting area for least terns on the Missouri River (USACE, 2007). In nearly 20 years (1988-2006) of adult least tern censuses conducted on Lake Sakakawea, the average number of adults counted has been 19 individuals annually (USACE, 2007). This represents less than three percent of the Missouri River system average of 655 adults counted in the adult census for the same time period (USACE, 2007). The

number of adults counted at Lake Sakakawea has varied from a low of two adults in 1997 to a high of 48 adults in 2006.

Least tern nesting on Lake Sakakawea has been diffuse since surveys began in 1988. They favor coastal beaches and river sandbars for nesting and chick rearing; along Lake Sakakawea they nest in the sand and gravel shorelines above the water line. Some of the favored locations include Douglas Creek Bay, Elbowwoods Bay, Deepwater Bay, portions of the Van Hook Arm, Hofflund Bay, and Tobacco Garden Bay.

Piping Plover (*Charadrius melodus*) - Northern Great Plains population – Listed Threatened

The piping plover is a shorebird that favors coastal beaches, alkali wetland, lakeshores, reservoir beaches, and riverine sandbars for nesting and chick rearing. In 1985, the USFWS listed the Northern Great Plains population as threatened (50 FR 50726). The Northern Great Plains population extends across three Canadian provinces and eight American states. The 2006 International Piping Plover Adult Census found about 4,700 adult plovers in the northern Great Plains (USACE, 2007). An important nesting area for piping plovers in the northern Great Plains is the Missouri River, where 1,311 adult plovers were counted in 2006. Piping plovers are migratory arriving on Lake Sakakawea as early as mid-April and continuing to arrive through May and into June. Favored habitat on the reservoir includes the shoreline beaches and islands. The typical plover nest is a shallow scrape in the sand that is lined with pebbles. Normally an adult pair will raise one brood of chicks during the nesting season and re-nesting commonly follows if a nest or a young brood is lost. The eggs will hatch after 27 to 31 days of incubation and the chicks fledge about 20 to 25 days after hatching. Piping plovers feed primarily on insects and aquatic invertebrates, and soon after hatching, the chicks begin foraging for themselves. After fledging, juveniles may remain in the nesting area around Lake Sakakawea for a time but begin their southward migration to the wintering grounds from early July to mid-August (USACE, 2007).

Depending on the water level, Lake Sakakawea can be a major nesting area for piping plovers in the Missouri River system. A high water level eliminates virtually all of the shoreline beaches and inundates the islands, as was the case in 1997 when a record low of only three adults were counted on the lake. In contrast, drought-induced low water levels expose hundreds of miles of shoreline beaches and islands, providing plentiful habitat as in 2005, when a record 746 adults were counted. During the nearly 20 years (1988-2006) of adult census conducted on Lake Sakakawea, the average adult count was 241 piping plovers (USACE, 2007). This represents approximately one-third of the annual number of adult piping plovers counted on the upper Missouri River system (annual average of 708 piping plovers for the same period) (USACE, 2007).

Fledglings on Lake Sakakawea also represent a major proportion of the total number of fledglings in the Missouri River system. Productivity monitoring has been conducted on Lake Sakakawea for 15 years (1992-2006), with an average of 170 fledglings annually (USACE, 2007). This represents over 40-percent of the upper Missouri River System's annual average of 409 fledglings for the same time (USACE, 2007). Piping plover fledgling numbers have varied from a low of zero in 1995 to a high of 552 in 2004 (USACE, 2007).

Piping plover nesting areas vary widely on Lake Sakakawea. Areas of major nesting concentrations include Douglas Creek Bay, Arikara Bay, Deepwater Bay, the Van Hook Arm

including the Van Hook islands, Hofflund Bay, Little Egypt, Red Mike Bay, Renner Bay, and a counterclockwise arc from the northeast part of Mallard Island through DeTrobriand Bay. Minor plover nesting area concentrations include Elbowwoods Bay, Beacon Island, White Earth Bay, Tobacco Garden Bay, Beacon Point, Antelope Creek, Independence Point, and Beaver Creek Bay.

The USFWS designated critical habitat for the Northern Great Plains population of the piping plover (67 FR 57638), including the Missouri River, in September 2002. Designated areas of critical habitat include prairie alkali wetlands and surrounding shoreline; river channels and associated sandbars and islands; and reservoirs and inland lakes and their sparsely vegetated shorelines, peninsulas, and islands.

These areas provide primary courtship, nesting, foraging, sheltering, brood-rearing, and dispersal habitat for piping plovers. For the Garrison Project, all of the islands and shoreline of Lake Audubon were designated as critical habitat (USACE, 2007). On Lake Sakakawea, all of the islands and shoreline with the exception of the Little Missouri Arm from McKenzie Bay westward were designated as critical habitat (USACE, 2007).

Bald Eagle (*Haliaeetus leucocephalus*) and Golden Eagle (*Aquila chrysaetos*)

A small portion of central ND is considered a breeding range for the bald eagle, including the river flood plains in southern McLean, Mercer, Oliver, Burleigh, and Morton counties (USACE, 2007). While the bald eagle tends to be more closely associated with forested areas near water (Buehler 2000), they have been found nesting in single trees several miles from the nearest water body. Therefore, there may also be potential habitat for the bald eagle at the proposed project sites. In addition, the golden eagle can be found throughout the badlands and along the upper reaches of the Missouri River, primarily the reach from McKenzie and Williams counties to western McLean and Mercer counties (Gomes, no date). Golden eagles inhabit a wide variety of habitat types, including open grassland areas. They are known to nest on cliffs, in trees, manmade structures, and on the ground (Kochert et al. 2002). There are numerous records of golden eagle nests on the Fort Berthold reservation.

The bald eagle was de-listed (i.e., removed from the list of threatened and endangered species) on June 29, 2007. However, the U.S. Fish and Wildlife Service continue to work with state wildlife agencies to monitor eagles for at least five years, as required by the Endangered Species Act. If at any time it appears that the bald eagle again needs the Act's protection, the U.S. Fish and Wildlife Service can propose to re-list the species.

The bald eagle remains protected by the Bald and Golden Eagle Protection Act (BGEPA) and the Migratory Bird Treaty Act (MBTA). In July 2007, the National Bald Eagle Management Guidelines (the Guidelines) (72 FR 31156 31157) were released for public review to identify certain human-caused impacts to bald eagles that are still prohibited by law. Commercial and residential development, forestry practices, outdoor recreation, natural resource recovery operations, and other human activities can potentially interfere with bald and golden eagles or permanently degrade or destroy bald and golden eagle nesting, roosting, and foraging areas (USACE, 2007). In some cases, such impacts amount to violations of the provisions of the BGEPA or the MBTA that protect bald and golden eagles. A permit is required for any take of bald or golden eagles or their nests whether or not they are active. Permits to take golden eagles or their nests are available only for legitimate emergencies and as part of a program to protect golden eagles.

The USFWS developed the Guidelines to advise landowners, land managers, and others who share public and private lands with bald and golden eagles when and under what circumstances the protective provisions of the BGEPA may apply to them. The Guidelines were designed to promote the continued conservation of the bald and golden eagle following the bald eagles removal from the Federal List of Endangered and Threatened Wildlife and Plants (protection under the ESA).

The Guidelines are intended to:

- (1) Publicize the provisions of the BGEPA that continue to protect bald eagles, in order to reduce the possibility that people will violate the law;
- (2) Advise landowners, land managers, and the general public of the potential for various human activities to disturb bald and golden eagles; and
- (3) Encourage land management practices that benefit bald and golden eagles and their habitat.

Especially early in the nesting season, eagles can be very sensitive to disturbance near the nest site and may abandon their nest as a result of low disturbance levels, even from foot traffic. During the critical nesting periods, construction activities and other forms of disturbance should not be permitted within $\frac{1}{4}$ mile of the active nest tree or perch trees if the activity is not visible from the nest (BLM, 2006). If the eagles have line-of-sight vision from these trees to the construction activities or other types of disturbance, the distance is one half ($\frac{1}{2}$) mile (USACE, 2007). The presence of human activity in this area would usually cause nesting disturbance.

Dakota Skipper (*Hesperia dacotae*) – Candidate Species

The Dakota skipper (*Hesperia dacotae*) is a small butterfly with a 1-inch wingspan. Like other skippers, they have a thick body and a faster and more powerful flight than most butterflies. The upper side of the male's wings range from tawny-orange to brown with a prominent mark on the forewing; the lower surface is dusty yellow-orange. The upper side of the female's wing is darker brown with tawny-orange spots and a few white spots on the margin of the forewing; the lower side is gray-brown with a faint white spotband across the middle of the wing. Dakota skipper pupae are reddish-brown and the larvae (caterpillars) are light brown with a black collar and dark brown head. The Dakota skipper has a relatively short flight window (approximately 3 weeks), with adults emerging from mid June to early July, depending on weather conditions.

The Dakota skipper is associated with high quality prairie ranging from wet-mesic tallgrass prairie to dry-mesic mixed grass prairie. The first type of habitat is relatively flat and moist native bluestem prairie. Three species of wildflowers are usually present: wood lily (*Lilium philadelphicum*), harebell (*Campanula rotundifolia*), and smooth camas (*Zygadenus elegans*). The second habitat type is upland (dry) prairie that is often on ridges and hillsides. Bluestem grasses and needlegrasses dominate these habitats. On this habitat type, three wildflowers are typically present in high quality sites that are suitable for Dakota skipper: pale purple (*Echinacea pallida*) and upright (*E. angustifolia*) coneflowers and blanketflower (*Gaillardia sp.*). Dakota skipper populations have declined historically due to widespread conversion of native prairie, but have been recorded in McKenzie, Dunn, Mountrail, and Ward counties (USGS, 2006).

The Dakota skipper is a candidate for listing under the Endangered Species Act. Candidate species are those for which U.S. Fish and Wildlife Service has sufficient information to list as threatened or endangered. To determine the order in which it proposes species for listing, the USFWS assigns listing priority numbers to candidate species based on the magnitude and immediacy of threats and the species' taxonomic distinctiveness. Listing priority numbers range from 1 (high priority) to 12 (low priority) and the Dakota skipper has a listing priority number of 11 (USFWS, 2009).

Candidate species receive no legal protection under the Endangered Species Act; that is, there are no legal prohibitions under the federal Endangered Species Act against taking candidate species. The Fish and Wildlife Service works to implement conservation actions for candidate species that may eliminate the need to list the species as threatened or endangered.

Sprague's Pipit (*Anthus spragueii*) – Candidate Species

Sprague's Pipit is a small (approximately 5.5 inches in length) grassland specialist bird endemic to the mixed-grass prairie in the northern Great Plains of North America. They are a Candidate Species for listing as "Endangered" or "Threatened" (USFWS, 2010a). After having been petitioned for listing in 2008 (WEG, 2008), the USFWS determined that the petition presented substantial information indicating that listing the Sprague's Pipit was warranted but was precluded by higher listing priorities (USFWS, 2010a). The following species information is taken from the USFWS 2010 Sprague's Pipit Conservation Plan (USFWS, 2010b).

Sprague's Pipits breed in the northern Great Plains, with their highest numbers occurring in the central mixed-grass prairie of north-central and eastern Montana, North Dakota, and northwestern and north-central South Dakota. Sprague's Pipits are closely associated with native prairie grassland throughout their range and are less abundant (or absent) in areas of introduced grasses. Generally, pipits prefer to breed in well-drained native grasslands with high plant species richness and diversity.

The principal causes for the declines in Sprague's Pipit range and populations are habitat conversion (to seeded pasture, hayfield, and cropland) as well as overgrazing by livestock. In addition to the habitat losses from changes in land use, energy development, introduced plant species, nest predation and parasitism, drought, and fragmentation of grasslands are all threats that currently impact Sprague's Pipits populations throughout their present range.

Anecdotal accounts from early naturalists suggest that Sprague's Pipits were one of the most common grassland songbirds in the northern Great Plains. Since its discovery, the Sprague's Pipit has suffered greatly throughout its breeding range from conversion of short- and mid-grass prairie to agriculture.

Sprague's Pipits are likely influenced by the size of grassland patches and the amount of grassland in the landscape. Pipits had a 50-percent probability of occurring on patches \geq approximately 400 acres; pipits were absent from grassland patches <72 acres. The shape of the habitat is also important; sites with a smaller edge-to-area ratio had higher pipit abundance, and were an important predictor of their occurrence. No consistent effect of patch size was found on nest success. Sprague's Pipits rarely occur in cultivated lands, and are uncommon on non-native planted pasturelands. They have not been documented to nest in cropland, in land in the Conservation Reserve Program, or in dense nesting cover planted for waterfowl habitat.

The conversion, degradation, fragmentation, and loss of native prairie are the primary threats to Sprague's Pipit populations. The once abundant grasslands of the Great Plains have been drastically reduced, altered, and fragmented by intensive agriculture, roads, tree plantings, encroachment by woody vegetation, invasion of exotic plants, and other human activities, including the removal of native grazers and a change in the natural fire regime. In the United States, about 60-percent of native mixed-grass prairies in Montana, North Dakota, and South Dakota have been converted to cropland. Grassland conversion has greatly reduced the quality and availability of suitable habitat for Sprague's Pipits.

Fragmentation of native prairie has likely contributed to the decline of Sprague's Pipit populations through a reduction in average patch size, increased isolation of habitat patches, and increase in the ratio of edge-to-interior in habitat and potentially, an increase in parasitism. In fragmented landscapes, habitat interior species such as Sprague's Pipits may experience lower reproductive success when nesting near habitat edges, where they are more susceptible to nest predators and brood parasites (e.g., brown headed cowbird). Sprague's Pipit abundance has been inversely correlated with distance to cropland and to water.

Sprague's Pipits may avoid roads and trails during the breeding season and the increased roads densities associated with energy development may have negative effects on Sprague's Pipit habitat. The type of road (e.g., secondary or tertiary, the presence of deep ditches on the sides, heavily graveled) and the level of traffic are the potential issues in determining the degree of effect roads and trails have on Sprague's Pipit populations. In Saskatchewan, Sprague's Pipits were significantly more abundant along trails (wheel ruts visually indistinct from surroundings) than along roadsides (fenced surfaced roads with adjacent ditches), which may be attributed to the reduction of suitable habitat associated with the road right-of-way. Sprague's Pipits avoidance of roads may also be due to the roadside habitat which tended to have non-native vegetation, dominated by smooth brome (*Bromus inermis*).

Energy exploration and extraction are expected to continue to be a threat to Sprague's Pipits habitat and populations into the future as demands for resources increase globally. Sprague's Pipit abundance decreases within approximately 1,000 feet of oil wells. In the United States, much of the Sprague's Pipit's breeding range overlaps major areas of oil production in eastern Montana, western North Dakota and northwestern South Dakota. Areas with a high density of oil production may also decrease migration and wintering habitats available.

As with the Dakota Skipper, the candidate species receive no legal protection under the Endangered Species Act; that is, there are no legal prohibitions under the federal Endangered Species Act against taking candidate species. The Fish and Wildlife Service works to implement conservation actions for candidate species that may eliminate the need to list the species as threatened or endangered.

6.18.2. Environmental Consequences

No Action

Under the No Action alternative, there would be no construction activities for water depot, retention pond, water intake, utility, and access road construction on or immediately adjacent to Garrison Project lands. However, taking No Action would likely require new water intake infrastructure be developed up-river from Lake Sakakawea that could affect the fish and wildlife resources, including listed species, depending on the intake location(s) selected.

Proposed Action

The expected effects from access, utility corridor, and intake construction associated with conventional excavation and directional drilling include temporary and minor noise disturbances, diesel emissions, and temporary and minor land disturbance that could have a temporary effect on the fish and wildlife resources in the immediate area. The construction methods selected for these projects (i.e., directional drilling) were chosen, in part, because they minimize the footprint of disturbance and eliminate the need for suspension of organic lake sediment, and the handling of such, in an aquatic environment. Thus, no significant effects to the aquatic or terrestrial biota would be expected to occur from the minor and temporary construction-related effects such as increased turbidity, or release of nutrients and associated impacts to dissolved oxygen levels. The predicted differences in water surface elevation within Lake Sakakawea between the No Action and the Proposed Action would be virtually indiscernible and would not lead to significant effects to fish and wildlife resources.

Listed Species Effects Determinations

Pallid Sturgeon (*Scaphirynchus albus*) – Listed Endangered

The physical limitations on intake screen size and maximum intake velocity identified in Section 4.2.5 (1/4 inch screen size and 1/2 foot per second velocity of intake flow) have been established in consultation with the U.S. Fish and Wildlife Service and the NDG&FD to be protective of pallid sturgeon. However, the potential exists to have construction of water supply intakes affect pallid sturgeon during construction. As stated in Section 4.2.5, an environmental window would be established as a condition for approval for any construction within the waterway prohibiting work from April 15 to June 1 to protect the fishery resource. In addition, the stipulations specifically listed for pallid sturgeon in section 4.2.5 are required conditions that must be met in order to ensure avoidance of adverse affects to the pallid sturgeon from the construction of water intakes.

The finding is a determination of may affect, but not likely to adversely affect the pallid sturgeon.

Shovelnose Sturgeon (*Scaphirhynchus platorynchus*) – Listed Threatened

Because this species is listed as threatened, but is not biologically threatened or endangered, no Biological Assessment or further Section 7 consultation under the Endangered Species Act would be required with the USFWS.

Because the proposed projects are not associated with commercial fishing, a determination for the shovelnose sturgeon is not required.

Black-Footed Ferret (*Mustela nigripes*) – Listed Endangered

The counties bordering Lake Sakakawea on the south (McKenzie, Dunn and Mercer) are all within the historic range of the black-footed ferret but have had no known sightings of the ferrets. As such, the black-footed ferret would not be likely to occur within the areas planned for construction of the intakes and associated infrastructure.

The finding is a determination of no effect to the black-footed ferret.

Gray Wolf (*Canis lupus*) – Listed Endangered

Given the extreme rarity of occurrence of the gray wolf near Lake Sakakawea, they would not be likely to occur within the areas planned for construction of the intakes and associated infrastructure and effects to the gray wolf would be highly unlikely.

The finding is a determination of no effect to the gray wolf.

Whooping Crane (*Grus americana*) – Listed Endangered

Other than a potential for brief stoppage during seasonal migration, the whooping crane would not be likely to occur within the areas planned for construction of the intakes and associated infrastructure. Effects of the Proposed Action on the whooping crane would be highly unlikely. As stated in Section 4.2.5, if a whooping crane were sighted within one mile of the proposed projects' construction, all work would cease within one mile of that part of the project (i.e. that intake) and the U.S. Fish and Wildlife Service would be contacted immediately. Work could resume after the birds left the area.

The finding is a determination of may affect, but not likely to adversely affect the whooping crane.

Interior Least Tern (*Sterna antillarum athalassos*) – Listed Endangered

As described in Section 4.2, the methods selected for the construction of the intakes and associated infrastructure were chosen, in part, because they minimize the disturbance of these shoreline areas surrounding the lake and therefore limit the potential to disturb interior least tern habitat. As stated in Section 4.2.5, overland access to intakes during interior least tern breeding season (April 1 – August 31) or at any time when nests may be left in suitable nesting habitat would be restricted. Intake owners would either access the intakes from the water or coordinate with the Corps' Garrison Project Office and the USFWS to ensure that the area that could be affected was surveyed prior to overland access. In addition to the above, the stipulations listed in section 4.2.5 that are specific to interior least tern and their habitat are also requirements that must be met in order to ensure avoidance of adverse affects from water intake construction.

The effect of the depletions associated with implementing the Proposed Action on interior least tern nesting area would be virtually identical to the effect of the No Action alternative. However, if the effect of the depletions were discernable, the action would create a small amount of additional shoreline, providing a small increase in potential nesting area.

The finding is a determination of may affect, but not likely to adversely affect the interior least tern.

Piping Plover (*Charadrius melodus*) - Northern Great Plains population – Listed Threatened

The ongoing nesting success of piping plover at Lake Sakakawea, as well as the designation of all Lake Sakakawea shoreline habitat as critical habitat, indicates that there is potential for the piping plover to be affected by the proposed construction of new water supply intakes as well as operation and maintenance of the intakes once completed.

As described in Section 4.2, the methods selected for the construction of the intakes and associated infrastructure were chosen, in part, because they minimize the disturbance of critical habitat (i.e., shoreline) for the piping plover. The use of directional drilling from the high-water mark to daylight beneath the water surface limits the potential effects to piping plover habitat.

As stated in Section 4.2.5, overland access to intakes during piping plover breeding season (April 1 – August 31) or at any time when ruts may be left in suitable nesting habitat would be restricted. Intake owners would either access the intakes from the water or coordinate with the Corps' Garrison Project Office and the USFWS to ensure that the area that could be affected was surveyed prior to overland access. In addition to the above, the stipulations listed in section 4.2.5 that are specific to piping plover and their habitat are also requirements that must be met in order to ensure avoidance of adverse effects from water intake construction.

The effect of the depletions associated with implementing the Proposed Action on piping plover nesting area would be virtually identical to the effect of the No Action alternative. However, if the effect of the depletions were discernable, the action would create a small amount of additional shoreline, providing a small increase in potential nesting area.

The finding is a determination of may affect, but not likely to adversely affect, the piping plover.

The finding with respect to the piping plover critical habitat is a determination that the project would not impact the critical habitat for the piping plover.

Bald Eagle (*Haliaeetus leucocephalus*) and Golden Eagle (*Aquila chrysaetos*)

The period from initiation of nest selection to one month after hatching is considered an “extremely sensitive” period, in which activity in the nest site may cause eagles to desert the nest. As long as the recommended buffer distances to avoid nesting sites are observed during the critical times of nesting for the intake construction, no significant effects to the bald eagle would be expected.

