

**Appendix A  
BakkenLink Risk Assessment  
and Environmental  
Consequences Analysis**

**BakkenLink Risk Assessment  
and Environmental  
Consequence Analysis**

Dry Creek to Beaver Lodge  
Pipeline



Prepared for:  
BakkenLink Pipeline LLC

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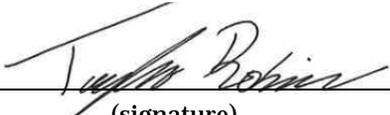
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WITH THE PIPELINE AND HAZARDOUS MATERIALS SAFETY ADMINISTRATION**

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# BakkenLink Risk Assessment and Environmental Consequence Analysis

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## Acronyms and Abbreviations

°F	degrees Fahrenheit
API	American Petroleum Institute
ASTM	American Society for Testing and Materials
BakkenLink	BakkenLink Pipeline LLC
bbbl	barrels
BLM	Bureau of Land Management
BMPs	Best Management Practices
bpd	barrels per day
CPM	computational pipeline monitoring
CFR	Code of Federal Regulations
cfs	cubic feet per second
CWA	Clean Water Act
EA	environmental assessment
ERP	Emergency Response Plan
ERW	electronic resistance welding
FBE	fusion bond epoxy
g/ml	grams per milliliter
HCA	high consequence area
HDD	horizontal direction drilling
IMP	Integrity Management Program
LC <sub>50</sub>	lethal concentration at which 50 percent of organisms die after 48 hours
MCL	maximum contaminant levels
mg/L	milligrams per liter
MOP	maximum operating pressure
NEPA	National Environmental Policy Act
NPDES	National Pollutant Discharge Elimination System
OCC	Operations Control Center
PAH	polycyclic aromatic hydrocarbons
PHMSA	Pipeline and Hazardous Materials Safety Administration
PIG	pipeline inspection gauge
ppm	parts per million
PSC	Public Service Commission
psig	pounds per square inch gauge

## BakkenLink Risk Assessment and Environmental Consequence Analysis

RA	Risk Assessment
ROW	right-of-way
SCADA	Supervisory Control and Data Acquisition
SPCC Plan	Spill Prevention, Control, and Countermeasures Plan
SWPPP	Storm Water Pollution Prevention Plan
U.S.	United States
USA	Unusually Sensitive Area
USACE	United States Army Corps of Engineers
USC	United States Code
USDOT	United States Department of Transportation
USEPA	United States Environmental Protection Agency
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
WT	wall thickness

# BakkenLink Risk Assessment and Environmental Consequence Analysis

## 1.0 PROJECT OVERVIEW

BakkenLink Pipeline LLC (BakkenLink), a wholly owned subsidiary of Great Northern Midstream LLC filed a right-of-way (ROW) application on March 14, 2013, proposing to amend their existing authorization (No. NDM 102507) to construct, operate, and maintain the Project on federal lands in McKenzie and Williams counties, North Dakota, as shown in **Figure 1-1**.

The Project would consist of approximately 37 miles of 16-inch-diameter steel crude oil pipeline extending from the northern terminus of BakkenLink's existing pipeline system (Dry Creek Terminal interconnect point near Johnson's Corner in McKenzie County, North Dakota), across Lake Sakakawea, to a proposed Beaver Lodge Interconnect Facility in Williams County, North Dakota, and also would include an oil receipt facility near Keene, North Dakota. The Project is a continuation of an ongoing crude oil pipeline system that BakkenLink originally proposed to construct between Fryburg, North Dakota, and the Beaver Lodge Interconnect Facility, near Tioga, North Dakota. The proposed pipeline is designed to initially carry up to 100,000 barrels (bbl) per day (bpd), with a maximum design flow rate of 135,000 bpd. The sources of the crude oil that would be transported by the Project are the middle Bakken and upper Three Forks formations (Bakken) of the Williston Basin.

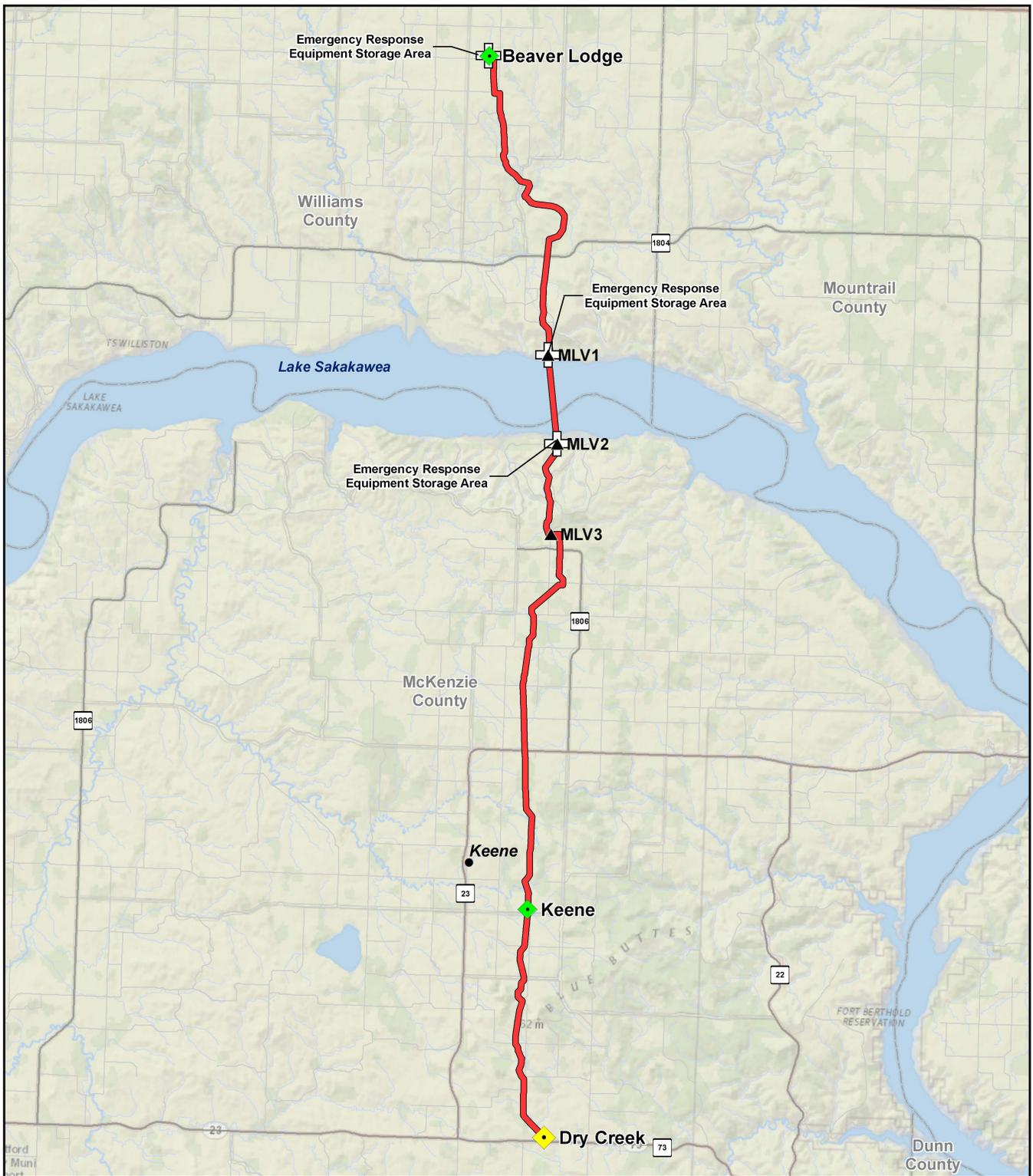
Surface facilities would include pipeline markers, pipeline inspection gauge (pig) launchers and receivers, cathodic protection rectifiers, and block valves. Block valves, including those on either side of Lake Sakakawea, would be remotely actuated, meaning that they could be closed by BakkenLink operators in the event of an emergency. BakkenLink maintains that the pressure provided by storage tank transfer pumps at the receipt locations would be adequate for operation of the pipeline at the current projected flow rates, and as such, no pumping stations would be built as part of the Project.

The crude oil collected by the Project would have improved access to key markets across the United States (U.S.). BakkenLink believes its Project would help to alleviate anticipated pipeline constraints in the Bakken Formation region and reduce the amount of truck mileage for hauling crude oil to truck receipt facility locations.

### **Federal Permitting Process**

The Project would require the issuance of a ROW grant by the Bureau of Land Management (BLM) to cross federal lands. The proposed route crosses federal lands managed by the U.S. Forest Service (USFS) and U.S. Army Corps of Engineers (USACE), which would require ROW easements, special use permits, and other applicable permits. The issuance of the ROW grant across federal lands is considered a federal action and, therefore, the Project is subject to environmental review pursuant to the National Environmental Policy Act (NEPA) (42 United States Code [U.S.C.] § 4321 et seq.). Per Section 28 of the Mineral Leasing Act of 1920, as amended (30 U.S.C. 185), the BLM is the lead federal agency for NEPA compliance (i.e., preparation of an environmental assessment [EA] for the Project) and the USFS, USFWS, and USACE are participating as cooperating agencies.

Consultation with the BLM indicated that an EA would be needed to fulfill NEPA requirements. The EA provides an objective disclosure of beneficial and adverse environmental impacts resulting from the Project, as well as a set of reasonable alternatives and mitigation measures. This Risk Assessment (RA) provides part of the technical basis for the EA, disclosing potential environmental consequences that might occur in the unlikely event of a crude oil release from the Project.



**Project Features**

- Proposed Route
- Existing Receipt Facility
- Proposed Receipt Facility
- Other Facility
- Mainline Valve (MLV)

Source: BakkenLink 2014.

**BakkenLink Dry Creek to Beaver Lodge Pipeline Project**

**Figure 1-1**

**Project Overview**

# BakkenLink Risk Assessment and Environmental Consequence Analysis

## 2.0 Introduction

This RA presents the results of a pipeline incident frequency analysis based on the Project's design and operation criteria and applies the resulting risk probabilities to an environmental consequence analysis that incorporates project-specific environmental data. Specifically, this RA evaluates the risk of crude oil spills during pipeline operations, including probable spill volumes; contribution of natural hazards to spill risk; and the subsequent potential effects on humans and other sensitive resources, particularly in areas of high environmental sensitivity, including federally designated high consequence areas (HCAs) (e.g., certain populated areas, designated zones around public drinking water intakes, and/or ecologically sensitive areas).

Based on agency scoping comments, this RA focuses particular attention to potential impacts to Lake Sakakawea and associated resources. Additional effects on public health and safety that could occur during Project construction are discussed under other resource sections (e.g., air quality, water resources, transportation, land use, and aesthetics) within the EA.

The purpose of this RA is to provide a conservative range of anticipated effects from the operation of the Project that is sufficient for the purposes of NEPA. Given this objective, the analysis summarized within this RA is intentionally conservative (i.e., overestimates risk). The expectation is that the spill frequencies presented in this analysis are not likely to occur, but are provided as a conservative framework to ensure agency decisions are based on knowledge of the potential range of effects.

## BakkenLink Risk Assessment and Environmental Consequence Analysis

### 3.0 Pipeline

The Project would consist of approximately 37 miles of crude oil pipeline extending from Dry Creek Terminal to Beaver Lodge, located in McKenzie and Williams counties, North Dakota (**Figure 1-1**). The 37.1 miles of 16-inch-diameter steel trunk line would have bi-directional capability, and would extend from the northern terminus of BakkenLink's existing pipeline system (Dry Creek Terminal interconnect point near Johnson's Corner in McKenzie County), across Lake Sakakawea, to a proposed Beaver Lodge Truck Facility in Williams County, and also would include a truck receipt facility near Keene. The proposed trunk line is designed to initially carry up to 100,000 bpd, with a maximum design flow rate of 135,000 bpd.

The Project would be designed, constructed, and operated in compliance with applicable portions of the U.S. Department of Transportation (USDOT) regulations as set forth in 49 Code of Federal Regulations (CFR) 195, Transportation of Hazardous Liquids by Pipeline and 49 CFR 194, Response Plans for Onshore Oil Pipelines. These regulations encompass general requirements, accident reporting and safety-related condition reporting, design requirements, construction, pressure testing, operation and maintenance, qualification of pipeline personnel, and corrosion control. Relevant industry standards are incorporated into these regulations by reference, including those of the American Petroleum Institute (API), American Society of Mechanical Engineers, the American Standard for Testing and Materials (ASTM), and others.

The proposed route would extend from multiple receipt points in McKenzie and Williams counties, North Dakota. An overview of the proposed route is presented in **Figure 1-1**. Initially, BakkenLink proposes to use three receipt facility locations for input of crude oil. The facilities, as depicted on **Figure 1-1**, are:

- **Proposed** Beaver Lodge Receipt Facility, Williams County;
- **Proposed** Keene Receipt Facility, McKenzie County; and
- Existing Dry Creek Terminal, McKenzie County.

Key Project design parameters are identified in **Table 3-1**. The proposed pipeline is designed for a maximum temperature rating of 120 degrees Fahrenheit (°F) and a maximum operating pressure (MOP) of 1,480 pound per square inch gauge (psig). The Project typically would operate at 60°F and between 200 to 1,480 psig. The pipeline would be buried underground at a depth that meets or exceeds the regulations specified in 49 CFR 195.248.

Table 3-1 Project Design Parameters

Parameter	Value
Pipe Specifications	16-inch outside diameter high-strength steel (API 5L-X65).
Coating	Fusion bond epoxy (FBE) coating (or other coating technique).
Maximum Operating Pressure	1,480 psig.
Depth of Cover	Generally <b>a minimum of 4 feet of cover as specified in 49 CFR 195.248 and the North Dakota Public Service Commission (PSC) Corridor Certificate.</b>
Aboveground versus Belowground Piping	Pipe will be belowground except within valve sites and receipt facilities.

## BakkenLink Risk Assessment and Environmental Consequence Analysis

Table 3-2 Project Design Parameters

Parameter	Value
Pipe Wall Thickness	16-inch pipe: 0.312-inch wall thickness (WT), typically; 0.375-inch WT for bores and horizontal directional drills (HDDs); <b>0.500-inch WT for the Lake Sakakawea crossing.</b>
Intermediate Valves	Currently there are <b>3</b> mainline valves planned for the route between Beaver Lodge and Dry Creek Terminal. The valves will meet or exceed federal requirements (49 CFR 195.260).
Pump Stations	No pump stations required.
Leak Prevention Program	Multiple overlapping and redundant systems, including: <ul style="list-style-type: none"> <li>• FBE or other protective pipeline coating;</li> <li>• Cathodic protection;</li> <li>• Non-destructive testing of the girth welds per 49 CFR 195.234;</li> <li>• Hydrostatic testing to 125 percent of the MOP (49 CFR 195 Subpart E);</li> <li>• Periodic in-line inspection;</li> <li>• Depth of cover meeting or exceeding federal standards;</li> <li>• Periodic aerial surveillance in accordance with federal requirements;</li> <li>• Supervisory Control and Data Acquisition (SCADA) system; and</li> <li>• Operations Control Center (OCC) providing continuous monitoring of the pipeline, 24 hours a day, every day of the year.</li> </ul>
Leak Detection Systems	<ul style="list-style-type: none"> <li>• Remote Monitoring with SCADA;</li> <li>• Computational Pipeline Monitoring (CPM) per 49 CFR 195.444;</li> <li>• ATMOS Wave System.</li> </ul>
Direct Observation Surveillance Frequency	<ul style="list-style-type: none"> <li>• Aerial surveillance: 26 times per year, not to exceed 3-week intervals.</li> </ul>

Surface facilities would be limited to pipeline markers, pig launchers and receivers, cathodic protection rectifiers, and remotely actuated block valves. BakkenLink maintains that the pressure provided by storage tank transfer pumps at the receipt locations would be adequate for operation of the pipeline at the current projected flow rates and, as such, no pumping stations would be built as part of the Project.

### 3.1 MAINLINE VALVE ASSEMBLIES

Mainline valve assemblies would be spaced along the pipeline to meet the requirements of 49 CFR 195.258 and 195.260. A study to identify locations of HCAs has been conducted to determine appropriate placement of the valves to minimize potential environmental impacts. Additionally, BakkenLink will cooperate with USDOT – Pipeline and Hazardous Materials Safety Administration (PHMSA) regarding their Project.

## 4.0 Incident Frequency-Spill Volume Estimation

### 4.1 PHMSA BASELINE INCIDENT FREQUENCIES

Since the Project has not yet been constructed, it does not have an operational history from which to derive incident frequency rates. Consequently, a conservative approach was taken by first determining the baseline incident frequencies from industry data (i.e., PHMSA 2014 data).

Baseline incident frequencies are derived from historical national pipeline incident data (PHMSA 2014). Since the majority of pipelines in the U.S. were constructed in the “pre-modern” era (i.e., the 1970s or earlier), these baseline frequencies reflect incident rates associated with earlier pipeline design and construction methods that often do not meet current regulatory requirements or Best Management Practices (BMPs). Further, these historical data do not account for supplemental protective measures that BakkenLink would implement.

The baseline incident frequencies identified in **Table 4-1** were generated from the PHMSA incident database (PHMSA 2014) and are expressed as per mile of pipeline per year (i.e., /mile-year).

Table 4-1 Baseline Incident Frequencies<sup>1</sup>

Threat Name	Incident Frequency/mile-year <sup>2</sup>	Occurrence Interval (years/mile <sup>3</sup> )
Corrosion	5.31E-04	1,882
Excavation Damage	1.67E-04	6,000
Incorrect Operation	3.01E-04	3,319
Material/Weld/Equip. Failure	7.76E-04	1,288
Natural Force Damage	1.12E-04	8,942
Other Outside Force Damage	4.32E-05	23,171
All Other Causes	1.30E-04	7,714
<b>Total All Causes</b>	<b>2.11E-03</b>	<b>473</b>

<sup>1</sup> Baseline statistics based on PHMSA hazardous liquid incident database (2014), excluding offshore data.

<sup>2</sup> Incident frequencies are expressed in scientific notation. A value of 2.90E-04 incidents/mile-year is equivalent to 0.00029 incident/mile-year, which is approximately equivalent to one incident every 3,400 years.

<sup>3</sup> Occurrence interval is the inverse of the incident frequency (i.e., years between events per mile of pipeline) similar in concept to flood frequencies (e.g., 100-year flood event).

The overall incident frequency was calculated by summing the likelihood of each individual root cause.

$$f_{\text{total}} = f_{\text{co}} + f_{\text{ex}} + f_{\text{md}} + f_{\text{hy}} + f_{\text{gm}} + f_{\text{wo}}$$

Where:

- $f_{\text{total}}$  = total leak frequency
- $f_{\text{co}}$  = leak frequency from corrosion
- $f_{\text{ex}}$  = leak frequency from excavation
- $f_{\text{md}}$  = leak frequency from material defects or construction deficiency
- $f_{\text{hy}}$  = leak frequency from a hydraulic event
- $f_{\text{gm}}$  = leak frequency from ground movement
- $f_{\text{wo}}$  = leak frequency from washout event

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The resultant incident frequency is 2.11E-03 incidents/mile-year, equivalent to 1 incident in 473 years per mile of pipe<sup>1</sup>. While future events cannot be known with absolute certainty, this historic incident frequency can be used to estimate the number of events that might occur over a period of time on the Project. Based on this spill frequency and a total of 37.1 miles of pipeline, this analysis estimates that there would be 0.783 spills during a 10-year period.

Utilizing this nationwide spill data results is a significantly more statistically robust and conservative analysis compared to utilizing only data from North Dakota. For example, the nationwide PHMSA database contains data on approximately 185,000 miles of hazardous liquid pipelines, whereas North Dakota has data for only 2,900 miles of hazardous liquid pipelines. Additionally, incident reports indicate that the state-specific incident frequency is approximately 0.00165 incidents/mile-year, substantially lower than the nationwide statistic of 0.00211 incidents/mile-year (PHMSA 2014). Thus, utilizing the nationwide data overestimates spill frequency by approximately 30 percent as compared with state-specific data.

***North Dakota's Environmental Incident Report database cannot be utilized to calculate incident frequencies as it does not directly specify the source of spills (e.g., pipeline, truck, rail, tank) (North Dakota Department of Health 2015).***

Additionally, this spill frequency does not account for Project- and site-specific conditions, including improved technologies and practices that are used on a newly constructed pipeline and are not currently reflected in the historical PHMSA incident frequency data. Consequently, the spill frequency is considered extremely conservative and overestimates the probability of a spill.

Improved technologies and practices that are used on a newly constructed pipeline currently are not reflected in the historical PHMSA incident frequency data. This is important as many of the recent, high profile pipeline spills that have occurred have involved pre-modern pipe. For instance, the Enbridge Line 6b spill in Marshall, Michigan, and the ExxonMobil spill in Mayflower, Arkansas, involved pre-1970s pipe. Both of these ruptures involved longitudinal seam failure, a prominent failure mode in pre-modern pipe due to the method of low frequency electronic resistance welding (ERW) that was utilized at the time of manufacturing. Additionally, this older pipe typically incorporates suboptimal corrosion resistant coatings (e.g., coal tar or asphalt). Modern pipelines, on the other hand, have significantly more robust longitudinal seams due to improved high frequency ERW techniques. Modern pipelines also are coated in a highly corrosion resistant FBE coating, which significantly reduces the probability of external corrosion. These factors, and other improved technologies, contribute to the improved safety record of the modern pipe that will be utilized for this Project. Consequently, the spill frequency is considered extremely conservative and overestimates the probability of a spill.

In 2002, PHMSA instituted a 5-gallon spill reporting limit. Prior to this action, only spills over 50 bbl (1,575 gallons) were reported. This change has resulted in a significant increase in the calculated baseline incident frequency. The calculated incident frequency using all available data (from 1993 to 2011) is 0.000883 incidents/mile-year. The calculated incident frequency using data obtained after the updated reporting limit (2002 to 2014) is 0.00211 incidents/mile-year, a substantial increase in incident frequency. However, it should be noted that this increase is attributable to different reporting requirements and not an actual increase in spills.

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<sup>1</sup> This value is an estimate based on historical statistics; actual values may differ from these estimates.

## BakkenLink Risk Assessment and Environmental Consequence Analysis

In fact, PHMSA data show that the number of spills on crude oil pipelines has substantially declined with the implementation of USDOT's Integrity Management Rule. Moreover, federal pipeline safety standards continue to evolve, and operators are required to comply with these standards. Implementation of current industry standards and compliance with federal regulatory standards ensures that the likelihood of spills to occur would be very small, and that the volume released, in the unlikely event of a spill, would be very small. For these reasons, it is expected that the actual number of incidents would be substantially lower than those estimated in this analysis.

### 4.2 SPILL VOLUME

Examination of the current PHMSA dataset (2002 to 2013)<sup>2</sup> indicates that the majority of actual pipeline spills are relatively small. Fifty percent of the spills consist of 4 bbl or less. In 84 percent of the cases, the spill volume was 100 bbl or less. In 95 percent of the incidents, spill volumes were less than 1,000 bbl. Oil spills of 10,000 bbl or larger occurred in 0.5 percent of cases. These data demonstrate that most pipeline spills are small and larger releases of 10,000 bbl or more are extremely uncommon. **Table 4-2** illustrates the frequencies that oil spills of different volumes are predicted to occur along the 37.1-mile section of pipe over a 10-year interval.

Table 4-2 Spill Occurrence Interval Associated with the Project over 10 Years  
Breakdown by Volume

<b>Spill Volume</b>	<b>Conservative Number of Spills in 10 Years</b>
Spill volume 4 bbl or less	<b>0.391</b>
Spill volume between 4 and 50 bbl	<b>0.234</b>
Spill volume between 50 and 100 bbl	<b>0.031</b>
Spill volume between 100 and 1,000 bbl	<b>0.086</b>
Spill volume between 1,000 and 10,000 bbl	<b>0.035</b>
Spill volume greater than 10,000 bbl	<b>0.004</b>
Total Spills	<b>0.783</b>

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<sup>2</sup> Incidents associated with offshore facilities and refining facilities were excluded from the analysis. Terminals and tanks are included.

### 5.0 Consequences of a Spill

#### 5.1 HUMAN CONSEQUENCES

The risk associated with the operation of the Project can be compared with the general risks encountered in everyday life. The National Center for Health Statistics reports that in 2011, the age-adjusted death rate in the U.S. from all causes was 740.6 per 100,000 (Centers for Disease Control and Prevention 2013). The USDOT reports the historical average risk to the general population per year associated with all hazardous liquids transmission pipelines is 0.004 in 100,000 (USDOT 2002). Therefore, the predicted risk of fatality to the public from incidents associated with the Project over and above the normal U.S. death rate is very small.

#### 5.2 ENVIRONMENTAL CONSEQUENCES

The environmental risk posed by a crude oil pipeline is a function of: 1) the probability of an accidental release; 2) the probability of a release reaching an environmental receptor (e.g., waterbody, fish); 3) the concentration of the contamination once it reaches the receptor; and 4) the hazard posed by that concentration of crude oil to the receptor. Based on spill probabilities and estimated spill volumes, this RA determines the probability of exposure to environmental receptors and the probable impacts based on a range of potential concentrations.

##### 5.2.1 Crude Oil Composition

The composition of crude oil varies widely, depending on the source and processing. Crude oils are complex mixtures of hundreds of organic (and a few inorganic) compounds. These compounds differ in their solubility, toxicity, persistence, and other properties that profoundly affect their impact on the environment. The effects of a specific crude oil cannot be thoroughly understood without taking its composition into account.

The system would transport light sweet crude, derived from production in the middle Bakken and upper Three Forks formations (Bakken). Representative chemical assay data are presented in **Table 5-1**. The primary classes of compounds found in crude oil are alkanes (hydrocarbon chains), cycloalkanes (hydrocarbons containing saturated carbon rings), and aromatics (hydrocarbons with unsaturated carbon rings). Most crude oils are more than 95 percent carbon and hydrogen, with small amounts of sulfur, nitrogen, oxygen, and traces of other elements. Crude oils contain lightweight straight-chained alkanes (e.g., hexane, heptane); cycloalkanes (e.g., cyclohexane); aromatics (e.g., benzene, toluene); and heavy aromatic hydrocarbons (e.g., polycyclic aromatic hydrocarbons [PAHs], asphaltenes). Straight-chained alkanes are more easily degraded in the environment than branched alkanes. Cycloalkanes are extremely resistant to biodegradation. Aromatics pose the most potential for environmental concern. PAHs are persistent in the environment and can cause adverse impacts. However, they do not biomagnify (increase in concentration within a food chain) and are not highly water soluble. In contrast, lightweight aromatics (i.e., benzene, toluene, ethyl benzene, xylenes) tend to be highly water soluble and have low toxicity thresholds. Studies of 69 crude oils found that benzene was the only aromatic or PAH compound tested that is capable of exceeding groundwater protection values for drinking water (i.e., maximum contaminant levels [MCLs] or Water Health Based Limits) (Kerr et al. 1999 as cited in O'Reilly et al. 2001).

## BakkenLink Risk Assessment and Environmental Consequence Analysis

Table 5-1 Composition of Representative Bakken Crude Oil

Constituent	Chemical Notation	Median (% by weight)	Range	
			Low (% by weight)	High (% by weight)
Nitrogen	N <sub>2</sub>	0.0420	0.012	0.116
Methane	C <sub>1</sub>	0.9270	0.182	1.696
Carbon dioxide	CO <sub>2</sub>	0.0200	0.000	0.063
Ethane	C <sub>2</sub>	2.5810	1.786	3.218
Propane	C <sub>3</sub>	5.4390	4.736	6.400
Iso-butane	i-C <sub>4</sub>	1.3300	1.107	1.457
N-butane	n-C <sub>4</sub>	6.2020	5.267	6.795
Iso-pentane	i-C <sub>5</sub>	2.2980	2.114	2.499
N-pentane	n-C <sub>5</sub>	4.1430	3.532	4.704
Iso-hexane	i-C <sub>6</sub>	2.1630	0.687	2.579
N-hexane	n-C <sub>6</sub>	2.2540	1.402	3.157
123-triethyl	123-triethyl	0.1150	0.100	0.162
Benzene	Benzene	0.2820	0.162	0.425
Heptanes	C <sub>7</sub>	9.9960	8.470	11.364
Toluene	Toluene	0.9210	0.651	1.593
Octanes	C <sub>8</sub>	8.8920	8.411	10.405
Ethylbenzene	Ethylbenzene	0.3250	0.289	0.441
Xylenes	m-, o-, p-xylenes	1.4030	1.239	2.110
Nonanes	C <sub>9</sub>	3.7090	3.646	5.472
Decanes plus	C <sub>10</sub> +	46.6760	40.214	49.884
API Gravity		42.1020	40.939	44.520
Specific Gravity		0.8151 g/ml*		

\* grams per milliliter

### 5.2.2 Environmental Fate and Transport

Overall, the environmental fate of crude oil is controlled by many factors and persistence is difficult to predict with great accuracy. The speed and efficiency of emergency response containment and cleanup largely dictates the fate and extent of transport within the environment. This section, however, discusses environmental fate and transport of crude oil without accounting for the benefits of emergency response. Major factors affecting the environmental fate include spill volume, type of crude oil, dispersal rate of the crude oil, terrain, receiving media, and weather conditions. Once released, the physical environment largely dictates the environmental persistence of the spilled material. Fate and transport of released crude oil are discussed by medium, and the primary degradation processes associated with each medium.

#### 5.2.2.1 Soils

##### Overview

If released in soil at pipeline depth, the released oil can volatilize or sorb to soil particles, constituents can also dissolve into the groundwater or remain in residual form (Spence et al. 2001). The movement of

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crude oil and the physical and chemical transformations of its constituents are influenced by a variety of factors and processes discussed below.

- **Physical Factors.** The movement of crude oil across the soil surface is governed by slope, soil permeability, and to a lesser extent, ambient temperature. Spreading across environmental surfaces reduces the bulk quantity of crude oil present in the immediate vicinity of the spill but increases the spatial area within which adverse effects may occur.
- **Evaporation.** The majority of the volatile hydrocarbon fractions will evaporate quickly from pooled oil on the soil surface. Crude oil that has dispersed downward in the soil profile will evaporate more slowly because of less oil surface area exposed to the air, and the presence of other binding forces (see sorption below). The rates of evaporation are primarily controlled by soil porosity and soil temperature.
- **Sorption.** Crude oil dispersed in soil will bind (adhere) to soil particles. Crude oil usually will bind most strongly with soil particles in organic soils; crude oil usually will bind less strongly with soil particles in sandy soils.
- **Dissolution.** Although most components of crude oil are relatively insoluble (Neff and Anderson 1981), crude oil released into soil can migrate toward water where certain constituents can dissolve into groundwater or surface water in limited amounts. Dissolution is not a major process controlling crude oil's fate as most crude oil constituents are more soluble in oil than water and, therefore, preferentially remain in the crude oil.
- **Photodegradation.** Photodegradation (breakdown of hydrocarbon molecules under exposure to sunlight) is an important process for soils directly exposed to sunlight at the soil surface. Crude oil that has penetrated deeper into the soil profile is not affected by this process.
- **Biodegradation.** With time, soil microorganisms capable of consuming crude oil generally increase in number and the biodegradation process naturally remediates the previously contaminated soil. The biodegradation process is enhanced as the surface area of spilled oil increases (e.g., by dispersion or spreading). Biodegradation has been shown to be an effective method of remediating soils and sediments contaminated by crude oil.

### 5.2.2.2 Water

#### Overview

If released into water, crude oil will float to the water's surface. If crude oil is left on the water's surface over an extended period of time, some constituents within the oil will evaporate, other fractions will dissolve, and eventually, some material may descend to the bottom as sedimentation. The following is a summary of the major processes that occur during crude oil dispersion and degradation.