As stated in Section 4.2.5, surveys are required to be conducted prior to final site selection in order to avoid choosing sites that initially have a high potential to impact bald or golden eagles. In addition, the stipulations also require that prior to any construction scheduled between February 1 and August 15, the applicant must conduct surveys for nesting eagles consisting of a 0.5 mile radius around all areas of project disturbance. If a bald or golden eagle nest is sighted within 0.5 mile of the project construction area, construction activities would cease and the U.S. Fish and Wildlife Service would be notified for further coordination.

The finding is a determination of no effect to the bald eagle or golden eagle.

Dakota Skipper (*Hesperia dacotae*) – Candidate Species

As described in Section 6.17.2, the areas identified for use to construct the proposed water depots, retention ponds, pipelines, utilities, and road construction, were selected because they had been previously utilized by motor vehicles (either with actual roads or primitive two-track trails) or were already utility corridors. The methods selected for the construction of the intakes

and associated infrastructure were chosen, in part, because they minimize the disturbance of habitat surrounding the lake and therefore limit the effects on the surrounding upland areas

In total, the footprint of disturbance from the three applicants and all seven of the proposed intakes and associated infrastructure (e.g., pipelines, utilities, roads, water depots, retention ponds) would be approximately 90 acres. Of these 90 acres in total, 24 acres would be the footprint of construction of water depots and retention ponds; the area of disturbance for pipelines, utilities, and roads to construct infrastructure from the intakes to the water depots would be approximately 66 acres. Given the extent of previous disturbance along the corridors selected for construction, effects to Dakota skipper habitat from construction within these disturbed upland prairie areas would be possible, but unlikely.

The finding is a determination of not likely to adversely affect for the Dakota skipper.

Sprague's Pipit (*Anthus spragueii*) – Candidate Species

The areas identified for use to construct the proposed water depots, retention ponds, pipelines, utilities, and road construction, were selected because they had been previously utilized by motor vehicles (either with actual roads or primitive two-track trails) or were already utility corridors. The methods selected for the construction of the intakes and associated infrastructure were chosen, in part, because they minimize the disturbance of habitat surrounding the lake and therefore limit the effects on the surrounding upland areas. Measures to avoid or minimize the potential effects to Sprague's Pipit have also been identified as conditions for easements in Sections 4.2.5(2)(f) and (g) where actions are described in accordance with the goals of the Migratory Bird Treaty Act and for the avoidance of high-value habitat are described.

In total, the footprint of disturbance from the three applicants and all seven of the proposed intakes and associated infrastructure (e.g., pipelines, utilities, roads, water depots, retention ponds) would be approximately 90 acres. Of these 90 acres in total, 24 acres would be the footprint of construction of water depots and retention ponds; the area of disturbance for pipelines, utilities, and roads to construct infrastructure from the intakes to the water depots would be approximately 66 acres. Given the extent of previous disturbance along the corridors selected for construction, and the conditions for easements described in Section 4.2.5, effects to Sprague's Pipit habitat from construction within these disturbed upland prairie areas would be possible, but unlikely.

The finding is a determination of may affect, but not likely to adversely affect, the Sprague's Pipit.

7. Cumulative Effects of the Proposed Action

NEPA requires a Federal agency to consider not only the direct and indirect impacts of a proposed action, but also the cumulative impact of the action. A cumulative impact is defined as “*the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions (40 CFR§1508.7).*” Cumulative impacts can result from individually minor, but collectively significant actions taking place over a period of time. These actions include on- or off-site projects conducted by government agencies, businesses, or individuals that are within the spatial and temporal boundaries of the actions considered.

7.1. Effects of Surplus Water Determination

Water supply--while necessary to oil and gas production--is not the limiting factor on the rate of drilling, hydrofracing or the industry’s rate of growth in North Dakota. Rather, the availability of drill rigs and hydrofracing crews are the critical factors limiting the rate at which industry grows within the region. This observation is supported by the growth of drilling and production in 2009-2010 without any Federal action affecting the availability of water by the Corps of Engineers (See Section 6.7). Additions to the supply of water for the industry from surplus water in Lake Sakakawea could affect the location of preferred water sources and how water is distributed and moved within the region, but changes in the rate of growth in the oil and gas industry as a consequence of implementing the Proposed Action, would not be expected.

7.2. Effects of Depletions

As stated the beginning of Section 6, three separate planning scenarios were used to evaluate the magnitude of the predicted environmental effects. The indirect effects were evaluated based on the baseline depletions (No Action) and the 527 acre-feet of depletions at Lake Sakakawea (Proposed Action). In addition, a total of 50,527 acre-feet of depletions (including 527 acre-feet at Lake Sakakawea and 10,000 acre-feet each at the other five system reservoirs) was assessed to evaluate the cumulative effects of removing an additional 10,000 acre-feet of water from each of the other five system reservoirs. This section addresses these cumulative effects to System hydrology.

The source of the actual System inflow data is the U.S. Geological Survey, which began acquiring daily data beginning in late 1929. The DRM adjusts these inflow data by the difference for depletions that have been estimated to occur between each year and 2002. The Bureau of Reclamation provided the monthly depletions, and these monthly data were further separated to daily values for use in the DRM. The 2002 depletion data are assumed to remain constant through 2010 (assumes no change from 2002 to 2010).

Because the Missouri River reservoirs are operated as an integrated system, 527 acre-feet in depletions from Lake Sakakawea and 10,000-acre feet in depletions in each of the other five System reservoirs (total of 50,527-acre feet in depletions) could conceivably reduce releases and water surface elevations throughout all six System reservoirs and the free-flowing reaches of the Missouri River. Reductions in reservoir releases and lake elevations have the potential effect on resources through these reductions in flows and water surface elevations.

In all cases, the differences in the duration plots of the differences in daily values (comparing same day to same day) were relatively the same with only minor increases for the Lake Sakakawea elevation plot. Figures 31, 32, and 33 are the duration plots for the Lake Sakakawea water surface elevations, the Garrison Dam releases, and the Gavins Point Dam releases, respectively, with both the duration difference plots for the GAR100 and CUM10 minus the CC2010 alternatives.

Figure 31
Cumulative Lake Sakakawea WSE Difference Distribution

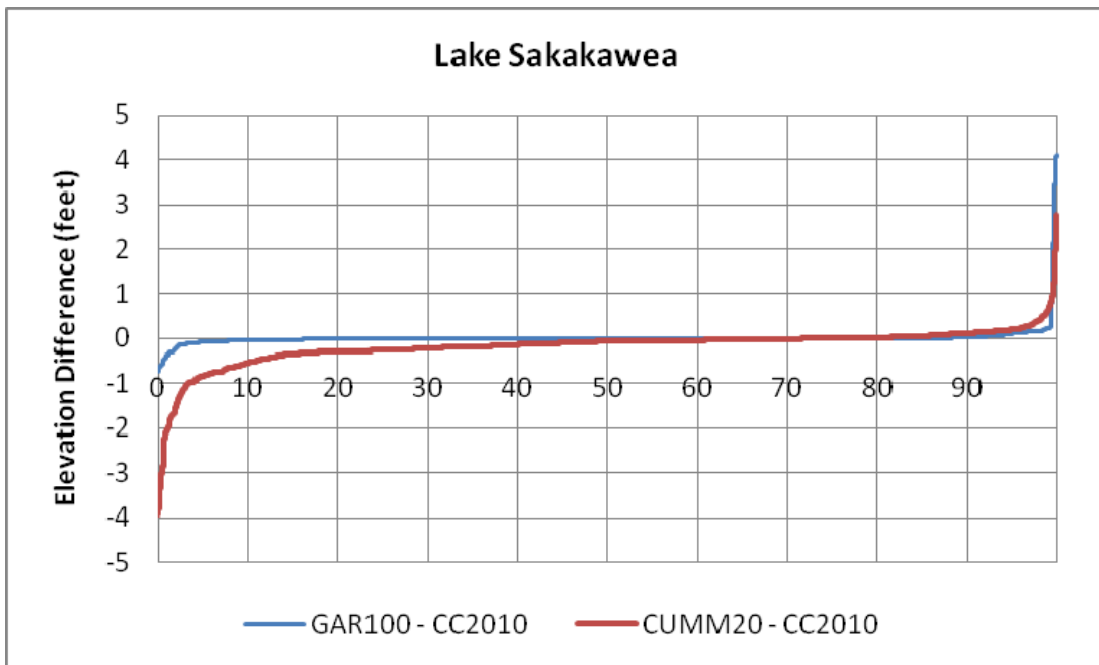


Figure 32
Cumulative Garrison Dam Release Difference Distribution

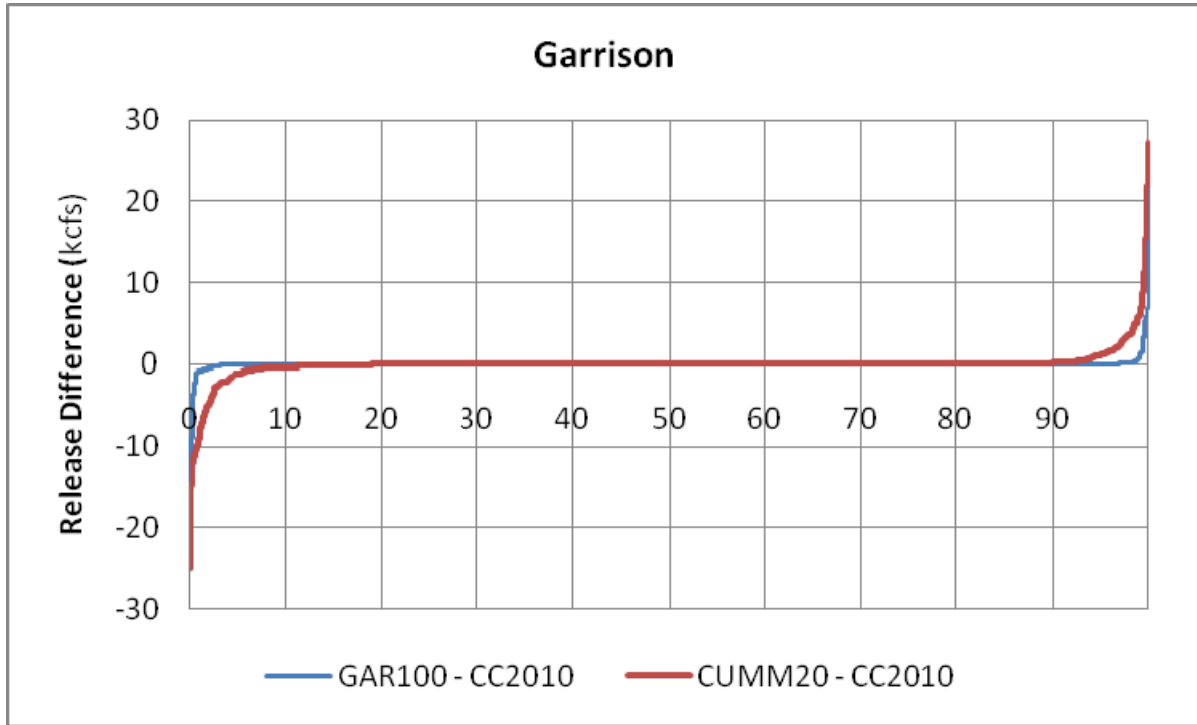
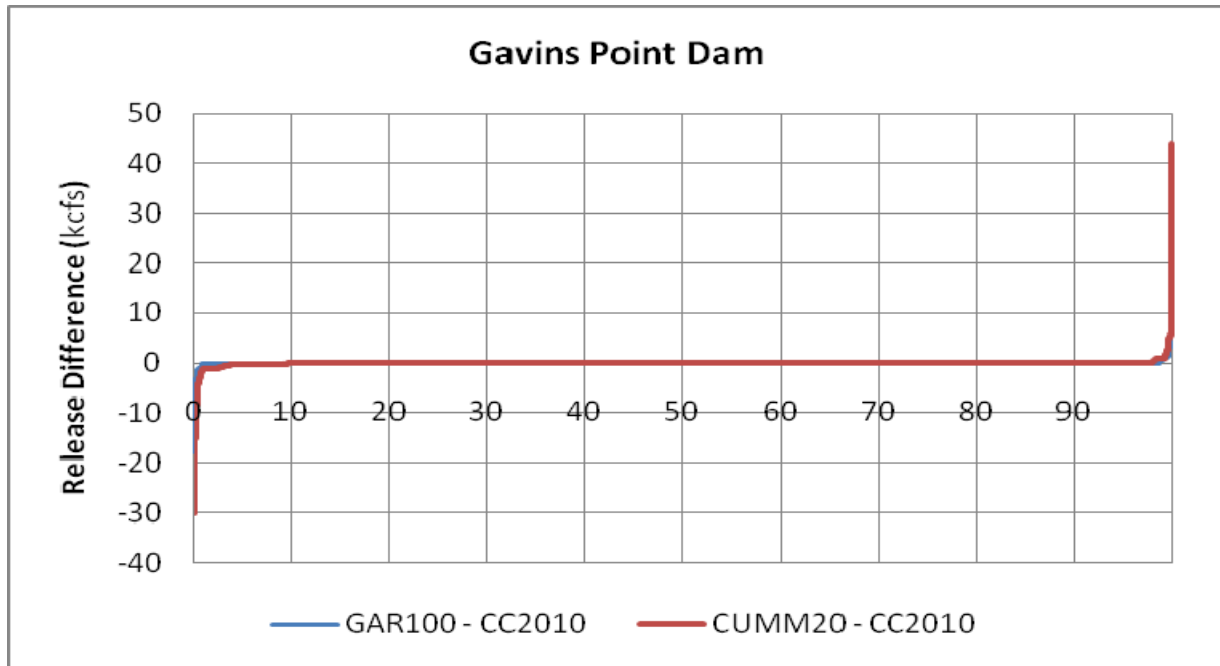


Figure 33
Cumulative Gavins Point Dam Release Difference Distribution



7.3. Cumulative Effects of Improved Water Distribution

A cumulative beneficial effect may be observed as a result of implementing the proposed action with respect to the environmental effects associated with truck traffic. When considering the differences between the Proposed Action and No Action alternative, it is important note that the water moved for the majority of all truck trips associated with the oil and gas industry cannot be transported any other way. The infrastructure for water distribution as well as oil and natural gas piping is not in place nor would it be reasonable to expect the infrastructure any time in the near future.

As stated in Section 4.1, water demand from the oil and gas industry is highly decentralized, with each individual oil producer making their own decision about where to get the water needed to develop their well. Thousands of these discrete decisions are made by scores of oil producers in any given year. It is, therefore, not feasible to model each of these decisions individually to depict the expected decrease in truck miles driven and the expected environmental benefit from closer access to water. However, because the operators are profit-maximizing producers, oil and gas companies would be expected to choose the least costly water source that would provide the required volume and quality of water they need. Section 6.9.2 quantifies the number of truck trips at more than 1,000,000 trips per year. Intake and water depot locations would be more centralized than under the No Action alternative. To the extent that the Proposed Action would allow more efficient access to a dependable and adequate supply of water, it would be reasonable to assume there would be a decrease in the number of miles of truck transportation to distribute water throughout western North Dakota as compared to the No Action alternative. The cumulative effect of this decrease in the number of truck miles driven would include decreased wear on infrastructure (e.g., culverts, roads, bridges), decreased diesel consumption and diesel emissions, decreased fugitive dust, decreased risk of accidents (property damage only, injury only, and fatality accidents), and a decrease in traffic congestion.

8. Compliance with Environmental Laws and Regulations

Making the surplus water determination and the subsequent construction of water intake and distribution infrastructure would not commence until the proposed action achieves environmental compliance with all applicable laws and regulations, as described below. Environmental compliance for the proposed action would be achieved upon coordination of this Environmental Assessment with appropriate agencies, organizations, and individuals for their review and comments.

American Indian Religious Freedom Act (AIRFA) of 1978, 42 U.S.C. 1996.

In compliance.

The American Indian Religious Freedom Act (AIRFA) calls for the U.S. government to respect and protect the rights of Indian tribes to the free exercise of their traditional religions. The courts have interpreted this act as requiring agencies to consider the effects of their actions on traditional religious practices. Federal agencies must make reasonable efforts to ensure religious rights are accommodated. AIRFA does not protect Native American religions beyond the guarantees of the First Amendment. There is no affirmative relief provision under the act. It merely provides that any subsequent federal laws enacted take into consideration religious practices of Native Americans. This project would not adversely affect the protections offered by this Act.

Bald Eagle Protection Act, 16 U.S.C. Sec. 668, 668 note, 668a-668d.

In compliance.

The Bald Eagle Protection Act contains requirements on Corps projects concerning bald eagles. This project would not adversely affect bald eagles or their habitat.

Clean Air Act, as amended, 42 U.S.C. 1857h-7, et seq.

In compliance.

The purpose of this Act is to protect public health and welfare by the control of air pollution at its source, and to set forth primary and secondary National Ambient Air Quality Standards to establish criteria for States to attain, or maintain. Some temporary emission releases may occur during construction activities; however, air quality would not be affected to any measurable degree.

Clean Water Act, as amended, (Federal Water Pollution Control Act) 33 U.S.C. 1251, et seq.

Full compliance.

The objective of this Act is to restore and maintain the chemical, physical and biological integrity of the Nation's waters (33 U.S.C. 1251). The Corps regulates discharges of dredged or fill material into waters of the United States pursuant to Section 404 of the Clean Water Act (33 U.S.C. 1344). This permitting authority applies to all waters of the United States including

navigable waters and wetlands. If a section 404 authorization is required, a section 401 water quality certification from the state in which the discharge originates is also required. The proposed projects consist of the installation of water intakes at various locations on the Lake Sakakawea shoreline including placement construction of the intake structure, pipeline, utility lines for power, access road if necessary, and then the length of pipeline to the water depot or other terminus. If the trenching and utility actions associated with the pump placement result in the discharge of dredged and/or fill material into waters of the United States, these activities may be verified under one or more nationwide permits, provided the activities comply with the terms and conditions of any applicable NWP(s) and result in no more than minimal effects to the aquatic environment. If activities in waters of the U.S. do not meet the terms and conditions of an applicable NWP, an individual permit evaluation would be required. Individual water quality certification may also be required from the North Dakota State Department of Health. If any discharge of pollutants from any point source occurs into waters of the United States, an NPDES permit would be required under Section 402 of the Clean Water Act.

If any activity would require a discharge of fill material into waters of the United States, the Corps Regulatory Branch staff should be provided with either a pre-construction notification consistent with the requirements of the Nationwide Permits, or an individual permit application if the activity would not meet NWP terms and conditions. Project proponents may contact the Regulatory office in Bismarck, ND before preparing this information and the Regulatory staff will provide guidance in the preparation of the appropriate information for regulatory review.

Comprehensive Environmental Response, Compensation, and Liability Act of 1980.

Not applicable.

Typically CERCLA is triggered by (1) the release or substantial threat of a release of a hazardous substance into the environment; or (2) the release or substantial threat of a release of any pollutant or contaminant into the environment that presents an imminent threat to the public health and welfare. To the extent such knowledge is available, 40 CFR Part 373 requires notification of CERCLA hazardous substances in a land transfer. This project would not involve any real estate transactions.

Endangered Species Act, as amended. 16 U.S.C. 1531, et seq.

Full compliance.

Section 7 (16 U.S.C. 1536) states that all Federal departments and agencies shall, in consultation with and with the assistance of the Secretary of the Interior, insure that any actions authorized, funded, or carried out by them do not jeopardize the continued existence of any threatened or endangered (T&E) species, or result in the destruction or adverse modification of habitat of such species which is determined by the Secretary to be critical.

This Environmental Assessment represents the assessment and findings regarding the Proposed Action and serves as the Biological Assessment with a determination of no effect to the Dakota wild buckwheat, Western prairie fringed orchid, the black footed ferret, gray wolf, and the

whooping crane. The findings also allow a determination of not likely to adversely affect the piping plover and their critical habitat, interior least tern, and pallid sturgeon. An email was received on 3 March 2011 from the U.S. Fish and Wildlife service concurring with the Corps' findings that this project would have no effect on or would not likely adversely affect threatened and endangered species.

Environmental Justice (E.O. 12898).

In compliance.

Federal agencies shall make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations in the United States. The project does not disproportionately affect minority or low-income populations.

Farmland Protection Policy Act (Subtitle I of Title XV of the Agriculture and Food Act of 1981), effective August 6, 1984.

Not applicable.

This Act instructs the Department of Agriculture, in cooperation with other departments, agencies, independent commissions and other units of the Federal government, to develop criteria for identifying the effects of Federal programs on the conversion of farmland to nonagricultural uses. No farmland would be adversely impacted by the proposed project.

Federal Water Project Recreation Act, as amended, 16 U.S.C. 460-1(12), et seq.

Not applicable.

The Act establishes the policy that consideration be given to the opportunities for outdoor recreation and fish and wildlife enhancement in the investigating and planning of any Federal navigation, flood control, reclamation, hydroelectric or multi-purpose water resource project, whenever any such project can reasonably serve either or both purposes consistently. There is no opportunity to enhance recreational resources in conjunction with this project.

Fish and Wildlife Coordination Act, as amended, 16 U.S.C. 661, et seq.

In compliance.

The FWCA requires governmental agencies, including the Corps, to coordinate activities so that adverse effects on fish and wildlife would be minimized when water bodies are proposed for modification. Conversations with Jeff Towner of the U.S. Fish and Wildlife Service and Steve Dyke and Bruce Kreft of the North Dakota Game and Fish Department have related no concerns regarding fish and wildlife species. Bruce Kreft provided recommendations for the placement of intakes including: (1) intake screens with a mesh opening of ¼ inch or less shall be installed, inspected annually, and maintained, (2) water velocity at the intake screen shall not exceed ½ foot per second, (3) intakes located in Lake Sakakawea shall be submerged, (4) the intake shall

be placed at least 20 vertical feet below the existing water level, (5) the intake shall be elevated 2 to 4 feet off the bottom, (6) if the 20 foot depth is not attainable, then the intake velocity shall be limited to ¼ foot per second, with intake placed at maximum practicable attainable depth.

These design considerations would protect juvenile and larval fish from entrainment into the water intake. Specific recommendations from these persons during the previous and current activity have prompted the Corps of Engineers to utilize construction methodologies that do not require in-lake dredging or excavation. The recommendations of the USFWS and NDGFD have been considered and were incorporated into the project plans.

Land and Water Conservation Fund Act (LWCFA), as amended, 16 U.S.C. 4601-4601-11, et seq.

Not applicable.

Planning for recreation development at Corps projects is coordinated with the appropriate states so that the plans are consistent with public needs as identified in the State Comprehensive Outdoor Recreation Plan (SCORP). The Corps must coordinate with the National Park Service (NPS) to insure that no property acquired or developed with assistance from this Act will be converted to other than outdoor recreation uses. If conversion is necessary, approval of NPS is required, and plans are developed to relocate or re-create affected recreational opportunities. No lands involved in the proposed project were acquired or developed with LWCFA funds.

Migratory Bird Treaty Act

In compliance.

The Migratory Bird Treaty Act of 1918 (MBTA) is the domestic law that affirms, or implements, the United States' commitment to four international conventions with Canada, Japan, Mexico and Russia for the protection of shared migratory bird resources. The MBTA governs the taking, killing, possession, transportation, and importation of migratory birds, their eggs, parts and nests. The take of all migratory birds is governed by the MBTA's regulation of taking migratory birds for educational, scientific, and recreational purposes and requiring harvest to be limited to levels that prevent over utilization. Executive Order 13186 (2001) directs executive agencies to take certain actions to implement the act. The Corps will be in consultation with the USFWS with regard to this activity's potential effects on migratory birds.

National Historic Preservation Act, as amended, 16 U.S.C. 470a, et seq.

Partial compliance.

Federal agencies having direct or indirect jurisdiction over a proposed Federal or federally assisted undertaking would take into account the effect of the undertaking on any district, site, building, structure, or object that is included in or eligible for inclusion in the National Register of Historic Places. Discussions between the Corps and North Dakota SHPO are ongoing, and final coordination with regard to this law would be completed before construction. Discussion is included in the EA with respect to the requirements to this law. The Corps has made the determination that the proposed project does not have the potential to adversely impact cultural

resource and SHPO concurrence is expected. Caution will be exercised during all phases of work in order to minimize any disturbance to deeply buried cultural resources. The contractor would be explicitly warned about this possibility and instructed that if any resources are found, they should stop work and contact the District Office immediately.

National Environmental Policy Act (NEPA), as amended, 42 U.S.C. 4321, et seq.

In compliance.

This environmental assessment (EA) has been prepared in accordance with the Council on Environmental Quality's NEPA Implementing Regulations (40 CFR 1508.9)..

1990 - Native American Graves Protection and Repatriation Act (P.L. 101-601; 25 U.S.C § 3001-13; 104 Stat. 3042)

In Compliance

The Native American Graves Protection and Repatriation Act (NAGPRA) provides for the protection of Native American and Native Hawaiian cultural items. It establishes a process for the authorized removal of human remains, funerary, sacred, and other objects of cultural patrimony from sites located on land owned or controlled by the federal government. NAGPRA requires federal agencies and federally assisted museums to return specified Native American cultural items to the federally recognized Indian tribes or Native Hawaiian groups to which they are associated.

In the event of inadvertent discoveries of human remains, artifacts, and funerary objects, the Corps will follow the terms of the NAGPRA regulations, 43 CFR 10 et seq. and applicable Memoranda of Agreement (MOA) with Tribes.

Noise Control Act of 1972, 42 U.S.C. Sec. 4901 to 4918.

In compliance.

This Act establishes a national policy to promote an environment for all Americans free from noise that jeopardizes their health and welfare. Federal agencies are required to limit noise emissions to within compliance levels. Noise emission levels at the project site would increase above current levels temporarily due to construction and the pumping plant sound levels would not exceed 75 dB at 50 feet. Appropriate measures would be taken to keep the noise level within the compliance levels.

North American Wetlands Conservation Act, 16 U.S. C. Sec. 4401 et. seq.

Not applicable.

This Act establishes the North American Wetlands Conservation Council (16 U.S.C.4403) (NAWCC) to recommend wetlands conservation projects to the Migratory Bird Conservation Commission (MBCC). Section 9 of the Act (16 U.S.C. 4408) addresses the restoration, management, and protection of wetlands and habitat for migratory birds on Federal lands.

Federal agencies acquiring, managing, or disposing of Federal lands and waters are to cooperate with the Fish and Wildlife Service to restore, protect, and enhance wetland ecosystems and other habitats for migratory birds, fish and wildlife on their lands, to the extent consistent with their missions and statutory authorities. There will be no disposal of land with this project.

Section 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. 403)

In compliance.

This law prohibits the unauthorized obstruction or alteration of any navigable water of the United States. This section provides that the construction of any structure in, over or under any navigable water of the United States, or the accomplishment of any other work affecting the course, location, condition, or physical capacity of such waters is unlawful unless the work has been recommended by the Chief of Engineers and authorized by the Secretary of the Army. The Secretary's approval authority has since been delegated to the Chief of Engineers. Lake Sakakawea is considered a "navigable water of the United States, and placement of intakes will need to involve coordination with the North Dakota Regulatory office for a Section 10 permit.

Watershed Protection and Flood Prevention Act, 16 U.S.C. 1101, et seq.

Not applicable.

This Act authorizes the Secretary of Agriculture to cooperate with states and other public agencies in works for flood prevention and soil conservation, as well as the conservation, development, utilization, and disposal of water. This act imposes no requirements on Corps Civil Works projects.

Flood plain Management (E.O. 11988).

In compliance.

Section 1 requires each agency to provide leadership and take action to reduce the risk of flood loss, to minimize the impact of floods on human safety, health and welfare, and to restore and preserve the natural and beneficial values served by flood plains in carrying out its responsibilities for (1) acquiring, managing, and disposing of Federal lands and facilities; (2) providing Federally undertaken, financed, or assisted construction and improvements; and (3) conducting Federal activities and programs affecting land use, including but not limited to water and related land resources planning, regulating, and licensing activities. The proposed project would not affect the flood holding capacity or flood surface profiles of any stream. Spoil material from construction would not be placed within any floodway or within any regulating portion of the reservoir.

Protection of Wetlands (E.O. 11990).

In compliance.

Federal agencies shall take action to minimize the destruction, loss or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands in carrying out the

agencies responsibilities. Each agency, to the extent permitted by law, shall avoid undertaking or providing assistance for new construction located in wetlands unless the head of the agency finds (1) that there is no practicable alternative to such construction, and (2) that the proposed action includes all practicable measures to minimize harm to wetlands, which may result from such use. In making this finding the head of the agency may take into account economic, environmental and other pertinent factors. Each agency shall also provide opportunity for early public review of any plans or proposals for new construction in wetlands. The nationwide permits planned for use in this project have already undergone public and agency review.

CEO Memorandum, August 10, 1980, Interagency Consultation to Avoid or Mitigate Adverse Effects on Rivers In the Nationwide Inventory.

Not applicable.

This memorandum states that each Federal agency shall take care to avoid or mitigate adverse effects on rivers identified in the Nationwide Inventory (FR 1980). No portion of Lake Sakakawea is listed on the Nationwide Rivers Inventory.

Wild and Scenic Rivers Act, as amended, 16 U.S.C. 1271, et sq.

In compliance.

This act establishes that certain rivers of the Nation, with their immediate environments, possess outstandingly remarkable scenic, recreational, geologic, fish and wildlife, historic, cultural, or other similar values, shall be preserved in free-flowing condition, and that they and their immediate environments shall be protected for the benefit and enjoyment of present and future generations. The area in which the direct effects of the proposed activity would occur is not designated as a wild or scenic river, nor is it on the National Inventory of Rivers potentially eligible for inclusion. The downstream indirect effects of the proposed action would be indiscernible from existing conditions within segments of the Missouri River designated as Wild and Scenic Rivers.

9. Summary of Environmental Effects

Because of the small magnitude of the predicted changes to discharges and water surface elevations of Lake Sakakawea, the remaining five System reservoirs, and the riverine reaches of the Upper Missouri River as a result of the Proposed Action, the following environmental resources would not be expected to have any measurable change over the existing condition: soils, groundwater, water quality (including cold water habitat fishery of Lake Sakakawea), air quality, demographics, socioeconomics, environmental justice, recreation, aesthetics, noise, cultural resources, vegetation/terrestrial habitat and listed plants, fish and wildlife and listed animals. In addition, there would be no effects to project purposes anticipated (See Section 3.7.1 of the Surplus Water Report - Volume 1).

The expected impacts of conventional excavation and directional drilling include temporary and minor land disturbance for utility line infrastructure installation and permanent loss of habitat for road installation. The areas identified for use to construct the proposed water depots, retention ponds, pipelines, utilities, and road construction, were selected because they had been previously utilized by motor vehicles (either with actual roads or primitive two-track trails) or were already utility corridors. The methods selected for the construction of the intakes and associated infrastructure were chosen, in part, because they minimize the disturbance of riparian, wetland, and shoreline areas surrounding the lake and therefore limit the effects on the terrestrial and aquatic environment to the upland areas. Site-specific habitat effects any future applications for intakes would likely be constructed in similar locations.

In total, the footprint of disturbance from the three applicants and all seven of the proposed intakes and associated infrastructure (e.g., pipelines, utilities, roads, water depots, retention ponds) would be approximately 90 acres of disturbed upland prairie habitat. Of these 90 acres, 24 acres would be the footprint of construction of water depots and retention ponds and the remainder would be for pipelines, utilities, and roads to construct infrastructure from the intakes (approximately 66 acres).

Localized and temporary construction-related effects (diesel emissions, noise, fugitive dust, minor earth-moving) would be expected to construct new intake infrastructure. The planning and execution of water intake construction on Lake Sakakawea has been a routine practice. Sound planning methods, including the easement applicant's coordination with resource agencies and Corps of Engineering Regulatory, and Garrison Project staff has been successful in avoiding the significant environmental and cultural resources of Lake Sakakawea. These practices of good planning, coordinated project reviews, and close regulatory and resource agency oversight would continue to the applications reviewed in detail within this EA as well as any future applicants. No significant effects would be expected in association with intake, transfer pipe, utility, roadway, or depot/retention pond construction and operation.

An increase in localized truck traffic (on water intake access roads) would be expected leading to/from new water depots; however, these intakes are in remote locations and are not in close proximity to municipalities. As a consequence of having sources of water closer to the areas needed for the oil and gas industry, there would likely be a cumulative beneficial effect from the concomitant decrease in total truck miles traveled for the water supply aspect of the oil/gas industry throughout the region. Industry practices routinely require water trucks to drive in

excess of 100 miles one way to obtain the necessary water. Implementing the Proposed Action would not change the number of trips needed, but would decrease the total miles traveled.

This Environmental Assessment represents the assessment and findings regarding the Proposed Action and serves as the Biological Assessment with a determination of no effect to the Dakota wild buckwheat, Western prairie fringed orchid, black footed ferret, gray wolf, and the whooping crane, as well as a determination of not likely to adversely affect the Dakota skipper. The EA also serves as the basis for a determination of not likely to adversely affect or adversely modify the critical habitat to the piping plover, interior least tern, and pallid sturgeon.

The expected environmental consequences of implementing the three different actions identified as the Proposed Action (below), would not be expected to be significant and would not require the preparation of an Environmental Impact Statement.

1. Identify surplus water storage, as defined in Section 6 of the 1944 Flood Control Act, which the Secretary of the Army can make available to execute surplus water supply agreements with prospective M&I water users for up to of up to 100,000 acre-feet of yield (257,000 acre-feet of storage) of water from Lake Sakakawea,
2. Execute surplus water supply agreements with the three applicants and grant them new water supply easements and, and
3. Execute surplus water supply agreements with holders of current easements for existing water intakes at Lake Sakakawea.

10. Coordination, Consultation, and List of Preparers

10.1. List of Agencies and Persons Consulted

In early September 2010, a letter was sent to Governors, state agencies and Tribes formally notifying them of the intent to undertake the surplus water study and inviting their representation at an informational meeting on 29 September 2010 in Bismarck, ND. The Governors included in the correspondence were: Honorable Dave Heineman, Governor of Nebraska; Honorable Brian Schweitzer, Governor of Montana, Montana State Capitol Building; Honorable Mike Rounds, Governor of South Dakota; Honorable John Hoeven; Governor of North Dakota; Honorable Chet Culver, Governor of Iowa; Honorable Jay Nixon; Governor of Missouri; and Honorable Mark Parkinson, Governor of Kansas. An example copy of one of these letters is attached in Appendix B.

A similar letter was provided to the following list of state agencies, tribes, and resource agencies similarly requesting participation in the 29 September 2010 meeting in Bismarck, ND.

A letter was also provided to each of the tribes on 24 August 2010 informing them of the intent to prepare the surplus water report and EA.

Agencies

Bureau of Reclamation, Dakotas Area Office, 304 East Broadway Ave., Bismarck, ND 5850

Natural Resources Conservation Service, Federal Building, Room 270, Bismarck, ND 58501

U.S. Army Corps of Engineers, North Dakota State Regulatory Office – Bismarck, ND 58504

Bureau of Land Management, North Dakota Field Office, Dickinson, ND 58601

USDA Forest Service, McKenzie Ranger District, 1901 South Main Street, Watford City, ND

David Valenzuela

U.S. Fish and Wildlife, Ecological Services, Bismarck, ND 58501

USGS North Dakota Water Science Center, Bismarck, North Dakota 58503

EPA Region 8 (8EPR-N), Denver, CO 80202-1129

North Dakota Public Service Commission, Bismarck, ND 58505-0480

Federal Highway Administration, Bismarck, ND 58503-0567

Bureau of Indian Affairs, Fort Berthold Agency PO Box 370 New Town, ND 58763

Howard Bemer – Fort Berthold Superintendent

Bureau of Indian Affairs, Regional Director, Aberdeen, SD 57401

Alice Harwood

North Dakota Game and Fish, Bismarck, ND 58501-5095

North Dakota Department of Health, Environmental Health Section, Bismarck, ND 58501-

North Dakota State Water Commission, Bismarck, ND 58505-0850

North Dakota Department of Transportation, Bismarck, ND 58505-0700

North Dakota State Historical Society, Bismarck, ND 58505

North Dakota Indian Affairs Commission, State Capitol Building, Bismarck, ND 58505

North Dakota Geological Survey, Bismarck ND 58505-0840

North Dakota Parks & Recreation Department, Bismarck, ND 58503

North Dakota Petroleum Council, Bismarck, ND 58502-1395

North Dakota Industrial Commission, Bismarck, ND 58501

Tribes

Three Affiliated Tribes, 404 Frontage Rd., New Town, ND 58763

Chairman Marcus D. Levings, Jr

Mr. Elgin Crows Breast

Tribal Historic Preservation Officer Perry "No Tears" Brady

Cheyenne River Sioux Tribe, Eagle Butte, South Dakota 57625

Chairman Joseph Brings Plenty

Tribal Councilman Robert Walters

Cultural Preservation Officer Donna Rae Peterson

Assiniboine and Sioux Tribes of Fort Peck, Poplar, Montana 59255

Chairman A.T. Stafne

Director Cultural Resource Department, Curley Youpee

Water Resources Department, Carl Fourstar

Santee Sioux Nation, Santee, Nebraska 68760

Chairman Roger Trudell

Environmental Specialist Felix Kitto

Turtle Mountain Band of Chippewa, Belcourt, North Dakota 58316

Chairman Richard Marcellais

Tribal Historic Preservation Officer Brady Grant

Lower Brule Sioux Tribe, Lower Brule, South Dakota 57548-0187

Chairman Michael Jandreau

Public Relations/Cultural Preservation Office, Clair S. Green

- Ponca Tribe of Nebraska, Niobrara, Nebraska 68760
Chairperson Larry Wright, Jr.
Director of Cultural Affairs, Gary Robinette
- Crow Creek Sioux Tribe, Fort Thompson, South Dakota 57339-0050
Chairman Duane Big Eagle
Tribal Government Liaison Wanda Wells
Tribal Council Member Kitty Wells
- Northern Cheyenne Tribe, Lame Deer, Montana 59043
President Leroy Spang
Tribal Historic Preservation Officer Linwood Tallbull
- Flandreau Santee Sioux Tribe, Flandreau, South Dakota 57028
President Joshua Weston
Cultural Preservation Officer Sam Allen
- Northern Arapaho Tribe, Fort Washakie, Wyoming 82514
Chairman Harvey Spoonhunter
Tribal Historic Preservation Officer Jo Ann White
- Eastern Shoshone Tribe, Fort Washakie, Wyoming 82514
Chairman Ivan D. Posey
- Sisseton-Wahpeton Sioux Tribe, Agency Village, South Dakota 57262-0509
Chairman Michael Selvage, Sr.
Tribal Historic Preservation Officer Dianne Desrosiers
- Winnebago Tribe of Nebraska, Winnebago, Nebraska 68071-0687
Chairman John Blackhawk
Tribal Council Member Darwin Snyder
- Sac and Fox Nation of Missouri in Kansas and Nebraska, Reserve, Kansas 66434
Chairperson Twen Barton
- Chippewa Cree Tribe of the Rocky Boys' Reservation, Box Elder, Montana 59521-9724
Chairman Jake Parker
Tribal Historic Preservation Officer Alvin Windy Boy
- Spirit Lake Sioux Tribe, Fort Totten, North Dakota 58335
Chairperson Myra Pearson
- Rosebud Sioux Tribe, Rosebud, South Dakota 57570-0430
President Rodney M. Bordeaux
Tribal Historic Preservation Officer Russell Eagle Bear
- Oglala Sioux Tribe, Pine Ridge, South Dakota 57770
President Theresa Two Bulls
- Blackfeet Tribe, Browning, Montana 59417
Chairman Willie A. Sharp, Jr
Tribal Historic Preservation Officer John Murray
- Gros Ventre and Assiniboine Tribes, Harlem, Montana 59526-9705

President Tracey King

Standing Rock Sioux Tribe, Fort Yates, North Dakota 58538
Chairman Charlie Murphy
Environmental Protection Specialist Adrienne Swallow
Tribal Historic Preservation Officer Waste' Win Young

Yankton Sioux Tribe, Marty, South Dakota 57361
Chairman Robert Cournoyer
Tribal Historic Preservation Officer Lana Gravatt
Business and Claims Member Baptiste Coumoyer
Business and Claims Member Myron Turner

Crow Nation, Crow Agency, Montana 59022
Chairman Cedric Black Eagle
Tribal Historic Preservation Officer Dale Old Horn

Sac and Fox Nation of Oklahoma, Stroud, Oklahoma 74079
Ms. Sandra Massey

Omaha Tribe of Nebraska, Macy, Nebraska 68039-0368
Chairman Amen Sheridan
Mr. Tony Provost

On 17 December 2010 notified letter was sent to Governors, state agencies and Tribes formally notifying them of the availability of the draft surplus water report and EA for comment. The Governors included in the correspondence were: Honorable Dave Heineman, Governor of Nebraska; Honorable Brian Schweitzer, Governor of Montana, Montana State Capitol Building; Honorable Mike Rounds, Governor of South Dakota; Honorable John Hoeven; Governor of North Dakota; Honorable Chet Culver, Governor of Iowa; Honorable Jay Nixon; Governor of Missouri; and Honorable Mark Parkinson, Governor of Kansas.

A letter was provided to the following list of state agencies, tribes, and resource agencies similarly requesting review and comment.