- **Physical Factors.** Crude oil mobility in water increases with wind, stream velocity, and increasing temperature. Most crude oils move across surface waters at a rate of 100 to 300 meters per hour. Surface ice will greatly reduce the spreading rate of oil across a waterbody. Crude oil in flowing, as opposed to contained, waterbodies may cause transitory impacts. Although reduced in intensity, a crude oil spill into flowing waters tends to move over a much larger area. Spreading and thinning of spilled crude oil in water also increases the surface area of the slick, thus enhancing surface dependent fate processes such as evaporation, degradation, and dissolution.

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- **Dissolution.** Dissolution of crude oil in water is not a significant process controlling the crude oil's fate in the environment since most components of oils are relatively insoluble (Neff and Anderson 1981). Moreover, evaporation tends to dominate the reduction of crude oil, with dissolution slowly occurring with time. Overall solubility of crude oils tend to be less than their constituents since solubility is limited to the partitioning between oil and water interface and individual compounds are often more soluble in oil than in water, thus they tend to remain in the oil. Nevertheless, dissolution is one of the primary processes affecting the toxic effects of a spill, especially in confined waterbodies. Dissolution increases with decreasing molecular weight, increasing temperature, decreasing salinity, and increasing concentrations of dissolved organic matter. Greater photodegradation also tends to enhance the solubility of crude oil in water.
- **Sorption.** In water, heavy molecular weight hydrocarbons will bind to suspended particulates, and this process can be significant in highly turbid or eutrophic waters. Organic particles (e.g., biogenic material) in soils or suspended in water tend to be more effective at sorbing oils than inorganic particles (e.g., clays). Sorption processes and sedimentation reduce the quantity of heavy hydrocarbons present in the water column and available to aquatic organisms. However, these processes also render hydrocarbons less susceptible to degradation. Sedimented oil tends to be highly persistent and can cause shoreline impacts.
- **Evaporation.** Over time, evaporation is the primary mechanism of loss of low molecular weight constituents and light oil products. As lighter components evaporate, remaining crude oil becomes denser and more viscous. Evaporation tends to reduce crude oil toxicity but enhances crude oil persistence. In field trials, bulk evaporation of crude oil accounted for an almost 50 percent reduction in volume over a 12-day period, while the remaining oil was still sufficiently buoyant to float on the water's surface (Shiu et al. 1988). Evaporation increases with increased spreading of a slick, increased temperature, and increased wind and wave action.
- **Photodegradation.** Photodegradation of crude oil in aquatic systems increases with greater solar intensity. It can be a significant factor controlling the reduction of a slick, especially of lighter oil constituents, but it will be less important during cloudy days and winter months. Photodegraded crude oil constituents can be more soluble and more toxic than parent compounds. Extensive photodegradation, like dissolution, may thus increase the biological impacts of a spill event.
- **Biodegradation.** In the immediate aftermath of a crude oil spill, natural biodegradation of crude oil will not tend to be a significant process controlling the fate of spilled crude oil in environments previously unexposed to oil. Microbial populations must become established before biodegradation can proceed at any appreciable rate. Also, prior to weathering (i.e., evaporation and dissolution of light-end constituents), oils may be toxic to the very organisms responsible for biodegradation and high molecular weight constituents tend to be resistant to biodegradation. Biodegradation is nutrient and oxygen demanding and may be precluded in nutrient-poor aquatic systems. It also may deplete oxygen reserves in closed waterbodies, causing adverse secondary effects to aquatic organisms.

### 5.2.3 Dispersion of Crude Oil

While crude oil does not dissolve in water the same way that, for example, salt dissolves in water, turbulent water is able to drive small droplets of the oil into the water column. Experimental data suggest that the maximum size of these droplets is approximately 70 microns. If the droplets are small enough,

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natural turbulence in the water will prevent the oil from resurfacing, just as turbulence in the air keeps small dust particles afloat. This process is called dispersion.

Environmental conditions dictate the importance of dispersion. For oil spills during storm events, dispersion is the chief removal mechanism of the slick. During storms, the majority of the oil can be dispersed into the water column. For spills under more normal weather conditions, evaporation will usually be more significant, but dispersion still can occur.

Dispersion is considered an appropriate method to clean up high volume spills, particularly those that occur in large waterbodies, including in marine systems. The argument in favor of dispersion is that spreading the oil into the water column facilitates natural weathering processes such as biodegradation and oxidation, thus reducing exposure of aquatic organisms to elevated oil concentrations.

### 5.2.4 Submersion of Crude Oil

The crude oil proposed for transport by BakkenLink has an API gravity greater than 10 and will therefore float on the surface of water. All crude oils weather (i.e., light-end hydrocarbons evaporate) when exposed to the environment. With time, the remaining crude oil becomes denser as the proportion of light hydrocarbons decreases. Eventually, this process, particularly when combined with turbulent water, can result in remaining weathered oil sinking. This weathering process is not unique to diluted bitumen and occurs with all types of crude oils, regardless of their origin.

Recent spills resulting in a significant amount of submerged crude oil, for instance the 2010 Enbridge Line 6b spill in the Kalamazoo River, have given emergency response teams the opportunity to test and refine sunken and submerged oil recovery techniques. Many conventional and unconventional techniques have proven to be quite effective, including:

- **Nets:** specialized nets can be utilized to contain submerged globules of weathered crude oil as they migrate downstream or with a current.
- **Bottom booms:** bottom booms have a heavy ballast to create a seal against the bottom of a waterbody and a float chamber that extends toward the surface of the water. These booms have the potential to be very effective in containing submerged oil.
- **Dams:** watergates, underflow weir dams, and other dams can be set up on the bottom of a waterbody to contain oil as it migrates downstream or with a current. Underflow weir dams can be built using standard spill response equipment (i.e., sandbags, shovels, PVC piping, etc.).
- **Dredging:** well-established dredging techniques can be extremely effective in recovering sunken and submerged oils and have been used effectively following spills of high density crude oils.
- **Manual Recovery:** sunken oil has the tendency to collect in depressions and areas of low flow, where it often can be manually recovered. Techniques for manual recovery (e.g., vacuuming) are well established and can be executed using only standard spill response materials.
- **Air Injection:** submerged oil can be floated and recovered using injection of air similar to soil vapor extraction techniques used in remediation of contaminated soil.

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### 5.2.5 Environmental Impacts

An evaluation of the potential impacts resulting from the accidental release of crude oil into the environment is discussed by environmental resource below.

#### 5.2.5.1 Soils

Because pipelines are buried, soil absorption of spilled crude oil could occur, thus impacting the soils. Subsurface releases to soil tend to disperse slowly and generally are located within a contiguous and discrete area, often limited to the less consolidated soils (lower soil bulk density) within the pipeline trench. Effects to soils can be quite slow to develop, allowing time for emergency response and cleanup actions to mitigate effects to potential receptors.

In the event of a spill, a portion of the released materials would enter the surrounding soil and disperse both vertically and horizontally in the soil. The extent of dispersal would depend on a number of factors, including speed and success of emergency containment and cleanup, size and rate of release, topography of the release site, vegetative cover, soil moisture, bulk density, and soil porosity. High rates of release from the buried pipeline would result in a greater likelihood that released materials would escape the trench and reach the ground surface.

If a release were to occur in sandy soils encountered along the proposed route, it is likely that the horizontal and vertical extent of the contamination would be greater than in areas containing more organic soils. Crude oil released into sandy soils likely would become visible to aerial surveillance due to product on the soils surface or discoloration of nearby vegetation, which will facilitate emergency response and soil remediation efforts. If present, soil moisture and moisture from precipitation would increase the dispersion and migration of crude oil.

The majority of the Project alignment is located in relatively flat or moderately rolling terrain. In these areas, the oil generally would begin dispersing horizontally within the pipeline trench, and with sufficient spill volume or flow, the oil could move out of the trench onto the soils surface, generally moving toward low lying areas. If the spill were to occur on a steep slope where trench breakers had been installed during construction, then crude oil would pool primarily within the trench behind any trench breakers. If sufficient volume existed, the crude oil would breach the soil's surface as it extended over the top of the trench breaker. In either case, once on the soil's surface, the release would be more apparent to leak surveillance patrols, facilitating emergency response and remediation.

Both on the surface and in the subsurface, rapid attenuation of light, volatile constituents (due to evaporation) would quickly reduce the total volume of crude oil, while heavier constituents would be more persistent. Except in rare cases of high rate and high total volume releases with environmental settings characterized by steep topography or karst terrain, soil impacts would be confined to a relatively small, contiguous, and easily defined area, facilitating cleanup and remediation. Within a relatively short time, lateral migration generally would stabilize. Downward vertical migration would begin at the onset of a spill, with rates governed by soil permeability. For example, in soils with moderately high permeability, water may penetrate 2.5 inches per hour, while penetration rates for soils of low permeability may occur at 0.05 inch per hour. Crude oil is more viscous than water; therefore, permeability of crude oil would be slower. Modeling indicates that the penetration of crude oils into soils, even sandy soils, is limited in the vadose zone to a few feet. North Dakota has a wide array of soil types with varying permeability and composition. The soils of western North Dakota (McKenzie County) are primarily fertile loam soils from

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silty clay loams (low permeability) to sandy loams (highly permeable) (U.S. Department of Agriculture [USDA] 2006). In accordance with federal and state regulations, BakkenLink would be responsible for cleanup of contaminated soils and would be required to meet applicable cleanup levels. In North Dakota, soil cleanup levels are determined on a risk-based analysis, designed to protect human health and the environment. The benchmark soil cleanup level from petroleum hydrocarbon release is 100 parts per million [ppm] of total petroleum hydrocarbons (North Dakota Department of Health 2006). Once remedial cleanup levels were achieved in the soils, no adverse or long-term impacts would be expected.

It is difficult to precisely estimate the volume of soil that might be contaminated in the event of a spill. Site-specific environmental conditions (e.g., soil type/permeability, weather conditions) and release dynamics (e.g., leak rate, leak duration) would result in substantially different surface spreading and infiltration rates, which in turn, affect the final volume of affected soil to be remediated. Based on historical data (PHMSA 2014), soil remediation involved 100 cubic yards of soil or less at the majority of spill sites where soil contamination occurred, and only 3 percent of the spill sites required remediation of 10,000 cubic yards or more (PHMSA 2014).

### 5.2.5.2 Vegetation and Soil Ecosystems

Crude oil released to the soil's surface potentially could produce localized effects on plant populations. Terrestrial plants are much less sensitive to crude oil than aquatic species. The lowest toxicity threshold for terrestrial plants found in the U.S. Environmental Protection Agency (USEPA) ECOTOX database (USEPA 2001) is 18.2 ppm for benzene, which is higher than the 7.4 ppm threshold for aquatic species and the 0.005 ppm threshold for human drinking water. Similarly, available data from the USEPA database indicate that earthworms also are less sensitive than aquatic species (toxicity threshold was greater than 1,000 ppm). If concentrations were sufficiently high, however, crude oil in the root zone could harm respiration and nutrient uptake by individual plants and organisms.

While a release of crude oil could result in the contamination of soils (see Section 5.2.5.1, Soils), BakkenLink would be responsible for cleanup of contaminated soils. Once remedial cleanup levels were achieved in the soils, no adverse or long-term impacts to vegetation would be expected.

### 5.2.5.3 Wildlife

Spilled crude oil can affect organisms directly and indirectly. Direct effects include physical processes, such as oiling of feathers and fur, and toxicological effects, which can cause sickness or mortality. Indirect effects are less conspicuous and include habitat impacts, nutrient cycling disruptions, and alterations in ecosystem relationships. The magnitude of effects varies with multiple factors, the most significant of which include the amount of material released, the size of the spill dispersal area, the type of crude oil spilled, the species assemblage present, climate, and the spill response tactics employed.

Wildlife, especially birds and shoreline mammals, typically are among the most visibly affected organisms in any crude oil spill. Effects of crude oil can be differentiated into physical (mechanical) and toxicological (chemical) effects. Physical effects result from the actual coating of animals and eggs with crude oil, causing reductions in thermal insulative capacity and buoyancy of plumage (feathers) and pelage (fur).

However, unlike aquatic organisms that frequently cannot avoid spills in their habitats, the behavioral responses of terrestrial wildlife may help reduce potential adverse effects. Many birds and mammals are mobile and generally will avoid oil-impacted areas and contaminated food (Sharp 1990; Stubblefield et

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al. 1995). In a few cases, such as cave-dwelling species, organisms that are obligate users of contaminated habitat may be exposed. However, most terrestrial species have alternative, unimpacted habitat available, as often will be the case with localized spills (in contrast to large-scale oil spills in marine systems); therefore, mortality of these species would be limited (Stubblefield et al. 1995).

Crude oil released to the environment may cause adverse biological effects on birds and mammals via inhalation or ingestion exposure. Ingestion of crude oil may occur when animals consume oil-contaminated food, drink oil-contaminated water, or orally consume crude oil during preening and grooming behaviors.

Terrestrial organisms, such as piping plovers, are known to utilize suitable breeding and **USFWS-designated** critical habitat in the Project area. These species may ingest or otherwise come in contact with oil during feeding and other behaviors. However, adverse impacts to the piping plover are most likely to occur due to physical impacts, such as oiling of feathers, rather than toxicological impacts from ingestion. Additionally, the interior least tern has been known to breed on the shorelines of Lake Sakakawea, and exhibits similar behaviors that may lead to exposure to crude oil following a spill.

Potential adverse effects could result from direct acute exposure. Acute toxic effects include drying of the skin, irritation of mucous membranes, diarrhea, narcotic effects, and possible mortality. While releases of crude oil may have an immediate and direct effect on wildlife populations, the potential for physical and toxicological effects attenuates with time as the volume of material diminishes, leaving behind more persistent, less volatile, and less water-soluble compounds. Although many of these remaining compounds are toxic and potentially carcinogenic, they do not readily disperse in the environment and their bioavailability is low; therefore, the potential for impacts is low.

Indirect environmental effects of spills can include reduction of suitable habitat or food supply. Primary producers (e.g., algae and plants) may experience an initial decrease in primary productivity due to physical effects and acute toxicity of the spill. However, these effects tend to be short-lived and a decreased food supply is not considered to be a major chronic stressor to herbivorous organisms after a spill. If mortality occurs to local invertebrate and wildlife populations, the ability of the population to recover will depend upon the size of the impact area and the ability of surrounding populations to repopulate the area.

### 5.2.5.4 Water Resources

Crude oil could be released to water resources if the pipeline is breached or leaks occur. Federal regulation (49 CFR 195.260) requires valves to be placed strategically along the proposed route that can stop flow to help reduce the amount of crude oil that potentially could spill into sensitive areas, such as waterbodies. Also, spill containment measures and implementation of preventive actions would be identified in the Project Emergency Response Plan (ERP), as required by federal regulation, and would help mitigate adverse effects to both surface water and groundwater.

#### Groundwater

Groundwater aquifers underlie the proposed Project area. Vulnerability of these aquifers is a function of the depth to groundwater and the permeability of the overlying soils. While routine operation of the Project would not affect groundwater, there is the possibility that a release could migrate through the overlying surface materials and enter a groundwater system.

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In general, the potential for groundwater contamination following a spill would be more probable in locations where a release into or on the surface of soils has occurred, for instance:

- Where a relatively shallow water table is present (as opposed to locations where a deeper, confined aquifer system is present);
- Where soils with high permeability are present throughout the unsaturated (vadose) zone; and
- Where, in cooperation with federal and state agencies, the PHMSA (in cooperation with the U.S. Geological Survey [USGS] and other federal and state agencies) has identified specific groundwater resources that are particularly vulnerable to contamination. These resources are designated by PHMSA as HCAs (see Section 5.4).

Depending on soil properties, the depth to groundwater, and the amount of crude oil in the unsaturated zone, localized groundwater contamination can result from the presence of free crude oil and the migration of its dissolved constituents. Crude oil is less dense than water and would tend to form a floating pool after reaching the groundwater surface. Movement of crude oil generally is quite limited due to adherence with soil particles, groundwater flow rates, and natural attenuation (i.e., microbial degradation) (Fetter 1993; Freeze and Cherry 1979). Those compounds in the crude oil that are soluble in water will form a larger, dissolved “plume.” This plume would tend to migrate laterally in the direction of groundwater flow. Movement of dissolved constituents typically extends for greater distances than movement of pure crude oil in the subsurface, but is still relatively limited. The flow velocity of dissolved constituents would be a function of the groundwater flow rate and natural attenuation, with the dissolved constituents migrating more slowly than groundwater.

Unlike chemicals with high environmental persistence (e.g., trichloroethylene, pesticides), the areal extent of the dissolved constituents will stabilize over time due to natural attenuation processes. Natural biodegradation through metabolism by naturally occurring microorganisms is often an effective mechanism for reducing the volume of crude oil and its constituents. Natural attenuation will reduce most toxic compounds into non-toxic metabolic byproducts, typically carbon dioxide and water (Minnesota Pollution Control Agency 2005). Field investigations of more than 600 historical petroleum hydrocarbon release sites indicate the migration of dissolved constituents typically stabilize within several hundred feet of the crude oil source area (Newell and Conner 1998; USGS 1998; Ruiz-Aguilar et al. 2003; Shih et al. 2004; Kamath et al., in press). Over a longer period, the area of the contaminant plume may begin to reduce due to natural biodegradation. Removal of crude oil contamination will eliminate the source of dissolved constituents impacting the groundwater.

Most crude oil constituents are not very soluble in water. The dissolved concentration of water soluble compounds (e.g., benzene) is not controlled by the amount of oil in contact with the water, but by the concentration of the specific constituent in the oil (Charbeneau et al. 2000; Charbeneau 2003; Freeze and Cherry 1979). Studies of 69 crude oils found that benzene was the only aromatic or PAH compound tested that is capable of exceeding groundwater protection threshold values for drinking water (i.e., MCLs or Water Health Based Limits) (Kerr et al. 1999 as cited in O'Reilly et al. 2001).

If exposure to humans or other important resources would be possible from a release into groundwater, regulatory standards, such as drinking water criteria (MCL), would mandate the scope of remedial actions, timeframe for remediation activities, and cleanup levels. For human health protection, the national MCL is an enforceable standard established by the USEPA and is designed to protect long-term

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human health. The promulgated drinking water standards for humans vary by several orders of magnitude for crude oil constituents. Of the various crude oil constituents, benzene has the lowest national MCL at 0.005 ppm; therefore, it was used to evaluate impacts on drinking water supplies, whether from surface water or groundwater.

Emergency response and remediation efforts, however, have the potential for appreciable adverse environmental effects from construction/cleanup equipment. If no active remediation activities were undertaken, natural biodegradation and attenuation ultimately would allow a return to preexisting conditions in both soil and groundwater. Depending on the amount of crude oil reaching the groundwater and natural attenuation rates, this likely would require up to tens of years. BakkenLink would utilize the appropriate cleanup procedures as determined in cooperation with the applicable federal and state agencies.

### Flowing Surface Waters

This report evaluated impacts to downstream drinking water sources by comparing projected surface water benzene concentrations with the national MCL for benzene. Like other pipelines already in existence, the Project will cross many surficial waterbodies, most of which include major river courses as well as intermittent streams that occur along the proposed route. The majority consists of unnamed tributaries to Dry Creek, Dry Fork Creek, and Sand Creek. A complete list can be found in Appendix IX of the POD. In addition to these numerous water features, wetlands and floodplains also occur within the Project area, which are discussed further in the EA.

Rather than evaluate the risk to each waterbody crossed by the Project, this RA evaluated categories of streams, based on the magnitude of streamflow and stream width. **Table 5-2** summarizes the stream categories used for the assessment and identifies several representative streams within these categories.

**Table 5-2 Stream Categories**

	<b>Streamflow (cubic feet per second [cfs])</b>	<b>Top of Bank Stream Width (feet)</b>	<b>Representative Streams</b>
Low Flow Stream	10 – 100	<50	Unnamed intermittent tributaries of Bear Den Creek, Handy Water Creek, Sand Creek, and Clear Creek
Lower Moderate Flow Stream	100 – 1,000	50 – 500	Clear Creek, Sand Creek, Dry Fork Creek
Upper Moderate Flow Stream	1,000 – 10,000	500 – 1,000	Missouri River (i.e., Lake Sakakawea)
High Flow Stream	>10,000	1,000 – 2,500	Missouri River (i.e., Lake Sakakawea peak flow)

The following extremely conservative assumptions were developed to overestimate potential spill effects for planning purposes:

- The entire volume of a spill was released directly into a waterbody;
- Complete, instantaneous mixing occurred; and
- The entire benzene content was solubilized into the water column.

Under the actual conditions of a crude oil release, the spill and mixing events outlined by these assumptions are not expected to occur at the very high levels described.

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A 1-hour release period for the entire spill volume was assumed in order to maximize the product concentration in water. The estimated benzene concentrations were then compared with the human health drinking water MCL for benzene (**Tables 5-3 and 5-4**). Based on these ultra-conservative assumptions, results suggest that most spills that enter a waterbody could exceed the national MCL for benzene. Although the assumptions used are highly conservative and, thus, overestimate potential benzene water concentrations, the analysis indicates the need for rapid notification of managers of municipal water intakes downstream of a spill so that any potentially affected drinking water intakes could be closed to bypass river water containing crude oil.

**Table 5-3 Volume of Water Required to Dilute Benzene in Bakken Crude Oil Spills Below Benchmark Values**

Barrels of Crude Oil	Volume of Water Required to Dilute Benzene in Crude Oil Below Benchmark (acre-feet) <sup>1</sup>		
	Acute Toxicity Threshold (7.4 milligrams per liter [mg/L])	Chronic Toxicity Threshold (1.4 mg/L)	Drinking Water MCL (0.005 mg/L)
4	0.7	3.2	891
50	7.5	39.8	11,140
1,000	151	796	222,796
10,000	1,505	7,957	2,227,959

<sup>1</sup> Benchmarks based on aquatic toxicity and drinking water thresholds established for benzene. The estimated benzene content of the Bakken crude oil is 0.28 percent by volume with a specific gravity of 0.8151 g/ml.

In addition to evaluating a general-case spill to flowing water, the potential for impacts to any specific waterbody also were evaluated. To do this, the occurrence interval for a spill at any one representative stream within one of the four stream categories reflected in **Table 5-2** was calculated based on spill probabilities generated from the PHMSA database. To be conservative, a 500-foot buffer on either side of the river was added to the crossing widths identified in **Table 5-2**. The occurrence intervals shown in **Table 5-4** indicate the chance of a spill occurring at any specific waterbody is very low. Conservative occurrence intervals for a spill at any representative stream within any of the stream categories ranged from about 1,430 years for a large waterbody to 4,766 years for a small waterbody (less likely to occur in any single small waterbody than any single large waterbody). If any release did occur, it is likely that the total release volume of a spill would be 4 bbl or less based on PHMSA data for historical spill volumes.

In summary, while a release of crude oil directly into any given waterbody may exceed the drinking water standards under the conservative assumptions used in this analysis, the frequency of such an event would be very low. Nevertheless, streams and rivers with downstream drinking water intakes represent sensitive environmental resources and could be temporarily impacted by a crude oil release. BakkenLink's ERP would contain provisions for protecting and mitigating potential impacts to drinking water.

### Wetlands/Reservoirs/Lakes

Wetlands and waterbodies with persistently saturated soils are present along and adjacent to the proposed route. The effects of crude oil released into a wetland environment would depend not only upon the quantity of oil released, but also on the physical conditions of the wetland at the time of the release. Wetlands include a wide range of environmental conditions. Wetlands can consist of many acres of standing water dissected with ponds and channels, or they may simply be areas of saturated soil with no open water. A single wetland can even vary between these two extremes as seasonal precipitation

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Table 5-4 Comparison of Estimated Benzene Concentrations with the Benzene MCL Resulting from a Bakken Crude Oil Spill

Streamflow	Stream Flow Rate (cfs)	Benzene MCL (ppm)	Product Released							
			Very Small Spill: 4 bbl		Small Spill: 50 bbl		Moderate Spill: 1,000 bbl		Large Spill: 10,000 bbl	
			Benzene Conc. (ppm)	Occurrence Interval (years)	Benzene Conc. (ppm)	Occurrence Interval (years)	Benzene Conc. (ppm)	Occurrence Interval (years)	Benzene Conc. (ppm)	Occurrence Interval (years)
Low Flow Stream	10	0.005	<b>1.7</b>	<b>4,766</b>	<b>21.8</b>	<b>11,916</b>	<b>437</b>	<b>47,664</b>	<b>4,369</b>	<b>476,642</b>
Lower Moderate Flow Stream	100	0.005	<b>0.17</b>	<b>3,336</b>	<b>2.2</b>	<b>8,341</b>	<b>43.7</b>	<b>33,365</b>	<b>437</b>	<b>333,649</b>
Upper Moderate Flow Stream	1,000	0.005	<b>0.017</b>	<b>2,502</b>	<b>0.2</b>	<b>6,256</b>	<b>4.4</b>	<b>25,024</b>	<b>43.7</b>	<b>250,237</b>
High Flow Stream	10,000	0.005	0.0017	1,430	<b>0.02</b>	<b>3,575</b>	<b>0.4</b>	<b>14,299</b>	<b>4.4</b>	<b>142,993</b>

Notes:

- Historical data indicate that the most probable spill volume would be 4 bbl or less. However, this entire analysis is based on conservative incident frequencies and a range of spill volumes to provide a range of the magnitude of potential effects for the NEPA analysis.
- Estimated concentration is based on release of benzene into water over a 1-hour period with uniform mixing conditions.
- Concentrations are based on a 0.28 percent by volume benzene content of the transported material (Marathon Oil 2010).
- Shading indicates estimated benzene concentrations that could exceed the benzene MCL of 0.005 ppm.
- Occurrence intervals are based on an overall predicted incident frequency of 0.00211 incident/mile\*year (Section 4.1), projected frequencies of each spill volume, and estimated stream widths. Widths of higher flow streams are greater than widths of lower flow streams, with more distance where an incident might occur. This results in a greater predicted frequency for high flow streams and a corresponding lower occurrence interval.

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varies. Wetland surfaces generally are low gradient with very slow unidirectional flow or no discernible flow. The presence of vegetation or narrow spits of dry land protruding into wetlands also could isolate parts of the wetland. Given these conditions, spilled materials could remain in restricted areas for longer periods than in river environments.

Crude oil released from a subsurface pipe within a wetland could reach the soil surface. If the water table reaches the surface, the release would manifest as floating crude oil. The general lack of surface flow within a wetland would restrict crude oil movement. Where surface water is present within a wetland, the spill would spread laterally across the water's surface and be readily visible during routine ROW surveillance. The depth of soil impacts likely would be minimal, due to shallow (or emergent) groundwater conditions. Conversely, groundwater impacts within the wetland are likely to be confined to the near-surface, enhancing the potential for biodegradation. If humans or other important resource exposures were to occur in proximity to the wetland, then regulatory drivers would mandate the scope of remedial actions, timeframe for remediation activities, and cleanup levels. However, response and remediation efforts in a wetland have the potential for appreciable adverse effects from construction/cleanup equipment. If no active remediation activities were undertaken, natural biodegradation and attenuation ultimately would allow a return to preexisting conditions in both soil and groundwater. This likely would require a timeframe on the order of tens of years. In the unlikely event of a spill, BakkenLink would utilize appropriate cleanup procedures as determined in coordination with the applicable federal and state agencies.

BakkenLink would avoid wetlands to the extent practical by routing or by crossing using HDD technology. Wetlands that cannot be avoided by either procedure would be crossed using open cut trenching similar to conventional upland construction procedures, with modifications and limitations to reduce the potential for pipeline construction to affect wetland hydrology and soil structure.

Techniques for wetland crossing would vary according to the type of wetland to be crossed, the length of the crossing, and the level of soil saturation or standing water at the time of crossing. An open cut trench technique may be used for trenching and installation where soils are saturated. This technique consists of stringing and welding the pipe outside of the wetland and excavating the trench through the wetland using equipment supported by mats. Water that seeps into the trench is used to float the pipeline into place using attached flotation devices and by pushing or pulling the pipe with equipment. The floats are then removed from the pipe and the pipe sinks into place. The trench is then backfilled and cleanup completed. Most pipes installed in saturated wetlands would be coated with concrete or equipped with weights to provide negative buoyancy.

If trench dewatering is necessary within wetlands, water would be discharged in accordance with BakkenLink's Storm Water Pollution Prevention Plan (SWPPP) (POD, Appendix XVII) and in a manner that does not cause erosion and does not discharge silt-laden water into waterbodies. Water would be discharged into an energy dissipation device/sediment filtration device such as a straw bale structure or geotextile filter bag. Dewatering structures would be sized to handle the volume of water in the trench.

Construction mitigation measures would limit equipment working in wetlands to that necessary for clearing, excavation, fabricating, and installing the pipeline; backfilling the trench; and restoring the ROW. If equipment must operate within a wetland that cannot support the equipment weight without rutting, the contractor would use wide-track or balloon-tire construction equipment or conventional equipment operated from timber mats or prefabricated equipment mats. All timber mats, prefabricated

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equipment mats, and subsoil not used as trench backfill would be removed upon completion of construction. Therefore, the chance of a spill occurring at any specific wetland along the pipeline is very low.

Based on National Wetlands Inventory survey data and aerial interpretation, the Project would cross approximately 3.0 miles of wetlands **and waterbodies**. Crossed wetlands **and waterbodies** include Lake Sakakawea, freshwater ponds, and freshwater emergent wetland along the pipeline ROW. Of the estimated 0. **783** spills postulated to occur during a 10-year period within the entire pipeline system, approximately 0. **063** spills would be expected to occur within wetland areas (equivalent to 1 spill every **158** years). If any release did occur, it is likely that the total release volume of a spill would be 4 bbl or less based on historical spill volumes (Section 4.2, Spill Volume).

Based on a review of publicly available toxicity literature for wetland plant groups (i.e., algae, annual macrophytes, and perennial macrophytes), crude oil is toxic to aquatic plants but at higher concentrations than observed for fish and invertebrates. Therefore, spill concentrations that are less than the toxic threshold required for fish and invertebrates (see Aquatic Organisms) also would not have toxic effects on wetland plant species.

The predicted effects of a spill reaching standing water (e.g., reservoirs, lakes) would depend largely upon the volume of crude oil entering the waterbody and the volume of water within the waterbody. **Table 5-3** summarizes the amount of water necessary to dilute spill volumes below aquatic toxicity and drinking water thresholds. While this preliminary approach does not account for fate and transport mechanisms, mixing zones, environmental factors, and emergency response capabilities, it does provide an initial screening benchmark for identifying areas of potential concern.

In summary, while a release of crude oil into wetland and static waterbodies has the potential to cause temporary environmental impacts, the frequency of such an event would be very low.

### Aquatic Organisms

The concentration of crude oil constituents in an actual spill would vary both temporally and spatially in surface water; however, localized toxicity could occur from virtually any size of crude oil spill. **Table 5-5** summarizes the acute toxicity values (USEPA 2001) of various crude oil hydrocarbons to a broad range of freshwater species. Acute toxicity refers to the death or complete immobility of an organism within a short period of exposure. The LC50 is the concentration of a compound necessary to cause 50 percent mortality in laboratory test organisms. For aquatic biota, most acute LC50 for monoaromatics range between 10 and 100 ppm. LC50 for the polyaromatic naphthalenes generally were between 1 and 10 ppm, while LC50 values for anthracene generally were less than 1 ppm.