Agencies

Bureau of Reclamation, Dakotas Area Office, Bismarck, ND 5850

Natural Resources Conservation Service, Federal Building, Bismarck, ND 58501

U.S. Army Corps of Engineers, North Dakota State Regulatory Office – Bismarck, ND 58504

Bureau of Land Management, North Dakota Field Office, Dickinson, ND 58601

USDA Forest Service, McKenzie Ranger District, Watford City, ND

U.S. Fish and Wildlife, Ecological Services, Bismarck, ND 58501

USGS North Dakota Water Science Center, Bismarck, North Dakota 58503

EPA Region 8 (8EPR-N), Denver, CO 80202-1129

North Dakota Public Service Commission, Bismarck, ND 58505-0480

Federal Highway Administration, Bismarck, ND 58503-0567

Bureau of Indian Affairs, Fort Berthold Agency, New Town, ND 58763

Bureau of Indian Affairs, Regional Director, Aberdeen, SD 57401

North Dakota Game and Fish, Bismarck, ND 58501-5095

North Dakota Department of Health, Environmental Health Section, Bismarck, ND 58501-

North Dakota State Water Commission, Bismarck, ND 58505-0850

North Dakota Department of Transportation, Bismarck, ND 58505-0700

North Dakota State Historical Society, Bismarck, ND 58505

North Dakota Indian Affairs Commission, State Capitol Building, Bismarck, ND 58505

North Dakota Geological Survey, Bismarck ND 58505-0840

North Dakota Parks & Recreation Department, Bismarck, ND 58503

North Dakota Petroleum Council, Bismarck, ND 58502-1395

North Dakota Industrial Commission, Bismarck, ND 58501

Advisory Council for Historic Preservation, Washington, DC 20004-2501

Nebraska State Historical Society, Crawford, Nebraska 69339

South Dakota Department of Game, Fish and Parks, Pierre, South Dakota 57501-3182

South Dakota State Historical Society, Pierre, South Dakota 57501-2217

Montana State Historic Preservation Office, Helena, Montana 59620-1202

National Trust for Historic Preservation, Denver, Colorado 80202

Western Area Power Administration, Billings, MT 59107

Tribes

Three Affiliated Tribes, 404 Frontage Rd., New Town, ND 58763
Chairman Tex Hall
Tribal Energy Department Administrator Fred Fox
Natural Resource Administrator Annette Young Bird
Tribal Historic Preservation Officer Perry "No Tears" Brady

- Cheyenne River Sioux Tribe, Eagle Butte, South Dakota 57625
Chairman Kevin Keckler
Tribal Councilman Robert Walters
Cultural Preservation Officer Donna Rae Peterson
- Assiniboine and Sioux Tribes of Fort Peck, Poplar, Montana 59255
Chairman A.T. Stafne
Director Cultural Resource Department, Curley Youpee
- Santee Sioux Nation, Santee, Nebraska 68760
Chairman Roger Trudell
Environmental Specialist Felix Kitto
- Turtle Mountain Band of Chippewa, Belcourt, North Dakota 58316
Chairman Merle St. Claire
Tribal Historic Preservation Officer Kade Ferris
- Lower Brule Sioux Tribe, Lower Brule, South Dakota 57548-0187
Chairman Michael Jandreau
Public Relations/Cultural Preservation Office, Clair S. Green
- Ponca Tribe of Nebraska, Niobrara, Nebraska 68760
Chairperson Rebecca White
Director of Cultural Affairs, Gary Robinette
- Crow Creek Sioux Tribe, Fort Thompson, South Dakota 57339-0050
Chairman Duane Big Eagle
Tribal Government Liaison Wanda Wells
Tribal Council Member Kitty Wells
- Northern Cheyenne Tribe, Lame Deer, Montana 59043
President Leroy Spang
Tribal Historic Preservation Officer Linwood Tallbull
- Flandreau Santee Sioux Tribe, Flandreau, South Dakota 57028
President Anthony Reider
Cultural Preservation Officer Sam Allen
- Northern Arapaho Tribe, Fort Washakie, Wyoming 82514
Chairman Harvey Spoonhunter
Tribal Historic Preservation Officer Jo Ann White
- Eastern Shoshone Tribe, Fort Washakie, Wyoming 82514
Chairman Ivan D. Posey
- Sisseton-Wahpeton Sioux Tribe, Agency Village, South Dakota 57262-0509
Chairman Robert Shepherd
Tribal Historic Preservation Officer Dianne Desrosiers
- Winnebago Tribe of Nebraska, Winnebago, Nebraska 68071-0687
Chairman John Blackhawk
Tribal Council Member Darwin Snyder
- Sac and Fox Nation of Missouri in Kansas and Nebraska, Reserve, Kansas 66434

Chairperson Twen Barton

Chippewa Cree Tribe of the Rocky Boys' Reservation, Box Elder, Montana 59521-9724

Chairman Jake Parker

Tribal Historic Preservation Officer Alvin Windy Boy

Spirit Lake Sioux Tribe, Fort Totten, North Dakota 58335

Chairperson Myra Pearson

Rosebud Sioux Tribe, Rosebud, South Dakota 57570-0430

President Rodney M. Bordeaux

Tribal Historic Preservation Officer Russell Eagle Bear

Oglala Sioux Tribe, Pine Ridge, South Dakota 57770

President John Yellow Bird Steele

Blackfeet Tribe, Browning, Montana 59417

Chairman Willie A. Sharp, Jr

Tribal Historic Preservation Officer John Murray

Gros Ventre and Assiniboine Tribes, Harlem, Montana 59526-9705

President Tracey King

Standing Rock Sioux Tribe, Fort Yates, North Dakota 58538

Chairman Charlie Murphy

Environmental Protection Specialist Adrienne Swallow

Tribal Historic Preservation Officer Waste' Win Young

Yankton Sioux Tribe, Marty, South Dakota 57361

Chairman Robert Cournoyer

Tribal Historic Preservation Officer Lana Gravatt

Business and Claims Member Baptiste Coumoyer

Business and Claims Member Myron Turner

Crow Nation, Crow Agency, Montana 59022

Chairman Cedric Black Eagle

Tribal Historic Preservation Officer Dale Old Horn

Sac and Fox Nation of Oklahoma, Stroud, Oklahoma 74079

Ms. Sandra Massey

Omaha Tribe of Nebraska, Macy, Nebraska 68039-0368

Chairman Amen Sheridan

Mr. Tony Provost

On 20 January 2011 a letter was sent to the North Dakota State Historical Society asking for concurrence on impacts to cultural resources in compliance with Section 106.

On 8 February 2011, in response to a comment received by Standing Rock Sioux Tribe that they had not received sufficient consultation opportunities, a letter containing more specific details of the seven intake locations was provided with a request that comments or concerns be forwarded by 11 March 2011.

On 14 February a letter was received from the Standing Rock Sioux Tribal Historic Preservation Officer (THPO) sharing several concerns and requesting more information. In response, a letter, dated 2 March was sent that addressed the concerns and provided the requested information.

On 21 March the Corps sent a letter to the North Dakota State Historical Society asking for concurrence with the “No Historic Properties Affected” determination on temporarily making surplus water available for municipal and industrial water supply and the “Ho Historic Properties Affected” for the seven intake easements documented in this Surplus Water Report. This letter was furnished to the programmatic agreement distribution list, which includes both signatory and non-signatory tribes.

10.2. Summary of 29 September 2010 Agency Meeting, Bismarck, ND

On 29 September 2010, the Corps of Engineers hosted an Agency Coordination Meeting at the North Dakota State Water Commission’s offices in Bismarck, ND. The purpose of the meeting was two-fold: to share information between the Corps of Engineers and the state/federal agencies and to receive input from the respective agencies regarding their concerns. The meeting was held to ensure transparency and understanding of current Corps of Engineers Surplus Water Supply Studies that are currently under way, with specific focus on Lake Sakakawea. Agencies and individuals that were in attendance at the meeting are listed below.

<u>Agency</u>	<u>Individual</u>
U.S. Department of the Interior-Bureau of Reclamation	Alicia Waters
U.S. Department of the Interior-Bureau of Reclamation	Greg Gere
U. S. Fish and Wildlife Service	Jeff Towner
U.S. Army Corps of Engineers-Regulatory Office	Toni Erhardt
U.S. Army Corps of Engineers-Omaha District	Tiffany Vanosdall
U.S. Army Corps of Engineers-Omaha District	Eric Laux
U.S. Bureau of Indian Affairs	Marietta Shortbull
N.D. Department of Agriculture	Jennifer Verleger
N.D. Industrial Commission-Mineral Resources-Oil & Gas Division	Bruce Hicks
N.D. State Water Commission	Todd Sando
N.D. State Water Commission	Robert White
N.D. State Water Commission	Dan Farrell
N.D. State Water Commission	William Schuh
N.D. State Water Commission	Kelly Casteel
N.D. State Water Commission	Patrick Fridgen
N.D. State Water Commission	Michelle Klose
N.D. State Water Commission	Tim Freije
N.D. State Water Commission	Bob Shaver
N.D. State Water Commission	Michael Hove
N.D. State Historic Preservation Office	Paul Picha
N.D. State Historic Preservation Office	Susan Quinnill
N.D. Game & Fish Department	Steve Dyke
N.D. Governor’s Office	Andrea Travnicsek
N.D. Governor’s Office	Jason Nisbet
N.D. Parks and Recreation Division	Kathy Duttenhefner

S.D. Department of Environment and Natural Resources

Mark Rath

At the conclusion of the briefing provided by the Corps of Engineers, Eric Laux requested that each agency have an opportunity to alert the Corps of Engineers to any concerns they had and provide additional information for the study and analyses. Individual comments are indicated below.

- Jeff Towner of the USFWS stated that, if there were measurable effects from the proposed depletions, they would probably lead to beneficial effects to interior least tern and piping plovers because of a potential increase in shoreline nesting area,
- Paul Picha of the SHPO's office encourage the Corps of Engineers to make sure the purpose and need was concise and focused,
- Steve Dyke of the ND Game and Fish Department stated that his agency was working on a list of recommended conditions for easements and intakes into Lake Sakakawea and offered to provide the results of the planning effort,
- Kathy Duttonhefner of the N.D. State Parks and Recreation Division indicated that they would be very interested in seeing the potential changes in water surface elevation predicted because of the proposed depletions and their potential effects to marinas within their three state parks, and
- Bruce Hicks of the N.D. Industrial Commission, Department of Mineral Resources, Oil and Gas Division stated that:
 - One inch of water on the surface of Lake Sakakawea would provide sufficient water for 5,000 wells,
 - Lake Sakakawea water does not need to go through treatment plants as it can be taken from the intakes and used,
 - That there is some seasonality to demand, but not significant, as progress would slow when severely cold, but operators heat the water needed to keep operations going, and
 - Water was not controlling to the growth of the oil and gas industry in North Dakota. He offered to provide additional information to that effect.

10.3. Additional Persons Consulted

<u>NAME</u>	<u>AFFILIATION</u>
Rodney Aman	Missouri Basin Well Services
Chris Anderson	Western Company
Chris Bader	North Dakota State Water Commission, Director of Information Technology
Wayne Biberdorf	North Dakota Petroleum Counsel's Water Committee Subgroup
Mark Bohrer	North Dakota Industrial Commission Department of Mineral Resources Oil and Gas Division, UIC Manager/Spill and Statistical Coordinator
Don Canton	North Dakota Industrial Commission, Communications Director and Policy Advisor
Darrell Casteel	Element Solutions
Alan Johnson	Ward Williston Oil Company
John Harju	Energy & Environment Research Center, Associate Director for Research
Jerome Helm	Badland Powerfuels
Lynn Helms	North Dakota Industrial Commission Department of Mineral Resources Oil and Gas Division, Director
Bruce Hicks	North Dakota Industrial Commission Department of Mineral Resources Oil and Gas Division, Assistant Director
Mike Hove	North Dakota State Water Commission, Water Appropriations
Dave Hvinden	North Dakota Industrial Commission, Oil and Gas Division, Executive Staff Officer
Stephanie Jones	U.S. Fish and Wildlife Service, Region 6, Nongame Migratory Bird Coordinator
Nathan Kirby	North Dakota Industrial Commission, Oil and Gas Division, Engineering Technologist
Bob Kline	International Western Company, Inc.
Bethany Kurz	Energy & Environment Research Center
Megan Nelson	Badland Powerfuels
Jason Petryszyn	Swenson, Hagen, & Co.
Bob Shaver	North Dakota State Water Commission, Water Appropriations
Dan Stepan	Energy & Environment Research Center
Al Wanek	North Dakota State Water Commission

10.4. Public Participation

A public comment period was scheduled from 16 December 2010 through 17 January 2011. In response to several requests for additional review time, a fifteen day extension was granted and comments were collected through 1 February 2011. A public meeting was held on 6 January 2011 in Bismarck, ND.

Over 75 comment letters totaling more than 400 pages were received from States, Agencies, Tribes and individuals (see Appendix B). A matrix that categorizes each commenter's concerns is shown in Table 16. In general there were 34 categories of concern in the comments that were received. These categories were further reviewed and it was determined that the concerns fell into themes. Nine themes resulted from this review and are as follows: hydropower, water rights, cost, irrigation, NEPA, tribal consultation, cultural resources, municipal & industrial water supply, and other. To provide structure, thematic responses to comments were developed and are provided in Table 17. This table illustrates how a majority of the comments were addressed.

Each comment was carefully considered and several resulted in revisions to the document. Revisions to the report as a result of the public comments were principally intended to provide additional clarity and did not ultimately affect the determination that surplus water is available or the determination that there are no significant environmental impacts associated with implementing the proposed action. Comments that are not addressed in Table 17 were considered, but determined to be either outside the scope of this study or they would not have an impact on the decision being made.

Table 16
Thematic Comment Matrix

Thematic Response Category ²⁹	H	W R	W S	C	C	I	N	N	TC	CR	N	N	N	W R	W S	W S	W R	W S	N	O	C	W S	O	N	O	N	H	N	W S	O	O	O	O	O
Concern	Hydropower	Water Rights	Authority	Pricing/Charge	Demand Analysis	Irrigation	No Action Alternative	Alternative Analysis	Consultation	Impacts to Cultural Resources	Cumulative Impacts	Oil and Gas/Hydrofracing	Depletions Analysis	Temporary vs. Permanent Use	Inappropriate Use of Section 6	Surplus Water Availability/Location	Natural Flows	Insufficient Account of Existing Users	EIS Needed	MRAPS	Downstream Use	Need for Contracts	Intakes	Environmental Justice	System Operation	Water Quality	Economic Impacts/Benefits	Fish and Wildlife	Compliance with Law	Insufficient Time to Comment	Comment Period (Extension)	Request for Information	No Comment	Other
1	IA Dept Ag – 7 Jan										X	X																			X			
2	MO AG–22 Dec																														X			
3	MO AG – 11 Jan																															X		
4	MO AG – 31 Jan		X				X				X	X	X	X	X			X											X					
5	MO DNR – 3 Jan																															X		
6	MO DNR – 28 Jan	X		X	X		X				X	X	X	X	X			X	X															X

²⁹ See end of this section for definition of thematic response categories

Table 16
Thematic Comment Matrix

Thematic Response Category ²⁹	H	W R	W S	C	C	I	N	N	TC	CR	N	N	N	W R	W S	W S	W R	W S	N	O	C	W S	O	N	O	N	H	N	W S	O	O	O	O	O	
Concern	Hydropower	Water Rights	Authority	Pricing/Charge	Demand Analysis	Irrigation	No Action Alternative	Alternative Analysis	Consultation	Impacts to Cultural Resources	Cumulative Impacts	Oil and Gas/Hydrofracing	Depletions Analysis	Temporary vs. Permanent Use	Inappropriate Use of Section 6	Surplus Water Availability/Location	Natural Flows	Insufficient Account of Existing Users	EIS Needed	MRAPS	Downstream Use	Need for Contracts	Intakes	Environmental Justice	System Operation	Water Quality	Economic Impacts/Benefits	Fish and Wildlife	Compliance with Law	Insufficient Time to Comment	Comment Period (Extension)	Request for Information	No Comment	Other	
7	Gov Schweitzer – 1 Feb		X	X										X	X	X						X													
8	NE AG– 1 Feb				X		X				X	X	X	X	X					X															X
9	NE DNR – 3 Jan																													X					
10	NE DNR – 31 Jan						X				X		X	X																					
11	City of Fargo (Mayor Walaker) – 27 Jan			X																															
12	City of Grand Forks – 24 Jan			X												X					X														
13	County of Burleigh – 27 Jan			X																	X	X													

Table 16
Thematic Comment Matrix

Thematic Response Category ²⁹	H	W R	W S	C	C	I	N	N	TC	CR	N	N	N	W R	W S	W S	W R	W S	N	O	C	W S	O	N	O	N	H	N	W S	O	O	O	O	O	
Concern	Hydropower	Water Rights	Authority	Pricing/Charge	Demand Analysis	Irrigation	No Action Alternative	Alternative Analysis	Consultation	Impacts to Cultural Resources	Cumulative Impacts	Oil and Gas/Hydrofracing	Depletions Analysis	Temporary vs. Permanent Use	Inappropriate Use of Section 6	Surplus Water Availability/Location	Natural Flows	Insufficient Account of Existing Users	EIS Needed	MRAPS	Downstream Use	Need for Contracts	Intakes	Environmental Justice	System Operation	Water Quality	Economic Impacts/Benefits	Fish and Wildlife	Compliance with Law	Insufficient Time to Comment	Comment Period (Extension)	Request for Information	No Comment	Other	
14	ND Dept Ag (Doug Goehring) – 1 Feb			X													X				X														
15	ND Dept of Health – 27 Dec																																	X	
16	ND Game & Fish – 17 Jan																						X					X							X
17	ND Parks & Rec (Jesse Hanson) – 27 Jan																						X		X			X							
18	ND SHPO – 23 Dec																															X			
19	ND SWC– 1 Feb	X	X	X		X											X	X			X	X												X	

Table 16
Thematic Comment Matrix

Thematic Response Category ²⁹	H	W R	W S	C	C	I	N	N	TC	CR	N	N	N	W R	W S	W S	W R	W S	N	O	C	W S	O	N	O	N	H	N	W S	O	O	O	O	O	
Concern	Hydropower	Water Rights	Authority	Pricing/Charge	Demand Analysis	Irrigation	No Action Alternative	Alternative Analysis	Consultation	Impacts to Cultural Resources	Cumulative Impacts	Oil and Gas/Hydrofracing	Depletions Analysis	Temporary vs. Permanent Use	Inappropriate Use of Section 6	Surplus Water Availability/Location	Natural Flows	Insufficient Account of Existing Users	EIS Needed	MRAPS	Downstream Use	Need for Contracts	Intakes	Environmental Justice	System Operation	Water Quality	Economic Impacts/Benefits	Fish and Wildlife	Compliance with Law	Insufficient Time to Comment	Comment Period (Extension)	Request for Information	No Comment	Other	
20	McKenzie County (Vogel Law Firm) – 31 Jan		X	X		X									X	X					X	X												X	
21	McKenzie County – 31 Jan			X			X	X																											X
22	McKenzie County (AE2S) – 31 Jan			X	X		X	X								X							X												
23	Mountrail County WRD –			X												X					X														
24	Williams County WRD – 27 Jan			X																															
25	Sen Conrad – 14 Jan	X		X																	X														

Table 16
Thematic Comment Matrix

Thematic Response Category ²⁹	H	W R	W S	C	C	I	N	N	TC	CR	N	N	N	W R	W S	W S	W R	W S	N	O	C	W S	O	N	O	N	H	N	W S	O	O	O	O	O	
Concern	Hydropower	Water Rights	Authority	Pricing/Charge	Demand Analysis	Irrigation	No Action Alternative	Alternative Analysis	Consultation	Impacts to Cultural Resources	Cumulative Impacts	Oil and Gas/Hydrofracing	Depletions Analysis	Temporary vs. Permanent Use	Inappropriate Use of Section 6	Surplus Water Availability/Location	Natural Flows	Insufficient Account of Existing Users	EIS Needed	MRAPS	Downstream Use	Need for Contracts	Intakes	Environmental Justice	System Operation	Water Quality	Economic Impacts/Benefits	Fish and Wildlife	Compliance with Law	Insufficient Time to Comment	Comment Period (Extension)	Request for Information	No Comment	Other	
26 Gov Dalrymple – 31 Jan				X												X					X	X												X	
27 Sen Hoeven – 31 Jan		X		X	X					X							X							X		X									X
28 Gov Daugaard – 20 Jan						X											X			X	X			X											X
29 Standing Rock – 14 Jan		X															X																		
30 Adrienne Swallow – 22 Dec																																X			
31 Standing Rock – 1 Feb		X			X		X	X	X	X	X	X	X						X				X	X	X			X							
32 TAT – 1 Feb		X	X	X	X				X				X		X							X	X	X	X	X	X	X	X						
33 USEPA – 1 Feb					X		X	X			X	X	X										X		X										X

Table 16
Thematic Comment Matrix

Thematic Response Category ²⁹	H	W R	W S	C	C	I	N	N	TC	CR	N	N	N	W R	W S	W S	W R	W S	N	O	C	W S	O	N	O	N	H	N	W S	O	O	O	O	O	
Concern	Hydropower	Water Rights	Authority	Pricing/Charge	Demand Analysis	Irrigation	No Action Alternative	Alternative Analysis	Consultation	Impacts to Cultural Resources	Cumulative Impacts	Oil and Gas/Hydrofracing	Depletions Analysis	Temporary vs. Permanent Use	Inappropriate Use of Section 6	Surplus Water Availability/Location	Natural Flows	Insufficient Account of Existing Users	EIS Needed	MRAPS	Downstream Use	Need for Contracts	Intakes	Environmental Justice	System Operation	Water Quality	Economic Impacts/Benefits	Fish and Wildlife	Compliance with Law	Insufficient Time to Comment	Comment Period (Extension)	Request for Information	No Comment	Other	
34	Western Area Power Association – 31 Jan	X		X				X					X																						
35	BIA – 28 Jan			X	X																	X													
36	BOR – 31 Jan	X	X		X	X							X			X						X	X												
37	USFWS							X															X												
38	Aarestad, Casper – 5 Jan				X	X																													
39	Asbury, Randy (CPMR) – 29 Jan						X	X			X	X	X	X	X	X																			

Table 16
Thematic Comment Matrix

Thematic Response Category ²⁹	H	W R	W S	C	C	I	N	N	TC	CR	N	N	N	W R	W S	W S	W R	W S	N	O	C	W S	O	N	O	N	H	N	W S	O	O	O	O	O	
Concern	Hydropower	Water Rights	Authority	Pricing/Charge	Demand Analysis	Irrigation	No Action Alternative	Alternative Analysis	Consultation	Impacts to Cultural Resources	Cumulative Impacts	Oil and Gas/Hydrofracing	Depletions Analysis	Temporary vs. Permanent Use	Inappropriate Use of Section 6	Surplus Water Availability/Location	Natural Flows	Insufficient Account of Existing Users	EIS Needed	MRAPS	Downstream Use	Need for Contracts	Intakes	Environmental Justice	System Operation	Water Quality	Economic Impacts/Benefits	Fish and Wildlife	Compliance with Law	Insufficient Time to Comment	Comment Period (Extension)	Request for Information	No Comment	Other	
40	Berger, Dwight (Ft Clark Irrigation) – 19 Jan			X		X												X				X													
41	Bry, Jonathan– 1 Feb									X	X	X															X	X							X
42	East River Electric – 31 Jan	X			X								X			X									X										
43	Gannaway, Robert (Buford Trenton ID) – 31 Jan				X																						X								
44	Guenther , Max		X			X																			X										
45	Iversen, Neil – 18 Jan				X		X	X																											X

Table 16
Thematic Comment Matrix

Thematic Response Category ²⁹	H	W R	W S	C	C	I	N	N	TC	CR	N	N	N	W R	W S	W S	W R	W S	N	O	C	W S	O	N	O	N	H	N	W S	O	O	O	O	O
Concern	Hydropower	Water Rights	Authority	Pricing/Charge	Demand Analysis	Irrigation	No Action Alternative	Alternative Analysis	Consultation	Impacts to Cultural Resources	Cumulative Impacts	Oil and Gas/Hydrofracing	Depletions Analysis	Temporary vs. Permanent Use	Inappropriate Use of Section 6	Surplus Water Availability/Location	Natural Flows	Insufficient Account of Existing Users	EIS Needed	MRAPS	Downstream Use	Need for Contracts	Intakes	Environmental Justice	System Operation	Water Quality	Economic Impacts/Benefits	Fish and Wildlife	Compliance with Law	Insufficient Time to Comment	Comment Period (Extension)	Request for Information	No Comment	Other
46	Johnson, Jim – 30 Jan		X	X		X											X																	
47	Johnson, Robert – 12 Jan			X																	X													
48	Kelly – 7 Jan			X																														
49	Kleeman, Robert – 4 Jan			X																														
50	Klippenstein, Brian – 29 Jan																																	X
51	Knox, Linda																																	X
52	Koland, Dave (Garrison Diversion) – 31 Jan		X	X		X										X																		

Table 16
Thematic Comment Matrix

Thematic Response Category ²⁹	H	W R	W S	C	C	I	N	N	TC	CR	N	N	N	W R	W S	W S	W R	W S	N	O	C	W S	O	N	O	N	H	N	W S	O	O	O	O	O		
Concern	Hydropower	Water Rights	Authority	Pricing/Charge	Demand Analysis	Irrigation	No Action Alternative	Alternative Analysis	Consultation	Impacts to Cultural Resources	Cumulative Impacts	Oil and Gas/Hydrofracing	Depletions Analysis	Temporary vs. Permanent Use	Inappropriate Use of Section 6	Surplus Water Availability/Location	Natural Flows	Insufficient Account of Existing Users	EIS Needed	MRAPS	Downstream Use	Need for Contracts	Intakes	Environmental Justice	System Operation	Water Quality	Economic Impacts/Benefits	Fish and Wildlife	Compliance with Law	Insufficient Time to Comment	Comment Period (Extension)	Request for Information	No Comment	Other		
53	Lee, Corinne – 31 Jan			X							X																									
54	Massad, Mary (SWA) – 25 Jan	X		X													X				X	X														
55	McCrary, Glenn – 31 Jan			X	X																															
56	McFadden, Jeffrey – 12 Jan													X								X														
57	MidWest Electric (Tom Graves) – 31 Jan	X			X			X	X			X			X					X																
58	Mortenson, Steve – 27 Jan		X		X																															
59	Ness, Ron – 28 Jan				X																		X													

Table 16
Thematic Comment Matrix

Thematic Response Category ²⁹	H	W R	W S	C	C	I	N	N	TC	CR	N	N	N	W R	W S	W S	W R	W S	N	O	C	W S	O	N	O	N	H	N	W S	O	O	O	O	O		
Concern	Hydropower	Water Rights	Authority	Pricing/Charge	Demand Analysis	Irrigation	No Action Alternative	Alternative Analysis	Consultation	Impacts to Cultural Resources	Cumulative Impacts	Oil and Gas/Hydrofracing	Depletions Analysis	Temporary vs. Permanent Use	Inappropriate Use of Section 6	Surplus Water Availability/Location	Natural Flows	Insufficient Account of Existing Users	EIS Needed	MRAPS	Downstream Use	Need for Contracts	Intakes	Environmental Justice	System Operation	Water Quality	Economic Impacts/Benefits	Fish and Wildlife	Compliance with Law	Insufficient Time to Comment	Comment Period (Extension)	Request for Information	No Comment	Other		
60	Olsen, Mike - 11 Jan		X																		X															
61	Ortiz, Steve -21 Dec																																	X		
62	Paryzek , Corey - 21 Jan	X		X													X																			
63	Pufalt, Caroline (MO Sierra Club) - 1 Feb				X			X			X	X												X	X		X									
64	Quandt Brothers - 7 Jan			X		X																														
65	Redmond, Jim (IA Sierra Club) - 30 Jan			X	X							X													X		X									

Table 16
Thematic Comment Matrix

Thematic Response Category ²⁹	H	W R	W S	C	C	I	N	N	TC	CR	N	N	N	W R	W S	W S	W R	W S	N	O	C	W S	O	N	O	N	H	N	W S	O	O	O	O	O	
Concern	Hydropower	Water Rights	Authority	Pricing/Charge	Demand Analysis	Irrigation	No Action Alternative	Alternative Analysis	Consultation	Impacts to Cultural Resources	Cumulative Impacts	Oil and Gas/Hydrofracing	Depletions Analysis	Temporary vs. Permanent Use	Inappropriate Use of Section 6	Surplus Water Availability/Location	Natural Flows	Insufficient Account of Existing Users	EIS Needed	MRAPS	Downstream Use	Need for Contracts	Intakes	Environmental Justice	System Operation	Water Quality	Economic Impacts/Benefits	Fish and Wildlife	Compliance with Law	Insufficient Time to Comment	Comment Period (Extension)	Request for Information	No Comment	Other	
66	Royse, Ken (MRJWB) – 10 Jan																																	X	
67	Scheel, Pete – 7 Jan	X																																	
68	Schrempp, Tom (MRPWA) – 1 Feb																			X					X										
69	Shae, Jerry – 31 Jan			X	X	X											X																		
70	ShortBull, Marietta –16 Dec																																		X
71	Two Eagle, Carol – 13 Jan				X																														
72	Ventsch/Little field – 25 Jan				X	X					X																								

Table 16
Thematic Comment Matrix

Thematic Response Category ²⁹	H	W R	W S	C	C	I	N	N	TC	CR	N	N	N	W R	W S	W S	W R	W S	N	O	C	W S	O	N	O	N	H	N	W S	O	O	O	O	O	
Concern	Hydropower	Water Rights	Authority	Pricing/Charge	Demand Analysis	Irrigation	No Action Alternative	Alternative Analysis	Consultation	Impacts to Cultural Resources	Cumulative Impacts	Oil and Gas/Hydrofracing	Depletions Analysis	Temporary vs. Permanent Use	Inappropriate Use of Section 6	Surplus Water Availability/Location	Natural Flows	Insufficient Account of Existing Users	EIS Needed	MRAPS	Downstream Use	Need for Contracts	Intakes	Environmental Justice	System Operation	Water Quality	Economic Impacts/Benefits	Fish and Wildlife	Compliance with Law	Insufficient Time to Comment	Comment Period (Extension)	Request for Information	No Comment	Other	
73	Voices for Lake Oahe – 13 Jan		X																	X	X														
74	Waletzko, Paul – 5 Jan	X		X																															
Public Meeting (6 January 2011)																																			
75	Gov Jack Dalrymple			X												X					X	X												X	
76	Chairman Tex Hall		X						X																		X								
77	Shane Goettle (Sen Hoeven's Office)	X		X	X					X							X								X		X								X
78	Wayne Stenehjem, ND AG	X	X	X													X					X		X											

Table 16
Thematic Comment Matrix

Thematic Response Category ²⁹	H	W R	W S	C	C	I	N	N	TC	CR	N	N	N	W R	W S	W S	W R	W S	N	O	C	W S	O	N	O	N	H	N	W S	O	O	O	O	O		
Concern	Hydropower	Water Rights	Authority	Pricing/Charge	Demand Analysis	Irrigation	No Action Alternative	Alternative Analysis	Consultation	Impacts to Cultural Resources	Cumulative Impacts	Oil and Gas/Hydrofracing	Depletions Analysis	Temporary vs. Permanent Use	Inappropriate Use of Section 6	Surplus Water Availability/Location	Natural Flows	Insufficient Account of Existing Users	EIS Needed	MRAPS	Downstream Use	Need for Contracts	Intakes	Environmental Justice	System Operation	Water Quality	Economic Impacts/Benefits	Fish and Wildlife	Compliance with Law	Insufficient Time to Comment	Comment Period (Extension)	Request for Information	No Comment	Other		
79	Todd Sando, ND SWC	X	X	X	X										X	X				X	X												X			
80	Royse, Ken (MRJWB)			X	X															X	X													X		
81	Ames, Brandon				X																						X									
82	Ames, Mike					X	X																												X	
83	Bearce, Roger																																		X	
84	Behan, Dale				X																															
85	Casteel, Darrell				X	X											X	X				X					X									
86	Dwyer, Mike																											X								X

Table 16
Thematic Comment Matrix

Thematic Response Category ²⁹	H	W R	W S	C	C	I	N	N	TC	CR	N	N	N	W R	W S	W S	W R	W S	N	O	C	W S	O	N	O	N	H	N	W S	O	O	O	O	O	
Concern	Hydropower	Water Rights	Authority	Pricing/Charge	Demand Analysis	Irrigation	No Action Alternative	Alternative Analysis	Consultation	Impacts to Cultural Resources	Cumulative Impacts	Oil and Gas/Hydrfracing	Depletions Analysis	Temporary vs. Permanent Use	Inappropriate Use of Section 6	Surplus Water Availability/Location	Natural Flows	Insufficient Account of Existing Users	EIS Needed	MRAPS	Downstream Use	Need for Contracts	Intakes	Environmental Justice	System Operation	Water Quality	Economic Impacts/Benefits	Fish and Wildlife	Compliance with Law	Insufficient Time to Comment	Comment Period (Extension)	Request for Information	No Comment	Other	
87	Fleck, Terry			X																					X										
88	Grenz, Herb			X		X																X													
89	Grossman, Brian	X				X																		X		X									
90	Harmon, Dean					X																													
91	Helgaas, Maynerd	X		X		X																													
92	Kitko, Kris			X								X																							
93	Lindvig, Milton	X				X											X				X	X			X										
94	Massed, Mary	X		X			X										X					X	X												

Table 16
Thematic Comment Matrix

Thematic Response Category ²⁹	H	W R	W S	C	C	I	N	N	TC	CR	N	N	N	W R	W S	W S	W R	W S	N	O	C	W S	O	N	O	N	H	N	W S	O	O	O	O	O	
Concern	Hydropower	Water Rights	Authority	Pricing/Charge	Demand Analysis	Irrigation	No Action Alternative	Alternative Analysis	Consultation	Impacts to Cultural Resources	Cumulative Impacts	Oil and Gas/Hydrofracing	Depletions Analysis	Temporary vs. Permanent Use	Inappropriate Use of Section 6	Surplus Water Availability/Location	Natural Flows	Insufficient Account of Existing Users	EIS Needed	MRAPS	Downstream Use	Need for Contracts	Intakes	Environmental Justice	System Operation	Water Quality	Economic Impacts/Benefits	Fish and Wildlife	Compliance with Law	Insufficient Time to Comment	Comment Period (Extension)	Request for Information	No Comment	Other	
95	Mortenson, Steve			X		X																													
96	Packineau, Roy	X		X					X													X													
97	Schmidt, Kevin																																		X
98	Sheldon, Bill			X																				X											
99	Vandemoer, Kate	X	X	X																						X									
100	Veeder, Gene			X			X	X																											X
101	Volk, Erik	X		X													X																		
102	Walter, Alan	X		X																															

Table 16
Thematic Comment Matrix

Thematic Response Category ²⁹	H	WR	WS	C	C	I	N	N	TC	CR	N	N	N	WR	WS	WS	WR	WS	N	O	C	WS	O	N	O	N	H	N	WS	O	O	O	O	
Concern	Hydropower	Water Rights	Authority	Pricing/Charge	Demand Analysis	Irrigation	No Action Alternative	Alternative Analysis	Consultation	Impacts to Cultural Resources	Cumulative Impacts	Oil and Gas/Hydrofracing	Depletions Analysis	Temporary vs. Permanent Use	Inappropriate Use of Section 6	Surplus Water Availability/Location	Natural Flows	Insufficient Account of Existing Users	EIS Needed	MRAPS	Downstream Use	Need for Contracts	Intakes	Environmental Justice	System Operation	Water Quality	Economic Impacts/Benefits	Fish and Wildlife	Compliance with Law	Insufficient Time to Comment	Comment Period (Extension)	Request for Information	No Comment	Other
103 Wheeler, Pat				X																														X

Thematic Response Category Legend: H - Hydropower; WR - Water Rights; C - Cost; I - Irrigation; N - NEPA; TC - Tribal Consultation; CR - Cultural Resources; WS - M&I Water Supply; O - Other

Table 17
Thematic Comment Responses

Thematic Comments	Responses
Hydropower	
1. Illogical analysis showing positive benefits to hydropower.	<u>Response:</u> One would expect minor reductions in one or more years, but a "major" change in Garrison releases caused a redistribution in releases in 1980, resulting in an increase in benefits (not expected for such a small change in depletions).
2. The Corps did not consult with Western Area Power Authority (WAPA).	<u>Response:</u> WAPA was coordinated with on a technical basis and we requested their views on the Federal action per a letter sent December 17 th . Western's comments were received and addressed in this document.
3. The model inaccurately reflects the real costs to federal hydropower customers.	<u>Response:</u> The Daily Routing Model and associated economic modules are used by the Corps for the Missouri River mainstem system, and is the best available model to calculate hydropower impacts given the scope of the study.
4. Inadequate reflection of the cost to hydropower customers of 100,000 AF depletion.	<u>Response:</u> The hydropower impacts have been calculated on a system-wide basis but are small because of the relatively insignificant amount of water resulting from the proposed Federal action (527 ac-ft) that would not be available to generate hydropower. Revenues for hydropower are a function of water availability and this can fluctuate widely from year to year (up or down) but payments to Treasury are constant.
5. Revenue foregone methodology concerns.	<u>Response:</u> The Corps determined that the true loss of generating capability is 527 ac-ft as opposed to 100,000 ac-ft per year over the 10 year period. This relatively small amount of difference is the result of users, without the Federal action, continuing to meet their water needs from the free flowing stretches, tributaries, or existing intakes on the Missouri River. It should also be noted that because other authorized purposes like irrigation have not developed as intended, additional water has been available and used by the hydropower purpose without a corresponding increase in revenues to the Federal Treasury.
6. Concerns that 257,000 acre/feet will never pass through hydro generators.	<u>Response:</u> 257,000 acre-feet is the amount of storage required to yield 100,000 acre-feet of water. The calculated storage is utilized for pricing purposes only, while the yield is what would pass through the generators. Our analysis shows that 527 acre-feet is the yield lost due to the proposed Federal action.
7. Updated cost of storage calculation does not include benefits of Ft. Peck.	<u>Response:</u> The calculation for updated cost of storage could be calculated on a system wide basis based on system-wide capacity and the system-wide joint updated costs. The Corps determined this would not result in a significantly different cost. Therefore the Corps would not add costs from Fort Peck directly to Garrison. It should also be noted that the 1944 Surplus Act allows the Secretary to set the price for the use of the water as she "deems reasonable". This allows the Secretary latitude in the methodology used to set the price.
8. How will cost allocations be shifted to reflect impacts to Hydropower?	<u>Response:</u> Because the water is surplus and not adversely impacting the authorized purposes including hydropower, it will not be used to offset hydropower reimbursement obligations. It should also be noted that because other authorized purposes like irrigation have not developed as intended, additional water has been available and used by the hydropower purpose without a corresponding increase in revenues to the Federal Treasury.
9. Bureau of Reclamation (Reclamation) facilities should have been included in the impact assessment, especially regarding potential impacts to hydropower.	<u>Response:</u> To the extent that data was available we collected Reclamation usage. Information on tribal intakes constructed under Reclamation authorities were also collected and considered. Specifically authorized Bureau of Reclamation projects do not require contracts with the Corps for surplus water, therefore the document has been revised to remove all the BOR facilities from the demand analysis.
10. Include a complete listing of all M&I contracts.	<u>Response:</u> The Corps has only one existing M&I contract. This contract is with Basin Electric and is mentioned in the report, but is not include in the demand analysis.

Table 17
Thematic Comment Responses

Thematic Comments	Responses
Cost	
11. Limits to repayment in the 1944 Flood Control Act (as amended in 1958).	<u>Response:</u> This language (1958 Water Supply Act) limits the repayment period to a term that cannot exceed 50 years “after the project is first used for the storage of water for water supply purposes” not after construction is complete.
12. The fee structure for pricing is unfounded.	<u>Response:</u> The Corps surplus water supply pricing is based on established policy found in ER 1105-2-100 and the water supply handbook.
13. Dakota Water Resources Act of 2000 exempts the state from water payment provisions.	<u>Response:</u> The Dakota Water Resources Act applies to Municipal, Rural, and Industrial (MR&I) projects constructed under the Bureau of Reclamation’s authorities and dictates how the BOR should charge users who withdraw from BOR projects. It does not apply to the Corps’ obligation to charge for the withdrawal of water directly from Corps reservoirs. Upon completion, the report and recommendations will be forwarded to the Assistant Secretary of the Army for Civil Works, where the issue of price will be addressed per her discretion.
14. Need to equitably spread costs to all benefactors in the whole basin.	<p><u>Response:</u> The Omaha District will conduct water supply reports at each of the other reservoirs throughout the Missouri River basin. Because of the demand for access to the water in North Dakota, Lake Sakakawea was the first to undergo the study. The timeline for the additional studies is being determined.</p> <p>With regard to downstream users, the Corps doesn’t charge downstream flood control beneficiaries (which include many ND communities). Unlike M&I water supply, which is considered a local or state responsibility, the Corps is responsible for providing flood control and navigation projects in line with Federal legislation and policy. The cost share at the time of construction of the Mainstem Missouri River System is set by statute. In the case of the main stem dams, downstream communities or navigators were not charged directly for the construction of the dams. Flood risk management benefits are considered benefits to the nation, and these benefits are calculated on an annual basis. Regarding navigation the Corps of Engineers is responsible for maintaining inland navigation waterways. Commercial operators on these designated waterways pay a fuel tax, deposited in the Inland Waterways Trust Fund, which funds half the cost of new and rehab of existing inland waterways infrastructure. Hydropower does make payments to the federal government for benefits that come from the Missouri River projects, and all receipts go to the U.S. treasury.</p>
15. Analysis should not include costs for power intake works, levees and floodwalls, and multiple reservoirs.	<u>Response:</u> The Corps charge for the use of surplus water is based on an appropriate proportion of project joint costs. Joint costs are the costs of features of the project that serve multiple authorized purposes. Cost which can be attributed to a specific purpose, such as hydropower (power intakes) or flood risk management (levees and floodwalls) are not included. The Corps surplus water supply pricing is based on established policy found in ER 1105-2-100 and the water supply handbook.
16. Oil and gas industry should pay for use of water.	<u>Response:</u> Upon completion, the report and recommendations will be forwarded to the Assistant Secretary of the Army for Civil Works, where the issue of price will be addressed per her discretion.
17. Section 6 authority to enter into agreements for surplus water does not include Tribes.	<u>Response:</u> The Report does not cover Bureau of Reclamation intakes, including those that have been authorized for the Tribes. To date, the Corps has not required surplus water agreements for such withdrawals, nor is it anticipated that such agreements will be required in the future for similar Bureau intakes.
18. The Corps’ charge is less than Reclamation’s.	<u>Response:</u> The charge is consistent with ER 1105-2-100.