**Table 5-5 Acute Toxicity of Aromatic Hydrocarbons to Freshwater Organisms**

Species	Toxicity Values (ppm)				
	Benzene	Toluene	Xylenes	Naphthalene	Anthracene
Carp ( <i>Cyprinus carpio</i> )	40.4	---	780	---	---
Channel catfish ( <i>Ictalurus</i> sp.)	--- <sup>1</sup>	240	---	---	---
Clarias catfish ( <i>Clarias</i> sp.)	425	26	---	---	---
Coho salmon ( <i>Oncorhynchus kisutch</i> )	100	---	---	2.6	---
Fathead minnow ( <i>Pimephales promelas</i> )	---	36	25	4.9	25

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Table 5-5 Acute Toxicity of Aromatic Hydrocarbons to Freshwater Organisms

Species	Toxicity Values (ppm)				
	Benzene	Toluene	Xylenes	Naphthalene	Anthracene
Goldfish ( <i>Carassius auratus</i> )	34.4	23	24	---	---
Guppy ( <i>Poecilia reticulata</i> )	56.8	41	---	---	---
Largemouth bass ( <i>Micropterus</i> )	---	---	---	0.59	---
Medaka ( <i>Oryzias</i> sp.)	82.3	54	---	---	---
Mosquito fish ( <i>Gambusia affinis</i> )	---	1,200	---	150	---
Rainbow trout ( <i>Oncorhynchus mykiss</i> )	7.4	8.9	8.2	3.4	---
Zebra fish ( <i>Therapon iarbua</i> )	---	25	20	---	---
Rotifer ( <i>Brachionus calyciflorus</i> )	>1,000	110	250	---	---
Midge ( <i>Chironomus attenuatus</i> )	---	---	---	15	---
Midge ( <i>Chironomus tentans</i> )	---	---	---	2.8	---
Zooplankton ( <i>Daphnia magna</i> )	30	41	---	6.3	0.43
Zooplankton ( <i>Daphnia pulex</i> )	111	---	---	9.2	---
Zooplankton ( <i>Diaptomus forbesi</i> )	---	450	100	68	---
Amphipod ( <i>Gammarus lacustris</i> )	---	---	0.35	---	---
Amphipod ( <i>Gammarus minus</i> )	---	---	---	3.9	---
Snail ( <i>Physa gyrina</i> )	---	---	---	5.0	---
Insect ( <i>Somatochloa cingulata</i> )	---	---	---	1.0	---
<i>Chlorella vulgaris</i>	---	230	---	25	---
<i>Microcystis aeruginosa</i>	---	---	---	0.85	---
<i>Nitzschia palea</i>	---	---	---	2.8	---
<i>Scenedesmus subspicatus</i>	---	130	---	---	---
<i>Selenastrum capricornutum</i>	70	25	72	7.5	---

<sup>1</sup> Indicates no value was available in the database.

Note: Data summarize conventional acute toxicity endpoints from USEPA's ECOTOX database. When several results were available for a given species, the geometric mean of the reported LC<sub>50</sub> values was calculated.

**Table 5-5** shows fish are among the most sensitive aquatic biota, while aquatic invertebrates generally have intermediate sensitivities, and algae and bacteria tend to be the least sensitive. Nevertheless, even when major fish kills have occurred as a result of oil spills, population recovery has been observed and long-term changes in fish abundance have not been reported. Benthic (bottom-dwelling) aquatic invertebrates tend to be more sensitive than algae, but are equally or less sensitive than fish. Planktonic (floating) species tend to be more sensitive than most benthic insects, crustaceans, and mollusks.

In aquatic environments, toxicity is a function of the concentration of a compound necessary to cause toxic effects combined with the compound's water solubility. For example, a compound may be highly toxic, but if it is not very soluble in water, then its toxicity to aquatic biota is relatively low. The toxicity of crude oil is dependent on the toxicity of its constituents. As an example, **Table 5-6** summarizes the toxicity of various crude oil hydrocarbons to the water flea, *Daphnia magna*. This species of water flea is used as a standard test organism to determine acute and chronic responses to toxicants. The relative toxicity of decane is much lower than for benzene or ethyl benzene because of the comparatively low solubility of decane. Most investigators have concluded that the acute toxicity of crude oil is related to the concentrations of relatively lightweight aromatic constituents, particularly benzene. As an example, for

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this Project, it is unlikely that an oil spill into Lake Sakakawea would result in acute benzene toxicity to even the most sensitive fish species, given that benzene concentrations in affected areas would not be expected to reach a sufficient threshold of concentration.

Table 5-6 Acute Toxicity of Crude Oil Hydrocarbons to *Daphnia magna*

Compound	48-hr LC <sub>50</sub> (ppm)	Optimum Solubility (ppm)	Relative Toxicity
Hexane	3.9	9.5	2.4
Octane	0.37	0.66	1.8
Decane	0.028	0.052	1.9
Cyclohexane	3.8	55	14.5
methyl cyclohexane	1.5	14	9.3
Benzene	9.2	1,800	195.6
Toluene	11.5	515	44.8
Ethylbenzene	2.1	152	72.4
p-xylene	8.5	185	21.8
m-xylene	9.6	162	16.9
o-xylene	3.2	175	54.7
1,2,4-trimethylbenzene	3.6	57	15.8
1,3,5-trimethylbenzene	6	97	16.2
Cumene	0.6	50	83.3
1,2,4,5-tetramethylbenzene	0.47	3.5	7.4
1-methylnaphthalene	1.4	28	20.0
2-methylnaphthalene	1.8	32	17.8
Biphenyl	3.1	21	6.8
Phenanthrene	1.2	6.6	5.5
Anthracene	3	5.9	2.0
9-methylanthracene	0.44	0.88	2.0
Pyrene	1.8	2.8	1.6

Note: The LC<sub>50</sub> is the concentration of a compound necessary to cause 50 percent mortality in laboratory test organisms within a predetermined time period (i.e., 48 hours) (USEPA 2001).

Relative toxicity = optimum solubility/LC<sub>50</sub>.

While lightweight aromatics such as benzene tend to be water soluble and relatively toxic, they also are highly volatile. Thus, most or all of the lightweight hydrocarbons accidentally released into the environment evaporate, and the environmental persistence of this crude oil fraction tends to be low. High molecular weight aromatic compounds, including PAHs, are not very water-soluble and have a high affinity for organic material. Consequently, these compounds, if present, have limited bioavailability, which render them substantially less toxic than more water-soluble compounds (Neff 1979). Additionally, these compounds generally do not accumulate to any great extent because these compounds are rapidly metabolized (Lawrence and Weber 1984; West et al.1984). There are some indications, however, that prolonged exposure to elevated concentrations of these compounds may result in a higher incidence of growth abnormalities and hyperplastic diseases in aquatic organisms (Couch and Harshbarger 1985).

For this analysis, the potential impacts of benzene on Lake Sakakawea water resources following an oil spill were evaluated and are presented in **Attachment A**. The analysis includes a discussion of the fate and transport of benzene in the aquatic environment, as well as an estimation of benzene concentrations in the water based on a hypothetical release into Lake Sakakawea.

Significantly, some constituents in crude oil may have greater environmental persistence than lightweight compounds (e.g., benzene), but their limited bioavailability renders them substantially less toxic than

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other more soluble compounds. For example, aromatics with four or more rings are not acutely toxic at their limits of solubility (Muller 1987). Based on the combination of toxicity, solubility, and bioavailability, benzene was determined to dominate toxicity associated with potential crude oil spills.

**Table 5-7** summarizes chronic toxicity values (most frequently measured as reduced reproduction, growth, or weight) of benzene to freshwater biota. Chronic toxicity from other oil constituents may occur, however, if sufficient quantities of crude oil are continually released into the water to maintain elevated concentrations.

**Table 5-7 Chronic Toxicity of Benzene to Freshwater Biota**

<b>Taxa</b>	<b>Test Species</b>	<b>Chronic Value (ppm)</b>
Fish	Fathead minnow ( <i>Pimephales promelas</i> )	17.2 *
	Guppy ( <i>Poecilia reticulata</i> )	63
	Coho salmon ( <i>Oncorhynchus kitsutch</i> )	1.4
Amphibian	Leopard frog ( <i>Rana pipens</i> )	3.7
Invertebrate	Zooplankton ( <i>Daphnia</i> spp.)	>98
Algae	Green algae ( <i>Selenastrum capricornutum</i> )	4.8 *

Note: Test endpoint was reproduction for those denoted with an asterisk (\*). The test endpoint for other studies was growth.

The potential impacts to aquatic organisms of various-sized spills to waterbodies were modeled assuming the benzene content within each type of crude oil completely dissolved in the water. The benzene concentration was predicted based on amount of crude oil spilled and streamflow. The estimated benzene concentrations were compared to conservative acute and chronic toxicity values for protection of aquatic organisms. For aquatic biota, the lowest acute and chronic toxicity thresholds for benzene are 7.4 ppm and 1.4 ppm, respectively, based on standardized toxicity tests (USEPA 2001). These toxicity threshold values are considered protective of acute and chronic effects to aquatic biota.

**Tables 5-8** and **5-9** summarize a screening-level assessment of acute and chronic toxicity, respectively, to aquatic resources. Although trout are not found in any of the habitats crossed by the Project, trout are among the most sensitive aquatic species and reliable acute and chronic trout toxicity data are available. Using trout toxicity thresholds, therefore, provides a conservative benchmark to screen for the potential for toxicity. Broadly, acute toxicity potentially could occur if substantial amounts of crude oil were to enter rivers and streams. If such an event were to occur within a small stream, aquatic species in the immediate vicinity and downstream of the rupture could be killed or injured. Chronic toxicity potentially also could occur in small and moderate sized streams and rivers. However, emergency response, containment, and cleanup efforts would help reduce the concentrations and minimize the potential for chronic toxicity. In comparison, relatively small spills (less than 50 bbl) into moderate and large rivers would not pose a major toxicological threat. In small to moderate sized streams and rivers, some toxicity might occur in localized areas, such as backwaters where concentrations likely would be higher than in the mainstream of the river.

The likelihood of a release into any single waterbody would be low, with a predicted occurrence interval of no more than once every 1,430 to 476,642 years (**Tables 5-8** and **5-9**). If any release did occur, it is likely that the total release volume of a spill would be 4 bbl or less based on historical spill volumes.

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Table 5-8 Comparison of Estimated Benzene Concentrations Following a Bakken Crude Oil Spill to the Acute Toxicity Thresholds for Aquatic Life (7.4 ppm) for Streams Crossed by the Project

Streamflow	Stream Flow Rate (cfs)	Acute Toxicity Threshold (ppm)	Product Released							
			Very Small Spill: 4 bbl		Small Spill: 50 bbl		Moderate Spill: 1,000 bbl		Large Spill: 10,000 bbl	
			Benzene Conc. (ppm)	Occurrence Interval (years)	Benzene Conc. (ppm)	Occurrence Interval (years)	Benzene Conc. (ppm)	Occurrence Interval (years)	Benzene Conc. (ppm)	Occurrence Interval (years)
Low Flow Stream	10	7.4	1.7	4,766	<b>21.8</b>	<b>11,916</b>	<b>437</b>	<b>47,664</b>	<b>4369</b>	<b>476,642</b>
Lower Moderate Flow Stream	100	7.4	0.17	3,336	2.2	8,341	<b>43.7</b>	<b>33,365</b>	<b>437</b>	<b>333,649</b>
Upper Moderate Flow Stream	1,000	7.4	0.017	2,502	0.2	6,256	4.4	25,024	<b>43.7</b>	<b>250,237</b>
High Flow Stream	10,000	7.4	0.0017	1,430	0.02	3,575	0.4	14,299	4.4	142,993

Notes:

- Historical data indicate that the most probable spill volume would be 4 bbl or less. However, this entire analysis is based on conservative incident frequencies and a range of spill volumes, to provide a range of the magnitude of potential effects for the NEPA analysis.
- Estimated concentration is based on release of benzene into water over a 1-hour period with uniform mixing conditions.
- Concentrations are based on a 0.28 percent by volume benzene content of the transported material (Marathon Oil 2010).
- Shading indicates concentrations that could potentially cause acute toxicity to aquatic species. The darkest shading represents high probability of acute toxicity (>10 times the toxicity threshold); lighter shading represents moderate probability of acute toxicity (1 to 10 times the toxicity threshold); and unshaded areas represent low probability of acute toxicity (<toxicity threshold).
- Occurrence intervals are based on an overall predicted incident frequency of 0.00211 incident/mile\*year (Section 4.1), projected frequencies of each spill volume, and estimated stream widths. Widths of higher flow streams are greater than widths of lower flow streams, with more distance where an incident might occur. This results in a greater predicted frequency for high flow streams and a corresponding lower occurrence interval.

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Table 5-9 Comparison of Estimated Benzene Concentrations Following a Bakken Crude Oil Spill to the Chronic Toxicity Thresholds for Aquatic Life (1.4 ppm) for Streams Crossed by the Project

Streamflow	Stream Flow Rate (cfs)	Chronic Toxicity Threshold (ppm)	Product Released							
			Very Small Spill: 4 bbl		Small Spill: 50 bbl		Moderate Spill: 1,000 bbl		Large Spill: 10,000 bbl	
			Benzene Conc. (ppm)	Occurrence Interval (years)	Benzene Conc. (ppm)	Occurrence Interval (years)	Benzene Conc. (ppm)	Occurrence Interval (years)	Benzene Conc. (ppm)	Occurrence Interval (years)
Low Flow Stream	10	1.4	0.01	4,766	0.13	11,916	<b>2.6</b>	<b>47,664</b>	<b>26</b>	<b>476,642</b>
Lower Moderate Flow Stream	100	1.4	0.001	3,336	0.013	8,341	0.26	33,365	<b>2.6</b>	<b>333,649</b>
Upper Moderate Flow Stream	1,000	1.4	0.0001	2,502	0.0013	6,256	0.026	25,024	0.26	250,237
High Flow Stream	10,000	1.4	1.04E-05	1,430	0.00013	3,575	0.0026	14,299	0.026	142,993

Notes:

- Historical data indicate that the most probable spill volume would be 4 bbl or less. However, this entire analysis is based on conservative incident frequencies and a range of spill volumes, to provide a range of the magnitude of potential effects for the NEPA analysis.
- Estimated proportion of benzene in the transported material is 0.28 percent (Marathon Oil 2010).
- It is assumed to be entirely water solubilized in the event of a spill. The resulting concentration was calculated by multiplying 0.28 percent of the total amount of material released divided by 7 days of stream flow volume. The model assumes uniform mixing conditions.
- The chronic toxicity value for benzene is based on a 7-day toxicity value of 1.4 ppm for trout.
- Exposure concentrations were estimated over a 7-day period since the chronic toxicity value was based on a 7-day exposure.
- Shading indicates concentrations that could potentially cause chronic toxicity to aquatic species. The darkest shading represents high probability of chronic toxicity (>10 times the toxicity threshold); lighter shading represents moderate probability of chronic toxicity (1 to 10 times the toxicity threshold); and unshaded areas represent low probability of chronic toxicity (<toxicity threshold).
- Occurrence intervals are based on an overall predicted incident frequency of 0.00211 incident/mile\*year (Section 4.1), projected frequencies of each spill volume, and estimated stream widths. Widths of higher flow streams are greater than widths of lower flow streams, with more distance where an incident might occur. This results in a greater predicted frequency for high flow streams and a corresponding lower occurrence interval.

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While a release of crude oil into any given waterbody might cause immediate localized toxicity to aquatic biota, particularly in smaller streams and rivers, the frequency of such an event would be very low. Nevertheless, streams and rivers with aquatic biota represent the sensitive environmental resources that could be temporarily impacted by a crude oil release.

### 5.3 LAKE SAKAKAWEA

Lake Sakakawea is a reservoir crossed by the pipeline. Its normal volume is 12,800,000 acre-feet, with a maximum capacity of 23,800,000 acre-feet (USACE 2007). The lake is used for drinking water, recreational activities, flood control, hydroelectric power, navigation, and irrigation. It also supports a coldwater fishery. Lake Sakakawea offers a wide range of water based recreational activities (USACE 2012). The lake offers swimming, boating, sailing, camping, and fishing. There also are camp grounds and a park located nearby. According to the Garrison Dam/Lake Sakakawea master plan prepared by the USACE (2007), Lake Sakakawea and the surrounding areas comprise a wide variety of habitats suitable for many different types of species. Garrison Dam National Fish Hatchery adds volume to some of the naturally reproducing fish populations.

As proposed, the pipe would be trenched across the bottom of the reservoir, so if a spill were to occur in Lake Sakakawea, the oil would immediately rise to the surface. Once at the water's surface, the oils would spread laterally, creating an oil slick. Lateral spread rates would be significantly reduced by the presence of ice. Emergency response teams would be dispatched and the oil contained and removed, even if ice is present. The magnitude of potential impacts would depend on the amount of oil released, where the oil spread prior to containment, and the amount of time prior to removal of the oil. If a spill were to occur, it is possible that there may be localized impacts to water quality and possible toxic effects to aquatic biota. Impacts to aquatic invertebrates and young fish may occur along shorelines and backwater areas where oil may be in contact with relatively small volumes of water; but, impacts to fish in the main portion of the reservoir are expected to be minimal. It is highly unlikely that a spill would impact drinking water, given the location of the drinking water intake and the distance (and associated time) from the pipeline. An in-depth, site-specific risk assessment for Lake Sakakawea is provided in **Attachment A**.

#### 5.3.1 Wildlife

According to the Garrison Dam/Lake Sakakawea master plan prepared by the USACE (2007), Lake Sakakawea and the surrounding areas comprise a wide variety of habitats suitable for many different types of species. Garrison Dam National Fish Hatchery adds volume to the naturally reproducing fish population. Several cold water fish species including rainbow smelt (*Osmerus mordax*) and Chinook salmon (*O. tshawytscha*) thrive near the riverine end of the lake. Warmer water species such as shovelnose and pallid sturgeon (*Scaphirhynchus platyrhynchus* and *S. albus*), paddlefish (*S. platyrhynchus*), walleye (*Sander vitreus*), sauger (*Sander canadense*), northern pike (*Exos lucius*), and common carp (*Cyprinus carpio*) are found inhabiting the delta at the north **west** end of the lake.

Large mammals including white-tailed deer (*Odocoileus virginianus*), mule deer (*O. hemionus*), mountain lions (*Puma concolor*), and pronghorn (*Antilocapra americana*) are commonly present in the **Project region**. Smaller mammals such as cottontail rabbit (*Sylvilagus floridanus*); black-tailed prairie dog (*Cynomys ludovicianus*); and many different species of bats, squirrels, shrews, and mice also are present. Species of birds that may be present near the crossing at Lake Sakakawea include the **interior**

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least tern (*Sterna antillarum*), piping plover (*Charadrius melodus*), and whooping crane (*Grus americana*). However, it should be noted that over 365 bird species have been known to occur in the area.

According to the U.S. Fish and Wildlife Service (USFWS), **six** species **potentially** occurring in the Lake Sakakawea area are federally listed **as** threatened **or** endangered species. The whooping crane, interior least tern, and pallid sturgeon (*S. albus*) are listed as endangered, while the piping plover, **northern long-eared bat (*Myotis septentrionalis*) and the rufa red knot (*Calidris canutus rufa*)** are listed as threatened (USACE 2007; **USFWS 2015**).

### 5.4 RISK TO HIGH CONSEQUENCE AREAS

Consequences of inadvertent releases from pipelines can vary greatly, depending on where the release occurs. Pipeline safety regulations use the concept of HCAs to identify specific locales and areas where a release could have the most significant adverse consequences. HCAs are defined by federal regulation (49 CFR 195.6 and 195.450) and include populated areas, designated zones around public drinking water intakes, and unusually sensitive ecologically resource areas that could be damaged by a hazardous liquid pipeline release. **Table 5-10** identifies the types and lengths of HCAs crossed by the Project. These HCA data are compiled from a variety of data sources, including federal and state agencies (e.g., state drinking water agencies, the USEPA). PHMSA acknowledges that spills within a sensitive area actually might not impact the sensitive resource and encourages operators to conduct detailed analysis, as needed. This assessment represents a preliminary evaluation of HCAs crossed or located downstream of the pipeline. Portions of the pipeline that potentially could affect HCAs would be subject to higher levels of inspection, as per 49 CFR 195.

Assuming that **0.783** spills occurred along the Project in a 10-year period, it is estimated that approximately 0.049 of these spills would occur in HCAs. Although the number of predicted spills in HCAs is relatively small, the potential impacts of these individual spills are expected to be greater than in other areas due to the environmental sensitivity within these areas. **Table 5-11** shows the predicted number of spills and their anticipated sizes.

**Table 5-10 Mileage Summary of Pipeline Segments that “Could Affect” PHMSA-defined HCAs**

County	Miles of Pipeline				Projected Number of Spills in 10 years (occurrence interval in years)			
	Populated Areas	Drinking Water	Ecologically Sensitive Area	Total in HCAs <sup>1</sup>	Populated Areas	Drinking Water	Ecologically Sensitive Area	Total HCAs <sup>1</sup>
McKenzie	0.0	0.0	0.72	0.72	0 (na)	0 (na)	0.0152 (658)	0.0152 (658)
Williams	0.0	0.0	1.59	1.59	0 (na)	0 (na)	0.0335 (298)	0.0335 (298)
<b>Project Total</b>	<b>0.0</b>	<b>0.0</b>	<b>2.31</b>	<b>2.31</b>	<b>0 (na)</b>	<b>0 (na)</b>	<b>0.0487 (205)</b>	<b>0.0487 (205)</b>

Numbers are not necessarily additive because some miles overlap in the different types of HCAs.

Notes: (na) indicates no PHMSA-defined populated area within the segment.

Projected number of spills in 10 years and occurrence interval were conservatively estimated based on the conservative probability of spills (0.00211 incidents/mile\*year). This conservative analysis intentionally overestimates the potential risk, and assumes risk is evenly distributed along the entire Project. Occurrence interval is the reciprocal of the overall incident rate and is given in units of years per incident for the defined pipeline miles.

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Table 5-11 Predicted Spills and Associated Volumes Within “Could Affect” Segments in 10-year Period

HCA Type	Miles of Pipe <sup>1</sup>	Total Number of Predicted Spills	<4 bbl	4 to 50 bbl	50 to 1,000 bbl	1,000 to 10,000+ bbl
Populated Areas	0.0	0.0	0.0	0.0	0.0	0.0
Drinking Water Areas	0.0	0.0	0.0	0.0	0.0	0.0
Ecologically Sensitive Areas	2.31	<b>0.0487</b>	0.0244	<b>0.015</b>	<b>0.007</b>	<b>0.00243</b>

The amount of pipe located within HCAs was quantified by the Project’s geographical information system and was based on the intersection of the pipeline’s centerline and PHMSA-defined HCAs. Probability of a spill was based on the conservative incident frequency of 0.00211 incidents per mile per year (Section 4.1).

### 5.4.1 Populated Areas

The nearest PHMSA-defined populated area is located 13.7 miles from the proposed pipeline; therefore, no impacts are anticipated (**Table 5-11**).

### 5.4.2 Drinking Water

PHMSA identifies certain surface water and groundwater resources as drinking water unusually sensitive areas (USAs) (49 CFR 195.6 and 195.450). Surface water USAs include intakes for community water systems and non-transient non-community water systems that do not have an adequate alternative drinking water source. Groundwater USAs include the source water protection area for community water systems and non-transient non-community water systems that obtain their water supply from a Class I or Class IIA aquifer and do not have an adequate alternative drinking water source. If the source water protection area has not been established by the state, the wellhead protection area becomes the USA.

Surface water USAs identified for their potential as a drinking water resource have a 5-mile buffer placed around their intake location. The groundwater USAs have buffers that vary in size. These buffers are designated by the state’s source water protection program or their wellhead protection program and the buffer sizes vary from state to state.

Miles of pipeline segments that potentially could reach sensitive drinking water resources are summarized in **Table 5-11**. Segments of the pipeline that potentially could affect HCAs would be subject to higher levels of inspection, as per 49 CFR 195.

### 5.4.3 Ecologically Sensitive Areas

Certain ecologically sensitive areas are classified as HCAs by PHMSA due to potential risks to unusually sensitive ecological resources. These areas focus on the characteristics of rarity, imperilment, or the potential for loss of large segments of an abundant population during periods of migratory concentration. These include:

- Critically imperiled and imperiled species and/or ecological communities;
- Threatened and endangered species (or multi-species assemblages where three or more different candidate resources co-occur);
- Migratory waterbird concentrations;

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- Areas containing candidate species or ecological communities identified as excellent or good quality; and
- Areas containing aquatic or terrestrial candidate species and ecological communities that are limited in range.

There are 2.31 miles of pipeline segments that potentially could reach ecologically sensitive areas as summarized in **Table 5-11**. Segments of the pipeline that potentially could affect HCAs would be subject to higher levels of inspection, as per 49 CFR 195.

### 5.4.4 Management of Risk within HCAs

To protect particularly sensitive resources, HCAs would be subject to a higher level of inspection per USDOT regulations. Federal regulations require periodic assessment of the pipe condition and timely correction of identified anomalies within HCAs. Under federal pipeline regulations, BakkenLink would be required to develop management and analysis processes that integrate available integrity-related data and information and assess the risks associated with segments that can affect HCAs.

BakkenLink also would be required to conduct routine surveys to locate HCA changes along the pipeline system. If portions of the pipeline become population HCAs during the operational pipeline life, BakkenLink would be required to integrate the information into their Integrity Management Plan, which is audited by PHMSA.

For Homeland Security reasons, the precise risk and specific locations of HCAs is highly confidential. Therefore, additional information on risk to HCAs is provided to federal and state regulatory agencies, if requested, as a confidential appendix to the document (**Attachment B**). Per federal regulations (Integrity Management Rule, 49 CFR 195), the site-specific evaluation of risk is an ongoing process and is regulated by PHMSA. As part of the compliance process, BakkenLink would need to develop and implement a risk-based integrity management program (IMP). The IMP will use state-of-practice technologies applied within a comprehensive risk-based methodology to assess and mitigate risk associated with all pipeline segments including HCAs.

## 5.5 IMPACTS FROM CONSTRUCTION OF THE PROJECT AND ENVIRONMENTAL MEASURES

### 5.5.1 Soils

***The Project area is located in the Williston Basin, a major structural basin that covers northeastern Montana, most of North Dakota, and northwestern South Dakota (Peterson and McCary 1987). The Williston Basin also extends north into Alberta, Saskatchewan, and Manitoba in southern Canada. The basin contains about 15,000 feet of Paleozoic through Tertiary sedimentary rock. The center of the basin is located in McKenzie County. The major structural feature in the Project vicinity is the Nesson Anticline, a north-south trending structure in eastern Williams and McKenzie counties (Gerhard et al. 1987). North-south trending fault zones paralleling the Nesson Anticline have been mapped in the deeper bedrock in Williams County, but do not extend up to the surface.***

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***Soils in the Project area vary depending on the topography, slope orientation, and parent material from which the soil is derived. The Project area is located within MLRA 54 – Rolling Soft Shale Plain and MLRA 53B – Central Dark Brown Glaciated Plains (USDA 2006). MLRA 54 is predominantly unglaciated, but the eastern and northern edges have been glaciated. The soils generally formed in residuum and alluvium from sedimentary parent materials. They are shallow to very deep, generally somewhat excessively drained to moderately well drained, and loamy or clayey. The nearly level to rolling till plains in MLRA 53B include kettle holes, kames, moraines, and small glacial lakes. Almost all of this MLRA is covered by glacial till plains. Some glaciolacustrine deposits also occur. The soils generally are very deep, well drained to very poorly drained, and clayey or loamy.***

No permanent impacts to the soils in the Project area are anticipated as a result of pipeline installation or operation, except at those locations where new aboveground facilities (***e.g., receipt facilities, emergency response equipment storage areas, and MLV locations***) are constructed. The majority of the soil disturbance along the proposed route would be limited to the construction ROW, but temporary access, staging areas, and additional temporary workspaces may be needed at select locations.

In order to prevent effects on the soil due to compaction by construction operations, topsoil stripping and/or soil decompaction techniques would be used during clearing, grading, and restoration activities. Topsoil stripping would occur in the Project ROW above the entire Project ROW (i.e., spoil, trench, and working side) ***for the entire length of the pipeline. Decompaction would occur in areas where the topsoil was not stripped but would have experienced sufficient construction traffic to cause soil compaction.*** Decompaction measures are further described in the Construction, Mitigation, and Reclamation Plan.

Soil impacts may occur due to wind and water erosion, ***compaction, and rutting*** on areas that are disturbed during construction. ***Reclamation and erosion control would be difficult on soils that occur on steeper sloping areas (15 percent or more), particularly those steeper sloping areas over shallow soils (60 inches or less to bedrock). Soils with unfavorable properties, including thin topsoil layers, moderate to strong salinity and alkalinity, clayey or sandy surface and subsoils, and shallow depths over bedrock are common and would present problems for erosion control and revegetation. BakkenLink plans to minimize or mitigate potential impacts to soils by implementing the soil protection measures identified in Environmental Assessment, Table 2-4; the SWPPP; and the CMRP. The CMRP, SWPPP, and Summary of Protection Measures (POD, Appendices XVII, XIII, and XVII, respectively), would provide an effective program that would ensure successful erosion control and reclamation of all land disturbance.***

Soils crossed by the proposed Project would be susceptible to contamination from spills or leaks of liquids used during construction. BakkenLink has developed a Spill Prevention, Control, and Countermeasures Plan (SPCC Plan) that would outline methods to reduce spills or leaks. Any contaminated soils would be excavated and removed from the Project area, and the appropriate agencies would be notified as required. Procedures for handling contaminated soil are further described in the SPCC Plan. During construction, soil erosion will be minimized by implementing procedures described in BMPs, the SWPPP, and the Reclamation Plan. Also, topsoil and subsoil will be segregated; the topsoil will be stripped and stored separately from the subsoil and replaced with minimum handling. In rocky areas, an assessment of the

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soil handling requirements will be made by BakkenLink. On agricultural land, subsoil will be chisel-plowed, rock-picked, and leveled prior to the replacement of topsoil.

### 5.5.2 Vegetation and Soil Ecosystems

The Project area occurs in the Northwestern Great Plains (ecoregion III) (**Bryce et al. 1996**), which is a western mixed-grass and short-grass prairie ecosystem (Bryce et al. **1996**). Native grasses include blue grama (*Bouteloua gracilis*), western wheatgrass (*Pascopyrum smithii*), green needlegrass (*Nassella viridula*), prairie sandreed (*Calamovilfa longifolia*), and **little bluestem (*Schizachyrium scoparium*)**. Common wetland vegetation includes various species of sedge (*Carex* spp.), bulrush (*Scirpus* spp.), and cattails (*Typha* spp.). Common plant species found in woody draws, coulees, and drainages include **green ash (*Fraxinus pennsylvanica*)**, **chokecherry (*Prunus virginiana*)**, silver buffaloberry (*Shepherdia argentea*), and western snowberry (*Symphoricarpos occidentalis*).

The habitat types identified during the field surveys include **grasslands, woodlands, shrublands, wetlands, and agricultural fields**. Temporary impacts would occur along the route and where access is needed for Project construction activities. Wooded or forest areas within the Project ROW primarily are associated with **wooded draws, streams and wind breaks. *Vegetative clearing, including trees and shrubs, related to construction activities would be limited to the approved construction ROW.***

Existing agricultural and grazing practices along the route have substantially altered the original vegetative landscape. Permanent vegetative impacts from pipeline construction are not anticipated, **except at those locations where new aboveground facilities (e.g., receipt facilities, emergency response equipment storage areas, and MLV locations) are constructed**. Temporarily disturbed areas that are normally cultivated would be available after Project construction. Areas not currently in agricultural use would be seeded with native seed mixes per USFS, **USACE**, USFWS, and Natural Resources Conservation Service recommendations, or as otherwise negotiated with private landowners.

BakkenLink would work closely with landowners to minimize adverse impacts to vegetation associated with construction of the pipeline. **With the construction ROW, it is assumed that all the tree and shrubs counted during the tree and shrub inventory would be removed during clearing. Woody species present within the shrubland and woodland vegetation cover types would be replaced pursuant to the PSC Tree and Shrub Mitigation Specifications (POD, Appendix XXIII) and the USACE tree and shrub mitigation specifications, SOP #14 – Garrison Project Tree/Vegetation Mitigation (POD, Appendix XXV). However, tree and shrub replacement would not be permitted within a 20- to 30-foot-wide path over the pipeline centerline to facilitate periodic visual inspections of the ROW.** The replacement location(s) would be coordinated with the landowner(s).