Table 17
Thematic Comment Responses

Thematic Comments	Responses
<p>19. Dakota Water Resources Act of 2000 (DWRA 2000) prohibits charging users for the cost of the construction of the Corps reservoirs.</p>	<p><u>Response:</u> The DWRA 2000 governs the price charged by Reclamation for users from Reclamation projects. It does not limit the Corps' authority to charge for withdrawals made directly from a Corps reservoir in North Dakota.</p>
Water Rights	
<p>20. North Dakota and the Tribes have rights to the natural flow of the Missouri River in North Dakota and river flows in Lake Sakakawea should not be considered stored water.</p>	<p><u>Response:</u> The Corps acknowledges that Tribes have water rights under the Winters Doctrine. Section 6 has no effect on such rights. Nor does it affect any allocation of rights in water by the appropriate Tribal or State jurisdictions. Corps policy recognizes that acquisition of water rights is the responsibility of the users entering into agreements with the Corps, and that the Corps will not become involved in conflicts concerning those rights. Section 6 merely provides a mechanism for the Government to contract for the use of surplus water from Corps reservoirs with domestic and industrial users who have obtained the appropriate water rights. The Report identifies surplus water and calculates the policy price for its use.</p>
<p>21. Charging Tribes for water violates the United States trust responsibilities to Tribal nations and ignores tribal water rights. Tribal water rights in Lake Sakakawea under Winters Doctrine should be acknowledged and that whenever they are adjudicated, it would influence future determinations of storage and surplus water.</p>	<p><u>Response:</u> The Corps acknowledges that Tribes have water rights under the Winters Doctrine, and has determined that Section 6 does not abrogate those rights. The Report identifies surplus water and calculates the policy price for its use. The Corps is not charging for water, but rather for the right to use surplus water as Section 6 allows.</p>
<p>22. Concern that temporary use could become permanent and affect availability of water for downstream states.</p>	<p><u>Response:</u> This report addresses temporary use of surplus water and is limited in scope and duration. Contracts for surplus water agreements are normally only for five years, with an option for a five year extension. The long term use of water is outside of the scope of this study, but the development of a comprehensive, long term strategy is proposed in the Report.</p>
Irrigation	
<p>23. Does Section 6 surplus water authority apply to irrigators?</p>	<p><u>Response:</u> The Section 6 authority is for municipal and industrial users only. The Corps lacks authority to contract for the use of surplus water for irrigation.</p>
M&I Water Supply	
<p>24. Water Supply is not the Corps' mission, and they should stay out of the business of water supply.</p>	<p><u>Response:</u> Water Supply is an authorized project purpose of the Missouri River Projects. While water supply is primarily the responsibility of States and local governments, the Corps is authorized to participate and cooperate with local entities in developing such water supplies in connection with the construction and operation of Federal projects.</p>
<p>25. The Corps of Engineers is inappropriately applying its section 6 authorities to permanent uses.</p>	<p><u>Response:</u> Section 6 gives the ASA(CW) broad authority to contract for the use of surplus water. It is within her discretion to offer short term contracts for existing users while USACE is determining how to deal with such permanent users provided that the contracts for such water will not adversely affect the existing lawful uses of such water.</p>

Table 17
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Thematic Comments	Responses
<p>26. The Corps has stated that there is no storage currently allocated in Lake Sakakawea for municipal and industrial water use. As such, the past practice of issuing easements for water withdrawals from Lake Sakakawea appears unlawful.</p>	<p><u>Response:</u> The easements were issued according to the guidance at the time.</p>
<p>27. Sediment storage, it would be in the permanent pool, not the carryover multiple-use zone.</p>	<p><u>Response:</u> The document was revised to designate surplus from sediment storage in the permanent pool rather than the carry over multiple use zone.</p>
<p>28. How will pricing affect oil and gas industry's demand for water?</p>	<p><u>Response:</u> To the extent this applies to the use of water by the oil and gas industry, the Report concludes there would be no effect. The EA makes a logical argument as to why oil and gas industry will not be affected by this federal decision, including that water is currently readily available to the industry (without a Corps action), and that there are other economic factors (such as supply of people and rigs, and the price of oil) upon which the industry is dependent. The fact that the industry is currently rapidly expanding in North Dakota is further evidence that these factors are the driving force of the industry... not the Corps decision to allow the temporary use of surplus water. The EA was updated to include a better description as to why this is the case (see Section 5.1.3 Scope of Analysis).</p>
<p>29. Section 6 does not authorize the reallocation of storage space in a Corps Reservoir.</p>	<p><u>Response:</u> The Corps is not reallocating storage space in the reservoirs. Although there were no specific amounts of storage allocated to any of the purposes originally, water supply is an authorized purpose of the project. Accordingly, the Secretary of the Army is authorized by law to enter into agreements with non-Federal entities for municipal and industrial (M&I) water supply storage in Lake Sakakawea. In this case, the Corps of Engineers is recommending to allow temporary use of surplus water under the authority of Section 6 of the Flood Control Act of 1944 (FCA). The surplus water report states and provides support for a determination of surplus water availability, the quantity of the surplus water and a cost for the water storage. The process used to quantify and determine the appropriate cost is provided in the Institute of Water Resources Water Supply Handbook, dated December 1998. There is no determination of temporary allocations of storage space mentioned in the report.</p> <p>During the term of the temporary use of surplus water, the Corps of Engineers plans to develop a more comprehensive strategy to address long term regional water needs be developed that may involve the administration, congress, and stakeholders.</p>
<p>30. Inappropriate to include Reclamation projects within the demand.</p>	<p><u>Response:</u> The document has been revised to remove all the BOR facilities from the demand analysis.</p>
<p>31. Failed to account for existing and future municipal and industrial uses.</p>	<p><u>Response:</u> The exact quantities of water being withdrawn through easements on Lake Sakakawea are difficult to determine from the available data. The Corps keeps records on easement allocations, but does not collect data on actual water usage. The North Dakota State Water Commission does keep detailed data on permitted water usage, and all Corps easements also require the recipient to possess a valid state or Tribal water right. There is no data set that allows direct correlation of State water use permits with Corps easements, therefore the analysis was based on usage under State permits within 1 mile of Lake Sakakawea. This information was determined to be the best available information.</p>
<p>32. No sponsor identified.</p>	<p><u>Response:</u> No sponsor is required under Section 6.</p>

Table 17
Thematic Comment Responses

Thematic Comments	Responses
33. The estimates for water use by the oil and gas industry appear arbitrary or unfounded.	<u>Response:</u> The estimate for new oil and gas wells (projected between 1,500 and 1,800 new wells per year) is based on information provided by the North Dakota Industrial Commission. Estimates on water requirements of each well were provided by the state and the industry.
34. The report fails to account for tribal water use and future water demand.	<u>Response:</u> Most if not all tribal intakes are part of a specifically authorized Bureau of Reclamation project and as such do not require contracts with the Corps for surplus water. Therefore they are not included in the demand analysis.
35. Will the development of this policy interrupt existing users?	<u>Response:</u> The Corps does not expect that this will interrupt existing users, although they may have to enter into a surplus water contract.
36. How do existing water users in Lake Sakakawea use their water, and how do the current users plan to utilize their water in the future.	<u>Response:</u> The total quantity of water being withdrawn through the 142 water intake easements (i.e., annual usage) is estimated to be approximately 33,000 acre-feet per year based on best available data. The majority of existing use is attributed to M&I and power (94%) with the remaining 5% and 1% attributed to irrigation (excluding irrigation through Reclamation facilities) and rural water respectively. Future demand by existing easement holders requiring renewal is predicted in the report to be approximately 26,000.
37. Corps out grant guidance dated March 30, 2009 excludes easements from charging for oil, gas or mineral exploration or extraction.	<u>Response:</u> This policy applies to real estate easements and not surplus water agreements.
38. The Corps needs to coordinate with Reclamation and Western.	<u>Response:</u> The Corps recognizes the importance and commits to close communication with the Bureau and Western Area Power with regard to any planning efforts on the Missouri River.
39. The Report states that irrigation diversions come from both the permanent pool and the carryover multiple use zones.	<u>Response:</u> The report has been modified to indicate that irrigation storage is from the carry-over multiple-use zone.
40. Need to plan for the full quantity allocated to irrigation.	<u>Response:</u> The Corps recognizes the full quantity that has been allocated to irrigation. The Corps also recognizes that irrigation has not developed as anticipated. The Corps has determined in this Surplus Water Report that a temporary use of up to 100,000 ac-ft of water for water supply will not significantly affect irrigation.
41. Should have simulated Lake Sakakawea operations and demands individually rather than as a system.	<u>Response:</u> The Missouri River mainstem reservoirs are operated as a system. Therefore, it is appropriate to determine the yield and storage requirements as a system, not individually.

Table 17
Thematic Comment Responses

Thematic Comments	Responses
Cultural	
<p>42. Failure to properly consult under Section 106 of the National Historic Preservation Act.</p>	<p><u>Response:</u> In August 2010, the Corps of Engineers formally notified Tribes of their intent to undertake the surplus water study. Notification went out to Omaha District State Historic Preservation Offices (SHPO) and Tribes listed in Section 10.1 of the EA. On 19 November 2010 the Corps sent a representative to the Semi-Annual Meeting for the Programmatic Agreement for Operation and Management of the Missouri River Main Stem System (PA) to describe the action and answer any questions. On 17 December 2010 the Corps of Engineers formally notified SHPOs and Tribes of the availability of the draft surplus water report and EA and requested review and comment.</p> <p>Concerning the Federal undertaking of removing 527 ac-ft of water from Lake Sakakawea, the Study indicates that the depletion of 527 ac-ft of water would have no measurable effect on the reservoir levels at Lake Sakakawea and the other Main Stem reservoirs and, therefore, no effect on cultural or historic properties on or near the shoreline. It is our understanding that consultation would only be required if there were going to be an effect cultural or historic properties, therefore the District has determined it is in compliance with Section 106 of the NHPA for the removal of 527 ac-ft from the reservoir.</p> <p>The Surplus Water Report Draft Environmental Assessment Chapter 8 page 122, NHPA, states "Discussions between the Corps and the North Dakota SHPO are ongoing and final coordination with regard to this law would be completed before construction." On 8 February 2011 the Corps formally notified SHPOs and Tribes of the proposed easement intakes applications and requested comments and concerns. Detailed intake easement application information was provided to SHPOs and Tribes (PA points of contact). Comments are due March 11, 2011.</p>
<p>43. Failure to address cultural resource concerns properly.</p>	<p><u>Response:</u> Routes for the seven (7) proposed intakes have been initially designed to avoid impacts to the environment and cultural and/or Traditional Cultural Properties (TCP) but their design is still preliminary. As the plans for the proposed intakes become more final, further coordination with Tribal, State, of Federal agencies will be completed as appropriate.</p>
<p>44. No cultural resource inventories of the proposed intakes and their associated infrastructure.</p>	<p><u>Response:</u> All Traditional Cultural Properties (TCPs) have been identified by Corps' sponsored Tribal TCP inventories including most recently, "Draft, A Traditional Cultural Property Study Lake Sakakawea, North Dakota"; Contract W9128F-04-P-0161 Authors: Elgin Crows Breast and Calvin Grinnell May 2007.</p>
<p>45. District Engineer is not qualified to allow a project to proceed should a cultural site be found in the field</p>	<p><u>Response:</u> The district does not claim that the DE can allow a project to continue should a site be found, but the DE has the authority direct all construction to cease until determinations can be made. The determination to continue construction would be made by the District Engineer upon coordination with appropriate authorities.</p>

Tribal Consultation

Table 17
Thematic Comment Responses

Thematic Comments	Responses
<p>46. The Corps must comply with the legal requirements for government to government consultation with the MHA nation prior to issuing a recommendation and final report on this project.</p>	<p>Response: The Corps understands that consultation is a process and not an event, and considers that it has begun the consultation process. Information has been shared with the Tribe throughout the process and the Corps met with the Tribe, at their request on October 28 2010. Repeated attempts have been made during and after the public comment period to reach the Chairman, with the intent to set up another meeting. The Corps will be willing to continue discussions, should the Tribe desire it. Note: An acceptable date has been agreed upon between the Corps and the MHA nation and a government to government consultation meeting is currently scheduled for 28 March 2011.</p>
NEPA	
<p>47. The public meeting in Bismarck was disappointing.</p>	<p>Response: The Corps recognizes the limits of the facility used for the public meeting and will take this comment into consideration in future events.</p>
<p>48. As the Corps has no authority to allow water withdrawal without contracts, the no action alternative of “<i>water users will continue to withdraw water from the project</i>” is illogical and indefensible, and usurps the intent of the NEPA.</p>	<p><u>Response:</u> The Corps is currently evaluating all users and is addressing this issue.</p>
<p>49. The hydrologic analysis and depletions projections are inadequate.</p>	<p><u>Response:</u> The Proposed Action for this EA is the temporary use of up to 100,000 acre-feet of surplus water (257,000 acre-feet of storage) from the Garrison Dam/Lake Sakakawea Project to meet municipal and industrial (M&I) water supply needs in the region over a 5-10 year period. As illustrated in Section 4 and Table 2 of the EA, the No Action alternative would result in 100,000 acre-feet of depletions from the Missouri River upstream from Lake Sakakawea, as would the Proposed Alternative. The only difference between the alternatives involves 527 acre feet of water that under the Proposed Action would be removed from Lake Sakakawea and under the No Action alternative would be provided by continued conversion of agricultural permits to M&I under a State program. Thus, 100,000AF depletion is not attributable to the proposed action, only the 527 additional AF per year would be. However, the report provides the reader context within which to understand the very small extent of change that 100,000 AF presents relative to the magnitude of the Missouri River system and its operation. Based on the magnitude of hydrologic changes that have been demonstrated to be associated with a depletion of 100,000AF (i.e., nearly immeasurable with regard to hydrologic effect), the scope of the analysis in the report is considered to be appropriate in determining significance of impacts related to the no action and the proposed alternative 527 AF.</p>

Table 17
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Thematic Comments	Responses
<p>50. Water quality impacts analysis is inadequate.</p>	<p><u>Response:</u> As mentioned above, the EA demonstrates that the Corps of Engineers took a “hard look” at quantifying the potential significance of the proposed action relative to the existing environmental baseline, prior to examining impacts specific to each resource area. As such, the document provides an appropriate level of analysis within each resource area for determination of significance.</p> <p>With regard to the water quality analysis, an extremely conservative approach to the analysis was taken by assuming a system-wide depletion of 150,000 acre-feet (essentially the difference of the alternatives from the environmental baseline). The analysis was conducted using the CE-QUAL-W2 model, which represents the best available water quality model to the Corps for measuring water quality differences in Lake Sakakawea. The water quality analysis showed a lowering of the depth to 15° C and 5 mg/l on the isopleths of less than one foot for the typically wet (2003) year and approximately two feet for the typical dry (2006) year. The Root Mean Square for each of these is greater than the actual predicted changes of the model, showing that there are no statistical differences that can be drawn from the results. The Corps used this analysis to meet the “hard look” standard in determining significance of impacts to water quality. The predicted change is so small as to not be measurable by the best modeling tools available.</p>
<p>51. Concerns with the indirect effect of oil and gas development, and practice of hydrofracing.</p>	<p><u>Response:</u> Many of the comments received on the EA were related to broader issues that are not part of the current decision. Specifically there are concerns as to the lack of information in the EA regarding how the provision of water to the oil and gas industry will impact the human environment. The EA makes a logical argument as to why oil and gas industry will not be affected by this federal decision, including that water is currently readily available to the industry (without a Corps action), and that there are other economic factors (such as supply of people and rigs, and the price of oil) upon which the industry is dependent. The fact that the industry is currently rapidly expanding in North Dakota is further evidence that these factors are the driving force of the industry. The Surplus Water Report and EA have been edited to add further discussion regarding the relationship of oil prices to industry growth to better address that the provision of water will not affect growth of the oil and gas industry.</p>
<p>52. Alternatives analysis should more fully characterize the no action alternative.</p>	<p><u>Response:</u> The report goes to great lengths to describe the development of alternatives, describing the planning goals, objectives, and constraints important in alternative development, and the management measures that are available to support needs. Within the description of these measures, the document details why or why not each one is determined to be a “feasible” alternative, or the rationale as to its screening from further consideration. Upon the screening, document defines the most likely future without project condition as the “least costly combination of feasible measures” to form the basis of comparison with the preferred alternative. The EA substantiates the likelihood of the no action alternative by describing the oil and gas industry as profit maximizing producers, and as such, it is reasonable to expect that oil and gas companies would choose the least costly method of obtaining water when needed.</p>

Table 17
Thematic Comment Responses

Thematic Comments	Responses
<p>53. Cumulative impacts analysis in the EA underestimates potential future depletions and doesn't include NAWS and Red River Valley projects.</p>	<p><u>Response:</u> A total of 50,527 acre-feet of depletions (including 527 acre-feet at Lake Sakakawea and 10,000 acre-feet each at the other five system reservoirs) was assessed in the report to evaluate the cumulative effects of removing an additional 10,000 acre-feet of water from each of the other five system reservoirs. The depletion data, that the Corps received from the Bureau of Reclamation, are adjusted up for other forecasted depletions such as other basin projects, population/M&I growth, and the Northwest Area Water Supply (NAWS) project. The Red River Valley Water Supply Project was not included in this analysis, as this project has not yet been authorized by Congress and would operate only during extreme extended droughts once authorized and constructed. The analysis shows that impacts to water surface elevations and flow releases are relatively the same for the proposed action and no action. As such, further analysis of hydrologic effects within the reservoirs and river reaches would be beyond the scope of the EA.</p> <p>10,000 AF was chosen as a conservative upper boundary of future demand at the other Missouri River Reservoirs for M&I water supply.</p>
<p>54. It is not clear what the environmental impacts of lost hydropower are (i.e. CO2 releases from replacement energy).</p>	<p><u>Response:</u> The Corps did not evaluate impacts that might occur due to a need for alternative energy to replace energy lost from hydropower. Due to the relatively small amount of depletion to the system that would result as a result of the proposed action, very little energy loss is anticipated. Due to the intensity of the impact being very small relative to the context in which the impacts would be occurring, such an impact was considered to be de minimus.</p>
<p>55. The report improperly concludes there is no environmental justice impact.</p>	<p><u>Response:</u> The Corps determined that the action being evaluated will not have a disproportionate impact to Tribal nations. The majority of the Tribal intakes come from Reclamation projects. Within the available water and subject to Corps policy and environmental laws, the Corps provides easements to all qualified applicants.</p>
<p>56. What if there is substantial new information or changes that occur with regard to the impacts of the Federal action.</p>	<p><u>Response:</u> If there are any substantial changes to the proposed action, or significant new circumstances or information becomes available that would change the scope of the evaluation conducted within the EA, a new or supplemental NEPA review would be necessary.</p>

Table 17
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Thematic Comments	Responses
<p>57. It appears that the Corps may be relying on a piecemeal approach in order to keep potential cumulative impacts of water intake projects below the significance threshold.</p>	<p><u>Response:</u> The purpose and need of the report is to identify and quantify whether surplus water is available in Lake Sakakawea project, as defined in Section 6 of the 1944 Flood Control Act, and the EA provides an evaluation of the direct, indirect, and cumulative environmental impacts of the proposed action and the “no action” alternatives for obtaining 100,000 AF surplus water. The use of a total of 257,000 acre-feet of storage (100,000 acre-feet of yield) is analyzed in the report, and accounts for the total amount for which current and future easements will be allowed to use from Lake Sakakawea. In addition, the cumulative effects analysis conservatively assumed 10,000 AF to be identified as surplus at each of the other Missouri River Projects. Thus, the EA depletions analysis does account for currently proposed intakes, as well as future M&I intakes that are likely to occur. In addition, typical intake designs that are thought to be representative of future applications were evaluated in order to give an approximation of how the features are likely to be constructed and what environmental impacts might be expected thereof. Future applications that are received by the Corps for water intakes will however require separate, independent NEPA review in order to evaluate site specific impacts that cannot be evaluated in this document.</p> <p>All future easements and water supply contracts will require review by the Corps of Engineers prior to allowing placement of infrastructure. In this process, the Corps will complete NEPA evaluations and comply with all appropriate environmental laws and regulations.</p>
<p>58. The Corps didn't consider climate change in its analysis.</p>	<p><u>Response:</u> Climate change is inconsequential considering the short term nature of the analysis.</p>
<p>59. This action requires an EIS.</p>	<p><u>Response:</u> Based on the environmental assessment the conclusion is that a finding of no significant impact (FONSI) is warranted.</p>
<p>Other</p>	
<p>60. The timing of this study is poor considering recent demand for water by oil and gas industry. This study should not delay or become an impediment to the development of irrigation and/or M&I projects.</p>	<p><u>Response:</u> The real estate policy guidance was enacted in July of 2008, which changed District processes for issuing easements. The District is applying those processes.</p>
<p>61. Why is this separate study even necessary when the Corps is already conducting the Missouri River Authorized Purposes Study (MRAPS)? Why can't the Corps lump the water supply issues in with that study and handle all of those Missouri River issues at the same time. How will the Corps coordinate these various studies.</p>	<p><u>Response:</u> MRAPS authorized the Corps to study the Missouri River Projects located within the Missouri River to review the authorized project purposes based on the 1944 Flood Control Act and subsequent legislation and judicial rulings to determine whether changes to the project purposes or existing federal water resources infrastructure are warranted. A study to identify surplus water in Lake Sakakawea is outside the scope of that study. However, the Corps is developing a comprehensive strategy to address long term regional water needs that may involve the Administration, Congress, and stakeholders. The Corps will consider its current studies as part of the overall strategy.</p>

Table 17
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Thematic Comments	Responses
<p>62. Is the water needed to meet the flows required under the current Master Manual considered an allocation, and will allowing use of surplus water impact the downstream flows?</p>	<p><u>Response:</u> The water needed to meet the flows required under the Master Manual is not considered an allocation. The Corps has determined that use of surplus water for municipal and industrial purposes as analyzed in this report would not have a significant effect on other authorized uses or change the way the system is operated under the current Master Manual because of the relatively small amount of water that is being used in light of the total system storage. In addition, the 2004 Master Manual Review and Update assumed depletions from the system for current and future depletions, which included both municipal and industrial use as well as irrigation.</p>
<p>63. ND Parks – The report only uses numbers to 2006, and updated visitation numbers should be used in the report to account for variation in visitation between low water (2006) and 2009 and 2010 (more normal years).</p>	<p><u>Response:</u> The report has been updated to include the most current visitation information.</p>
<p>64. Nowhere does the Draft Report identify or quantify reservoir allocations for authorized project purposes (specifically irrigation).</p>	<p><u>Response:</u> There is not a specific allocation of storage for the irrigation project purpose. Storage from the carryover is used for the irrigation purpose, as well as other purposes. Based on the original authorization and the Missouri Cost Allocation (1958), while the projects were authorized and designed to accommodate large amounts of storage for irrigation water, the actual demand has not developed as anticipated.</p>
<p>65. The proposed water intakes would require easements across tribal lands, and may conflict with existing pipelines from existing water intakes.</p>	<p><u>Response:</u> The Corps may only grant property interests on land it administers. If an intake location requires the user to cross Tribal or Forest Service land, those entities are authorized to deny the request or grant them with whatever restrictions they think are advisable.</p>
<p>66. These newly proposed water intakes may compete with tribal sales of water to the oil and gas industry again negatively affecting the MHA Nation.</p>	<p><u>Response:</u> The Corps has no authority to deny an easement request for access to water to which the user has a valid legal interest because the user may compete with a Tribe for water sales.</p>
<p>67. There is more than enough groundwater to supply needs of the oil and gas industry.</p>	<p><u>Response:</u> Based on data the Corps gathered the North Dakota Water Commission is opposed to the use of ground water for oil and gas development because that source is allocated to the extent the Commission feels is advisable. Future allocations of groundwater for this purpose are uncertain.</p>
<p>68. If the Corps is operating the system to meet the needs of downstream intakes, will water supply agreements be necessary for downstream intakes?"</p>	<p><u>Response:</u> Under the Master Manual, releases to meet the needs of downstream water intakes are made "to the extent reasonably possible", so releases are not guaranteed. If a downstream user required a specific, single purpose water supply release, the Corps would require a water supply agreement for that purpose. There have been times when downstream intakes were put out of service because it was not "reasonable" for the Corps to make a release to meet the minimum flow requirements.</p>
<p>69. Provide source of Reclamation depletions used by the Corps for their modeling.</p>	<p><u>Response:</u> A report documenting depletions for the RRVWSP was provided by the Reclamation's Great Plains Regional Office and is titled "A Study to Determine the Historic and Present-Level Streamflow Depletions in the Missouri River Basin for the Period 1929 to 2002", Dated January 2005.</p>
<p>70. Infrastructure needs to be included in table 3-30 to make the comparison analogous.</p>	<p><u>Response:</u> The infrastructure costs were not included for any of the alternatives. The alternative costs include the provision of supply. Infrastructure costs for the permit applications are available, but only general (and much higher) infrastructure costs for the Williston Plant are provided at this time.</p>

Table 17
Thematic Comment Responses

Thematic Comments	Responses
71. Report is not consistent with Corps policy to exclude the permanent pool from usable storage	<u>Response:</u> As part of this Garrison Surplus Water Report the Corps examined the way the system is operated. Garrison in cooperation with the other mainstem projects is operated to service project purposes by using the available water in the system including the permanent pool. Because of this reason, it is appropriate to include the permanent pool as part of the total usable storage in our calculations.
72. Accurate water usage data should be obtained by the Corps	<u>Response:</u> The Corps obtained reported usage records from the State on as many easements as possible on Lake Sakakawea. These records were used in the demand analysis. Additional information on tribal intakes constructed under Reclamation authorities were also added and considered.
73. U.S. Fish and Wildlife Service recommendations for avoiding adverse impacts to Fish and Wildlife resources, including T&E species.	<u>Response:</u> The Corps has reviewed and incorporated recommendations from the U.S. Fish and Wildlife Service on monitoring amount of water withdrawn at intake sites, avoiding impacts to T&E species, migratory birds, and other natural resources considered to be of high value.
74. Length of comment period was insufficient to provide comments.	<u>Response:</u> The comment period was originally scheduled from 16 December 2010 through 17 January 2011. In response to several requests for additional review time, a fifteen day extension was granted and comments were collected through 1 February 2011. A public meeting was also held on 6 January 2011 in Bismarck, ND to provide the public opportunity to provide comments.
75. Sediment storage should be designated in the Permanent zone rather than Carry over multiple use pool.	<u>Response:</u> We have changed the document to state that the permanent pool will be utilized.
76. Coordinate with the State of North Dakota on water use.	<u>Response:</u> The Corps has worked extensively with North Dakota to gather data and has used the best available information for an accurate depiction of water use.
77. Need more information to be able to complete a review.	<u>Response:</u> The Corps responded to all requests for more information that were received during the comment period.