BakkenLink will coordinate with appropriate agencies to identify other efficient restoration and mitigation measures following construction. For areas reclaimed along the ROW, monitoring of reclamation will be conducted for the first growing season following reclamation **and 3 to 5 years thereafter, depending on land ownership**. Reclamation success will be based on the revegetation to 70 percent (**90 percent on USACE-administered lands**) of the background cover. The Reclamation

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Plan will outline the procedures to be followed to return the land to pre-existing vegetative cover and land uses.

### 5.5.3 Wildlife

Impacts to wildlife would include modifications to habitat, and an increase of human activity in the area. Activities may result in temporary displacement of wildlife in the area and the disturbance of avian nest locations. The Migratory Bird Treaty Act of 1918 (16 U.S.C. §§ 703-712) protects bird species, including, but not limited to, cranes, ducks, geese, shorebirds, hawks, and songbirds and their nests. These impacts would be temporary and permanent impacts are not anticipated. Activities closer to the construction would be more concentrated, and may temporarily displace nesting birds and wildlife, or destroy nests. The impact on terrestrial wildlife would be short-term and minimal, and permanent impacts are not anticipated.

Direct impacts to wildlife populations may include limited direct mortalities from pipeline construction, habitat loss or alteration, incremental habitat fragmentation, and animal displacement. Indirect impacts could include increased noise, additional human presence, and the potential for increased vehicle-related mortalities. The degree of the impacts on terrestrial wildlife species and their upland habitats would depend on factors such as the sensitivity of the species, seasonal use patterns, type and timing of Project activity, and physical parameters (e.g., topography, cover, forage, and climate).

To protect species protected under the Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act, a presence/absence survey for active nests would be conducted prior to construction. To minimize impacts, migratory birds and nests would be avoided during construction and operation of the pipeline. Any wildlife encountered during work activities would be avoided to the extent possible. Clearing and grubbing of the Project ROW would occur in the fall or early spring to discourage bird nesting. In the event clearing and grubbing of the ROW is not possible prior to the nesting season, nesting surveys for migratory birds would be conducted where suitable nesting habitat exists prior to construction. If active nests are encountered on the ROW, the USFWS would be consulted for instructions on avoidance and/or mitigation measures. Consultation with the USFWS regarding nesting avian species would be continued during construction activities.

Adverse impacts to special status species (i.e., federally listed or USFS sensitive) are not anticipated. One USFS sensitive plant species (i.e., Hooker's townsend daisy) has been identified at four different locations **near** the construction ROW. If, during construction, additional special status species are encountered, construction would be halted and the USFS would be notified and consulted for additional information on how to proceed. The **Project route** does not **cross** any areas designated as Wildlife Management Areas (North Dakota Game and Fish Department 2014) or USFWS Waterfowl Production Areas.

### 5.5.4 Groundwater

Construction activities could temporarily alter overland flow and groundwater recharge. Surface soil compaction caused by the operation of heavy equipment could reduce the soil's ability to absorb water, which could increase surface runoff and the potential for erosion. These impacts would be temporary and localized following proper and sufficient de-compaction during reclamation. More details can be found in the Construction, Mitigation and Reclamation Plan (Appendix XIII of POD).

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Some dewatering of construction areas and the pipeline trench may occur; however, relatively small volumes are expected and effects on the overall groundwater system would be small and temporary. Potential impacts on the groundwater would include minor fluctuations in groundwater levels and/or increased turbidity within the aquifer adjacent to the activity. Because of the relatively small amount of water removed, the short duration of the activity, and the local discharge of the water, groundwater levels would quickly recover after pumping stops.

The greatest risk for impacts to groundwater would result from the accidental release of a hazardous substance during construction or from a release during operations of the pipeline. BakkenLink has developed a SPCC Plan and a SWPPP to address preventive and mitigation measures that would be used to avoid or minimize the potential impact of hazardous material spills during construction. The Project would be monitored through a fiber optic cable control system, which would alert operations personnel to any potential leaks. Additionally, communications equipment would be installed allowing valves to be operated remotely to minimize any potential impacts of a spill. Expected actuator locations include both sides of the Lake Sakakawea crossing.

### 5.5.5 Flowing Surface Waters

Construction of the Project could affect surface water in several ways. Clearing, grading, trenching, and soil stockpiling activities could temporarily alter overland flow. Surface soil compaction caused by the operation of heavy equipment could reduce the soil's ability to absorb water, which could increase surface runoff and the potential for ponding. These impacts would be localized and temporary following proper and sufficient de-compaction during reclamation (Appendix XIII of POD).

Environmentally sensitive areas such as wetlands and waterbodies, if necessary and warranted, can be by-passed underground with trenchless methods. When HDD is employed, inadvertent releases of drilling fluids and lubricants through seepage may occur, which sometimes can reach surface water(s).

BakkenLink has developed an Inadvertent Returns Contingency Plan and Hydrostatic Test Plan, provided in POD Appendices XXI and XIV, respectively. The Project would be designed and constructed so it would not impede the flow of any waterway. The pipeline would be installed below the bed of the waterway, at a level so the channel bed gradient does not change.

During construction of the Project, the SWPPP and BMPs will be implemented to minimize storm water transport of sediment from disturbed areas to streams and wetlands. All Project-related storm water and hydrostatic test water discharges will be in compliance with a National Pollutant Discharge Elimination System (NPDES) permit. Persons familiar with wetland and riparian identification will post signs at the edges of the wetland/waterbody features prior to construction. No aboveground facilities or staging areas will be constructed within wetlands, riparian areas, or other waters of the U.S. Additional temporary workspace will be located a minimum of 50 feet outside wetland boundaries. BMPs will be utilized at all wetland and waterbody crossings to minimize sedimentation. For areas where additional setbacks are deemed necessary to protect the resource, the applicability of the appropriate setback will be determined in consultation with agencies on a site-specific basis.

The surface water resources in the Project area would be managed and protected according to existing federal laws and policies regarding the use, storage, and disposal of the resource during the construction and operation of the Project. Surface water resource use and protection is administered under the following federal laws:

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- Clean Water Act of 1972 (CWA), as amended (33 U.S.C. 1251 et seq.);
- Federal Land Policy and Management Act of 1976 (43 U.S.C. 1711–1712);
- NEPA (42 U.S.C. 4321); and
- Safe Drinking Water Act of 1974, as amended (42 U.S.C. 300 et seq.).

Water quality is protected under the Federal Water Pollution Control Act (as amended), otherwise known as the CWA. The CWA has developed rules for regulating discharges of pollutants into waters of the U.S. and also regulates water quality standards for surface waters. The CWA also has made it unlawful to discharge any pollutant from a point source into any navigable waters of the U.S., unless a permit has been obtained from the NPDES program.

A total of **24** waterbody crossings were identified during the field surveys, of which **23** were intermittent and 1 perennial. Each intermittent and perennial waterbody is considered to be jurisdictional due to the presence of an ordinary high water mark. BakkenLink is proposing to use an open-cut crossing methods, **or Horizontal Directional Drilling (HDD)** for installing the pipeline through intermittent streams. **For the Lake Sakakawea crossing, Bakkenlink is proposing to install the pipe using the pipeline-pull method.** In order to prevent shoreline erosion and possible pipeline exposure in the long term, shoreline stabilization for the excavated areas on the north and south shorelines of Lake Sakakawea between elevations 1,820 feet National Geodetic Vertical Datum of 1929 (NGVD29) and 1,860 feet NVGD29 would be achieved utilizing Class I riprap stone cover. The riprap on the north and south shorelines would cover an area 30 feet by **362** feet and 30 feet by **850** feet, respectively. The riprap would extend slightly beyond Lake Sakakawea's full pool elevation of 1,854 feet NGVD29 and consist of angular shape, hard, granite bases, non-corrosive, and non-magnetic material. **The top of the pipeline protection system being relatively flat would be utilized for the launching of an emergency response boat. For the riprap pipeline protection system design, smaller-sized riprap and/or sand will be utilized to help "smooth out" the top of the riprap cap. For the concrete mat pipeline protection system design, the top of the concrete matting would provide a smooth surface that would allow for the launching of an emergency response boat. BakkenLink would maintain the pipeline protection system throughout the life of the Project to serve as a non-public boat launch to be used only for launching emergency response boats.** More details on waterbody crossings can be found in Appendix **X and IX** of the POD.

The Project would be designed and constructed so it would not impede the flow of any waterway. Pipeline crossings would be scheduled at times when there is as little rainfall as possible to minimize the risks of debris, stockpiled soil, and other sources of sediment from being washed into water bodies or wetlands. Temporary erosion and sediment control BMPs would be installed across the entire width of the construction ROW, upslope of and on both sides of each waterbody crossing, after clearing, and before ground surface disturbance. No silt-laden/turbid discharge water from trench dewatering operations would be allowed to enter any waterbody or wetland. The pipeline would be installed below the bed of the waterway, at a level so the channel bed gradient does not change.

### 5.5.6 Wetlands, Reservoirs, and Lakes

The pipeline would be routed to avoid most wetland crossings. Wetlands that cannot be avoided would be crossed using open cut methods and mitigation measures. Standard wetland construction mitigation

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measures would include reducing construction ROW to 75 feet and limiting equipment working in wetlands to that essential for clearing the ROW, excavating the trench, fabricating and installing the pipeline, backfilling the trench, and restoring the ROW. In areas where access to the ROW is only available through the wetland area, non-essential equipment would be allowed to travel through wetlands only if the ground is firm enough, or has been stabilized, to avoid rutting. If rutting is anticipated, non-essential equipment would be allowed to travel through the wetlands only once, and essential equipment would need to be stabilized with prefabricated mats or terra mats. Areas that would be disturbed by excavation, grading, and construction traffic may increase sedimentation into a wetland area. Reasonable efforts would be employed to limit any sediment movement within the Project area. Following completion of pipeline installation, it is anticipated that there would be no additional impacts on wetlands or water quality. Permanent impacts are not anticipated.

Erosion and sediment control BMPs would be used during construction, operation, and maintenance of the pipeline to protect topsoil and minimize soil erosion into adjacent wetlands. Vegetation clearing would be limited to trees and shrubs, and excavation would be limited to the pipeline trench only. During clearing activities, sediment barriers would be installed and maintained adjacent to wetland areas and within temporary extra workspaces, as necessary, to minimize the potential for sediment runoff.

***Sensitive areas such as wetland boundaries and cultural resource sites would be marked and flagged for implementing protective measures. Markers will be labeled***

***“Environmentally Sensitive Area” and won’t specifically identify the resource.*** Biologists recorded and delineated 14 wetlands (mainly freshwater emergent) within the **200- to 250-foot-wide survey corridor** centered on the proposed pipe centerline. There are **14.0** acres of wetland vegetation, hydric soils, and potential hydrologic functionality that are temporarily impacted. **No** permanent disturbance would occur **in wetlands from** construction of aboveground facilities.

### 6.0 BakkenLink's Pipeline Safety Program

Pipelines are one of the safest forms of crude oil transportation and provide a cost-effective and safe mode of transportation for oil on land. Overland transportation of oil by truck or rail produces higher risk of injury to the general public than the proposed pipeline (USDOT 2002). The Project will be designed, constructed, and maintained in a manner that meets or exceeds industry standards.

Safeguards have been implemented during design, and will be implemented during construction and operations of the pipeline. Historically, one of the most significant risks associated with operating a crude oil pipeline is the potential for third-party excavation damage. To minimize the risk of third-party damage, the pipeline will be built within an approved ROW and markers will be installed at all road, railway, and water crossings. BakkenLink plans to use a minimum depth of cover that will meet or exceed federal requirements outlined in 49 CFR 195.248. In most circumstances, depth of cover will be 36 inches (3 feet). This would substantially reduce the chance of third-party excavation damage, a leading cause of pipeline incidents.

Per federal regulations, BakkenLink would have a maintenance, inspection, and repair program that ensures the integrity of the pipeline during operations. BakkenLink's pipeline maintenance program would be designed to maintain the safe and reliable operation of the pipeline. Data collected during maintenance would be fed back into the decision-making process for the development of the ongoing maintenance program.

BakkenLink also would mitigate third-party excavation risk by implementing comprehensive Public Awareness and Damage Prevention programs focused on education and awareness in accordance with 49 CFR 195.440 and API RP1162. Further, BakkenLink would complete regular visual inspections (ground or aerial) of the ROW as per 49 CFR 195.412, and monitor activity in the area to prevent unauthorized trespass or access.

To mitigate the effects of corrosion on the pipeline, BakkenLink would apply a FBE or other type of protective pipeline coating to the external surface of the pipe to prevent corrosion. A cathodic protection system would be installed, comprised of engineered metal alloys or anodes, which would be connected to the pipeline. A low voltage direct current would be applied to the pipeline; the process corrodes the anodes rather than the pipeline. During operations, the pipeline would be routinely cleaned. The pipeline would be inspected with a smart in-line inspection tool, which measures and records internal and external metal loss, thereby allowing BakkenLink the ability to proactively detect signs of corrosion.

In addition, the pipeline would be monitored 24 hours a day, 365 days a year from the OCC using a sophisticated SCADA system. BakkenLink would implement multiple leak detection methods and systems that are overlapping in nature and progress through a series of leak detection thresholds. The leak detection methods are as follows:

- Remote monitoring performed by the OCC Operator, which would consist of monitoring pressure and flow data received from pump stations and valve sites fed back to the OCC by the BakkenLink SCADA system. Remote monitoring typically is able to detect leaks down to approximately 25 to 30 percent of the pipeline flow rate.

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- Software-based volume balance systems that would monitor receipt and delivery volumes. These systems typically are able to detect leaks down to approximately 5 percent of the pipeline flow rate.
- CPM or model-based leak detection systems that would break the pipeline into smaller segments and monitor each of these segments on a mass balance basis. These systems typically are capable of detecting leaks down to a level of approximately 1.5 to 2 percent of pipeline flow rate.
- Atmos Pipe is the Real Time Statistical System (RTSS) which was originally developed by Shell between 1988 and 1994 and has continuously been developed by Atmos International since then. It is pipeline leak detection software developed specifically to provide high sensitivity (in detecting leaks) with high reliability (few false alarms) in all operating conditions. Atmos Pipe applies Sequential Probability Ratio Test (SPRT) to detect changes in the overall behavior of flow and pressure at the receipt and delivery points. Although the control and operation may vary from one pipeline to another, the relationship between the pipeline pressure and flow will always change after a leak develops in a pipeline. For example, a leak will normally cause the pipeline pressure to decrease and introduce a discrepancy between the receipt and delivery flow-rate. Atmos Pipe is designed to recognize these patterns. Leak determination is based on probability calculations at regular sample intervals. Although the flow and pressure in a pipeline fluctuate due to operational changes, statistically, the total mass entering and leaving a network must be balanced by the inventory variation inside the network. Such a balance cannot be maintained if a leak occurs in a network. The deviation from the established balance is detected by SPRT. The combination of SPRT with pattern recognition provides Atmos Pipe a very high level of system reliability i.e. minimum spurious alarms. Computer-based, non-real time accumulated gain/loss volume trending that would assist in identifying low rate or seepage releases below the 1.5 to 2 percent by volume detection thresholds.
- Direct observation methods, which include aerial patrols, ground patrols, and public and landowner awareness programs that would be designed to encourage and facilitate the reporting of suspected leaks and events that may suggest a threat to the integrity of the pipeline.

The leak detection system would be configured in a manner capable of alarming the OCC operators through the SCADA system and also would provide the OCC operators with a comprehensive assortment of display screens for incident analysis and investigation. In addition, there would be a redundant, stand-by OCC to be used in case of emergency.

After contracts are awarded, a Project Safety Plan and Procedures document would be developed with the Contractor. All work would be conducted in compliance with the Safety Plan and Procedures. A copy of the Safety Plan would be maintained on site at all times during work. During construction planning, emergency egress and nearest urgent care facilities would be identified and used in the Safety Plan.

The Contractor would provide an emergency conveyance vehicle (a Suburban equivalent) for transportation of an injured worker. At a minimum, this vehicle would be equipped with stretcher/cot and basic first aid supplies. BakkenLink would require the construction crew involved in a serious or critical incident injury to worker(s) and crews with similar work operations to stand down from work until an investigation is completed and mitigations put in place to minimize the risk of the incident occurring again.

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Lastly, BakkenLink would have an ERP in place to respond to incidents. The ERP would contain comprehensive manuals, detailed training plans, equipment requirements, resources plans, auditing, change management and continuous improvement processes. The IMP (49 CFR 195) and ERP would ensure BakkenLink operates the pipeline in an environmentally responsible manner.

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### 7.0 Summary

In summary, this conservative analysis of the proposed Project shows that the predicted frequency of incidents is very low, the probability of a large spill occurring is very low, and consequently, risk of environmental impacts is minimal. Compliance with regulations, application of BakkenLink's IMPs and ERP, as well as adherence to safety procedures would help to ensure long-term environmentally responsible and safe operation of the pipeline.

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## 9.0 Glossary

### **Accidental Release**

An accidental release is an unplanned occurrence that results in a release of oil from a pipeline.

### **Acute exposure**

Exposure to a chemical or situation for a short period of time.

### **Acute toxicity**

The ability of a substance to cause severe biological harm or death soon after a single exposure or dose.

### **Adverse effect**

Any effect that causes harm to the normal functioning of plants or animals due to exposure to a substance (i.e., a chemical contaminant).

### **Algae**

Chiefly aquatic, eukaryotic one-celled or multicellular plants without true stems, roots and leaves that are typically autotrophic, photosynthetic, and contain chlorophyll. They are food for fish and small aquatic animals.

### **Aquifer**

An underground layer of water-bearing permeable rock or unconsolidated materials (gravel, sand, silt, or clay) from which groundwater can be usefully extracted using a water well.

### **Barrel**

A barrel is a standard measure of a volume of oil and is equal to 42 gallons.

### **Benthic invertebrates**

Those animals without backbones that live on or in the sediments of a lake, pond, river, etc.

### **Bioavailability**

How easily a plant or animal can absorb a particular contaminant from the environment.

### **Biodegradation**

Biodegradation is the breakdown of organic contaminants by microbial organisms into smaller compounds. The microbial organisms transform the contaminants through metabolic or enzymatic processes. Biodegradation processes vary greatly, but frequently the final product of the degradation is carbon dioxide or methane.

### **Cathodic Protection System**

A technique to provide corrosion protection to a metal surface by making the surface of the metal object the cathode of an electrochemical cell. In the pipeline industry that is done using impressed current.

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Impressed current cathodic protection systems use an anode connected to a DC power source (a cathodic protection rectifier).

### **Chronic toxicity**

The capacity of a substance to cause long-term poisonous health effects in humans, animals, fish, or other organisms. Biological tests use sublethal effects, such as abnormal development, growth, and reproduction, rather than mortality, as endpoints.

### **Contaminant**

Any physical, chemical, biological, or radiological substance found in air, water, soil or biological matter that has a harmful effect on plants or animals; harmful or hazardous matter introduced into the environment.

### **Ecosystem**

The sum of all the living plants and animals, their interactions, and the physical components in a particular area.

### **Emergency Flow Restricting Device**

An emergency flow-restricting device is a device used to restrict or limit the amount of oil that can release out of a leak or break in a pipeline. Check valves and remote control valves are types of emergency flow restricting devices.

### **Exposure**

How a biological system (i.e., ecosystem), plant, or animal comes in contact with a chemical.

### **Event**

An event is a significant occurrence or happening. As applicable to pipeline safety, an event could be an accident, abnormal condition, incident, equipment failure, human failure, or release.

### **Facility**

Any structure, underground or above, used to transmit a product.

### **Geographical Information System**

A computer data system for creating and managing spatial data and associated attributes.

### **Habitat**

The place where a population of plants or animals and its surroundings are located, including both living and non-living components.

### **High Consequence Area (HCA)**

A high consequence area is a location that is specially defined in PHMSA pipeline safety regulations as an area where pipeline releases could have greater consequences to health and safety or the environment. For oil pipelines, HCAs include high population areas, other population areas, commercially navigable waterways, and areas unusually sensitive to environmental damage, including certain ecologically

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sensitive areas and drinking water resources. Regulations require a pipeline operator to take specific steps to ensure the integrity of a pipeline for which a release could affect an HCA and, thereby, provide protection of the HCA.

### **High Population Area**

A high population area is an urbanized area, as defined and delineated by the U.S. Census Bureau, which contains 50,000 or more people and has a population density of at least 1,000 people per square mile. High population areas are considered HCAs.

### **Incident**

As used in pipeline safety regulations, an incident is an event occurring on a pipeline for which the operator must make a report to the Office of Pipeline Safety. There are specific reporting criteria that define an incident that include the volume of the material released, monetary property damage, injuries, and fatalities (Reference 49 CFR Section 191.3, 49 CFR Section 195.50).

### **Incident Frequency**

Incident frequency is the rate at which failures are observed or are predicted to occur, expressed as events per given timeframe.

### **Incident Rate**

Incident rate is the rate at which failures occur. It is the number of failure events that occur divided by the total elapsed operating time during which those events occur or by the total number of demands, as applicable.

### **Integrity Management Program (IMP)**

An IMP is a documented set of policies, processes, and procedures that are implemented to ensure the integrity of a pipeline. An oil pipeline operator's IMP must comply with the federal regulations (i.e., the Integrity Management Rule, 49 CFR Part 195).

### **Integrity Management Rule**

The Integrity Management Rule specifies regulations to assess, evaluate, repair, and validate the integrity of hazardous liquid pipelines that, in the event of a leak or failure, could affect HCAs.

### **Invertebrates**

Animals without backbones: e.g., insects, spiders, crayfish, worms, snails, mussels, clams, etc.

### **LC50**

A concentration expected to be lethal to 50 percent of a group of test organisms.

### **Leak**

A leak is a small opening, crack, or hole in a pipeline allowing a release of oil.

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### **Likelihood**

Likelihood refers to the probability that something possible may occur. The likelihood may be expressed as a frequency (e.g., events per year), a probability of occurrence during a time interval (e.g., annual probability), or a conditional probability (e.g., probability of occurrence, given that a precursor event has occurred).

### **Maximum Contaminant Level (MCL)**

The maximum level of a contaminant allowed in drinking water by federal or state law and is based on the avoidance of health effects and currently available water treatment methods.

### **Other Populated Areas**

An 'other populated area' is a census designated place, defined and delineated by the U.S. Census Bureau as settled concentrations of population that are identifiable by name but are not legally incorporated under the laws of the state in which they are located. Other populated areas are considered HCAs by PHMSA.

### **Operator**

An operator is a person who owns or operates pipeline facilities (Reference 49 CFR Section 195.2).

### **Polycyclic Aromatic Hydrocarbons (PAHs)**

Group of organic chemicals.

### **Pipeline**

Used broadly, pipeline includes all parts of those physical facilities through which gas, hazardous liquid, or carbon dioxide moves in transportation. Pipeline includes but is not limited to: line pipe, valves and other appurtenances attached to the pipe, pumping/compressor units and associated fabricated units, metering, regulating, and delivery stations, and holders and fabricated assemblies located therein, and breakout tanks.

### **Receptor**

The species, population, community, habitat, etc. that may be exposed to contaminants.

### **Risk**

Risk is a measure of both the likelihood that an adverse event could occur and the magnitude of the expected consequences should it occur.

### **Sediment**

The material of the bottom of a body of water (i.e., pond, river, stream, etc.).

### **Stressor**

Any factor that may harm plants or animals; includes chemical (e.g., metals or organic compounds), physical (e.g., extreme temperatures, fire, storms, flooding, and construction/development) and biological (e.g., disease, parasites, predation, and competition).

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### **Supervisory Control and Data Acquisition System (SCADA)**

A supervisory control and data acquisition system is a pipeline control system designed to gather information such as pipeline pressures and flow rates from remote locations and regularly transmit this information to a central control facility where the data can be monitored and analyzed.

### **Toxicity Testing**

A type of test that studies the harmful effects of chemicals on particular plants or animals.

### **Toxicity Threshold**

Numerical values that represent concentrations of contaminants in abiotic media (sediments, water, soil) or tissues of plants and animals above which those contaminants are expected to cause harm.

### **Unusually Sensitive Areas (USAs)**

USAs refers to certain drinking water and ecological resource areas that are unusually sensitive to environmental damage from a hazardous liquid pipeline release, as defined in 49 CFR Section 195.6.

### **Zooplankton**

Small, usually microscopic animals (such as protozoans) found in lakes and reservoirs.

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**Attachment A Lake Sakakawea Site-specific Risk Assessment**

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**Attachment B Analysis of High Consequence Areas**

HCA figure is not included but can be made available to agencies only upon request.

**CONFIDENTIAL**

**Appendix B  
Lake Sakakawea Erosion  
Monitoring Plan**



BakkenLink Pipeline North Project  
Lake Sakakawea Pipeline Crossing

Erosion Monitoring Plan

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# 1 Erosion Monitoring Plan

## 1.1 Purpose

The purpose of this Erosion Monitoring Plan (Plan) is to identify construction and monitoring actions at various lake levels for the proposed BakkenLink North Pipeline Project (Project) crossing of Lake Sakakawea (Lake). Measures taken during pipeline construction provide protection of the pipeline for Lake levels between 1860<sup>1</sup> and 1820 are addressed in the POD Appendix X.E Lake Sakakawea Work Plan. This Plan will therefore address Lake levels from 1824 down to 1775.

## 1.2 Project Description

BakkenLink Pipeline LLC (BakkenLink or Company or permittee) is planning to build a new crude oil pipeline (Project) consisting of approximately 37 miles of 16-inch steel crude oil pipeline extending from the Beaver Lodge Receipt Point in Williams County, North Dakota, to the existing Dry Creek Terminal in McKenzie County, North Dakota. The interconnect to the Dry Creek Terminal will establish a connection with the existing BakkenLink Pipeline that is transporting crude oil to a rail facility operated by Great Northern Midstream LLC at Fryburg, North Dakota. BakkenLink is developing and intends to construct, own, and operate the Project.

The optimum pipeline route between Beaver Lodge and Dry Creek results in an approximately 12,000 feet long crossing of the Lake, the design of which has incorporated numerous industry-standard pipeline protection measures. Remotely controlled Mainline Valve (MLV) assemblies, each consisting of two gate valves (for redundancy), will be spaced along the pipeline to meet the requirements of 49 CFR, Part 195, inclusive of one MLV assembly adjacent to both north and south shorelines.

Measures described in the Project Design Basis Memorandum<sup>2</sup> which are specific to identify minimum requirements, inclusive of cover requirement, that must be maintained at all times to provide an allowable pipeline operation risk, include:

- The pipeline segment within the Lake will be lowered to achieve a top of pipe elevation of four feet below the undisturbed lake bottom elevation, which will protect navigation/recreation vessels from coming into contact with the pipeline;
- To mitigate risk of accidental damage and leakage, the pipe utilized for the Lake Sakakawea crossing will exceed the minimum design factor, F, required and be designed using a factor of 0.50.;
- The Lake crossing FBE coated pipe will also be coated with 2.0" thick, 140 pcf concrete weight coating to provide buoyancy control and mechanical protection from dropped objects. The concrete weight coating is designed to withstand any anticipated external loads to satisfy the requirements of 49 CFR, 195.248(b);

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<sup>1</sup> All Lake elevation levels listed in this plan are referenced to feet relative to NAVD 88.

<sup>2</sup> Design Basis Memorandum, Oil Pipeline and Facilities, Dry Creek to Beaver lodge Pipeline Project, Lake Sakakawea Pipeline Segment, produced for BakkenLink Pipeline LLC by Project Consulting Services®, Inc.

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- Stabilization of the excavated shoreline crossing and protection of the in place pipeline will be achieved utilizing stone rip-rap or concrete mattresses designed to withstand the wind driven waves, ice formation, and localized scour. The shoreline stabilization will extend from elevation 1820 feet to 1860 feet to accommodate for historically drastic changes in water levels of Lake Sakakawea, thereby protecting the pipeline during extreme conditions;
- The full length of the crossing will have pipe coated with a concrete weight coating that is sufficient to withstand impact from dropped objects, e.g. anchors, without inducing damage to the pipeline. At field joint areas (gaps in the concrete coating), the increase in wall thickness allows for impact resistance to prevent damage levels requiring repair of the pipe, and;
- Impact analyses were performed in accordance with DNV-RP-107 “Risk Assessment of Pipeline Protection”. The results of the analysis indicate an exposed pipeline (no soil cover) can withstand the largest anticipated anchor strike with and without the concrete coating with “minimal damage” that would not require repair or produce rupture.

In accordance with cost forecast data submitted with various permit applications and the methods described within this Plan, pipeline protection is feasible for all possible future Lake levels.

**1.3 Delineation of Lake Conditions Warranting Remedial Protection**

BakkenLink’s hazard survey report, conducted in August 2014, stated that maximum water depth along the Lake crossing segment of the Project (1800 NAVD88) occurred toward the southern side of the Lake in the vicinity of Station 98+00 and appears to be associated with the center of the historic Missouri River Channel.<sup>3</sup> The report went on to state that hydrographic data acquired in the corridor show the lakebed to be steeply sloping along the shorelines and flat-lying in the middle. Slope grades (rise/run) along the northern shore (~9%) were slightly steeper than those measured along the southern shore (~5%). Between Stations 15+00 and 110+00 only a four-foot fluctuation of lakebed elevation was measured (1802-1806 NAVD88).

**1.3.1 Phase I Condition**

A Phase I Condition is identified as occurring with Lake levels 1824 to 1810 (lakebed elevations 1820 and 1806). This range will cover Lake elevations from the lower end of the nearshore pipeline protection system, installed during construction, to an elevation roughly four feet above the comparatively flat lake bed identified during the hazard survey. These elevations will allow the roughly 9,500’ width of the reservoir to accommodate river flow across a greater cross section area of the Lake.

**1.3.2 Phase II Condition**

Phase II Condition is identified as occurring when Lake levels are between 1810 to 1802, elevations at which river flow may begin to concentrate within the historic Missouri River bed.

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<sup>3</sup> Operations Report (OSI REPORT NO. 14ES030), Multi-sensor Geophysical & Underwater Video Survey and Groundtruth Sampling Program, Proposed Submarine Pipeline Crossing, Lake Sakakawea North Dakota, 1 August 2014.

### 1.3.3 Phase III Condition

Phase III Condition is identified as occurring when Lake level is below 1802, elevations at which significant portions of the existing lake bed have become exposed, facilitating greater access to the historic river bed and at which water/river flow would potentially have an impact on the river channel.

## 1.4 Responsibilities

Funding for work completed to ensure the BakkenLink pipeline is built, operated, and monitored per this plan as well as local, state, and federal regulations shall be the responsibility of BakkenLink Pipeline. The legal authorities that are understood to have jurisdiction over these activities include: USACE, ND Office of State Engineer (Sovereign Lands Permit), DOT's PHMSA, ND DoH, and ND Public Service Commission. Additional agencies may have certain levels of authority/ input.

## 1.5 Lake Level forecast

A threat assessment meeting will be held at least once per year between BakkenLink Pipeline LLC (Permittee) and USACE Riverdale office and USACE ND Regulatory office (possibly after the USACE provides its annual reservoir levels forecast) and other interested agencies as appropriate.

The purpose of the threat assessment meeting would be to (1) assess the likelihood over the upcoming 12-24 months that the lake has returned or will return to a riverine system at the pipeline crossing location, (2) assess whether there is reasonable risk of a major water flow event that will cause substantial scour at the thalweg, (3) assess and confirm that pipeline is properly protected to ensure safe operation and structural integrity across the entire lake crossing, and (4) assess if circumstances have changed in the prior twelve months that might put the pipeline at higher probability to be under threat of not being properly protected. At that time and based on circumstances and available information, Permittee will work with the USACE Riverdale office and the ND Regulatory office (and any other appropriate agency) on the appropriate additional pipeline protection measures which may include additional riprap/concrete mattresses being placed over the pipeline and/or lowering of the pipeline.

If the threat is foreseeable and there is time to protect or lower the pipe, the Permittee will provide plans to protect and/or lower the pipeline within 60 days of the threat assessment meeting at which it is directed to do so, and will work with appropriate USACE office, and other regulating agencies/authorities to determine the required steps to take to protect the pipe.

If for any reason the threat is imminent, leaving insufficient time to take measures to physically protect the pipe, Permittee will temporarily suspend service and remove all oil from the pipe until such threat passes or the pipe can be lowered or otherwise properly protected from damage and spills. Prior to putting the pipeline back into service, the pipeline will be evaluated to ensure the pipeline can be operated in a safe manner.

## 1.6 Monitoring

BakkenLink will conduct an as-built geophysical and diver survey after completion of all construction operations to establish the baseline elevation and condition of the pipeline. Any subsequent surveys as

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defined below, which may be required after occurrence of a defined event, including forecast low water level, will be compared with this baseline condition.

**1.6.1 Level 1 Survey:**

A Level 1 survey consists of a general visual inspection (GVI) that focuses on obvious damage to the protective cover at the shorelines. Perform a GVI by conducting a walk-through of the area with the goal of visually identifying specific areas of damage and potential concern. Conduct an underwater visual inspection using divers, underwater camera, or scanning sonar processor with the goal of visually identifying specific areas of damage and/or potential concern. If during the course of inspecting there are indications of pipeline exposure, damage, or potential concern move to a Level 2 survey.

**1.6.2 Level 2 Survey:**

A Level 2 survey consists of an underwater inspection using divers, underwater camera or sidescan sonar in combination with a magnetometer to focus on areas of concern/exposed areas of the pipeline and particularly to verify the performance of the selected erosion protection system. If during the course of inspecting there are indications of pipeline movement or damage, move to a Level 3 survey.

Additional inspection will be conducted to evaluate effects of river bed scour downstream of the pipeline crossing, bank erosion, and channel lateral migration.

At this point, the pipeline will be taken out of service.

**1.6.3 Level 3 Survey:**

A Level 3 survey consists of an underwater inspection using divers to determine the extent of movement and/or damage of the pipeline. The Level 3 survey will also include running of an inline inspection tool (pig) to map any geometric defects (dents) for evaluation and repair.

**1.6.4 Leak testing:**

Perform a leak test before returning the pipeline to service. When conducting the leak test, the pressure must be stabilized and at a level sufficient to detect all leaks, use pressure gauges and recorders that are sufficiently accurate to detect leaks, and conduct the test for a minimum of two hours.

**1.7 On-site Stockpile Provisions**

BakkenLink will maintain a stockpile of riprap and/or concrete mats at a nearby Company storage site (within 10 miles on north side and 25 miles on south side) sufficient to protect approximately 500 linear feet of pipeline, which is sufficient to extend the south shore pipeline protection system from 1820 to 1810. This stockpile will also function as a buffer for material storage, enabling commencement of remedial protection operations while any additional required materials are being transported to the work site. Materials to be stockpiled are defined in the pipeline protection system design drawings located in the POD Appendix X.E Lake Sakakawea Work Plan.

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### 1.8 Remedial Protection System Installation Equipment

BakkenLink has established and will continue contractual agreements with local pipeline construction contractors that would expedite mobilization to the work site to commence remedial protection system installation. BakkenLink has also established and will continue to have agreements in place with spill response contractors. BakkenLink has a contract in place Clean Harbors (approved OSRO), is a member of Sakakawea Area Spill Response, LLC (SASR), has a Master Service Agreement with Swat Consulting who specializes in winter spill response, as well as many local contractors.

## 2 Phase I Condition - Lake levels 1824 to 1810

Forecast Phase I lake levels are anticipated to provide sufficient water depth to allow floating equipment to work in the reservoir.

### 2.1 Phase I Reporting

Standard reporting on the condition of the Lake crossing pipeline will be accomplished in the annual meetings defined in Section 1.5 above. If Lake levels are forecast to drop below 1824, the meeting will be used as a forum to discuss remedial protection measures to be implemented and to establish further reporting processes for updating the USACE and other concerned bodies.

Should a defined event occur and the results of the monitoring program defined in Section 1.6 indicate the pipeline is at risk and needs protection and/or to be lowered, BakkenLink will notify and work with the USACE office(s) and other concerned agencies of the specific remedial protection measures to be undertaken.

### 2.2 Phase I Remedial Protection Installation Methodology

If Phase I Condition lake levels are anticipated, BakkenLink will implement the survey processes defined in Section 1.6 to identify areas that may be susceptible to effects of low water levels, particularly including ice. Upon coordination and concurrence with USACE and other agencies, remedial protection materials will be installed over the pipeline only in those areas where the forecast water level will be less than six feet above the as-built Top of Pipe (TOP) elevation, which would be the depth to which ice may be expected to affect the pipeline.

The pipeline will be taken out of service prior to any excavation as noted in the Level 2 survey above.

The allowable window for installation of remedial protection will be June 1, close of pallid sturgeon season, through approximately end of October each year. Estimated duration of the remedial work will depend upon the extent of the work required, however any timing stipulations required by USACE or other governing agencies will be followed.

Should the results of the monitoring survey indicate remedial protection of the pipeline is required, BakkenLink (with review and concurrence from USACE and other governing agencies) will determine the steps required to achieve the pipeline protection. Should the case be that the pipeline protection system is not fully down to a new waterline, BakkenLink would first mobilize a land-based construction spread to use the stockpiled material to extend the south shore pipeline protection system down to the new water's

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edge. Once the pipeline protection system has been extended or if this step is not needed, BakkenLink will mobilize a construction spread similar to that used for nearshore pipeline trenching during the initial construction phase. A flexifloat vessel will be assembled and equipped with either a backhoe or a crane with a clamshell bucket. Positioning of the flexifloat excavation vessels will be provided by spuds (mooring pilings which can be raised and lowered as required to temporarily “pin” the vessel to the lakebed).

Sedimentation created at the excavation sites will be mitigated with turbidity curtains. The turbidity curtains will be secured in position with either temporary wooden pilings or other curtain mooring system such as buoys and anchors, and will be maintained by divers as required.

Turbidity monitoring instrumentation and personnel with STOP authority in case construction activity exceeds an agreed turbidity level will be deployed.

The location of the pipeline will be verified with onboard positioning equipment and/or buoys on the pipeline to prevent spuds or excavation bucket from being dropped onto the pipeline.

A trench will be excavated on both sides of the pipeline to the dimensions designated on the remedial protection design drawings to enable the riprap or concrete mats to be “keyed” into the lakebed.

After sufficient length of trenches have been excavated, spoil material that was sidecast and stored on the lakebed during excavation will be returned to the trench over the pipeline to a depth that will enable capping with the selected pipeline protection design system. The underlying riprap material will be placed over the spoil material, then the larger rip rap material, or cable-tied concrete mattresses, will be the final cap on the pipeline protection system.

The underlying riprap will be pre-loaded into hoppers onshore. The hoppers will be similar to those used for pouring concrete and will be equipped with a tremie tube or sock to control placement. The hoppers will be transported to the flexifloat excavation vessel on a flexifloat barge. The crane on the excavation vessel will lift each hopper and suspend it over the trench such that the riprap material will be placed in accordance with design requirements in a controlled manner.

A cap, composed of riprap, or cable-tied concrete mats, will be placed over the underlying riprap material.

To install the larger riprap, a rock grapple bucket will be used to lift the rock off of the flexifloat transportation barge. The bucket will be positioned over the underlying riprap and the larger riprap rocks/boulders will be placed over the pipeline trench. Surveys will be conducted and riprap will then be repositioned with diver assistance such that the final grade of the surrounding lakebed is maintained.

### **3 Phase II Condition - Lake levels 1810 to 1802**

Forecast Phase II lake levels are anticipated to require a combination of floating equipment and amphibious/wetland equipment to complete installation of the remedial pipeline protection system. BakkenLink will work with USACE and other governing agencies to evaluate and approve the best methods to achieve the proposed pipeline protection.

BakkenLink Pipeline North Project	File No.: 14003
Lake Sakakawea Erosion Monitoring Plan	Date: 11/23/2015
PREPARED BY: Project Consulting Services®, Inc.	Page 8 of 10

### 3.1 Phase II Reporting

Standard reporting on the condition of the Lake crossing pipeline will be accomplished in the annual meetings defined in Section 1.5 above. If Lake levels are forecast to drop below 1810, the meeting will be used as a forum to discuss remedial protection measures to be implemented and to establish further reporting processes for updating the USACE and other concerned bodies.

Should a defined event occur and the results of the monitoring program defined in Section 1.6 indicate the pipeline is at risk and needs additional protection and/or to be lowered, BakkenLink will notify and work with the USACE and other concerned agencies of the specific remedial protection measures to be undertaken.

### 3.2 Phase II Remedial Protection Installation Methodology

If Phase II Condition lake levels are anticipated, BakkenLink will implement the survey processes defined in Section 1.6 to identify areas that may be susceptible to effects of low water levels, particularly including ice. Remedial protection materials will be installed over the pipeline across the entire width of the reservoir that is not already protected.

The pipeline will be taken out of service prior to any excavation as noted in the Level 2 survey above.

The allowable window for installation of remedial protection will be June 1, close of pallid sturgeon season, through approximately end of October each year. Estimated duration of the remedial work will depend upon the extent of the work required, however any timing stipulations required by USACE or other governing agencies will be followed.

Should the results of the monitoring survey indicate remedial protection of the pipeline is required, BakkenLink (with review and concurrence from USACE and other governing agencies) will implement the procedures as stated in 2.2 with the difference being protection materials being installed over the pipeline across the entire width of the reservoir not already protected.

## 4 Phase III Condition - Lake levels below 1802

Phase III lake levels are anticipated to occur when the lake level is sufficiently low to allow heavy equipment, including HDD equipment and pipe assembly spreads, to access work sites adjacent to the historic Missouri River bed. Presuming appropriate soils conditions, HDD methodology will be employed to attain a depth of not less than 1770 (or other agreed upon depth) beneath the historic Missouri River bed. The new HDD section of pipeline underneath the historic Missouri River bed would then be tied into the existing pipeline on each side of the historic riverbed.

### 4.1 Phase III Reporting

Standard reporting on the condition of the Lake crossing pipeline will be accomplished in the annual meetings defined in Section 1.5 above. If Lake levels are forecasted to drop below 1802, the meeting will be used as a forum to discuss remedial protection measures to be implemented and to establish further reporting processes for updating the USACE and other concerned bodies.

BakkenLink Pipeline North Project	File No.: 14003
Lake Sakakawea Erosion Monitoring Plan	Date: 11/23/2015
PREPARED BY: Project Consulting Services®, Inc.	Page 9 of 10

Should a defined event occur and the results of the monitoring program defined in Section 1.6 indicate unanticipated exposure of the pipeline, BakkenLink will notify and work with the USACE and other concerned agencies of the specific remedial protection measures to be undertaken.

#### **4.2 Phase III Remedial Protection Installation Methodology**

Additional remedial pipeline protection will be installed over the remainder of the pipeline as described in the Phase II condition using marsh buggies.

If Phase III Condition lake levels are anticipated, BakkenLink will implement the survey processes defined in Section 1.6 to identify areas that may be susceptible to effects of low water levels, particularly including ice.

The pipeline will be taken out of service prior to any excavation as noted in the Level 2 survey above. All residual product will be pigged out of the line and it will be filled with nitrogen.

The allowable window for installation of remedial protection will be June 1, close of pallid sturgeon season, through approximately end of October each year. Estimated duration of the remedial work will depend upon the extent of the work required, however any timing stipulations required by USACE or other governing agencies will be followed.

Should the results of the monitoring survey indicate remedial protection of the pipeline is required, BakkenLink (with review and concurrence from USACE and other governing agencies) will implement the procedures as stated in 2.2 with flexifloat bridges being used to supplement access across any residual portions of water remaining in the reservoir.

The entry side HDD rig will set up on the south side of the river bed. A second drilling rig may be set up on the north, or exit, side of the river bed if warranted by drilling conditions. The work site for fabrication of the pipe will be on the exit side.

After completion of pullback, a pit sufficiently large to safely complete tie-in of the newly installed HDD pipe to the existing pipeline will be excavated on both sides of the river.

The section of the existing pipeline that has been removed from service will be recovered and disposed of off-site.

**Appendix C  
Geologic and Horizontal  
Directional Drill Review of the  
Proposed Crossing and  
Missouri River/Lake  
Sakakawea Crossing  
Alternatives**

**Geologic and Horizontal  
Directional Drill Review of the  
Proposed Crossing and  
Missouri River/Lake  
Sakakawea Crossing  
Alternatives**

**BakkenLink Dry Creek to  
Beaver Lodge Pipeline Project**



**Prepared for:**  
BakkenLink Pipeline LLC

**Prepared by:**  
Stantec Consulting Services Inc.

May 2016

## Sign-off Sheet

This document entitled Geologic and Horizontal Directional Drill Review of the Proposed Crossing and Missouri River/Lake Sakakawea Crossing Alternatives was prepared by Stantec Consulting Services Inc. ("Stantec") for the account of BakkenLink Pipeline LLC (the "Client") in support of the Bureau of Land Management. Any reliance on this document by any third party is strictly prohibited. The material in it reflects Stantec's professional judgment in light of the scope, schedule and other limitations stated in the document and in the contract between Stantec and the Client. The opinions in the document are based on conditions and information existing at the time the document was published and do not take into account any subsequent changes. In preparing the document, Stantec did not verify information supplied to it by others. Any use which a third party makes of this document is the responsibility of such third party. Such third party agrees that Stantec shall not be responsible for costs or damages of any kind, if any, suffered by it or any other third party as a result of decisions made or actions taken based on this document.

Prepared by 

Bob Berry

Reviewed by 

Jon Alstad

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## Abbreviations

BakkenLink	BakkenLink Pipeline LLC
BLM	Bureau of Land Management
HDD	horizontal directional drill
U.S.	United States
USACE	United States Army Corps of Engineers

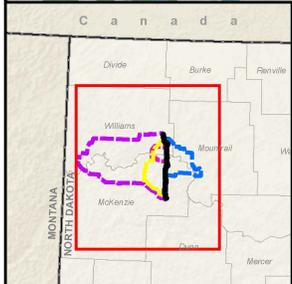
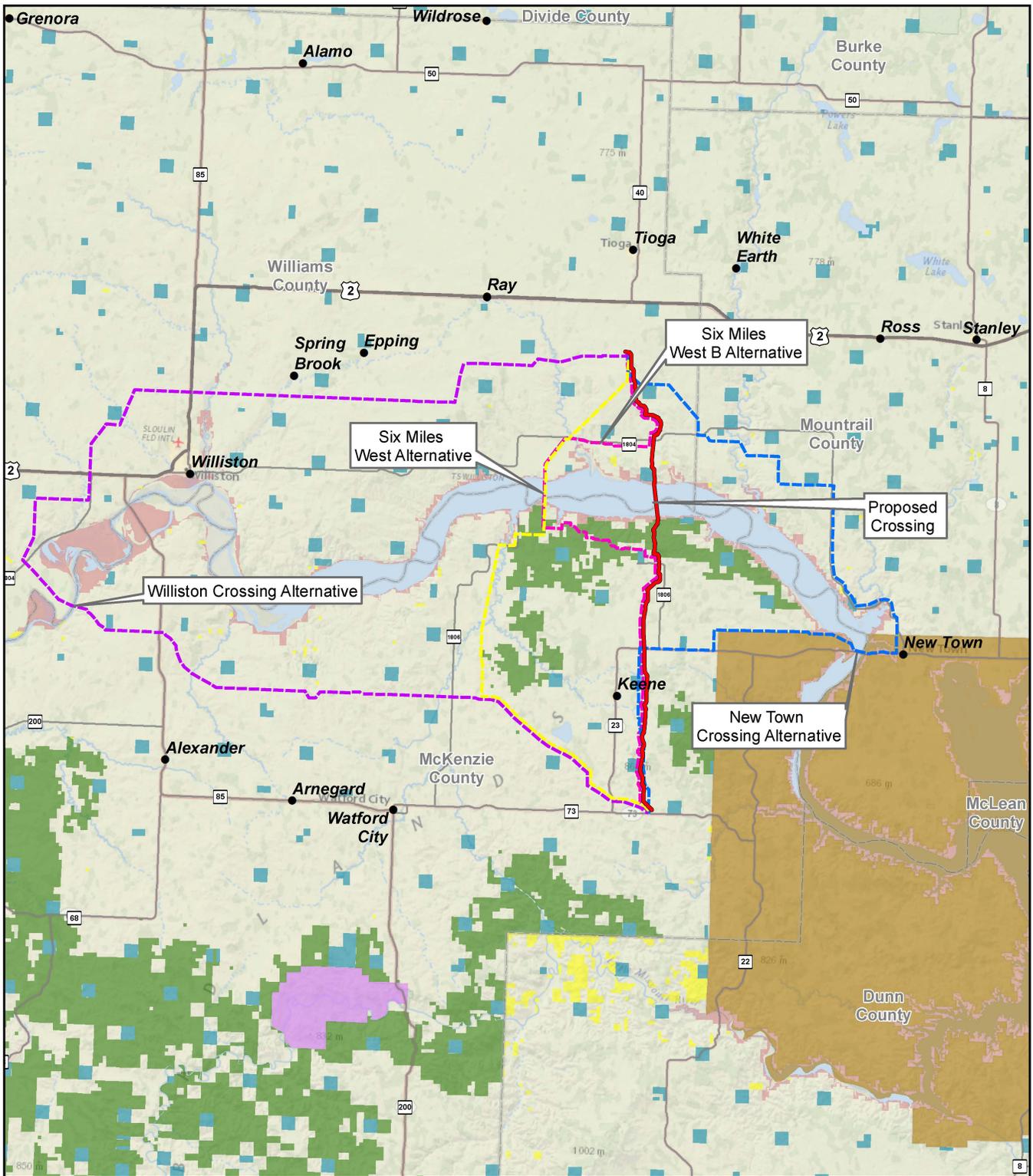
## 1.0 INTRODUCTION

BakkenLink Pipeline LLC (BakkenLink) submitted a Right-of-Way Grant application to the Bureau of Land Management (BLM), North Dakota Field Office, to construct a 37.1-mile-long, 16-inch-diameter crude oil pipeline from the Dry Creek Terminal to Beaver Lodge, North Dakota (**Figure C-1**). A segment (12,923 feet) of the proposed route would cross Lake Sakakawea. Based on environmental concerns associated with the proposed lake crossing that were expressed by United States (U.S.) Army Corps of Engineers (USACE) staff, BakkenLink completed horizontal directional drill (HDD) feasibility and geotechnical boring evaluation reports for the Lake Sakakawea crossing, which included the following:

- Horizontal Directional Drilling Feasibility Report, BakkenLink Pipeline Project Lake Sakakawea HDD, Williams and McKenzie Counties, North Dakota; prepared by Laney Direction Drilling Co., February 15, 2013; and
- HDD Geotechnical Boring Evaluation Report, BakkenLink Pipeline Lake Sakakawea, Tioga, North Dakota; prepared by Braun Intertec Corp., January 22, 2013.

BakkenLink, BLM, Stantec Consulting Services Inc. (Stantec), and USACE staff held a meeting in the USACE – Omaha District Office on November 7, 2013. At the meeting, BakkenLink requested that USACE staff review the geotechnical information they had acquired for the proposed lake crossing to determine if they agreed that the HDD method would not be feasible. After review of this information, the USACE provided a letter to the BLM on May 21, 2014, indicating the HDD method would not be feasible at the proposed crossing. In this letter, the USACE also requested that alternative lake crossings be evaluated to determine if the HDD method could be used to successfully to cross the Missouri River/Lake Sakakawea at other locations. As stated in the letter, the Garrison Dam/Lake Sakakawea Oil and Gas Management Plan states that “HDD is the preferred method of pipeline installation, but if not feasible other locations should be investigated and if not found, alternate installation methods can be considered” (USACE 2014).

This technical report provides information regarding the geologic setting of and geologic stratigraphy present at the proposed crossing and three alternative crossings (**Six Miles West and Six Miles West B Alternatives would use the same lake crossing**) of Lake Sakakawea to determine if the HDD construction method would be feasible. In addition, an overview of the engineering limitations and constraints considered in the evaluation of the HDD construction method at these crossings is provided.



Project Features		Land Ownership	
	Proposed Route		Bureau of Land Management
	Six Miles West Alternative		National Park Service
	New Town Alternative		U.S. Forest Service
	Williston Alternative		Army Corps of Engineers
	Six Miles West B Alternative		Tribal Lands
			State Land

**BakkenLink Dry Creek to  
Beaver Lodge Pipeline Project**

**Figure C-1**

**Lake Sakakawea  
Crossing Alternatives**

0 2.5 5 10  
 Miles

Source: BakkenLink 2014.

## 2.0 PROPOSED CROSSING

### 2.1 GEOLOGIC OVERVIEW

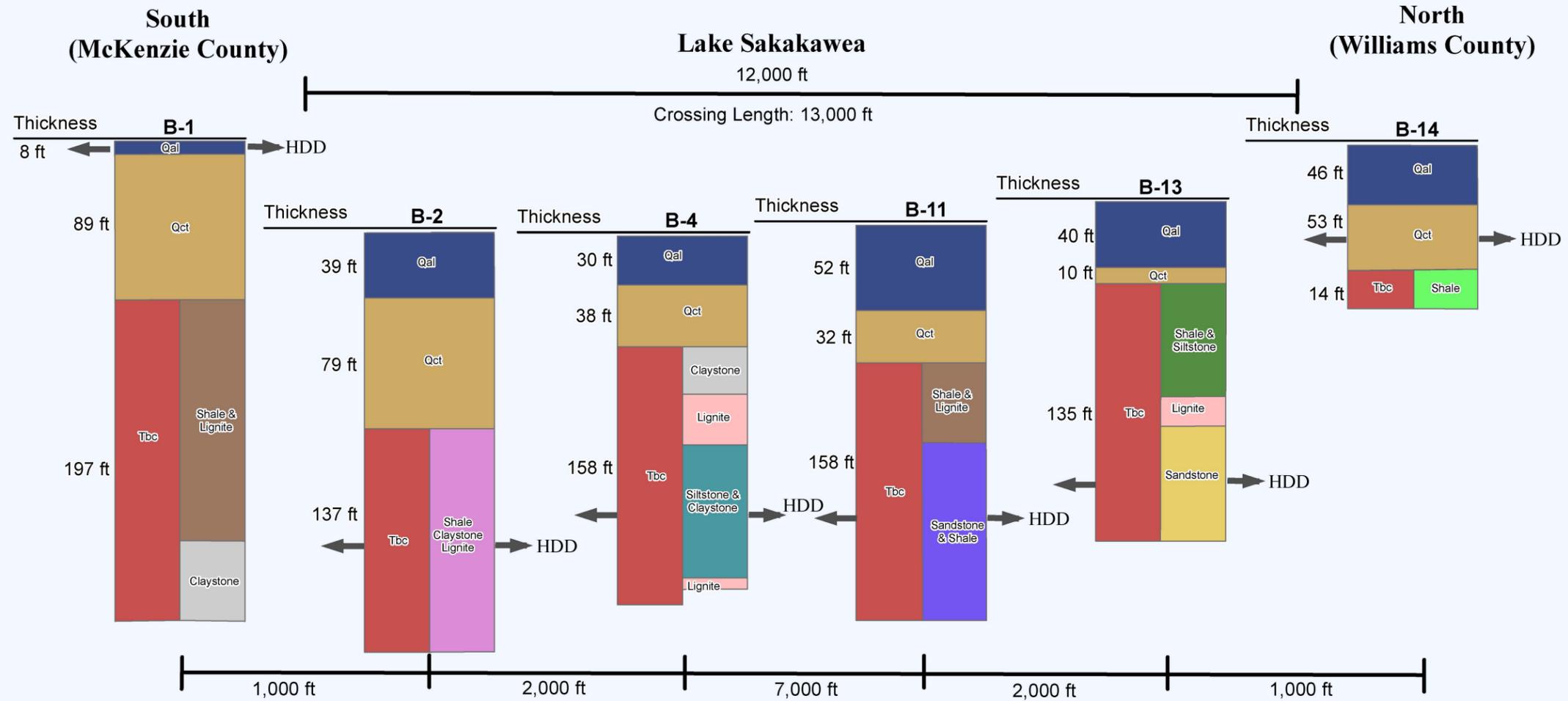
The proposed crossing of Lake Sakakawea is illustrated on **Figure C-1** and the geologic stratigraphy is illustrated in **Figure C-2**. The length of the crossing for HDD at the proposed crossing would be 12,923 feet, as identified by Laney Directional Drilling (Laney 2013). Geotechnical evaluation of this crossing, as completed by Braun Intertec Corporation (Braun 2013), indicated potential problems with the use of the HDD method, which included caving sands, extensive gravel and cobbles, and lignite. The report completed by Laney (2013) concluded that HDD was not feasible at the proposed crossing and the USACE concurred with this conclusion, as stated in a letter dated May 21, 2014.

The geotechnical evaluation of the proposed crossing completed by Braun (2013) revealed the following geotechnical issues for installation of the proposed pipeline using the HDD method:

1. Glacial deposits on the north side of the lake (entrance side) and the south side of the lake (exit side) at the proposed crossing have abundant gravel and cobbles that resulted in refusal of the borings in 6 of the 12 borings (B-02, B-08, B-08 offset, B-10, and B-10 offsets 1 and 2). These glacial deposits range in thickness from 40 to 80 feet and must be crossed on both the north and south sides of the lake with inclined borings in order to reach the proposed crossing elevation of 1,640 feet above mean sea level (approximately 160 feet below the bottom of the lake).
2. Drilling in the Bullion Creek Formation member of the Fort Union Group encountered caving sands in 5 of the 12 test borings. The Bullion Creek would be the main unit intersected by the pipeline beneath the lake at the proposed crossing. The Bullion Creek Formation lies directly below the glacial deposits.
3. The Bullion Creek Formation is typical of the Fort Union Group and contains abundant lignite, along with carbonaceous clays, shales, siltstones, and claystones (Braun 2013; Freers 1970). Evaluation of the lignite and its potential effect on the HDD method by Laney (2013) indicated that the abundant lignites in the Bullion Creek Formation pose a problem for the drilling fluid pH. The acidity of the lignites may reduce the pH of the drilling fluids used in HDD and thus, reduce the carrying capacity of the fluids for cuttings and possibly raise the annular pressure during drilling, leading potentially to hydraulic fracturing.
4. An additional issue raised by Laney (2013) was the length of the lake crossing at the proposed crossing for HDD, which would be 12,923 feet. The HDD method has never been used successfully at this length. Hole caving, drilling materials becoming lodged in the boring resulting in abandonment of the boring, and problems pushing and pulling pipe over that length were identified as a concern.

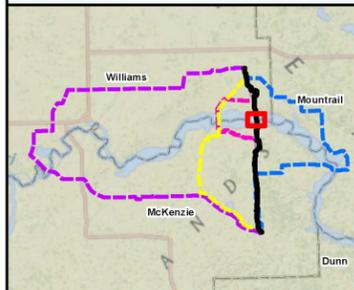
### 2.2 HDD OVERVIEW

At a horizontal length of 12,923 feet, the conceptual Lake Sakakawea HDD crossing would be the longest HDD crossing ever attempted by HDD contractors in the U.S. The longest successful



**Stratigraphic Legend**

- Claystone
- Lignite
- Qal - Quaternary Alluvium. Interlayered sands, silts and clays. Thick clay zones common.
- Qct - Quaternary Coleharbor Till. Unsorted glacial till consisting of boulders, cobbles, and pebbles in a sandy to silty clay-rich matrix. Outwash gravels and sands with interbedded clays and silts. Referred to simply as glacial till and outwash in Braun (2013) boring logs.
- Sandstone
- Sandstone and Shale
- Shale
- Shale and Lignite
- Shale and Siltstone
- Shale, Claystone, and Lignite
- Siltstone and Claystone
- Tbc - Tertiary Bullion Creek Formation. Interbedded sandstone, siltstone, mudstone, claystone, carbonaceous shale, and lignite. Color consists of subdued grays and browns. Ironstone concretions, claystone beds, and petrified wood common. Middle member of the Tongue River Formation of the Fort Union Group in North Dakota. Lignite beds usually in zones with overlying shales and underlying claystones or sandstones. Sands often unconsolidated and subject to caving when penetrated with a drill. Formation is stratigraphically equivalent to the Tongue River Formation at the Williston and New Town crossings.



Location  
Williams & McKenzie Co., ND

Project Information  
Project Number: 212205012  
Last Modified: March 07, 2016

Note: Not to Scale

Data Sources:  
Braun Intertec Corporation (Braun 2013).  
HDD Geotechnical Boring Evaluation Report.  
Bakkenlink Pipeline, Lake Sakakawea, North Dakota.  
Prepared for Bakkenlink, January 22, 2013. Data sourced from boring logs in Appendix A to report.

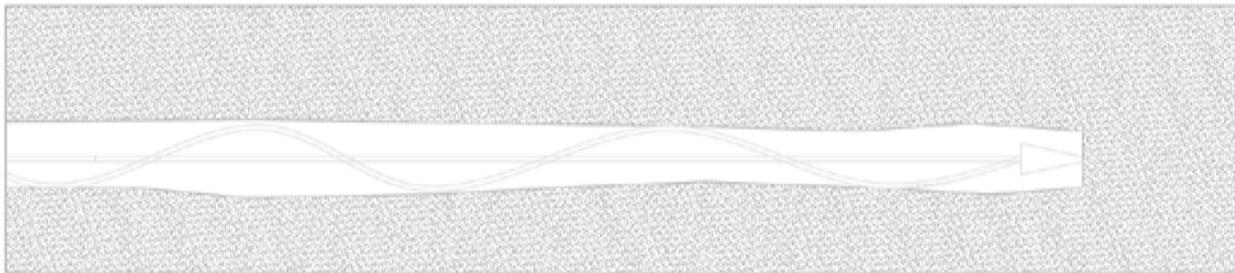
**BakkenLink Dry Creek to Beaver Lodge Pipeline Project**

**Figure C-2**

**Proposed Crossing - Geologic Stratigraphy**

crossing in the U.S. currently is 10,971 feet. The length presents a huge challenge in addition to the unfavorable geotechnical conditions.

The challenges for an HDD of the proposed length include the ability to push nearly 13,000 feet of drill pipe through a drilled hole to connect both sides in order to start the hole-opening process. Drill pipe is fabricated to be placed in tension and not compression; therefore, trying to push (place the pipe in compression) greatly reduces the ability to exert axial loads high enough to push the drilling assembly to the ground surface. Essentially, at some point, the drill pipe would compress on itself and become a very long spring (see illustration below).



If the pilot hole was able to be completed, the hole would then need to be opened to a minimum of 24 inches in order to accept the product pipe and reduce the potential for the pipeline coating to be damaged. The high torque required to turn the hole opener at the constant required speed would become difficult to achieve. This variability in the torque applied to the drill pipe would decrease its strength and may lead to failure of the drill pipe. This type of failure would cause the hole opener to become lodged in the hole and may not be able to be retrieved. If the tool was unable to be retrieved or if parts of the tools stayed lodged in the hole, the hole would then need to be abandoned and another attempt in a new location would be required.