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Appendices

Appendix A - Stratigraphy of the Williston Basin in Western North Dakota

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Basement Rocks (Precambrian)

Basement is the crust of the earth extending from the base of sedimentary cover down to the Mohorovicic discontinuity, or all Precambrian rocks. The Precambrian is subdivided into two eons. The older is the Archean Era, from between 4 to 2.5 billion years while the younger, Proterozoic Era occurred between 2.5 to 0.670 billion years. Phanerozoic deposition in the Williston Basin began on a surface of weathered basement rocks. The geology of the Precambrian rocks underlying the Williston Basin is complex, consisting of many juxtaposed, fault-bounded lithostructural domains (USACE, 2007). In general, basement rocks do not produce oil in North Dakota.

Sauk Sequence (Cambrian-Lower Ordovician)

The Sauk Sequence begins with the earliest records of sedimentation in the Williston Basin during the Phanerozoic Eon. The Upper Cambrian Deadwood Formations are the beginning of the Sauk Sequence in the Williston Basin (USACE, 2007). The Cambrian sea transgressed eastward into an embayment on the edge of the Cordilleran shelf and deposited siliciclastic sediments, sands and shales, as the dominant sediment type in North Dakota. During Lower Ordovician, carbonate sediments began to be deposited in the center of the basin, which was now formed and had begun to subside (LeFever et al., 1987). The Cambrian Deadwood Formation produces oil along the Nesson anticline, in eastern Williams and McKenzie counties, and in Newporte Field in Renville County.

Tippecanoe Sequence (Ordovician-Silurian)

The Williston Basin began to be a slightly negative area during deposition of the Tippecanoe Sequence allowing epicontinental seas to invade from the south and east (USACE, 2007). Equivalent strata are thought to have covered a much greater area, once extending at least as far as Nebraska to the south and southeast, but later erosion has removed much of the strata. Deposition was continuous across the Ordovician-Silurian boundary and sedimentation continued at least until Middle Silurian. The top of the sequence is a major erosional unconformity that has removed an unknown amount of strata. Two major groups of formations comprise this sequence: the Winnipeg Group and the Bighorn Group.

Winnipeg Group

Sedimentation in the Tippecanoe Sequence begins with the Winnipeg Group. The Black Island, Icebox, and Roughlock formations of the Winnipeg Group were deposited in marginal to shallow marine environments (Carlson, 1960). The Black Island Formation has two members; the lower member is comprised of two lithofacies, a lower red-bed lithofacies containing quartz arenites and "clayshales", and an upper green quartz wacke. The Icebox Formation, an organic rich green shale, is thought to be a source rock for Lower Paleozoic reservoirs. The Roughlock Formation is predominantly a nodular limestone and is transitional with the overlying Red River Formation (LeFever et al., 1987). The Winnipeg Group produces hydrocarbons on the Nesson anticline and at Richardton and Taylor fields, and on the Heart River anticline in eastern Stark County. In both areas, production is from Black Island sandstones and natural gas is the dominant hydrocarbon produced.

Bighorn Group

The Big Horn Group is comprised of four formations: the Red River, Stony Mountain, Stonewall, and Interlake Formations. The Red River Formation is the basal unit of the Big Horn Group and the formation conformably overlies the Roughlock Formation of the Winnipeg Group.

The Red River Formation is predominantly limestone or dolomitic limestone with some evaporite beds. It is the second most important hydrocarbon-producing horizon in North Dakota and produces oil and gas in many fields across most of the western part of the state. Most Red River Formation production occurs west of the Nesson anticline, in the deepest parts of the basin, and is associated with structural closures. Red River production occurs mostly at depths from 8500 to 9500 ft (Heck et al., 2007).

The Stony Mountain Formation conformably overlies the Red River Formation and is comprised of interbedded calcareous shales and argillaceous³⁰ limestones. The Stony Mountain Formation is rarely productive for hydrocarbons, but where it is productive, it is always associated with a Red River Formation structure.

The Stonewall Formation is the uppermost formation in the Big Horn Group and conformably overlies the Stony Mountain Formation. Continuous sedimentation occurred across the Ordovician-Silurian boundary and dolomites and limestones, with thin anhydrite beds near the basin center, were deposited. The Stonewall Formation produces oil and gas from several zones, usually associated with a Red River structure.

The Interlake Formation conformably overlies the Stonewall Formation and records latest Tippecanoe Sequence deposition. The formation was exposed from Late Silurian through Early Devonian when karst topography was formed. Interlake lithologies are dominated by dolomitic mudstones and dolomites. The upper Interlake Formation is commercially productive in structural traps along the Nesson Anticline (Carlson and Anderson, 1965). The middle Interlake Formation is productive in two fields in Stark County and the lower Interlake Formation produces from two porosity zones. Typically, oil with a significant volume of gas is produced from Interlake reservoirs (Heck et al., 2007).

Kaskaskia Sequence (Devonian-Mississippian)

The Kaskaskia Sequence is divided into two parts: upper and lower. Limestones dominate the Kaskaskia Sequence rock-record, but two major evaporate sections are preserved. Rocks of the lower cycle record a northwest connection into the Elk Point Basin while deposition in the upper cycle records a westward connection into the Central Montana Trough.

Lower Kaskaskia Sequence

Elk Point Group

The initial Kaskaskia Sequence transgression into the basin was from the northwest out of the Elk Point Basin. At the base of the sequence is the Ashern Formation with two members, a lower red dolostone and an upper gray dolostone. The lower member was deposited in a restricted marine environment, whereas the upper member records a change to a less restricted environment as marine transgression continued. Both nodular and bedded anhydrite is present

³⁰ Containing, made of, or resembling clay.

throughout the Ashern, but is more common in the lower member. The Ashern Formation is non-productive for hydrocarbons in North Dakota.

The Winnipegosis Formation conformably overlies the Ashern Formation and is dominantly a limestone. Commercial production of this formation has been established in North Dakota at Temple, Hamlet, and Round Prairie Fields. The Winnipegosis Formation produces oil and a large volume of natural gas.

After major reef building events of the early Winnipegosis, the basin became restricted and the evaporites of the Prairie Formation were deposited. With time, salt deposition spread from the basin onto the basin margins. The restriction continued until eventually, the reefs became encased in salt (Heck et al., 2007). Dissolution of the Prairie salt is an important local trapping mechanism in the Williston Basin. Beds draped across dissolution edges enhanced closure, as exhibited by Glenburn, Sherwood, and Wiley fields, while two stage salt dissolution formed the "Nisku Reefs" of northeastern Montana (Heck et al., 2007).

Manitoba Group

The Manitoba Group of formations (Dawson Bay and Souris River Formations) is characterized by deposition associated with the reopening of the northern seaway into North Dakota and unrestricted marine circulation. The Dawson Bay Formation was deposited on a stable, low relief shelf and consists of limestone and dolomitic limestone. Anhydrite beds in the upper Dawson Bay Formation record renewed restriction of the seaway into the Williston Basin.

The Dawson Bay Formation has produced oil in three North Dakota fields. Porous carbonates pinch out updip on a structural nose resulting in significant oil production at Dolphin and Temple fields (Heck et al., 2007). At Marmon Field, the trap is essentially the same as at Dolphin and Temple fields, but the volume of oil produced is insignificant. In western North Dakota, porosity in the Dawson Bay Formation is generally saltplugged. However, the localized dissolution of the pore-filling salt can form or enhance a stratigraphic trap as is the case in Dolphin Field. Dawson Bay production is primarily oil, but with a significant volume of associated natural gas.

The Souris River Formation conformably overlies the Dawson Bay Formation, and is lithologically similar. The formation's interbedded carbonates and evaporites are evidence that the marine restriction, begun during latest Dawson Bay deposition, continued into Souris River deposition. The Souris River Formation is not considered to be an important oil producing zone.

Jefferson Group

The Duperow Formation conformably overlies the Souris River Formation. The Duperow Formation produces hydrocarbons from stratigraphic traps in the central Williston Basin, from structural traps along the Nesson anticline, and from combination traps on the Billings anticline. The Duperow Formation also produces on the eastern flank of the Cedar Creek anticline. The Duperow Formation is the third largest oil-producing zone in the state, after the Madison Group and the Red River Formation, and produces a combination of oil and natural gas.

The Birdbear (Nisku) Formation conformably overlies the Duperow Formation and consists mainly of limestones that change upwards into anhydrites and dolomites (Carlson and Anderson, 1965). The Birdbear Formation is quite porous and produces oil and natural gas from a variety of traps. In North Dakota, the formation also produces from small structures on the Nesson Anticline.

The Three Forks Formation conformably overlies the Birdbear Formation and consists of shale, anhydrite, siltstone, and dolomite deposited in shallow marine to supratidal environments (Carlson and Anderson, 1965). A thin layer of sandstone, called the Sanish sandstone, can be developed at the top of the Three Forks Formation. The Sanish sandstone produces oil and gas in Antelope Field on the Nesson Anticline and is one of the largest oil pools in the state (Heck et al., 2007).

Bakken Formation

The Bakken Formation conformably overlies the Three Forks Formation in the basin center, and unconformably overlies it elsewhere (Heck et al., 2007). The Bakken Formation is expansive. Beneath approximately 200,000 square miles of the Williston Basin in North Dakota, Montana, Saskatchewan, and Manitoba, the Bakken Formation and is one of the largest contiguous deposits of oil and natural gas in the United States (Pollastro, 2008). It is an interbedded sequence of uniform, clastic, black shale, siltstone, and sandstone. The Bakken was deposited within the Williston Basin and is Late Devonian to Early Mississippian in age. The Bakken Formation consists of a lower shale member, a middle sandstone member, and an upper shale member.

The formation overlies truncated and weathered Upper Devonian Big Valley and Torquay formations in Saskatchewan, the Lyleton Formation in Manitoba, and Three Forks Formation in North Dakota and Montana (Smith et al., 1995; Christopher, 1961), and is conformably overlain by the Lodgepole Formation (Lower Mississippian) in North Dakota and Manitoba and the Souris Valley Beds in Saskatchewan (LeFever et al., 1991).

The Lower Bakken Member

The lower Bakken member is an organic rich, black mudstone with an average 8-percent total organic carbon and a maximum of 20-percent TOC. The shale averages 10 feet in thickness over the Williston Basin and has a maximum thickness of 65 feet at the basin depocentre near the Nesson Anticline in North Dakota (Halabura et al., 2007).

The Middle Bakken Member

The middle Bakken member has been informally subdivided into three units, A, B, and C. Unit A consists of dark grey to greenish grey, intensely bioturbated, massive, calcareous, highly fossiliferous siltstone. Unit B consists of dark grey cross-bedded, calcareous coarse- to very fine-grained sandstone to siltstone. Unit C is a grey and green, massive, dolomitic, argillaceous, slightly bioturbated, fossiliferous siltstone (Halabura et al., 2007).

The Devonian-Mississippian boundary occurs at the contact between units A and B. The middle member contains on average less than 1-percent TOC with rare concentrations of up to 7-percent TOC in mudstone layers. For this reason, the middle Bakken is not considered to be a source rock, but rather the unit in which hydrocarbons have migrated and have been trapped under suitable conditions (Halabura et al., 2007).

The Middle Bakken member overlaps the depositional and/or erosional edge of the lower member. All units are at a maximum thickness near the centre of the Williston Basin in North Dakota and thin to zero toward its northern, southern, and eastern margins. The total thickness of the middle Bakken member averages 43 feet in the Williston Basin with a maximum of 65 feet just east of the Nesson Anticline in North Dakota. Areas of significant thinning include the basin margins and east-central Saskatchewan (Halabura et al., 2007).

The Upper Bakken Member

The upper Bakken member consists of a dark grey to brownish-black to black fissile, noncalcareous, carbonaceous, and bituminous shale composed of illite and minor quartz, orthoclase feldspar, dolomite, and pyrite (Halabura et al., 2007). The upper member has an average basin wide thickness of 6-7 feet, but attains a maximum of 28 feet in North Dakota. The depocentre of the upper member is however, poorly defined. The upper Bakken member, by overlap of the middle Member, presents the largest surface area of the three Bakken members (Halabura et al., 2007).

Upper Kaskaskia Sequence

Deposition of the upper Kaskaskia Sequence began sometime after the middle Lodgepole deposition. At that time, the sedimentation in the basin records a change in sediment source from the Elk Point Basin to the Central Montana Trough (LeFever and Anderson, 1984). Two groups of formations, the Madison and Big Snowy Group comprise the Upper Kaskaskia Sequence. Within the Upper Kaskaskia Sequence, the Madison Group's Mission Canyon Formation and Charles Formation produce the largest quantity of oil in North Dakota.

Madison Group

The Madison Group is made up of three formations: the Lodgepole, Mission Canyon, and Charles. The Lodgepole Formation conformably overlies the Bakken Formation in the basin center, and unconformably onlaps Upper Devonian strata in both eastern North Dakota and along the Cedar Creek anticline. The formation consists of limestones and dolomites deposited in normal marine to restricted shelf environments (Heck et al., 1997). The Lodgepole Formation produces significant quantities of oil in North Dakota from the Dickinson Lodgepole pool. Lodgepole wells in this pool, and several nearby fields, are capable of producing several thousand barrels per day.

The Mission Canyon Formation consists primarily of limestones interbedded with anhydrites and dolomites. The Mission Canyon Formation is porous with structural traps. As a result, this formation has produced more oil than any other stratigraphic unit in the Williston Basin.

The Charles Formation overlies Mission Canyon. It consists of interbedded evaporites and limestones deposited in a restricted marine environment. The Charles Formation records a major marine regression during the upper Kaskaskia Sequence. Approximately 60-percent of the oil produced in North Dakota has come from the Charles and Mission Canyon formations.

Big Snowy Group

The Big Snowy Group overlies the Madison Group. Two formations: the Kibby and Otter formations comprise this group and both formations consist of interbedded sandstones, shales, and limestones.

The Kibbey Formation is productive for oil along the Weldon fault in Montana and from one well in Red Wing Creek Field, North Dakota. In central North Dakota, the unconformity at the top of the Kaskaskia Sequence truncated only the Otter Formation. Elsewhere, variable amounts of Kaskaskia Sequence strata are missing.

Absaroka Sequence (Pennsylvanian–Triassic)

During Absaroka deposition, marine transgressions were from the southwest, and deposition was concurrent with tectonic activity southwest of the Williston Basin. As a result, this sequence is made of interbedded, marginal marine evaporites and terrestrial rocks that record sedimentation within the basin. The Minnelusa Group makes up the formation of the Absaroka Sequence.

Minnelusa Group

Deposition of the Tyler Formation (Pennsylvanian) occurred in a slowly subsiding basin and recorded the beginning of the Absaroka Sequence. The Tyler Formation has a lower unit of interbedded shales, mudstones, and sandstones; and an upper unit of interbedded limestones, calcareous mudstones, and anhydrites. The Tyler Formation produces oil from the sandstones and is limited mostly to southwestern North Dakota. The source rocks for this oil are thought to be the shales within the Tyler and possibly the limestone beds.

Zuni Sequence (Jurassic–Early Tertiary [Eocene])

Zuni Sequence sedimentation marks a shallow marine transgressive event during the Jurassic. The top of the Jurassic is marked by marine regression and subareal exposure when a second and significant transgressive event occurred, and deposition continued in shallow marine conditions throughout most of the sequence. Sedimentation during the later portion of this second transgressive phase is marked by an increase in clastic deposition. The erosion of the Laramide Rockies sourced the clastics. The last marine sediments in the Williston Basin were deposited during early Paleocene in the late Zuni Sequence.

Tejas Sequence (Tertiary to Quaternary)

Few lower Tejas sediments are present in the Williston Basin. Where present, these sediments consist of localized limestones and shaly sandstones that correlate to White River formation sediments elsewhere. Throughout much of the basin, glacial sedimentation defines the upper Tejas Sequence and thick glacial till and drift can be found throughout much of Manitoba, eastern Montana, Saskatchewan, and North Dakota.

Surficial Geology

Poorly consolidated sediments and lignite (soft coal) beds of the Tertiary-age Fort Union Formation characterizes the surficial geology of the entire Lake Sakakawea project area. The Fort Union Formation mainly consists of alternating beds of moderately to well compacted, gray to brown, stiff to hard clay shale, with moderately to well compacted silt and fine sand, and numerous lignite beds. The lignite beds are jointed and frequently contain water. The bedding ranges from very thin to more than 15 feet thick. Thin limestone and sandstone beds and/or concretions occur infrequently. Overlying the Fort Union Formation are Pleistocene glacial till and alluvial deposits (sands, gravels, and alluvial clays). Because the Fort Union Formation and the overlying glacial till and alluvium are so highly erodible, when packed snow in gullies melts, it saturates, dissociates, and frequently collapses the unconsolidated sediment out from under any vegetative cap that may exist. Clumps of soil and turf then slough off into the gully and are eroded by surface runoff. This process is often initiated by piping, which is the process by which water percolating through the soil dissolves and carries away soil particles. Piping results in fissure-like channels in and beneath several feet of silt-clay soils and sediments. Rainfall-

generated gully erosion also probably delivers sediment down pre-existing gullies into embayments.

Because of such erosional mechanisms, unstable slopes created along Lake Sakakawea's shoreline may not stabilize for many years and may continue to erode back through adjacent land in the more actively eroding areas.

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Appendix B – Gubernatorial and Agency Correspondence

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Example Letter to the Governors



REPLY TO
ATTENTION OF

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS, OMAHA DISTRICT
1616 CAPITOL AVENUE
OMAHA NE 68102-4901

SEP 21 2010

District Commander

Honorable Dave Heineman
Governor of Nebraska
P.O. Box 94848
Lincoln, Nebraska 68509-4848

Dear Governor Heineman:

The U.S. Army Corps of Engineers, Omaha District (Corps) has received new requests for water storage at several of its reservoirs, which cannot be processed until a Surplus Water Letter Report with appropriate National Environmental Policy Act documentation has been completed for each of the reservoirs. The purpose of a Letter Report is to identify and quantify surplus water storage, which the Secretary of the Army can use to execute temporary (5-10 years) surplus water storage contracts. The Letter Reports will also determine the updated cost of water storage. A system wide reallocation study will be undertaken in the future to address the needs for long-term water storage.

The Letter Reports will be completed in accordance with Engineering Regulation-1105-2-100, Planning Guidance Notebook and the Revised U.S. Army Institute for Water Resources Report 96-PS-4, a Handbook on Water Supply Planning and Resource Management. The Water Surplus Letter Report Outline will include the following:

1. Purpose
 - a. Request for Municipal and Industrial water supply
 - b. Authority for seeking reallocation
2. Project Background
 - a. Project authorization, construction and operation history
 - b. Project purpose and outputs
 - c. Project map and pertinent data table
 - d. Information on previous water supply agreements
3. Economic Analysis
 - a. Water supply demand analysis
 - b. Analysis of water supply alternatives (benefits)
 - c. Impacts on other project purposes (benefits forgone)
 - d. Information on approved cost allocation
4. Derivation of User Cost
 - a. Water supply storage/yield analysis
 - b. Cost of storage analysis

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- c. Revenues foregone and cost account adjustments
- d. Summary, user cost

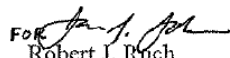
- 5. Other Considerations
 - a. Test of financial feasibility
 - b. Cost account adjustments
 - c. Environmental considerations

- 6. Conclusions and Recommendations
 - a. Summarization of findings
 - b. Reference applicable appendices
 - c. Recommendation of District Engineer

- 7. Appendices
 - a. National Environmental Protection Act Documentation (Environmental Assessment/Finding of No Significant Impact)
 - b. Documentation of opportunity for public review action
 - c. Letters and views of Tribes, federal, state and/or local interests affected by the action

The Corps is committed to transparent communication regarding these important decision documents. The Corps is contacting state, tribal and federal agencies to assist in development of the Surplus Water Letter Reports which will be provided for your review and comment in January 2011. If you have any additional questions regarding the letter reports please contact the Project Manager, Mr. Larry Janis, Branch Chief Recreation and Natural Resources by telephone at (402) 995-2697 or by email at larry.d.janis@usace.army.mil. The Corps looks forward to working with you in the completion of this important report.

Sincerely,


FOR
Robert J. Ruch
Colonel, Corps of Engineers
District Commander

Example Letter to Agencies



REPLY TO
ATTENTION OF

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS, OMAHA DISTRICT
1616 CAPITOL AVENUE
OMAHA NE 68102-4901

September 21, 2010

Planning Branch

Ms. Cheryl Kulas
North Dakota Indian Affairs Commission
600 East Boulevard Avenue
State Capitol, 1st Floor, Judicial Wing, Room #117
Bismarck, North Dakota 58505

Dear Ms. Kulas:

The U.S. Army Corps of Engineers, Omaha District (Corps) has received new requests for water storage at Lake Sakakawea which cannot be processed until a Surplus Water Letter Report with appropriate National Environmental Policy Act (NEPA) documentation has been completed. The purpose of the Letter Report is to identify and quantify surplus water storage, which the Secretary of the Army can use to execute temporary (5-10 years) surplus water storage contracts. The Letter Reports will also determine the updated cost of water storage. A system-wide reallocation study will be undertaken in the future to address the needs for long-term water storage.

The Letter Report will be completed in accordance with Engineering Regulation-1105-2-100, Planning Guidance Notebook and the Revised U.S. Army Institute for Water Resources Report 96-PS-4, A Handbook on Water Supply Planning and Resource Management. The Water Surplus Letter Report Outline will include the following:

1. Purpose
 - a. Request for Municipal and Industrial water supply
 - b. Authority for seeking reallocation
2. Project Background
 - a. Project authorization, construction and operation history
 - b. Project purpose and outputs
 - c. Project map and pertinent data table
 - d. Information on previous water supply agreements
3. Economic Analysis
 - a. Water supply demand analysis
 - b. Analysis of water supply alternatives (benefits)
 - c. Impacts on other project purposes (benefits forgone)
 - d. Information on approved cost allocation
4. Derivation of User Cost
 - a. Water supply storage/yield analysis
 - b. Cost of storage analysis

-2-

- c. Revenues foregone and cost account adjustments
- d. Summary, user cost

- 5. Other Considerations
 - a. Test of financial feasibility
 - b. Cost account adjustments
 - c. Environmental considerations

- 6. Conclusions and Recommendations
 - a. Summarization of findings
 - b. Reference applicable appendices
 - c. Recommendation of District Engineer

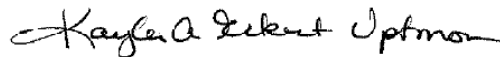
- 7. Appendices
 - a. NEPA Documentation (Environmental Assessment/Finding of No Significant Impact)
 - b. Documentation of opportunity for public review action
 - c. Letters and views of tribes, federal, state and/or local interests affected by the action

The Corps is committed to transparent communication regarding this important decision document. We will be holding an agency meeting on September 29, 2010 in Bismarck, North Dakota. Once we have set up the meeting location and agenda we will send it out by e-mail to those who have expressed interest in attending. The purpose of the meeting is to provide information to the agencies on the study as well as give the agencies an opportunity to ask questions and provide initial feedback. If you are interested in participating in this effort, please contact Ms. Tiffany Vanosdall:

U.S. Army Corps of Engineers
Attention: CENWO-PM-AA (Tiffany Vanosdall)
1616 Capitol Avenue
Omaha, Nebraska 68102-1901
Phone number: (402) 995-2695
Fax number: (402) 995-2758
E-mail: tiffany.k.vanosdall@usace.army.mil

The Corps looks forward to working with you in the completion of this important report.

Sincerely,



KAYLA A. ECKERT UPTMOR
Chief, Planning Branch

Appendix C – North Dakota Natural Heritage Inventory

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The North Dakota Natural Heritage Inventory provides a comprehensive system (Heritage System) for identifying and prioritizing ecologically significant natural features in the state including species of concern. A species of concern is not legally protected unless it is also listed on the Federal threatened and endangered species list. Each species of concern receives a state rank and global rank which indicates its status within the state and globally. Appendix C explains these ranks and lists all species of concern that have been recorded to occur within one of the six counties bordering Lake Sakakawea (Dunn, McLean, McKenzie, Mercer, Mountrail, and Williams).

The North Dakota Game and Fish Department (NDGFD) also maintain information about nongame wildlife in the state. In 2001, Congress approved legislation authorizing Federal dollars for States to use in developing programs to protect nongame wildlife, now called the State Wildlife Grants (SWG) program. In order to receive funds under the program, the NDGFD was required to develop a Comprehensive Wildlife Conservation Strategy, which included a list of 100 species of conservation priority (USACE, 2007). The species on the list are declining in the state of North Dakota or have stable populations in North Dakota but are declining elsewhere. Invertebrates were excluded from the list because of a lack of information on status and distribution of invertebrate species in the state, with the exception of mussels. Plants were excluded because the Comprehensive Wildlife Conservation Strategy applies only to animals. Species were classified as a Level I, Level II, or Level III species of conservation priority to determine their priority for SWG funding:

Level I species. These species are declining and currently receive little or no monetary support for conservation efforts. These species have a high level of conservation priority because of declining status either in North Dakota or across their range or have a high rate of occurrence in North Dakota, constituting the core of the species' breeding range but are at-risk range wide.

Level II species. The NDGFD will use SWG funding to implement conservation actions to benefit these species if SWG funding for a Level I species is sufficient or conservation needs have been met. Level II species have a moderate level of conservation priority or a high level of conservation priority but a substantial amount of non-SWG funding is available to them.

Level III species. These species have a moderate level of conservation priority but are believed to be peripheral or non-breeding in North Dakota. Appendix D includes the table of species of conservation priority that occur in the eight counties bordering Lake Sakakawea. Because the NDNHP and NDGFD compiled their species of concern and species of conservation priority lists separately using different methodologies, some species may be on one list but not the other.

Natural Heritage Program State and Global Ranks

State Rank	Description
S1	Critically Imperiled – Critically imperiled in the state because of extreme rarity or because of some factor of its biology making it especially vulnerable to extirpation from the state. Typically 5 or fewer occurrences or very few remaining individuals (<1,000). [Critically endangered in state.]
S2	Imperiled – Imperiled in the state because of rarity or because of other factors making it very vulnerable to extirpation from the state. Typically 6 to 20 occurrences or few remaining individuals (1,000 to 3,000). [Endangered in the state.]
S3	Vulnerable – Vulnerable in the state either because rare and uncommon, or found only in a restricted range (even if abundant at some locations), or because of other factors making it vulnerable to extirpation. Typically 21 to 100 occurrences or between 3,000 to 10,000 individuals. [Threatened in the state.]
S4	Apparently Secure – Uncommon but not rare, and usually widespread in the state. Possible cause of long-term concern. Usually more than 100 occurrences and more than 10,000 individuals.
S5	Secure – Common, widespread, and abundant in the state. Essentially ineradicable under present conditions. Typically with considerably more than 100 occurrences and more than 10,000 individuals.
SX	Presumed Extirpated – Element is believed extirpated from the state. Virtually no likelihood that it will be rediscovered.
SH	Possibly Extirpated (Historical) – Elements occurred historically in the state, and there is some expectation that it may be rediscovered. Its presence may not have been verified in the past 20 years.
S?	Unranked – State rank not yet assessed.
SU	Unrankable – Currently unrankable due to lack of information or due to substantially conflicting information about status or trends.
S#S#	Range Rank – A numeric range rank (e.g., S2S3) is used to indicate the range of uncertainty about the exact status of the element. Ranges cannot skip more than one rank (e.g., SU should be used rather than S1S4).

Global Rank	Description
G1	Critically Imperiled – Critically imperiled globally because of extreme rarity or because of some factor of its biology making it especially vulnerable to extinction. Typically 5 or fewer occurrences or very few remaining individuals (<1,000) or acres (<2,000) or stream miles (<10). [Critically endangered throughout its range.]
G2	Imperiled - Imperiled globally because of rarity or because of other factors demonstrably making it very vulnerable to extinction or elimination throughout its range. Typically 6 to 20 occurrences or few remaining individuals (1,000 to 3,000) or acres (2,000 to 10,000) or stream miles (10 to 50). [Endangered throughout its range.]
G3	Vulnerable – Vulnerable globally either because very rare and local throughout its range, found only in a restricted range (even if abundant at some locations) or because of other factors making it vulnerable to extinction or elimination throughout its range. Typically 21 to 100 occurrences or between 3,000 and 10,000 individuals. [Threatened throughout its range.]
G4	Apparently Secure – Uncommon but not rare (although it may be quite rare in parts of its range, especially at the periphery), and usually widespread. Apparently not vulnerable in most of its range, but possibly cause for long-term concern. Typically more than 100 occurrences and more than 10,000 individuals.
G5	Secure – Common, widespread, and abundant (although it may be quite rare in parts of its range, especially on the periphery). Not vulnerable in most of its range. Typically with considerably more than 100 occurrences and more than 10,000 individuals.
G#G#	Range Rank – A numeric range rank (e.g., G2G3) is used to indicate uncertainty about the exact status of a taxon. Ranges cannot skip more than one rank (e.g., GU should be used rather than G1G4).
G?	Unranked – Global rank not yet assessed.
T	Intraspecific Taxon (trinomial) – The status of intraspecific taxa (subspecies or varieties) are indicated by a “T-rank” following the species’ basic global rank. A T subrank cannot imply the subspecies or variety is more abundant than the species’ basic global rank (i.e., a G1T2 subrank should not occur).

NDNHP Species of Concern and NDGFD Species of Conservation Priority

Common Name	Scientific Name	State/ Global Rank	Habitat
MAMMALS			
NDGFD Level I Species of Conservation Priority			
Black-tailed prairie dog	<i>Cynomys ludovicianus</i>	SU/G3G 4	Short and mixed grasslands, usually well grazed lands
NDGFD Level II Species of Conservation Priority			
River otter	<i>Lutra canadensis</i>	S1/G5	River, streams, wetlands, lakes, ponds
Black-footed ferret	<i>Mustela nigripes</i>	S1/G1	Prairie dog towns
Pygmy shrew	<i>Sorex hoyi</i>	SU/G5	Near wetland areas to forested tracts
Richardson's ground squirrel	<i>Spermophilus richardsonii</i>	N/A	Native mixed grass prairie
Swift fox	<i>Vulpes velox</i>	S1/G3	Short grass, mixed grass, and sandhill prairies
NDGFD Level III Species of Conservation Priority			
Sagebrush vole	<i>Lemmiscus curtatus</i>	S4/G5	Semi-arid areas with loose soil, usually combination of grass and sagebrush
Western smallfooted myotis	<i>Myotis ciliolabrum</i>	SU/G5	Rugged terrain, strong association with coniferous trees
Long-eared myotis	<i>Myotis evotis</i>	SU/G5	Wooded areas, principally coniferous or oak forests, near rocky bluffs or cliffs
Long-legged myotis	<i>Myotis volans</i>	SU/G5	Rugged terrain, strong association with coniferous trees
Arctic shrew	<i>Sorex arcticus</i>	N/A	Grass-sedge meadows and wet meadows
BIRDS			
NDGFD Level I Species of Conservation Priority			
Baird's sparrow	<i>Ammodramus bairdii</i>	SU/G4	Upland mixed grass or tallgrass prairie
Nelson's sharptailed sparrow	<i>Ammodramus nelsoni</i>	SU/G5	Freshwater prairie marshes and meadows
Grasshopper sparrow	<i>Ammodramussavannarum</i>	N/A	Idle or lightly grazed tall or mixed grass prairie, shrub prairie meadows, hayfields
Sprague's pipit	<i>Anthus spragueii</i>	S3/G4	Upland mixed grass prairie
American bittern	<i>Botaurus lentiginosus</i>	N/A	Variety of wetlands

Common Name	Scientific Name	State/ Global Rank	Habitat
Ferruginous hawk	<i>Buteo regalis</i>	SU/G4	Flat and rolling prairie, grasslands, sagebrush country
Swainson's hawk	<i>Buteo swainsoni</i>	SU/G5	Native prairie or cropland that includes thickets of natural tree growth or brush margins of native forested tracts
Lark bunting	<i>Calamospiza melanocorys</i>	N/A	Sagebrush communities or mixed grass prairie
Willet	<i>Catoptrophorus semipalmatus</i>	SU/G5	Semipermanent, seasonal, permanent, and alkali ponds and lakes, intermittent streams
Black-billed cuckoo	<i>Coccyzus erythrophthalmus</i>	N/A	Brushy margins or woodland openings, thickets of small trees or shrubs
Yellow rail	<i>Coturnicops noveboracensis</i>	S2/G4	Sedge meadows and grassy marshes
Marbled godwit	<i>Limosa fedoa</i>	SU/G5	Wetlands, intermittent streams, and various types of ponds and lakes
American white pelican	<i>Pelecanus erythrorhynchos</i>	N/A	Isolated, barren islands or peninsulas in large lakes or reservoirs
Wilson's phalarope	<i>Phalaropes tricolor</i>	N/A	Shallow wetlands and mudflats
Horned grebe	<i>Podiceps auritus</i>	N/A	Ponds and wetlands with beds of emergent vegetation and substantial areas of open water

NDGFD Level II Species of Conservation Priority

Northern pintail	<i>Anas acuta</i>	S?/G5	Wetland complexes of open water and associated upland prairie
Short-eared owl	<i>Asio flammeus</i>	N/A	Open grasslands, native prairie, wet meadows, or hayfields
Burrowing owl	<i>Athene cunicularia</i>	SU/G4	Dry, open, shortgrass prairie, often associated with burrowing mammals
Golden eagle	<i>Aquila chrysaetos</i>	S3/G5	Badland buttes and adjoining native prairie
Redhead	<i>Aythya americana</i>	N/A	Deep wetlands
Canvasback	<i>Aythya valisineria</i>	N/A	Deep wetlands
Piping plover	<i>Charadrius melodus</i>	S1S2/G3	Barren sand and gravel shores of rivers and lakes, sparsely vegetated shorelines
Northern harrier	<i>Circus cyaneus</i>	N/A	Open grasslands, wet meadows, marshes
Sedge wren	<i>Cistothorus platensis</i>	N/A	Wet meadows of tall grasses and sedges

Common Name	Scientific Name	State/ Global Rank	Habitat
Bobolink	<i>Dolichonyx oryzivorus</i>	N/A	Tallgrass prairie, hayland, and retired cropland
Prairie falcon	<i>Falco mexicanus</i>	S3/G5	Native prairie and cropland, badlands and high cliffs along stream valleys or scattered buttes on the high plains
Bald eagle	<i>Haliaeetus leucocephalus</i>	S1/G4	Lakes and rivers in forested areas
Loggerhead shrike	<i>Lanius ludovicianus</i>	SU/G5	Open country and dry upland prairie where shrubs and small trees occur
Red-headed woodpecker	<i>Melanerpes erythrocephalus</i>	N/A	Mature deciduous trees along river bottoms, shelterbelts, wooded areas of towns
American avocet	<i>Recurvirostra americana</i>	N/A	Ponds or lakes with exposed, sparsely vegetated shorelines
Dickcissel	<i>Spiza americana</i>	N/A	Alfalfa, sweet clover, and other brushy grasslands
Least tern	<i>Sterna antillarum</i>	S1/G4	Sparsely vegetated sandbars of the Missouri and Yellowstone Rivers
Sharp-tailed grouse	<i>Tympanuchus phasianellus</i>	N/A	Mixed grass prairie interspersed with shrubs
NDGFD Level III Species of Conservation Priority			
Peregrine falcon	<i>Falco peregrinus</i>	S1/G4T 3	Cliff ledges, mostly along rivers or lakes
Whooping crane	<i>Grus americana</i>	SX/G1	Extensive marshes with shallow ponds dominated by bulrush, cattails, sedges, and other aquatic plants
Brewer's sparrow	<i>Spizella breweri</i>	S3/G5	Scrub and sage prairie

REPTILES**NDGFD Level I Species of Conservation Priority**

Western hognose snake	<i>Heterodon nasicus</i>	N/A	Dry grasslands with sandy or gravelly soil
Smooth green snake	<i>Liochlorophis vernalis</i>	N/A	Grassland, upland hills

NDGFD Level II Species of Conservation Priority

Common snapping turtle	<i>Chelydra serpentina</i>	N/A	Warm water in permanent lakes or rivers
Short-horned lizard	<i>Phrynosoma douglassi</i>	N/A	Semi-arid, shortgrass prairie in rough terrain

NDGFD Level III Species of Conservation Priority

Sagebrush lizard	<i>Sceloporus graciosus</i>	S4/G5	Badlands, rocky areas near water, adjacent areas of sandy soil and sagebrush
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AMPHIBIANS**NDGFD Level I Species of Conservation Priority**

Canadian toad	<i>Bufo hemiophrys</i>	N/A	Margins of lakes, ponds, and a variety of wetlands
Plains spadefoot	<i>Spea bombifrons</i>	N/A	Dry grasslands with loose or sandy soil

FISH / MUSSELS**NDGFD Level I Species of Conservation Priority**

Blue sucker	<i>Cypleptus elongatus</i>	S3/G3G 4	Deep pools and channels of large rivers
Sturgeon chub	<i>Hybopsis gelida</i>	S2/G3	Large, turbid streams and rivers. Rock on gravel bottom.
Sickelfin chub	<i>Hybopsis meeki</i>	S2/G3	Large, swift flowing rivers with sandy bottom
Pearl dace	<i>Semotilus argarita</i>	S3/G5	Cool, clear ponds, creeks, and lakes

NDGFD Level II Species of Conservation Priority

Northern redbelly dace	<i>Phoxinus eos</i>	S4/G5	Slow flowing creeks with clear water and vegetation
Flathead chub	<i>Platygobio gracilis</i>	S?/G5	Rivers with turbid waters and swift current
Paddlefish	<i>Polyodon spathula</i>	S?/G4	Large rivers with swift currents
Pallid sturgeon	<i>Scaphirhynchus albus</i>	S1/G1	Large, turbid rivers with strong current and firm sand bottom

NDGFD Level III Species of Conservation Priority

Finescale dace	<i>Phoxinus neogaeus</i>	SU/G5	Cool bog lakes, streams, some larger lakes, beaver ponds
Pink papershell mussel	<i>Potamilus ohioensis</i>	SU/G5	Small permanent stream
Flathead catfish	<i>Pylodictis olivaris</i>	N/A	Large rivers in pools with woody debris; impoundments

INSECTS

Flea beetle species	<i>Altica nancyae</i>	S2/G?	Range grasses
Dakota skipper	<i>Hesperia dacotae</i>	S2/G2	Tall grass and mid-grass prairie with little bluestem, needle and thread grass, and purple coneflower
Tawny crescent	<i>Phyciodes batesii</i>	S3/G4	Moist forest borders in riparian situations and moist valley bottoms that border riparian woodlands

PLANTS

Woolly milkweed	<i>Asclepias lanuginosa</i>	S1/G4	Sandy or rocky calcareous prairie
Drummond's milkvetch	<i>Astragalus drummondii</i>	S1/G5	Open or wooded hillsides, ravines
Bent-flowered milkvetch	<i>Astragalus vexilliflexus</i>	S3/G4	Barren badland slopes and buttes
Jointed-spike sedge	<i>Carex athrostachya</i>	S3/G5	Low prairie, marsh margins
Dry-spiked sedge	<i>Carex foenea</i>	S1S2/G5	Aspen woods, ravines
Hayden's sedge	<i>Carex haydenii</i>	S1/G5	Wet meadows, sloughs
Spikerush sedge	<i>Carex scirpoidea</i>	S1S2/G5	Rocky slopes, wet meadows
Slender lip fern	<i>Cheilanthes feei</i>	S1/G5	Dry rocky slopes, on sandstone or limestone
Slender-lobed celmatis	<i>Clematis columbiana var tenuiloba</i>	S1/G5? T4?	Rocky slopes, limestone soil
Blue lips	<i>Collinsia parviflora</i>	S2/G5	Mesic slopes of buttes
Small yellow lady's-slipper orchid	<i>Cypripedium parviflorum</i>	S2S3/G5	Damp woods, fens, stream banks
Nine-anthered dalea	<i>Dalea enneandra</i>	S2S3/G5	Sandy or gravelly slopes, dry mixed grass prairie
Cushion fleabane	<i>Erigeron radicans</i>	S1/G3	Dry, exposed hillsides, buttes at higher elevations
Nodding buckwheat	<i>Eriogonum cernuum</i>	S1/G5	Buttes on scoria or limestone
Dakota buckwheat	<i>Eriogonum visherii</i>	S2S3/G3	Clayey badland buttes and slopes, sandy-clay outwash areas
Stickseed	<i>Lappula cenchrusoides</i>	S1/G4	Dry soils in the open
Twinflower	<i>Linnaea borealis</i>	S4/G5	Moist, wooded (northfacing) slopes

Indianpipe	<i>Monotropa uniflora</i>	S3/G5	Rich shady woods
Sedge mousetail	<i>Myosurus aristatus</i>	S1/G5	Moist areas, vernal wetlands of mixed grass praires
Smooth cliffbrake	<i>Pellaea glabella</i>	S4/G5	Sandstone caprock of buttes and ledges
Alyssum-leaved phlox	<i>Phlox alyssifolia</i>	S1S2/G 5	Sandy, gravelly, or clayey slopes and ridges, buttes
American primrose	<i>Primula incana</i>	S1S2/G 4G5	Alkali wet meadows, fens
Heart-leaved buttercup	<i>Ranunculus cardiophyllus</i>	S1/G4G 5	Wet meadows, seeps
Hayden's yellowcress	<i>Rorippa calycina</i>	SH/G3	Riverbanks, shores
Greenthread	<i>Thelesperma subnudum</i> <i>var marginatum</i>	S2S3/G 5T5	Sandy prairie, open plains
Bog violet	<i>Viola conspersa</i>	S2S3/G 5	Moist woods, stream banks

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