Tracking of the initial cutting tool that creates the pilot hole has its own challenges. The cutting tools for HDDs are tracked utilizing magnetic guidance systems. Coils of wire placed on the ground surface create magnetic signatures that are used to steer the path of the drill. Often, river crossings are short enough where the coils can be placed on each shoreline and still be identified. For longer crossings, there may be a "blind" segment where the operator must rely on experience to properly steer the tools. For this length of crossing, "blind" steering would not be feasible. Wire coils would need to be placed on the lake bottom to establish a magnetic grid to steer the cutting tool. In order to achieve a length in excess of 7,000 feet, two drilling rigs (one on each shoreline) are required (Project Consulting Services [PCS] 2012). Accurate tracking is mandatory as the two initial pilot holes would need to intersect at the midpoint in order to create a single, continuous path.

Should the pilot hole drilling and hole opening processes be successful, the terrain on each shoreline poses the final challenge. When pulling the product pipe back through the completed hole, minimizing the number of starts and stops reduces the risk of the pipe sticking in the hole partially through or the hole collapsing in front of the product pipe. At this location, approximately 14 individual segments would be needed (PCS 2012).

## 3.0 ALTERNATIVE LAKE CROSSINGS

### 3.1 SIX MILES WEST CROSSING ALTERNATIVE

#### 3.1.1 Geologic Overview

This alternative crossing includes a crossing length of approximately 10,032 feet. Geologically, this alternative crossing would intersect the same glacial units and the Bullion Creek member of the Fort Union Group as intersected by the proposed crossing (**Figure C-2**). Some key geological issues for this crossing include the following:

1. This area of Lake Sakakawea lies above the pre-glacial drainage of the Little Missouri River (Freers 1970). This pre-glacial drainage contains abundant gravel and was dammed by glacial ice during the movement of glacial lobes into North Dakota (Freers 1970). This resulted in extensive deposits of glacial gravels, cobbles, boulders, and silts. The Six Miles West crossing can be expected to encounter the same issues with gravel, cobbles, and boulders in the glacial material as identified by Braun (2013) at the proposed crossing.
2. The Fort Union Group underlies the glacial material at the Six Miles West Crossing. The Bullion Creek member can be expected to occur at this crossing since it is only 6 miles west of the proposed crossing, where Braun (2013) completed a geotechnical evaluation. Thus, issues with caving sands and lignite experienced at the proposed crossing can be expected at the Six Miles West Crossing.

The Six Miles West Crossing offers little advantage over the proposed crossing. The geological issues with glacial gravels and cobbles, caving sands in the Fort Union, and abundant lignites in the Fort Union Group described by Braun (2013) and Laney (2013) for the proposed crossing apply to the Six Miles West Crossing.

#### 3.1.2 HDD Overview

Conceptually, the crossing length would be approximately 10,032 feet. While the length does place it within the current record capabilities, the same risks as the proposed crossing location apply with one exception. The flat terrain on the north side of the crossing would allow the full length of the product pipe to be fabricated in a single segment.

## 3.2 SIX MILES WEST B CROSSING ALTERNATIVE

### 3.2.1 Geologic Overview

*This alternative crossing includes a crossing length of approximately 10,032 feet. Geologically, this alternative crossing would intersect the same glacial units and the Bullion Creek member of the Fort Union Group as intersected by the proposed crossing (Figure C-2). Some key geological issues for this crossing include the following:*

- 3. This area of Lake Sakakawea lies above the pre-glacial drainage of the Little Missouri River (Freers 1970). This pre-glacial drainage contains abundant gravel and was dammed by glacial ice during the movement of glacial lobes into North Dakota (Freers 1970). This resulted in extensive deposits of glacial gravels, cobbles, boulders, and silts. The Six Miles West B crossing can be expected to encounter the same issues with gravel, cobbles, and boulders in the glacial material as identified by Braun (2013) at the proposed crossing.*
- 4. The Fort Union Group underlies the glacial material at the Six Miles West B Crossing. The Bullion Creek member can be expected to occur at this crossing since it is only 6 miles west of the proposed crossing, where Braun (2013) completed a geotechnical evaluation. Thus, issues with caving sands and lignite experienced at the proposed crossing can be expected at the Six Miles West B Crossing.*

*The Six Miles West B Crossing offers little advantage over the proposed crossing. The geological issues with glacial gravels and cobbles, caving sands in the Fort Union, and abundant lignites in the Fort Union Group described by Braun (2013) and Laney (2013) for the proposed crossing apply to the Six Miles West B Crossing.*

### 3.2.2 HDD Overview

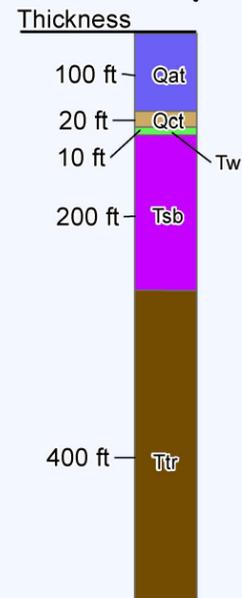
Conceptually, the crossing length would be approximately 10,032 feet. While the length does place it within the current record capabilities, the same risks as the proposed crossing location apply with one exception. The flat terrain on the north side of the crossing would allow the full length of the product pipe to be fabricated in a single segment.

## 3.3 WILLISTON CROSSING ALTERNATIVE

### 3.3.1 Geologic Overview

The Williston Crossing is located 12 miles southwest of Williston, North Dakota, along the Missouri River upstream of Lake Sakakawea (Figure C-1). The length of the crossing is approximately 2,300 feet. Generalized geologic stratigraphy based on geologic data near the crossing is illustrated in Figure C-3.

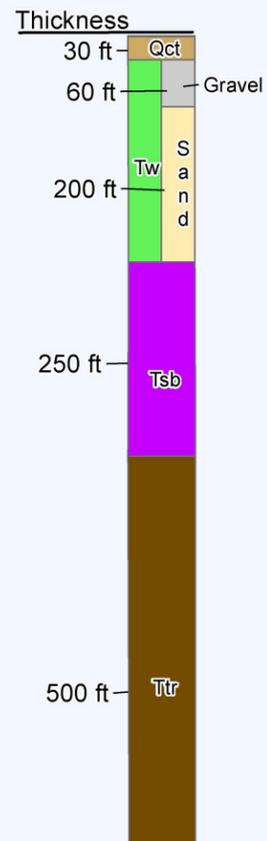
**Northwest  
(Williams County)**



**Missouri River**

860 ft

Crossing Length: 2,300 ft

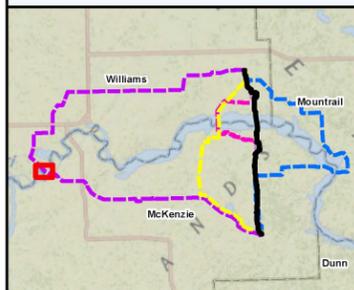


**Southeast  
(McKenzie County)**



**Stratigraphic Legend**

- Gravel
- Qat - Quaternary alluvial terrace and alluvial plain deposits. Silts, clays, and minor sands.
- Qct - Coleharbor Till. Unsorted glacial till consisting of boulders, cobbles, and pebbles in a sandy to silty clay-rich matrix.
- Sand
- Tsb - Sentinel Butte Formation. Interbedded sand, silt, mudstone, carbonaceous shale, and lignite. Color consists of subdued grays and browns. Ironstone concretions, claystone beds, and petrified wood common. Upper member of the Fort Union Group in North Dakota.
- Ttr - Tongue River Formation. Similar in lithology to the Sentinel Butte Formation, but consists of bright or buff yellow and gray colors, rather than somber colors of the overlying Sentinel Butte. Dominated by lignites averaging 10 feet in thickness and interbedded with clays and claystones. Bullion Creek Formation is a member of the Tongue River in the Missouri River region. Middle member of the Fort Union Group in North Dakota.
- Tw - Wiota Gravel. Gravels and sands of the pre-glacial Yellowstone River. Well-sorted quartzite-rich gravels consisting of alternating layers of coarse gravel and sand.



Location  
Williams & McKenzie Co., ND

Project Information  
Project Number: 212205012  
Last Modified: March 07, 2016

Note: Not to Scale

Data Sources:  
Braun Intertec Corporation (Braun 2013).  
HDD Geotechnical Boring Evaluation Report.  
Bakkenlink Pipeline, Lake Sakakawea, North Dakota.  
Prepared for Bakkenlink, January 22, 2013. Data sourced from boring logs in Appendix A to report.

**BakkenLink Dry Creek to  
Beaver Lodge Pipeline Project**

**Figure C-3**

**Williston Crossing Alternative -  
Geologic Stratigraphy**

This crossing is located in an area of bottom land flats (Freers 1970) underlain by Quaternary glacial sands and gravels and the Tertiary Sentinel Butte member of the Fort Union Group. This crossing also is located in the area of the pre-glacial drainage of the Yellowstone River (Freers 1970). As with the pre-glacial Little Missouri River drainage at the Six Miles West Crossing, this buried paleo-drainage was dammed by glacial ice lobes and thus contains layers of gravels, sands, cobbles, and boulders. The Sentinel Butte Formation is the upper facies of the Tongue River member of the Fort Union Group (Freers 1970) and contains lignites; loosely consolidated to unconsolidated sands; and carbonaceous clays, siltstones, and claystones. The crossing probably would require boring through the glacial sands and maybe even the gravels of the pre-glacial Yellowstone River to reach the desired crossing depth in the underlying Sentinel Butte Formation. Key geological issues for this crossing include the following:

1. Coleharbor Glacial Till: The Coleharbor Till is approximately 20 to 50 feet thick and consists of clay, sand, and boulders. Sands and gravels are most common and are thickest in the paleo-valley of the pre-glacial Yellowstone River. The amount of cobbles and boulders in the glacial till at the crossing would need to be determined by geotechnical drilling.
2. Wiota Gravel: The Wiota Gravel is the pre-glacial gravel of the Yellowstone River deposited in the northward flowing Yellowstone that was subsequently dammed by glacial lobes (Freers 1970). These gravels are 260 feet thick north of Williston. This maximum thickness has been assumed for the generalized geologic stratigraphy in **Figure C-3**. The Wiota Gravel consists of an upper member of gravel underlain by a thick layer of sands with cobbles and pebbles. It underlies the Missouri River area, with minor exposures on either bank of the Missouri River.
3. Sentinel Butte Formation: The Sentinel Butte Formation consists of a cross-bedded fine- to medium-grained sandstone with abundant carbonaceous clays and lignites. Lithologically, this formation is similar to the Tongue River member of the Fort Union Group that lies stratigraphically below the Sentinel Butte. The Bullion Creek Formation found in the Fort Union Group at the crossing is the middle member of the Tongue River Formation (Carlson 1985). The Sentinel Butte Formation is lithologically similar to the Tongue River member of the Fort Union Group, with the main difference being the somber color of the Sentinel Butte (Freers 1970). Therefore, the Sentinel Butte Formation has the potential for caving sands like the Bullion Creek and would present the same lignite issue for HDD that was presented by the Bullion Creek at the proposed crossing.
4. Tongue River Formation: The Tongue River Formation is the main upper member of the Fort Union Group. Lithologically it is similar to the Sentinel Butte Formation and probably lithologically similar to the Bullion Creek Formation found at the proposed crossing.

The Williston Crossing offers the advantage of a much shorter crossing distance compared to the proposed crossing. The issue with gravels and cobbles in the glacial till present at the proposed crossing likely also would occur at the Williston Crossing because of the need to cross the pre-glacial valley of the Yellowstone River. The lignites of the Fort Union Group at the proposed crossing also would be present in the Sentinel Butte Formation and the Tongue River Formation at the Williston Crossing. Based on review of the geologic strata at this crossing, using the HDD construction methodology may be extremely difficult.

### 3.3.2 HDD Overview

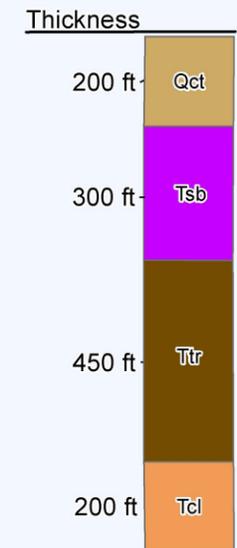
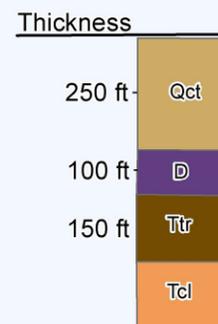
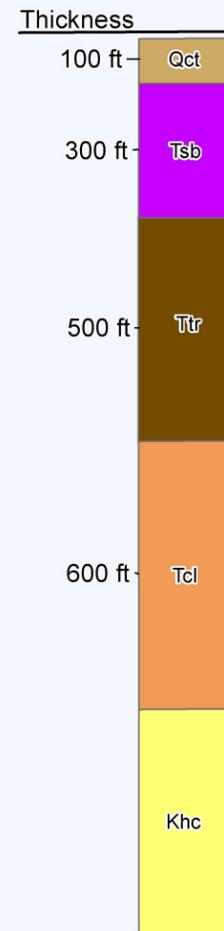
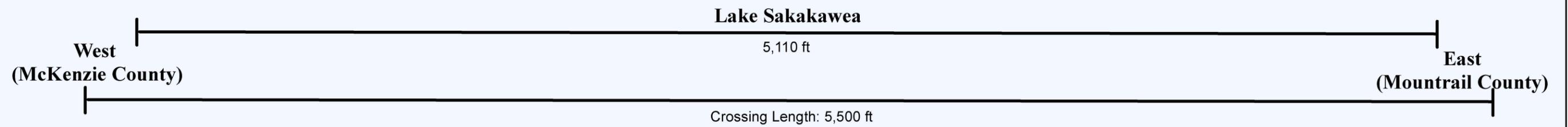
With a conceptual length of about 2,300 feet, this crossing would be the most traditional of all the alternative crossing locations. There appears to be ample flat terrain on either side of the crossing for pipe fabrication. This crossing poses no extraordinary engineering challenges beyond the normal risk profile for HDDs. North Dakota's Western Area Water Supply Project (2,500 foot-long, 20 inch diameter pipeline) was recently installed under the Missouri River near Williston, North Dakota using the HDD construction method.

## 3.4 NEW TOWN CROSSING ALTERNATIVE

### 3.4.1 Geologic Overview

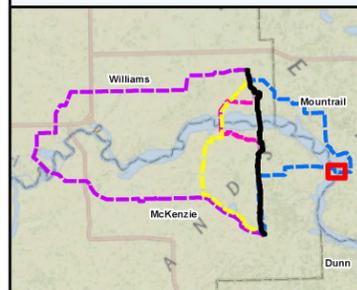
The New Town Crossing would begin in Mountrail County and cross Lake Sakakawea and exit in McKenzie County, North Dakota. Geologically, the crossing would encounter the Quaternary Coleharbor Formation glacial tills and gravels underlain by Formation D and the Tertiary Sentinel Butte and Tongue River members of the Fort Union Group (Clayton 1972). The Coleharbor Formation is 200 to 300 feet thick in Mountrail County and thins to the southwest across the county. The Sentinel Butte and Tongue River members of the Fort Union Group are very similar lithologically and are grouped as one unit by Clayton (1972). Their combined thickness ranges from 300 to 600 feet. The New Town Crossing would be much shorter than the proposed crossing and require about 5,500 feet of HDD boring (Istre 2014). A generalized geologic stratigraphy for the New Town area is presented in **Figure C-4**. Geological issues present at the New Town Crossing include:

1. Coleharbor Formation: The Coleharbor Formation is a glacial till consisting of 87 percent pebbly sandy to silty clays with cobbles and boulders up to 10 feet in diameter (Clayton 1972). Approximately 8 percent of the formation consists of sand and gravel and 5 percent silt and clay. The high content of pebbles and the potential for large boulders in the Coleharbor Formation may present the same problems for HDD as found with the glacial tills at the proposed crossing.
2. Formation D: Formation D of Clayton (1972) is a pre-glacial formation of quartzite-rich gravels and sands deposited in a north-trending river valley prior to deposition of the Coleharbor Formation. Lithologically and stratigraphically, Formation D is similar to the Wiota Gravel at the Williston crossing.
3. Sentinel Butte and Tongue River Formations: The Sentinel Butte and Tongue River members of the Fort Union Group consist of about 60 to 80 percent silt and clay with abundant lignite and sands. The Sentinel Butte member is about 35 percent sand and the Tongue River member is about 15 percent sand (Clayton 1972). The sands are cohesive, but generally are not cemented. They carry water and are a source of water in Mountrail County. Thus, the Sentinel Butte and Tongue River members of the Fort Union Group potentially may pose the same problem with caving sands due to water in the sands, as was found at the proposed crossing. The lignites may have the same effect on drilling fluid pH as was found with the Bullion Creek lignites at the proposed crossing.



**Stratigraphic Legend**

- D - Formation D. Gravels and sands of the pre-glacial north-trending river valley. Well-sorted quartzite-rich gravels consisting of alternating layers of coarse gravel and sand with cobbles and pebbles. Stratigraphically and lithologically equivalent to the Wiota Gravel at the Williston Crossing.
- Khc - Hell Creek Formation. Cretaceous sandstone unit consisting of alternating sandstones, siltstones, mudstones, carbonaceous shales, and minor lignites.
- Qat - Quaternary alluvial terrace and alluvial plain deposits. Silts, clays, and minor sands.
- Qct - Coleharbor Till. Unsorted glacial till consisting of boulders, cobbles, and pebbles in a sandy to silty clay-rich matrix.
- Tcl - Cannonball/Ludlow Formation. Alternating sandstones, siltstones, and mudstones. Lignite beds around 3 feet in thickness in the Ludlow.
- Tsb - Sentinel Butte Formation. Interbedded sand, silt, mudstone, carbonaceous shale, and lignite. Color consists of subdued grays and browns. Ironstone concretions, claystone beds, and petrified wood common. Upper member of the Fort Union Group in North Dakota.
- Ttr - Tongue River Formation. Similar in lithology to the Sentinel Butte Formation, but consists of bright or buff yellow and gray colors, rather than somber colors of the overlying Sentinel Butte. Dominated by lignites averaging 10 feet in thickness and interbedded with clays and claystones. Bullion Creek Formation is a member of the Tongue River in the Missouri River region. Middle member of the Fort Union Group in North Dakota.
- Tw - Wiota Gravel. Gravels and sands of the pre-glacial Yellowstone River. Well-sorted quartzite-rich gravels consisting of alternating layers of coarse gravel and sand.



**Location**  
Williams & McKenzie Co., ND

**Project Information**  
Project Number: 212205012  
Last Modified: March 07, 2016



**Data Sources:**

Carlson, C.G. 1985. Geology of McKenzie County, North Dakota. North Dakota Geological Survey Bulletin 80.  
Clayton, L. 1972. Geology of Mountrail County North Dakota. North Dakota Geological Survey Bulletin 55-IV.

**BakkenLink Dry Creek to Beaver Lodge Pipeline Project**

**Figure C-4**

**New Town Crossing Alternative - Geologic Stratigraphy**

4. Cannonball/Ludlow Formation: This lower member of the Fort Union Group consists of clays, claystones, shales, and lignites. The lignites average around 3 feet in thickness. This unit should not be intersected by an HDD crossing.
5. Hell Creek Formation. The Hell Creek is Cretaceous in age and consists of sands, sandstones, shales, and lignites. This unit should not be intersected by an HDD crossing.

The New Town Crossing provides a shorter crossing distance than the proposed crossing. There appears to be a pre-glacial river channel beneath the crossing area, as evidenced by Formation D. The Coleharbor Formation appears to present the same geotechnical issues with glacial gravels and cobbles as was found at the proposed crossing. The Fort Union Group members present at the New Town Crossing, the Sentinel Butte and the Tongue River formations, are similar lithologically to the Bullion Creek Formation encountered at the proposed crossing.

### 3.4.2 HDD Overview

Conceptually, this crossing would be approximately 5,500 feet and would parallel to the Four Bears Memorial Bridge. This crossing length is well within the practical range of HDDs. While not as critical, tracking across the water would be important to avoid interfering with the bridge and other nearby infrastructure. To avoid Four Bears village on the west side of the crossing, the product pipe would need to be fabricated along Highway 23 on the east side toward New Town. This area also has some significant relief and elevation changes in the terrain creating challenges in fabrication of the pipe. Two pipe segments would be likely in order to avoid housing and other commercial developments.

## 4.0 SUMMARY

Based on the review of the geologic information, two of the crossing alternatives (Six Miles West **[and Six Miles West B]** and New Town Crossing Alternatives) would not be suitable for the HDD construction method and one of the crossing alternatives (Williston Crossing Alternative) has some geologic constraints that would make it extremely difficult to use the HDD construction method. The Six Miles West **(and Six Miles West B) Crossing** has the same geologic constraints as the proposed crossing. The Williston and New Town alternative crossings may have significant geotechnical issues with the glacial tills, pre-glacial river gravels, and the Fort Union Group sediments. Consideration should be given to crossing Lake Sakakawea using construction methods other than HDD since this is allowed under the Garrison Dam/Lake Sakakawea Oil and Gas Management Plan when it has been determined, based on geologic and engineering constraints, that the HDD construction method would not be feasible (applies to the Six Miles West **[and Six Miles West B]**, and New Town Crossing Alternatives).

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**Appendix D  
Plant and Wildlife Species  
Identified for the USFS  
McKenzie Ranger District**

# Common/Scientific Names

## Plants

Adder's tongue	<i>Ophioglossum vulgatum</i>	Buckbean	<i>Menyanthes trifoliata</i>
Alfalfa	<i>Medicago sativa</i>	Buffaloberry	<i>Shepherdia spp</i>
Alkali cordgrass	<i>Spartina gracilis</i>	Buffalograss	<i>Buchloe dactyloides</i>
Alkali grass	<i>Puccinellia nuttaliana</i>	Bulrush	<i>Scirpus spp</i>
Alkali sacton	<i>Sporobolus airoides</i>	Bur oak	<i>Quercus macrocarpa</i>
Alyssum-leaf phlox	<i>Phlox alyssifolia</i>	Canada anemone	<i>Anemone canadensis</i>
American elm	<i>Ulmus americana</i>	Canada goldenrod	<i>Solidago canadensis</i>
American plum	<i>Prunus americana</i>	Canada thistle	<i>Cirsium canadensis</i>
American sea blite	<i>Suaeda caleoliformis</i>	Canada wild rye	<i>Elymus canadensis</i>
Annual ragweed	<i>Ambrosia artemisiifolia</i>	Cattail	<i>Typha spp</i>
Arrowhead	<i>Sagittaria spp</i>	Cheatgrass	<i>Calamagrostis spp</i>
Aspen	<i>Populus spp</i>	Chokecherry	<i>Prunus virginiana</i>
Austrian pine	<i>Pinus balfouriana austrina</i>	Club moss	<i>Lycopodium spp</i>
Baltic rush	<i>Juncus balticus</i>	Common rabbitbrush	<i>Chrysothamnus nauseosus</i>
Barr's milkvetch	<i>Astragalus barii</i>	Common scouring rush	<i>Equisetum hyemale</i>
Basin wild rye	<i>Leymus cinerus</i>	Common spikesedge	<i>Carex spp</i>
Basswood	<i>Tilia americana</i>	Coneflower	<i>Rudbeckia spp</i>
Beach heather	<i>Hudsonia tomentosa</i>	Corn	<i>Zea mays</i>
Beaked willow	<i>Salix bebbiana</i>	Cottonwood	<i>Populus deltoides</i>
Bearded wheatgrass	<i>Agropyron subsecundum</i>	Creeping cedar	<i>Juniperus horizontalis</i>
Beebalm	<i>Monarda spp</i>	Crested shield fern	<i>Dryopteris cristata</i>
Big bluestem	<i>Andropogon gerardii</i>	Crested wheatgrass	<i>Agropyron cristatum</i>
Birdfoot sagebrush	<i>Artemisia pedatifida</i>	Crested woodfern	<i>Dryopteris cristata</i>
Black greasewood	<i>Sarcobatus vermiculatus</i>	Dakota buckwheat	<i>Eriogonum visherii</i>
Black-eyed Susan	<i>Rudbeckia hirta</i>	Delicate sedge	<i>Carex leptalea</i>
Blanket flower	<i>Gaillardia spp</i>	Dogberry	<i>Ribes cynosbati</i>
Blowout grass	<i>Redfieldia flexuosa</i>	Dotted gayfeather	<i>Liatris punctata</i>
Blowout penstemon	<i>Penstemon haydenii</i>	Douglas knotweed	<i>Polygonum douglasii</i>
Blue grama	<i>Bouteloua gracilis</i>	Downy brome	<i>Bromus tectorum</i>
Blue lips	<i>Collinsia parviflora</i>	Dwarf juniper	<i>Juniperus communis</i>
Bluebunch wheatgrass	<i>Agropyron spicatum</i>	Eastern red cedar	<i>Juniperus virginiana</i>
Bluejoint	<i>Calamagrostis canadensis</i>	Fescue sedge	<i>Carex alopecoidea</i>
Bog willow	<i>Salix pedicellaris</i>	Fleabane	<i>Erigeron spp</i>
Boston ivy	<i>Parthenocissus tricuspidata</i>	Four-wing saltbush	<i>Atriplex canescens</i>
Boxelder	<i>Acer negundo</i>	Fowl bluegrass	<i>Poa palustris</i>
Broad-leaved goldenrod	<i>Solidago flexcaulis</i>	Foxtail barley	<i>Hordeum jubatum</i>
Broom snakeweed	<i>Gutierrezia dracunculoides</i>	Foxtail sedge	<i>Carex alopecoidea</i>

Fringed sage	<i>Artemisia frigida</i>	Little-seed ricegrass	<i>Oryzopsis micrantha</i>
Frostweed	<i>Helianthemum bicknellii</i>	Locust	<i>Robinia pseudo-acacia</i>
Gardner's saltbush	<i>Atriplex gardneri</i>	Loesels twayblade	<i>Liparis loeselii</i>
Gayfeather	<i>Liatris spp</i>	Long-headed coneflower	<i>Rudbeckia spp</i>
Golden stickleaf	<i>Mentzelia pumila</i>	Lupine	<i>Lupinus spp</i>
Goldenrod	<i>Solidago spp</i>	Marsh bellflower	<i>Campanula aparinoides</i>
Grass-leaved goldenrod	<i>Euthamia graminifolia</i>	Marsh fern	<i>Thelypteris palustris</i>
Gray sagewort	<i>Artemisia ludoviciana</i>	Marsh horsetail	<i>Equisetum palustre</i>
Greasewood	<i>Sarcobatus vermiculatus</i>	Mat muhly	<i>Muhlenbergia richardsonis</i>
Green ash	<i>Fraxinus pennsylvanica</i>	Meadow brome	<i>Bromus erectus</i>
Green needlegrass	<i>Stipa viridula</i>	Meadow horsetail	<i>Equisetum pratense</i>
Green sagewort	<i>Artemisia dracunculus</i>	Meadow Willow	<i>Salix petiolaris</i>
Gumbo lily	<i>Oenothera caespitosa</i>	Milkweed	<i>Asclepias spp</i>
Hackberry	<i>Celtis occidentalis</i>	Mountain brome	<i>Bromus marginatus</i>
Hairy grama	<i>Bouteloua hirsuta</i>	Mountain mahogany	<i>Cercocarpus montanus</i>
Handsome sedge	<i>Carex formosa</i>	Musk thistle	<i>Carduus nutans</i>
Hardstem bulrush	<i>Scirpus acutus</i>	Narrow-leaved purple coneflower	<i>Echinacea angustifolia</i>
Harebell	<i>Campanula rotundifolia</i>	Needle-and-thread	<i>Stipa comata</i>
Hawthorn	<i>Crataegus spp</i>	Needleleaf sedge	<i>Carex duriuscula</i>
Hedge-nettle	<i>Stachys palustris</i>	Nodding buckwheat	<i>Eriogonum cernuum</i>
Hoary cress	<i>Cardaria draba</i>	Northern green orchid	<i>Platanthera hyperborea</i>
Hoary vervain	<i>Verbena stricta</i>	Northern pin oak	<i>Quercus ellipsoidalis</i>
Hooker's townsendia	<i>Townsendia hookeri</i>	Northern reedgrass	<i>Calamagrostis stricta</i>
Ill scented sumac	<i>Rhus trilobata</i>	Nuttall alkali grass	<i>Puccinellia nuttalliana</i>
Indian grass	<i>Sorghastrum nutans</i>	Oakfern	<i>Gymnocarpium dryopteris</i>
Inland saltgrass	<i>Distichlis spicata spicata</i>	Oregon grape	<i>Berberis repens</i>
Ironwood	<i>Ostrya virginiana</i>	Pale echinacea	<i>Echinacea pallida</i>
Jack pine	<i>Pinus bamsian</i>	Panicled aster	<i>Aster simplex</i>
Japanese brome	<i>Bromus japonicus</i>	Paper birch	<i>Betula papyrifera</i>
Joe Pye weed	<i>Eupatorium macutatum bruneri</i>	Peachleaf willow	<i>Salix amygdaloides</i>
Junegrass	<i>Koeleria pyramidata</i>	Penstemon	<i>Penstemon spp</i>
Juniper	<i>Juniperus spp</i>	Plains cactus	<i>Opuntia spp</i>
Kentucky bluegrass	<i>Poa pratensis</i>	Plains muhly	<i>Muhlenbergia cuspidata</i>
Kochia	<i>Kochia scoparia</i>	Poison ivy	<i>Toxicodendron spp</i>
Labrador bedstraw	<i>Galium labradoricum</i>	Ponderosa pine	<i>Pinus ponderosa</i>
Lady fern	<i>Athyrium filix-femina</i>	Porcupine-grass	<i>Stipa spartea</i>
Lancefeaf cottonwood	<i>Populus x acuminata</i>	Prairie cordgrass	<i>Spartina pectinata</i>
Large gayfeather	<i>Liatris spp</i>	Prairie dropseed	<i>Sporobolus heterolepsis</i>
Lead plant	<i>Amorpha canescens</i>	Prairie rose	<i>Rosa arkansana</i>
Leafy bulrush	<i>Scirpus polyphyllus</i>	Prairie sandreed	<i>Calamovilfa longifolia</i>
Leafy spruge	<i>Euphorbia esula</i>	Prairie spiderwort	<i>Tradescantia spp</i>
Leathery grapefern	<i>Botrychium multifidum</i>	Prickly pear	<i>Opuntia polyacantha</i>
Limber pine	<i>Pinus flexilis</i>	Purple prairie clover	<i>Dalea purpurea</i>
Little bluestem	<i>Andropogon scoparius</i>	Pussy willow	<i>Salix discolor</i>
Little bluestem	<i>Schizachyrium scoparium</i>	Quaking aspen	<i>Populus tremuloides</i>
Little grapefern	<i>Botrychium simplex</i>	Red clover	<i>Trifolium pratense</i>

Red osier dogwood	<i>Cornus sericea</i>	Snowberry	<i>Symphoricarpos occidentalis</i>
Red threeawn	<i>Aristida purpurea robusta</i>	Soft-leaf muhly	<i>Muhlenbergia richardsonis</i>
Redtop	<i>Agrostis stolonifera</i>	Softstem bulrush	<i>Scirpus tabernaemontani</i>
Ricegrass	<i>Oryzopsis spp</i>	Sorghum	<i>Sorghum halepense</i>
Rocky Mountain juniper	<i>Juniperus scopulorum</i>	Soybean	<i>Glycine max</i>
Rose	<i>Rosa spp</i>	Spikerush	<i>Eleocharis spp</i>
Rubber rabbitbrush	<i>Chrysothamnus nauseosus</i>	Spinulose woodfern	<i>Dryopteris spinulosa</i>
Rush	<i>Juncus spp</i>	Spotted evening primrose	<i>Oenothera canescens</i>
Russian knapweed	<i>Centaurea repens</i>	Spotted knapweed	<i>Centaurea maculosa</i>
Rydberg's sunflower	<i>Helianthus spp</i>	Squaw currant	<i>Ribes cereum colubrinum</i>
Salsify	<i>Tragopogon spp</i>	Stiff sunflower	<i>Helianthus rigidus</i>
Sand bluestem	<i>Andropogon hallii</i>	Sumac	<i>Rhus spp</i>
Sand dropseed	<i>Sporobolus cryptandrius</i>	Sun sedge	<i>Carex inops heliophila</i>
Sand lily	<i>Leucocrinum montanum</i>	Sunflower	<i>Helianthus spp</i>
Sand lovegrass	<i>Eragrostis trichodes</i>	Sweetclover	<i>Melilotus spp</i>
Sand muhly	<i>Muhlenbergia arenicola</i>	Switchgrass	<i>Panicum virgatum</i>
Sand sagebrush	<i>Artemisia filifolia</i>	Tall goldenrod	<i>Solidago gigantea</i>
Sandbar willow	<i>Salix exigua</i>	Tall white aster	<i>Aster ericoides</i>
Sandberg bluegrass	<i>Poa sandbergii</i>	Tawny crescent	<i>Phyciodes batesii</i>
Sandgrass	<i>Triplasis purpurea</i>	Thickspike wheatgrass	<i>Agropyron dasystachyum</i>
Scotch pine	<i>Pinus sylvestris</i>	Thistle	<i>Cirsium spp</i>
Sensitive fern	<i>Onoclea sensibilis</i>	Threadleaf sedge	<i>Carex fillifolia</i>
Serviceberry	<i>Amelanchier spp</i>	Three-square bulrush	<i>Scirpus pungens</i>
Shadscale	<i>Atriplex spp</i>	Timothy	<i>Phleum pratense</i>
Shadscale saltbrush	<i>Atriplex confertifolia</i>	Torrey's cryptantha	<i>Cryptantha torreyana</i>
Shining flatsedge	<i>Cyperus bipartitus</i>	Umbrella flatsedge	<i>Cyperus diandrus</i>
Showy lady's slipper	<i>Cypripedium reginae</i>	Upright pinweed	<i>Lechea stricta</i>
Shrubby cinquefoil	<i>Pentaphylloides floribunda</i>	Ute ladies'-tresses	<i>Spiranthes diluvialis</i>
Sideoats grama	<i>Bouteloua curtipendula</i>	Violet	<i>Viola spp</i>
Silky prairie clover	<i>Dalea villosa</i>	Wahoo spindle-tree	<i>Euonymus atropurpureus</i>
Silver buffaloberry	<i>Shepherdia argentea</i>	Wedge-leaf frog-fruit	<i>Phyla cuneifolia</i>
Silver sage	<i>Artemisia cana</i>	Western prairie fringed orchid	<i>Platanthera praeclara</i>
Silver sagebrush	<i>Artemisia cana</i>	Western ragweed	<i>Ambrosia psilostachya</i>
Silverberry	<i>Elaeagnus commutata</i>	Western snowberry	<i>Symphoricarpos occidentalis</i>
Silverweed cinquefoil	<i>Potenilla argentea</i>	Western wheatgrass	<i>Agropyron smithii</i>
Skunkbrush	<i>Rhus aromatica</i>	Western wheatgrass	<i>Pascopyrum smithii</i>
Skunkbrush sumac	<i>Rhus aromatica</i>	Western yarrow	<i>Achillea millefolium</i>
Slendar cottongrass	<i>Eriphorum gracile</i>	Wheat	<i>Triticum aestivum</i>
Slendar wheatgrass	<i>Agropyron trachycaulum</i>	White prairie clover	<i>Dalea candida</i>
Small white lady's slipper	<i>Cypripedium candidum</i>	White prairie clover	<i>Petalostemum candidum</i>
Smartweed	<i>Polygonum spp</i>	White sweetclover	<i>Melilotus alba</i>
Smooth brome	<i>Bromus inermis</i>	Wilcox dicanthelium	<i>Dicanthelium wilcoxianum</i>
Smooth goosefoot	<i>Chenopodium subglabrum</i>	Wild plum	<i>Prunus americana</i>
Smooth scouring rush	<i>Equisetum laevigatum</i>	Wild strawberry	<i>Fragaria virginiana</i>
Smooth sumac	<i>Rhus glabra</i>	Wildrose	<i>Rosa spp</i>
Smoothbark cottonwood	<i>Populus x acuminata</i>	Willow	<i>Salix spp</i>

Willow buckbrush	<i>Symphoricarpos occidentalis</i>
Wolfberry	<i>Symphoricarpos occidentalis</i>
Wood lily	<i>Lilium philadelphicum</i>
Woolly sedge	<i>Carex lanuginosa</i>
Wyoming big sagebrush	<i>Artemisia tridentata wyomingensis</i>
Yellow alyssum	<i>Alyssum desertorum</i>
Yucca	<i>Yucca glauca</i>

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## Animals

Alkali fairy shrimp	<i>Branchinecta spp</i>	Bull snake	<i>Pituophis melanoleucus sayi</i>
American bittern	<i>Botaurus lentiginosus</i>	Bullfrog	<i>Rana catesbeiana</i>
American burying beetle	<i>Nicrophorus americanus</i>	Bullock's oriole	<i>Icterus bullocki</i>
American crow	<i>Corvus brachyrhynchos</i>	Bumble bees	<i>Bombus spp</i>
American goldfinch	<i>Carduelis tristis</i>	Burrowing owl	<i>Speotyto cunicularia</i>
American peregrine falcon	<i>Falco peregrinus</i>	California bighorn sheep	<i>Ovis canadensis californiana</i>
American wigeon	<i>Anas americana</i>	Canada goose	<i>Branta canadensis</i>
Argos skipper	<i>Atrytone arogos</i>	Cardinal	<i>Cardinalis cardinalis</i>
Badger	<i>Taxidea taxus</i>	Channel catfish	<i>Ictalurus punctatus</i>
Baird's sparrow	<i>Ammodramus bairdii</i>	Chestnut-collared longspur	<i>Calcarius ornatus</i>
Bald eagle	<i>Haliaeetus leucocephalus</i>	Chorus frog	<i>Pseudacris spp</i>
Beaver	<i>Castor canadensis</i>	Clark's nutcracker	<i>Nucifraga columbiana</i>
Belfragii's bug	<i>Chlorochroa belfragii</i>	Clay-colored sparrow	<i>Spizella pallida</i>
Bell's vireo	<i>Vireo bellii</i>	Common loon	<i>Gavia immer</i>
Belted kingfisher	<i>Ceryle alcyon</i>	Cooper's hawk	<i>Accipiter cooperii</i>
Bison	<i>Bison bison</i>	Cottontail	<i>Sylvilagus spp</i>
Black bullhead	<i>Ameiurus melas</i>	Coyote	<i>Canis latrans</i>
Black tern	<i>Chlidonias niger</i>	Crappie	<i>Pomoxis spp</i>
Black-backed woodpecker	<i>Picoides arcticus</i>	Dakota skipper	<i>Hesperia dacotae</i>
Black-billed cuckoo	<i>Cucyzyus erythrophthalmus</i>	Dickcissel	<i>Spiza americana</i>
Black-billed magpie	<i>Pica hudsonia</i>	Downy woodpecker	<i>Picoides pubescens</i>
Black-capped chickadee	<i>Poecile atricapilla</i>	Dwarf shrew	<i>Sorex nanus</i>
Black-footed ferret	<i>Mustela nigripes</i>	Eastern bluebird	<i>Sialia sialis</i>
Black-tailed prairie dog	<i>Cynomys ludovicianus</i>	Eastern screech-owl	<i>Otus asio</i>
Blanding's turtle	<i>Emydoidea blandingii</i>	Eastern wood-pewee	<i>Contopus virens</i>
Blue grosbeak	<i>Guiraca caerulea</i>	Elk	<i>Cervus elaphus</i>
Blue jay	<i>Cyanocitta cristata</i>	Fathead minnow	<i>Pimephales promelas</i>
Bluegill	<i>Lepomis macrochirus</i>	Ferruginous hawk	<i>Buteo regalis</i>
Blue-winged teal	<i>Anas discors</i>	field sparrow	<i>Spizella pusilla</i>
Bobcat	<i>Felis rufus</i>	Finscale dace	<i>Phoxinus neogaeus</i>
Bobolink	<i>Dolichonyx oryzivorus</i>	Flathead chub	<i>Platygobio gracilis</i>
Box turtle	<i>Terrapene ornata</i>	Fox sparrow	<i>Passerella iliaca</i>
Brewer's sparrow	<i>Spizella brewi</i>	Fox squirrel	<i>Sciurus niger</i>
Brook trout	<i>Salvelinus fontinalis</i>	Franklin's ground squirrel	<i>Spermophilus franklinii</i>
Brown trout	<i>Salmo trutta</i>	Fringed-tailed myotis	<i>Myotis thysanodes</i>

Gadwall	<i>Anas strepera</i>	Moose	<i>Alces alces</i>
Garter snake	<i>Thamnophis radix</i>	Mountain bluebird	<i>Sialia cursuoides</i>
Golden eagle	<i>Aquila chrysaetos</i>	Mountain lion	<i>Puma concolor</i>
Goshawk	<i>Accipiter gentilis</i>	Mountain plover	<i>Charadrius montanus</i>
Grasshopper sparrow	<i>Ammodramus savannarum</i>	Mourning dove	<i>Zenaida macroura</i>
Gray catbird	<i>Dumetella carolinensis</i>	Mule deer	<i>Odocoileus hemionus</i>
Gray fox	<i>Urocyon cinereoargenteus</i>	Muskrat	<i>Ondatra zibethicus</i>
Gray partridge	<i>Perdix perdix</i>	Northern bald eagle	<i>Haliaeetus leucephalus alascanus</i>
Gray squirrel	<i>Sciurus carolinensis</i>	Northern flicker	<i>Colaptes auratus</i>
Great blue heron	<i>Ardea herodias</i>	Northern goshawk	<i>Accipiter gentilius</i>
Great horned owl	<i>Bubo virginianus</i>	Northern grasshopper mouse	<i>Onychomys leucogaster</i>
Great-crested flycatcher	<i>Myiarchus crinitus</i>	Northern harrier	<i>Circus cyaneus</i>
Greater prairie chicken	<i>Tympanuchus cupido pinnatus</i>	Northern leopard frog	<i>Rana pipiens</i>
Green-winged teal	<i>Anas crecca</i>	Northern oriole	<i>Icterus bullocki</i>
Ground squirrel	<i>Spermophilus sp</i>	Northern pike	<i>Esox lucius</i>
Hairy woodpecker	<i>Picoides villosus</i>	Northern pocket gopher	<i>Thomomys talpoides</i>
Hispid pocket mouse	<i>Chaetodipus hispidus</i>	Northern short-horned lizard	<i>Phrynosoma douglasii douglasii</i>
Hog-nose snake	<i>Heterodon nasicus</i>	Olive-backed pocket mouse	<i>Perognathus fasciatus</i>
Horned lark	<i>Eremophila alpestris</i>	Orchard oriole	<i>Icterus spurius</i>
Horse	<i>Equus caballus</i>	Osprey	<i>Pandion haliaetus</i>
House wren	<i>Troglodytes aedon</i>	Ottoo skipper	<i>Hesperia ottoe</i>
Iowa darter	<i>Etheostama exile</i>	Ovenbird	<i>Sciurus aurocapillus</i>
Jack rabbit	<i>Lepus townsendii</i>	Pale milk snake	<i>Lampropeltis triangulum</i>
Large-mouthed bass	<i>Micropterus salmoides</i>	Pallid sturgeon	<i>Scaphirhynchus albus</i>
Lark bunting	<i>Calamospiza melanocorys</i>	Pearl dace	<i>Semotilus margarita</i>
Lark sparrow	<i>Chondestes grammacus</i>	Peregrine falcon	<i>Falco peregrinus</i>
Lazuli bunting	<i>Passerina amoena</i>	Pintail	<i>Anas acuta</i>
Least flycatcher	<i>Empidonax minimus</i>	Plains harvest mouse	<i>Reithrodontomys montanus</i>
Least weasel	<i>Mustela nivalis</i>	Plains pocket mouse	<i>Perognathus flavescens</i>
LeConte's sparrow	<i>Ammodramus belcontei</i>	Plains spadefoot	<i>Spea bombifrons</i>
Lewis woodpecker	<i>Melanerpes lewis</i>	Plains spotted skunk	<i>Spilogale putorius interrupta</i>
Loggerhead shrike	<i>Lanius ludovicianus</i>	Plains topminnow	<i>Fundulus sciadicus</i>
Long-billed curlew	<i>Numenius americanus</i>	Porcupine	<i>Erithizon dorsalis</i>
Long-eared owl	<i>Asio otus</i>	Powesheik skipper	<i>Oarisma powesheik</i>
Longnose dace	<i>Rhinichthys cataractae</i>	Prairie falcon	<i>Falco mexicanus</i>
Longnose sucker	<i>Catostomus catostomus</i>	Prairie rattlesnake	<i>Crotalus viridis viridis</i>
Long-tailed weasel	<i>Mustela frenata</i>	Prairie skink	<i>Eumeces septentrionalis</i>
Mallard	<i>Anas platyrhynchos</i>	Prairie vole	<i>Microtus ochrogaster</i>
Marbled godwit	<i>Limosa fedoa</i>	Pronghorn	<i>Antilocapra americana</i>
Marmot	<i>Marmota spp</i>	Pygmy nuthatch	<i>Sitta pygmaea</i>
Marsh wren	<i>Cistothorus palustris</i>	Raccoon	<i>Procyon lotor</i>
McCown's longspur	<i>Calcarius mccownii</i>	Red crossbill	<i>Loxia curvirostra</i>
Meadowlark	<i>Sturnella spp</i>	Red fox	<i>Vulpes vulpes</i>
Merlin	<i>Falco columbarius</i>	Red shiner	<i>Notropis lutrensis</i>
Milk snake	<i>Lampropeltis triangulum</i>	Red-breasted nuthatch	<i>Sitta canadensis</i>
Mink	<i>Mustela vison</i>	Red-headed woodpecker	<i>Melanerpes erythrocephalus</i>

Red-tailed hawk	<i>Buteo jamaicensis</i>	White sucker	<i>Catostomus commersoni</i>
Regal fritillary	<i>Spyeria idalia</i>	White-breasted nuthatch	<i>Sitta carolinensis</i>
Richardson's ground squirrel	<i>Spermophilus richardsonii</i>	White-faced ibis	<i>Plegadis chihi</i>
Ring-necked pheasant	<i>Phasianus colchicus</i>	White-footed mouse	<i>Arborimus albipes</i>
River otter	<i>Lontra canadensis</i>	White-tailed deer	<i>Odocoileus virginianus</i>
Rocky Mountain bighorn sheep	<i>Ovis canadensis canadensis</i>	White-tailed jackrabbit	<i>Lepus townsendii</i>
Ruby-throated hummingbird	<i>Archilochus colubris</i>	Whooping crane	<i>Grus americana</i>
Rufous-sided towhee	<i>Pipilo erythrophthalmus</i>	Wild turkey	<i>Meleagris gallopavo</i>
Sage grouse	<i>Centrocercus urophasianus</i>	Willow flycatcher	<i>Empidonax traillii</i>
Sage sparrow	<i>Amphispiza belli</i>	Wood duck	<i>Aix sponsa</i>
Sage thrasher	<i>Oreoscoptes montanus</i>	Woodhouse's toad	<i>Bufo woodhousii</i>
Sage vole	<i>Lagurus curtatus</i>	Yellow perch	<i>Perca flavescens</i>
Sand shiner	<i>Notropis stramineus</i>	yellow warbler	<i>Dendroica petechia</i>
savannah sparrow	<i>Passerculus sandwichensis</i>	Yellow-billed cuckoo	<i>Coccyzus americanus</i>
Scarlet tanager	<i>Piranga ludoviciana</i>	Yellow-breasted chat	<i>Icteria virens</i>
Sedge wren	<i>Cistothorus platensis</i>	Yellow-headed blackbird	<i>Xanthocephalus xanthocephalus</i>
Sharp-shinned hawk	<i>Accipiter striatus</i>	Yellow-throated vireo	<i>Vireo flavifrons</i>
Sharp-tailed grouse	<i>Tympanuchus phasianellus jamesi</i>		
sharp-tailed sparrow	<i>Ammodramus nelsoni</i>		
Short-eared owl	<i>Asio flammeus</i>		
Shorthead redhorse	<i>Maxostoma macrolepidotum</i>		
Shoveler	<i>Anas clypeata</i>		
Skunk	<i>Spilogale spp</i>		
Spiny softshell turtle	<i>Trionyx spinifer</i>		
Spotted bat	<i>Euderma maculatum</i>		
Sprague's pipit	<i>Anthus spragueii</i>		
Stonecat	<i>Noturus flavus</i>		
Striped skunk	<i>Mephitis mephitis</i>		
Sturgeon chub	<i>Macrohybopsis gelida</i>		
Summer tanager	<i>Piranga rubra</i>		
Swainson's hawk	<i>Buteo swainsoni</i>		
Swift fox	<i>Vulpes velox</i>		
Thirteen-lined ground squirrel	<i>Spermophilus tridecemlineatus</i>		
Tiger salamander	<i>Ambystoma tigrinum</i>		
Topeka shiner	<i>Notropis topeka</i>		
Townsend's big-eared bat	<i>Corynorhinus townsendii</i>		
Trumpeter swan	<i>Cygnus buccinator</i>		
Turkey vulture	<i>Cathartes aura</i>		
Upland sandpiper	<i>Bartramia longicauda</i>		
Vesper sparrow	<i>Pooecetes gramineus</i>		
Warbling vireo	<i>Vireo gilvus</i>		
Western big-eared bat	<i>Plecotus townsendii</i>		
Western burrowing owl	<i>Speotyto cunicularia</i>		
Western screech-owl	<i>Otus kennicottii</i>		
Western smooth green snake	<i>Liochlorophis vernalis</i>		
Western tanager	<i>Piranga ludoviciana</i>		

**Appendix E  
Special Status Species  
Potentially Occurring within  
the Project Area**

**Table E-1 Special Status Species Potentially Occurring within the Project Area**

Species	Scientific Name	Status <sup>1</sup>	Habitat Association	Primary Habitat	Potential for Occurrence Within Project Area	Eliminated from Detailed Analysis	Counties	Source
<b>MAMMALS</b>								
Northern long-eared bat	<i>Myotis septentrionalis</i>	FT	Habitat generally includes many trees, where northern long-eared bats roost during the day, either singly or colonially. Northern long-ear bats are opportunistic roosters, readily roosting in live trees of multiple species, snags, and isolated instances of using manmade structures as roosts. Trees and snags generally are considered good roosts if they have suitable cavities or retain bark, under which the bats often roost.	Shrublands, woodlands, and riparian areas.	Yes. Suitable habitat is present within the Project area.	No.	McKenzie and Williams.	USFWS 2014a.
Black-footed ferret	<i>Mustela nigripes</i>	FE	This species is an obligate of prairie dog colonies, which provide both shelter (i.e., burrows) and a prey base to support ferret populations.	Black-tailed prairie dog colonies.	No.	Yes. Suitable habitat does not exist in the Project area.	None.	Hagen et al. 2005; Carlson McCain, Inc. 2014.
Gray wolf	<i>Canis lupus</i>	FE	This species occurs in a wide range of habitats with large ungulates present. Gray wolves utilize mixed hardwood- coniferous forests in wilderness and sparsely settled areas, to forest and prairie landscapes dominated by agricultural and pasture lands.	Wide variety of habitats with sufficient prey base.	No.	Yes. The gray wolf is an occasional visitor in North Dakota, but no breeding records have been documented in the state.	McKenzie and Williams.	Hagen et al. 2005.
Black-tailed prairie dog	<i>Cynomys ludovicianus</i>	USFS	The species inhabits prairie communities with short vegetation and flat topography. Black-tailed prairie dogs are often found in areas grazed by livestock and other disturbed areas with exposed soil.	Short and mixed grasslands, usually well- grazed lands.	Yes. No colonies have been documented near the Project area; however, suitable habitat exists within the Project area.	No.	McKenzie.	Carlson McCain, Inc. 2014; Hagen et al. 2005.
Rocky Mountain bighorn sheep	<i>Ovis canadensis</i>	USFS	Bighorn sheep inhabit steep, precipitous, rocky terrain and feed on grasses and forbs. Bighorn sheep require considerable acres of rough terrain and limited disturbance for lambing habitat.	Steep, rocky terrain; badlands.	No.	Yes. The known range of this species in North Dakota does not overlap with the Project area.	McKenzie.	Armstrong et al. 2011; NDGFD 2014.
<b>BIRDS</b>								
Interior least tern	<i>Sterna antillarum athalassos</i>	FE	This species inhabits sparsely vegetated sandbars or shoreline salt flats of lakes along the Missouri River System. The Missouri River, Lake Sakakawea, and Lake Oahe are the only areas in North Dakota known to support interior least tern populations. Interior least terns are present in North Dakota from mid-May to mid-August. The peak breeding season occurs from early June to mid-July.	Sparsely vegetated sandbars or shorelines.	Yes. Potential habitat exists at Lake Sakakawea.	No.	McKenzie and Williams.	Hagen et al. 2005; USFWS 2014b.

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Whooping crane	<i>Grus americana</i>	FE	This species primarily utilizes wetlands and cropland ponds for roosting and feeding during migration. Spring and fall migration through the Project area generally occurs from April to mid-May and from mid-September to October, respectively. The Project route would intersect a known whooping crane migration route that includes 75-percent of all reported whooping crane sightings in North Dakota.	Wetlands bordered by agricultural fields.	Yes. The Project area is at the western edge of the species' migratory route through North Dakota.	No.	McKenzie and Williams.	Hagen et al. 2005; USFWS 2014c.
Piping plover	<i>Charadrius melodus</i>	FT	This species nests on exposed, sparsely vegetated shores and islands of shallow, alkali lakes and impoundments. Nests are placed in sand or gravel, generally near a clump of grass, rock, or small log. The peak breeding season occurs from late May to mid-July.	Sand or gravel beaches, alkaline wetlands.	Yes. Designated critical habitat exists along the Missouri River in McKenzie and Williams counties. Potential habitat exists at Lake Sakakawea.	No.	McKenzie and Williams.	Hagen et al. 2005; USFWS 2014d.
Rufa red knot	<i>Calidris canutus ssp. rufa</i>	FT	This shorebird breeds in the central Canadian Arctic, with primary breeding grounds in Nunavut Territory. The rufa red knot winters along the Atlantic coasts of Argentina and Chile, the north coast of Brazil, and further north into Mexico and the southeast U.S. During migration (July-August and March-June), the rufa red knot primarily follows the Atlantic coastline to and from breeding and wintering grounds. However, geolocator results from red knots wintering in Texas showed that some birds migrate using a central flyway across the midwestern U.S. and may have a northern Great Plains stopover .	Sand or gravel beaches, alkaline wetlands.	Yes. Potential stop-over habitat occurs at Lake Sakakawea and wetlands crossed by the Project.	No.	McKenzie and Williams.	NDNHI 1998; USFWS 2014e.
Sprague's pipit	<i>Anthus spragueii</i>	FC	This species requires large expanses of native grasslands of intermediate height and sparse to intermediate vegetation density, low forb density, and little bare ground but low litter depth. The abundance of this species is positively correlated with the percent of clubmoss cover and dominant native grass species. Sprague's pipit is present in North Dakota from mid-April to mid-October. Peak breeding season occurs from early May to mid-August.	Large expanses of native grasslands.	Yes. Potential habitat occurs within the Project area.	No.	McKenzie and Williams.	Hagen et al. 2005.

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Baird's sparrow	<i>Ammodramus bairdii</i>	USFS	This species inhabits extensive tracts of native prairie, but will utilize idle, agricultural grasslands and lightly to moderately grazed pastures. Baird's sparrow is present in North Dakota from May to August. The peak breeding season occurs from early June to late July.	Grasslands and pastures.	Yes. Potential habitat occurs within the Project area.	No.	McKenzie and Williams.	Hagen et al. 2005.
Bald eagle	<i>Haliaeetus leucocephalus</i>	USFS	This species typically occurs near large waterbodies, which supports suitable roosting, nesting, and foraging habitat. Winter habitat typically includes areas of open water, adequate food sources, and sufficient diurnal and nocturnal roosts. Nest sites are usually located in mature trees close to open water. Bald eagles are present in North Dakota year-round. Peak breeding season occurs from early March to July.	Large rivers and waterbodies with mature stands of trees.	No.	Yes. Suitable nesting habitat does not occur within the Project area. The nearest nest is approximately 7 miles west of the Project area. Occurrence would be limited to migrating or foraging individuals.	McKenzie and Williams.	Hagen et al. 2005; USFS 2014.
Burrowing owl	<i>Athene cunicularia</i>	USFS	This species inhabits open grasslands with short vegetation and bare ground. Burrowing owls rely exclusively on burrowing mammals (primarily prairie dogs) to create burrows for nest sites. The species is present in North Dakota from April to September. Peak breeding season occurs from early May to mid-August.	Short-grass/bare ground.	Yes. While preferred habitat (i.e., black-tailed prairie dog colonies) does not occur within the Project area, burrowing owls can also inhabit other mammalian burrows.	No.	McKenzie and Williams.	Hagen et al. 2005.
Greater prairie chicken	<i>Tympanuchus cupido</i>	USFS	This species inhabits grassland and agricultural lands. Leks are located in areas of bare ground or short vegetation. Peak breeding season occurs from late April to early July.	Grasslands, short-grass/bare ground.	No.	Yes. The Project area is outside the known range for this species.	None.	Hagen et al. 2005; USFS 2011.
Greater sage-grouse	<i>Centrocercus urophasianus</i>	USFS	This species primarily inhabits big sagebrush communities. Riparian, upland meadows and agricultural land are also utilized, especially for brood-rearing habitat. Leks are located in areas of bare ground or short vegetation. Peak breeding and nesting season occurs from mid-March to mid-July.	Big sagebrush, short-grass/bare ground, meadows, and agricultural land.	No.	Yes. The Project area is outside the known range for this species.	None.	Hagen et al. 2005; USFS 2011.
Loggerhead shrike	<i>Lanius ludovicianus</i>	USFS	This species inhabits open country with thickets of small trees, shrubs, and shelterbelts. The loggerhead shrike is present in North Dakota from mid-March to October. Peak breeding season occurs from early May to mid-July.	Open country with intermittent woody vegetation.	Yes. Potential habitat occurs within the Project Area.	No.	McKenzie and Williams.	Hagen et al. 2005.

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Species	Scientific Name	Status <sup>1</sup>	Habitat Association	Primary Habitat	Potential for Occurrence Within Project Area	Eliminated from Detailed Analysis	Counties	Source
Long-billed curlew	<i>Numenius americanus</i>	USFS	This species inhabits expansive short-grass prairie with topography that is open, flat to gently rolling, or sloping. Proximity to water is an important habitat component. Nests are usually located near cowpies or other conspicuous objects for concealment and are often on hummocks for improved visibility. Peak breeding season occurs from early May to early July.	Grasslands.	Yes. Potential habitat occurs within the Project area.	No.	McKenzie.	Hagen et al. 2005.
<b>INVERTEBRATES</b>								
Dakota skipper	<i>Hesperia dactotae</i>	FT	This species inhabits wet tall-grass or mixed-grass native prairies, often with mountain death camas. The larvae feed on grasses, especially little bluestem. Dakota skippers produce one brood in mid-June to early July.	Native prairie containing a high diversity of wildflowers and grasses.	Yes. Potential habitat occurs within the Project area. <b>Designated</b> critical habitat is located 3.2 miles west and 2.3 miles east of the Project area on USFS-administered lands south of Lake Sakakawea.	No.	McKenzie.	Royer 2004; USFWS 2014f.
Argos skipper	<i>Atrytone arogos iowa</i>	USFS	This species inhabits mesic, undisturbed tall- to mixed-grass native bluestem prairies. Caterpillars hibernate and pupate the following spring. Adult flight is one brood from June to July.	Native prairie.	No.	Yes. The Project area is outside the known range for this species.	None.	Royer 2004.
Broad-winged skipper	<i>Poanes viator</i>	USFS	This species inhabits oxbow marshes with hairy sedge and swamp milkweed. Adult flight is one brood from late June to early August.	Oxbow marshes.	No.	Yes. The Project area is outside the known range for this species.	None.	Royer 2004.
Dion skipper	<i>Euphyes dion</i>	USFS	This species inhabits marshes with sedge, swamp milkweed, and cattails. Adult flight is one brood in July.	Marshes.	No.	Yes. The Project area is outside the known range for this species.	None.	Royer 2004.
Mulberry wing	<i>Poanes massasoit</i>	USFS	This species inhabits woody hummock meadows with sedge and dogwood. Adult flight is one brood in July.	Sedge meadows.	No.	Yes. The Project area is outside the known range for this species.	None.	Royer 2004.
Ottoe skipper	<i>Hesperia ottoe</i>	USFS	This species inhabits ungrazed or lightly grazed native prairie hilltops, often found on purple coneflower blooms. The larvae feed on bluestem, grama, stipa, and bluegrass. The Ottoe skipper produces one brood in mid-June to early July.	Native prairie.	Yes. Potential habitat occurs within the Project area.	No.	McKenzie and Williams.	Royer 2004.
Powesheik skipperling	<i>Oarisma powesheik</i>	USFS	This species inhabits native tall-grass meadows.	Tallgrass meadows.	No.	Yes. The Project area is outside the known range for this species.	None.	Royer 2004.

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Regal fritillary butterfly	<i>Speyeria idalia</i>	USFS	This species inhabits native prairie, feeding on milkweed, thistle, and blazing star. The larvae feed on birdfoot violet. The regal fritillary overwinters shortly after enclosure. Adult flight occurs in late June (males) through August (mostly females).	Native prairie.	Yes. Potential habitat occurs within the Project area.	No.	McKenzie and Williams.	Royer 2004.
Tawny crescent	<i>Phyciodes batesii</i>	USFS	This species inhabits woodland roadsides, usually near bluestem prairie, feeding on dogbane and leafy spurge. The larvae feed on aster. The tawny crescent produces one brood, which usually emerges during the first week in June.	Woodland.	Yes. Potential habitat occurs within the Project area. This species has been documented near the Project area at milepost 20.4.	No.	McKenzie.	Royer 2004; USFS 2013.
<b>FISH</b>								
Pallid sturgeon	<i>Scaphirhynchus albus</i>	FE	This species is generally found in large, slow moving turbid rivers. Chutes between sandbars are commonly utilized. Spawning occurs from June through August.	Large, turbid rivers with sand substrate.	Yes. Potential habitat exists in Lake Sakakawea and the Missouri River upstream of Lake Sakakawea.	No.	McKenzie and Williams.	Hagen et al. 2005.
Northern Redbelly Dace	<i>Phoxinus eos</i>	USFS	This species inhabits cold, clear, spring-fed streams.	Cold, clear headwater streams.	No.	Yes. The Project area is outside the known range for this species.	McKenzie.	Hagen et al. 2005.
<b>PLANTS</b>								
Smooth goosefoot	<i>Chenopodium pallescens</i>	USFS	The species inhabits sandbars, terraces, and dune complexes along rivers and creeks. Exposed sandy substrates in uplands, blowouts, outcrops, colluvium, etc. Elevation range 656 to 3609 ft. amsl. Flowering period: June to September.	Sand dunes.	No.	Yes. Potential habitat for this species is not present within the Project area.	Billings.	Flora of North America 1993; Mohlenbrock 2002; USFS 2011.
Blue lips	<i>Collinsia parviflora</i>	USFS	This species inhabits woody understories, including green ash/elm draws, Rocky Mountain juniper, mesic shrub communities, and occasional xeric shrub communities. Elevation range unknown. Flowering period: March to June.	Woodlands and shrublands.	Yes. Potential habitat occurs within the Project area.	No.	Billings and Dunn.	Elle and Carney 2003; NatureServe 2014; USFS 2011
Torry's cryptantha	<i>Cryptantha torreyana</i>	USFS	This species inhabits open areas at low to mid-elevation ranges within dry plains and pine slopes. Within the Little Missouri National Grassland, the species has been reported from scoria ridgelines, dry plains, rocky outcrops, escarpments, and pine slopes. Elevation range 1148 to 6562 ft. amsl. Flowering period May to July.	Varies.	No.	Yes. Potential habitat for this species is not present within the Project area.	Billings.	Jepson 1993; NatureServe 2014; USFS 2011.

**Table E-1 Special Status Species Potentially Occurring within the Project Area**

Species	Scientific Name	Status <sup>1</sup>	Habitat Association	Primary Habitat	Potential for Occurrence Within Project Area	Eliminated from Detailed Analysis	Counties	Source
Nodding wild buckwheat	<i>Eriogonum cernuum</i>	USFS	This species inhabits exposed sand substrates with low plant cover in grasslands, hillsides, and sandstone outcrops. Elevation range 1,970 to 10,170 feet. Flowering period: late June to September.	Sandy substrates	No.	Yes. Potential habitat for this species is not present within the Project area.	Dunn.	Jepson 2013; Niehaus 1998; USFS 2011.
Dakota buckwheat	<i>Eriogonum visheri</i>	USFS	This species inhabits relatively exposed clay/silt substrate with low plant cover such as outwash zones around eroding buttes, saddles, steep convex slopes, and erosional breaks on prairie slopes. Occasional populations among dense saltgrass communities. 1,886 to 2,707 feet amsl. Flowering period: June to late September.	Barren, Prairie.	Yes. Potential habitat occurs within the Project area.	No.	Billings and McKenzie.	Flora of North America 1993; Ladyman 2006; MFWP 2014; NatureServe 2014; USFS 2011.
Missouri pincushion cactus	<i>Escobaria missouriensis</i>	USFS	This species inhabits prairie slopes and plains and stony to loamy to clayey short-grass to mixed-grass prairies. Also reported in woodlands of ponderosa pine or <i>Quercus</i> spp. Elevation range unknown. Flowering period April to June.	Prairie, Woodlands.	Yes. Potential habitat occurs within the Project area.	No.	McKenzie.	Flora of North America 1993; NRCS 2014; USFS 2011.
Sand lily	<i>Leucocrinum montanum</i>	USFS	This species inhabits shortgrass communities with fine textured substrates but also found in crested wheatgrass communities. Reported from open coniferous woodlands and hillsides, sagebrush scrub, and sandy flats. Elevation range 2,620 to 7,875 feet amsl. Flowering period March-June.	Varies.	Yes. Potential habitat occurs within the Project area.	No.	Billings and McKenzie.	Flora of North America 1993; NatureServe 2014; USFS 2011.
Golden stickleaf	<i>Mentzelia pumila</i>	USFS	This species inhabits scoria exposures and colluvium with low plant cover. Also reported on slopes and sandy plains; occasionally on hard clays and rocky soils. Elevation range unknown. Flowering period: June to early July.	Varies.	Yes. Potential habitat occurs within the Project area.	No.	N/A – No known populations within the Project- affected counties.	MFWP 2014; Nature Serve 2014; USFS 2011.
Alyssum-leaved phlox	<i>Phlox alyssifolia</i>	USFS	This species inhabits sandy or gravelly soil on and around Bullion Butte. Also reported on clay banks and limestone ridges of open prairie. Elevation range unknown. Flowering period May.	Prairie, sandy and gravelly substrates.	Yes. Potential habitat occurs within the Project area.	No.	Billings and Williams.	NatureServe 2014; USGS 2014; USFS 2011.
Limber pine	<i>Pinus flexilis</i>	USFS	This species inhabits semi-arid exposed rocky ridges and foothills in the Limber Pines RNA, likely of native-American origin. Elevation range 4,000 to 12,500 feet amsl. Fruiting period: August-September.	Rocky ridges, Foothills.	No.	Yes. Potential habitat for this species is not present within the Project area.	Slope.	Johnson 2001; NRCS 2014; USFS 1990.

**Table E-1 Special Status Species Potentially Occurring within the Project Area**

Species	Scientific Name	Status <sup>1</sup>	Habitat Association	Primary Habitat	Potential for Occurrence Within Project Area	Eliminated from Detailed Analysis	Counties	Source
Lance-leaf cottonwood	<i>Populus acuminata</i>	USFS	This species inhabits mesic woody draws, often with springs/seeps, and is found occasionally near springs on open hillsides, floodplains, and stream banks. Elevation range 4,921 to 7,874 feet. Flowering period: April-May.	Riparian.	No.	Yes. Potential habitat for this species is not present within the Project area.	Billings, Slope.	Flora of North America 1993; NatureServe 2014; NRCS 2014; USFS 2011.
Alkali sacaton	<i>Sporobolus airoides</i>	USFS	This species inhabits secondary succession on clay outwash where tolerant of saline conditions, also on dry to moist sandy or gravelly soil. Elevation range 2,500 to 8,000 feet. Flowering period: June to October.	Desert, Prairie.	No.	Yes. Potential habitat for this species is not present within the Project area.	Billings.	Johnson, 2000; NatureServe 2014; NRCS 2014; USFS 2011.
Stemless townsend daisy	<i>Townsendia exscapa</i>	USFS	This species inhabits dry plains and hillsides, often with loamy or increased soil development and increased plant cover relative to <i>T. hookeri</i> . Elevation range: up to 10,000 feet amsl. Flowering period: April to May.	Plains.	Yes. A population of <i>Townsendia</i> spp. has been documented within the Project area.	No.	Billings, Burke, Divide, Dunn, Slope, Stark, Williams.	Carlson McCain 2014b; NRCS 2014; NatureServe 2014; USFS 2011; USGS 2014.
Hooker's townsendia	<i>Townsendia hookeri</i>	USFS	This species inhabits areas with low to moderate plant cover on dry plains, hillsides, gravelly benches and weathered scoria, but often clay matrix subsoil 2,296 to 5,905 feet amsl. Flowering period: March to June.	Plains.	Yes. A population of <i>Townsendia</i> spp. has been documented within the Project area.	No.	Billings.	Carlson McCain 2014b; Flora of North America 1993; NatureServe 2014; USFS 2011.

<sup>1</sup> FE = Federally Endangered.

FT = Federally Threatened.

FC = Federal Candidate.

FP = Federally Proposed

USFS = USFS Region 1 Sensitive Species.

Note: There are no greater sage-grouse leks along the project route (Carlson McCain 2014a).

**Appendix F  
BLM Responses to Comments  
on the January 2015  
BakkenLink Dry Creek to  
Beaver Lodge Project Draft EA**

**Table F-1 BLM Responses to Comments on the January 2015 BakkenLink Dry Creek to Beaver Lodge Pipeline Project Draft EA**

<b>Comment Number</b>	<b>Resource/Topic</b>	<b>Commenter</b>	<b>Comment</b>	<b>BLM Response To Comment</b>
1	Proposed Action and Alternatives	MHA Nation	As Chairman of the MHA Nation, this letter serves as notice of the MHA Nation's objection to action that affects the lake bottom, Lake Sakakawea itself, or the ecology of the lake.	Comment noted. (No change to Environmental Assessment (EA) warranted.)
2	Cultural Resources	MHA Nation	The Missouri River is culturally and historically very sacred to the Mandan, Hidatsa, and Arikara people.	BLM acknowledges and respects that the Mandan, Hidatsa, and Arikara consider the Missouri River sacred to its history and culture. (No change to EA warranted.)
3	Proposed Action and Alternatives	MHA Nation	As I am sure you are aware, BakkenLink operates a crude oil pipeline system consisting of approximately 132 miles of 8-inch and 12-inch steel crude oil pipeline extending from multiple receipt points in Billings, McKenzie, Stark, and Williams Counties, North Dakota to an interconnection with a crude rail loading facility at Fryburg, North Dakota. It is the Tribes' understanding that BakkenLink is currently attempting to secure the necessary USACE Section 404 permitting to trench a north/south pipeline on the lake bottom of Lake Sakakawea north of the Fort Berthold Indian Reservation, the home to the MHA Nation. The tribes have also learned that BakkenLink had previously tried to secure approval from the Bureau of Land Management in 2012 for a similar project but was denied due to the effects of water disturbance on endangered species found in and around the lake that would have resulted from the work.	The current BakkenLink Dry Creek to Beaver Lodge Project is a continuation of an ongoing crude oil pipeline system that BakkenLink originally proposed to construct between Fryburg and the Beaver Lodge Interconnect Facility, near Tioga. The original proposed project was evaluated in an EA by the jurisdictional agencies in 2012. At that time, the jurisdictional agencies were interested in evaluating a horizontal directional drill (HDD) alternative crossing method of Lake Sakakawea; however, there was inadequate geotechnical data at the time to determine the feasibility of an HDD at the proposed crossing location. Since BakkenLink indicated a willingness to construct part of the project that did not include the lake crossing but did have independent utility, a mitigated Finding of No Significant Impact (FONSI) was issued for the segment of the project extending from Fryburg to Arrow Midstream. In March 2013, BakkenLink filed an application to amend its existing right-of-way (ROW) to complete the Project as originally proposed, including the crossing of Lake Sakakawea using conventional pipeline construction methods. The location of the proposed action, as described in the EA for the Project, is located in a corridor where existing pipelines cross Lake Sakakawea and that is acknowledged by United States Forest Service (USFS) and USACE. From September 2012 to February 2013, BakkenLink obtained and evaluated the necessary geotechnical data at the lake crossing from a third-party horizontal direction drill (HDD) consultant. The HDD consultant determined that HDD is not feasible at the proposed location due to multiple factors and that there would be a very high likelihood of failure using the HDD construction method. USACE reviewed the HDD consultant's report and agreed with the findings on May 21, 2014. (Change to EA warranted.)

**Table F-1 BLM Responses to Comments on the January 2015 BakkenLink Dry Creek to Beaver Lodge Pipeline Project Draft EA**

<b>Comment Number</b>	<b>Resource/Topic</b>	<b>Commenter</b>	<b>Comment</b>	<b>BLM Response To Comment</b>
4	Proposed Action and Alternatives	MHA Nation	Allowing a trenched oil pipeline along the bottom of the river when other preferred alternatives exist is simply unacceptable.	The EA addresses several route alternatives that were considered but dropped from further analyses (Section 2.4). Route alternatives were evaluated in terms of economics, engineering design, construction feasibility, environmental impacts, and serving the Bakken development areas. The reasons that route alternatives were considered but were dropped from further analyses include greater environmental impacts, higher construction costs, and unfeasibility of using HDD as a construction method. (No change to EA warranted.)
5	Proposed Action and Alternatives	MHA Nation	BakkenLink readily admits that alternative locations have been identified for an HDD pipeline where less lake bottom would be directly affected by the pipeline construction, but it would be at an added expense to the company.	The EA addresses several route alternatives that were considered but dropped from further analyses (Section 2.4). Route alternatives were evaluated in terms of economics, engineering design, construction feasibility, environmental impacts, and serving the Bakken development areas. The reasons that route alternatives were considered but were dropped from further analyses include greater environmental impacts, higher construction costs, and unfeasibility of using HDD as a construction method. (No change to EA warranted.)
6	Wildlife and Fisheries; Special Status Species; Water Resources; Vegetation Resources; Tribal Treaty Rights and Interests	MHA Nation	The same issues that resulted in the denial of BakkenLink's 2012 project are at issue again. The water disturbance that would result from the trenching of the lake bottom would create an incredible amount of sediment disruption, potentially killing and damaging plants and animals in and around the lake, and sending sediment downstream toward out Reservation. Additionally, as BakkenLink noted in its Plan of Development (POD) for its 2012 BakkenLink Pipeline Project, ground water recharge of the aquifers that underlie Lake Sakakawea could be affected as well. BakkenLink also admits to their POD that there exists potential for ground water contamination during construction and operation of the pipeline. All of these issues have the potential to harm downstream Tribal communities and the quality of the Tribes' water.	The proposed action has been designed to offset construction and operation impacts to the lake, including potential impacts to water quality, federally listed species (pallid sturgeon, interior least tern and piping plover), and shorelines. The design and mitigation features include placing turbidity containment fencing around excavation/soil discharge areas on the shorelines of the lake to minimize movement of silt, utilizing turbidity mats behind the pipe lowering skid and above the discharge diffuser to reduce turbidity during pipe pulling across the lake, and restoring the shorelines to pre-existing conditions. Pre-construction surveys and potential nest protection buffers would be implemented for the interior least tern and piping plover during the breeding season (April 1 to August 31). For more information, Table 2-4 in the EA provides detailed descriptions of environmental protection measures that would be implemented to minimize impacts to the federally listed species at the lake crossing. In addition, Section 2.2.5.5 provides detailed information regarding construction procedures that would be implemented at the lake crossing and Appendix A contains the spill risk assessment. Similar pipeline installation methods have been utilized to construct pipelines in the same area as recently as 2007 (ie. Dakota Gasification Company). BakkenLink also conducted underwater surveys of the lake bottom using side-scan sonar and video at the proposed action location and adjacent areas for the purposes of gathering information on the lake bottom. No evidence of scouring or sediment movement of other pipeline crossings was observed. (No change to EA warranted).

**Table F-1 BLM Responses to Comments on the January 2015 BakkenLink Dry Creek to Beaver Lodge Pipeline Project Draft EA**

<b>Comment Number</b>	<b>Resource/Topic</b>	<b>Commenter</b>	<b>Comment</b>	<b>BLM Response To Comment</b>
7	Proposed Action and Alternatives	MHA Nation	<i>The USACE should also be apprised of a study conducted by the U.S. Department of Transportation's Pipeline and Hazardous Materials Safety Administration (PHMSA) in conjunction with the Montana Governor's Task Force that resulted from the July 2, 2011 open trench pipeline oil spill in the Yellowstone River, a tributary of the Missouri River. The study was aimed at ensuring the integrity and safety of petroleum pipelines at major water crossings and cataloging the inventory of those pipelines in Montana. As a result of the findings found in the study, the state of Montana is requiring pipeline operators to remove all open trench pipelines since they expose water crossings to greater potential for environmental damage and replace them with horizontal directionally drilled (HDD) pipelines. HDD lines are the safer preferred alternative for pipelines that transport hazardous products under water bodies.</i>	<i>A task force led by the State of Montana and PHMSA Western Region evaluated existing procedures on operating pipelines. The goal of the task force was to improve PHMSA inspection effectiveness and support to operators. The PHMSA Western Region does not include North Dakota and the task force examined pipelines crossing rivers that are not impounded. It is not applicable to the Proposed Action. (No change to EA warranted.)</i>
8	Appendix A - Risk Assessment & Environmental Consequence Analysis	MHA Nation	<i>The spill highlights a key concern for the MHA Nation. Despite the Revised Yellowstone River Pipeline Crossing Risk Assessment Site Summary's assesment that the Bridger Pipeline's environmental risk potential was low, the Bridger pipeline spilled and failed to contain tens of thousands of crude oil from spilling into the water supply in a matter of hours. This is of grave concern to the MHA Nation since the Bridger pipeline has a five foot depth of cover. The BakkenLink Dry Creek to Beaver Lodge Project only proposes a three foot depth of cover.</i>	<i>The proposed action, as described in the EA (Section 2.2), is proposed to be constructed using the open cut method of construction. The pipeline-pull method would be used to install and lower the pipeline at the Lake Sakakawea crossing. The pipeline-pull installation would include a conventional pull with segments of pipe welded together in sections on the north shore of the lake and then joined to form an approximate 13,000-foot-long pipeline that is pulled toward the south shore by a linear winch located on the south shore. The lowering and protection of the pipeline at the north and south shorelines would be achieved by excavating a trench using long-reach excavators on both banks. The excavators would commence at the shoreline and construct a berm from trench materials that is adjacent to the pipeline centerline and use the berm to move the excavator out from the shore. After the pipeline is installed the excavators would reverse the process and transfer berm material back into the trench and over the pipeline. A 220-foot-long by 35-foot-wide strip of rip rap would be placed over the pipeline trench to prevent wave action from exposing the pipeline. The proposed pipeline would have a minimum of four (4) feet depth of cover across the bottom of the lake. (No change to EA warranted.)</i>
9	Proposed Action and Alternatives	MHA Nation	<i>BakkenLink's permit request is ill-advised at best, with the potential for large scale environmental damage. The fact that there have been two breaches of trenched pipelines on the Yellowstone makes the threat from the BakkenLink very real.</i>	<i>Comment noted. (No change to EA warranted.)</i>

**Table F-1 BLM Responses to Comments on the January 2015 BakkenLink Dry Creek to Beaver Lodge Pipeline Project Draft EA**

<b>Comment Number</b>	<b>Resource/Topic</b>	<b>Commenter</b>	<b>Comment</b>	<b>BLM Response To Comment</b>
10	Wildlife and Fisheries; Special Status Species; Water Resources; Tribal Treaty Rights and Interests; Cumulative Impacts	MHA Nation	The correlative effects of BakkenLink's trenching efforts would create an array of actual and potential environmental and ecological damage to the lake ecosystem as well as to downstream communities like the MHA Nation that rely so heavily upon the Missouri River and Lake Sakakawea.	Bakkenlink has proposed preventive measures to reduce the likelihood of a spill to minimize impacts if a spill were to occur (Section 2.2). Preventive measures include dual remote actuated mainline valves (MLVs) at the shore crossings, concrete coating, heavier wall pipe, and positioning of spill response equipment at both the north and south shorelines to expedite spill response. BakkenLink has a cooperative agreement with the Sakakawea Area Spill Response LLC (SASR) and has access to the SASR spill containment equipment at the SASR trailer storage in New Town. Appendix A of the EA contains the spill risk assessment (SRA). The SRA indicates that by the time a potential lake spill reaches Four Bears Village and New Town, oil constituent concentrations in the water are highly unlikely to exceed water quality standards even when conservative assumptions are used. Evaporative loss and emergency containment and cleanup would further reduce potential impacts to water quality. (No change to EA warranted.)
11	Proposed Action; Appendix A - Risk Assessment & Environmental Consequence Analysis	MHA Nation	The environmental threat posed by trenched pipelines was once again recently illustrated just recently. On Saturday, January 17, 2015, yet another pipeline spill sent approximately 50,000 gallons of crude oil into the Yellowstone River just upstream from Glendive, Montana. The Bridger pipeline oil spill on the Yellowstone River resulted in a declaration of emergency by Montana Governor, Steve Bullock, for two counties and calls into the question the long term potability and use of water downstream from the spill. Effects of the spill have been reported as far downstream as Williston, ND.	There are important differences between Bridger LLC Poplar Pipeline and the proposed BakkenLink Project. A primary difference is the age of the pipelines and technologies used during their manufacturing and installation. The Bridger Poplar Pipeline was originally manufactured in the 1950s, though portions of the pipeline were replaced in the late 1960s and early 1970s. During this time period, a number of now-obsolete technologies were commonly utilized in the manufacturing of pipelines, including a process of welding that predisposes the pipe to catastrophic longitudinal seam failure. Furthermore, pipelines from this era often used forms of corrosion-resistant coating that are less effective than modern high performance coatings, such as fusion bonded epoxy. BakkenLink would utilize modern technologies that reduce the risk of many of these types of failures. In addition, the Bridger Poplar Pipeline crossed the Yellowstone River in an area identified as at risk for bank erosion and channel migration. Investigations after the spill revealed that the portion of the pipeline that failed was exposed within the river, and so was subjected to high external stresses. The proposed BakkenLink pipeline would be buried within a trench beneath the bed of Lake Sakakawea. Due to the extremely low flows within Lake Sakakawea, the likelihood of exposed spans at the lake bottom developing over time is negligible. (No change to EA warranted.)

**Table F-1 BLM Responses to Comments on the January 2015 BakkenLink Dry Creek to Beaver Lodge Pipeline Project Draft EA**

<b>Comment Number</b>	<b>Resource/Topic</b>	<b>Commenter</b>	<b>Comment</b>	<b>BLM Response To Comment</b>
12	Tribal Treaty Rights and Interests	MHA Nation	<i>The MHA Nation also reminds the BLM that consultation with the Tribes must be sought before any consideration is give to BakkenLink's proposal and other proposals similar to it. Under Executive Order 13175, signed by President Clinton on November 6, 2000, the federal government must consult with Indian tribes before making decisions on matters affecting American Indian and Alaska Native peoples. Executive Order 13175 was reaffirmed by President Obama in 2009 (74 Fed. Reg. 57881) and again by BLM in its own Tribal Consultation Policy.</i>	<i>BLM initiated consultation for this Project on April 18, 2013. Seventeen tribes, including Three Affiliated Tribes, Turtle Mountain Chippewa, Northern Cheyenne, Fort Peck Assiniboine and Sioux, and several bands of Sioux, were invited to participate in consultation concerning the Project. On June 29, 2015, BLM, USACE, USFS, BakkenLink and MHA Nation staff met in New Town to discuss the Project and concerns expressed at the Fort Berthold Partners meeting in June 2015. BLM met with the Chairman and Executive Council on July 9, 2015 in formal government-to-government consultation. In addition, two face-to-face tribal consultation meetings were held during the spring and summer of 2014 and several phone calls and emails have transpired between the agency and Three Affiliated Tribes. In addition, seven tribes, including Three Affiliated Tribes, participated in a survey of the Project corridor in July 2014. Twenty-one areas of resource concern were identified during the tribal survey. The Project has been designed to avoid these areas of resource concern. (No change to EA warranted.)</i>
13	Tribal Treaty Rights and Interests	MHA Nation	<i>The MHA Nation reiterates its opposition to BakkenLink's proposed pipeline and respectfully requests that the BLM and all other cooperating agencies comply with and honor the Executive Order and its Tribal Consultation Policy and consult with the Tribes before any action is taken.</i>	<i>On February 25, 2015, the BLM, USACE, and Chairman Fox of the MHA Nation met in Denver, Colorado, for the Fort Berthold Partners Meeting. During the meeting, the BLM provided information on several proposed projects, including the BakkenLink Dry Creek to Beaver Lodge Project. Chairman Fox expressed several concerns about the BakkenLink Project. These concerns include the location of the proposed Project, potential impacts to Lake Sakakawea, and the potential for an oil spill and leak during pipeline operation. At the meeting, the BLM and Chairman Fox agreed to schedule a face-to-face meeting to further discuss the Project. Over the next few months following the meeting, the BLM attempted numerous times to schedule a meeting with the Chairman.</i>  <i>On June 22, 2015, the BLM attended the spring Fort Berthold Partners Meeting, which was held in Rapid City, South Dakota. During the meeting, MHA Nation Chairman and staff expressed concerns with the potential for an oil spill in Lake Sakakawea and impacts to Fort Berthold's drinking water, and asked questions about the flow rate and dispersion rate of a potential oil spill in the lake. A week later on June 29, 2015, the BLM, USACE, USFS, BakkenLink, and MHA Nation staff met in New Town, North Dakota, to further discuss the Project and concerns expressed at the Fort Berthold Partners Meeting. BLM met with the Chairman and Executive Council on July 9, 2015, in formal government-to-government consultation. Chairman Fox and all seven members of the Executive Council voiced their opposition to and concerns about the Project, which included the effects of a potential spill on their water and other resources, sacredness of the Missouri River, lack of community involvement, and BLM's trust responsibility to protect MHA Nation resources. (Change to EA warranted.)</i>

**Table F-1 BLM Responses to Comments on the January 2015 BakkenLink Dry Creek to Beaver Lodge Pipeline Project Draft EA**

<b>Comment Number</b>	<b>Resource/Topic</b>	<b>Commenter</b>	<b>Comment</b>	<b>BLM Response To Comment</b>
14	Other	MHA Nation	The Tribes also request that the BLM and USACE provide notice of any other proposed trenching proposal like BakkenLink's that would disturb the lake bottom or river bottom.	Comment noted. (No change to EA warranted.)
15	Public Scoping	Cheyenne River Sioux	In reading 1.10.2.1 Public Issues and Concerns, only the Standing Rock Sioux Tribe is mentioned on comments received. Is this because it was in a letter form? I know there has been comments from all Tribes who consulted with this had the same concerns and comments. Where will BLM mention comments and recommendations from the other Tribes?	Standing Rock sent a letter regarding the Project during the scoping period and initial government to government notification of the Project. Chapter 3.0, Section 3.22 (Tribal Treaty Rights and Interests) discusses comments received from tribes during face-to-face meetings and written form after the public scoping period.
16	Cumulative Impacts	Cheyenne River Sioux	I must reiterate my comment and concern of cumulative environmental effects from multiple projects in the northern plains, not just one (1) pipeline	Your comment concerning cumulative effects will be noted as a comment on the draft EA.
17	Other	Cheyenne River Sioux	Is this (BakkenLink Dry Creek to Beaver Lodge Pipeline Project Environmental Assessment) a DRAFT or a final? Your email states draft but I don't see it on the document. Maybe I'm reading the wrong one. The BakkenLink Pipeline Project Plan of Development has DRAFT on it but I haven't read that one yet.	This is in reference to the DRAFT environmental assessment (EA) for the BakkenLink Dry Creek to Beaver Lodge project. A FINAL EA will be prepared after the public comment period.
19	Other	Valero Marketing and Supply Company	On behalf of Valero Marketing and Supply Company ("Valero"), I am expressing support for BakkenLink Pipeline LLC's ("BakkenLink") right-of-way (ROW) application to the Bureau of Land Management ("BLM") regarding the continuation of their pipeline 37 miles north from near Johnson's Corner area of McKenzie County, North Dakota to interconnect with storage and pipeline facilities south of Tioga in Williams County, North Dakota.	Comment noted.
20	Other	XTO Energy Inc.	On behalf of XTO Energy Inc., I am expressing support for Bakkenlink Pipeline LLC's right-of-way (ROW) application to the Bureau of Land Management (BLM) regarding the continuation of their pipeline 37 miles north from near Johnson's Corner area of McKenzie County, North Dakota to interconnect with pipeline and storage facilities south of Tioga in Williams County, North Dakota. The BLM's swift action to grant this ROW will help move North Dakota's growing volume of crude oil to market and will assist in removing a large number of heavy trucks from local roads.	Comment noted.

**Appendix G  
USACE Responses to  
Comments on the  
December 2015 BakkenLink  
Dry Creek to Beaver Lodge  
Project Draft EA**

**Table G-1 USACE Responses to Comments on the December 2015 BakkenLink Dry Creek to Beaver Lodge Pipeline Project Draft EA**

Agency/ Organization	Comment No.	EA Section	Comment	USACE Response
North Dakota Office of State Engineer	1-1	NA	<p>We question why this effort has been addressed by an Environmental Assessment and not a full Environmental Impact Statement. In addition to potential impacts to the state's largest water source of surface water, this project also has the potential to impact threatened and endangered species including piping plover, interior least tern, and the pallid sturgeon. According to the BLM's Website: <a href="http://www.blm.gov/wo/st/en/prog/planning/nepa/webguide/departmental_manual/516_dm_chapter_11.html#11-8">http://www.blm.gov/wo/st/en/prog/planning/nepa/webguide/departmental_manual/516_dm_chapter_11.html#11-8</a>, Section 11.8 Major Actions Requiring an EIS, B.5.b. "Right-of-way for major reservoirs, canals, pipelines, transmission lines, highways, and railroads. It seems this project meets the requirements to be analyzed at the Environmental Impact Statement level.</p>	<p>The referenced BLM documents, 516 DM 11.8 and BLM H-1790 7.2, define ROWs for major pipelines as one of the actions requiring an EIS. BLM Manual 2884.1.D.1.c further defines a major pipeline project as 20 inches in diameter or larger. An EIS could also be deemed necessary if a high degree of public interest or controversy is identified during the scoping process. This pipeline is less than 20 inches and the BLM received seven comments during the 30-day public scoping period. Those comments were from one federal agency, four state agencies, one Native American tribe and one private party. The NEPA process is used to identify and analyze potential impacts from a proposed action. It is this analysis that agency decision-makers utilize to determine if the quality of the human environment would be significantly impacted. The BLM, USFS, and USACE have utilized an EA to determine if there are significant impacts.</p>
North Dakota Office of State Engineer	1-2	Appendix B	<p>A total of five route alternatives for the proposed pipeline were analyzed in the EA. However, a thorough and robust geotechnical investigation was conducted for only one of the potential crossing locations, that being the preferred alternative. Based on that geotechnical report, it was determined by BakkenLink that it was highly unlikely that constructing the reservoir crossing via horizontal directional bore (HDD) at the preferred location would be successful.</p> <p>It appears that a desktop geologic review was conducted for the five route locations (Appendix B), with the results of the geotechnical investigations for the preferred alternative then being applied to the four other route locations. As a result, those four route locations were eliminated for further analysis in part because of presumed unfavorable geology.</p> <p>While general comparisons can be made from one location to the next when looking at the same or similar geologic formations, drawing very specific conclusions without conducting a robust geotechnical investigation of each crossing location is a gross application of study results. A robust geotechnical investigation needs to be conducted for each crossing location before site-specific conclusions can be made and potentially viable alternatives are eliminated from consideration.</p>	<p>The BLM and USACE (Federal Agencies) requested that BakkenLink conduct geotechnical investigations for the Preferred Alternative crossing. The geotechnical investigations completed for the Preferred Alternative were also applied to the 6-Miles West Alternative and 6-Miles West B Alternative, since it was expected that the geotechnical formations would be similar due to their immediate proximity to the Preferred Alternative area. At the request of USACE a desktop geologic review was completed for the other alternatives and included in Appendix B. After review of the desktop geologic review the Federal Agencies determined the information was adequate to evaluate the feasibility of HDD for the other alternatives.</p>
North Dakota Office of State Engineer	1-3	Chapter 6	<p>EA pg. 6-9, Covers the agencies, organizations/companies, individuals, and other entities were notified of the availability of the Draft EA on the BLM's website and 30 day comment period.</p> <p>The State Water Commission and Office of the State Engineer would also like to bring into question the choice to conduct a 15-day, rather than a 30-day comment period. Comment periods of 15 days are rarely used unless a proposed action is not likely to draw many comments. This project obviously has the potential to draw numerous comments. The spirit of NEPA is to provide transparency into projects on public lands for the public who owns them. By trying to expedite the process, the BLM is compromising the opportunity of the public to comment on, and be educated about a seemingly divisive project.</p> <p>The SWC/OSE feels the failure to allow for a full 30-day comment period does not allow adequate time to comment on a project that has the potential for large-scale impacts to our state and its water resources.</p>	<p>Reference Section 6.4, Draft EA Review, for information on the original availability of the EA for public review. The decision to allow for an additional 15-day review was made to allow the public to consider the revisions that resulted from the 33 USC 408 (Section 408) review performed by the USACE. Since the SWC/OSE had been given the opportunity to review the EA during the January-February 2015 review period, the USACE believes that the additional 15-day review period was acceptable given the changes.</p>
North Dakota Office of State Engineer	1-4	Section 2.2.2	<p>Environmental Assessment (EA) pg. 2-18, Recreation and Visual Resources: Use of ROW by off road vehicles and subsequent potential impacts would be blocked at locations specified by agencies.</p> <p>Will it be fenced? Will fencing be added or removed according to fluctuating water levels? Fencing on the shoreline extending to the water's edge is problematic. If fencing is not continually maintained and modified as water levels go up and down, the fences could pose safety hazards with recreational boaters, fisherman and other users should it become submerged.</p>	<p>To provide further clarification, text in Table 2-4, Summary of Environmental Protection Measures for the Project, has been modified to "To prevent unauthorized use of the ROW by off-road vehicles and subsequent potential impacts to soil, vegetation, and wildlife resources, access to the ROW would be restricted by BakkenLink during construction. On federally-administered lands (i.e., USFS and USACE), existing regulations regarding off-road vehicles would also apply." No new fences would be installed along the ROW as part of the proposed Project; however, a chain-link fence would be installed around the emergency response storage areas outside of the floodplain on USACE-administered land.</p>
North Dakota Office of State Engineer	1-5	Section 2.2.2.5	<p>Environmental Assessment (EA) pg. 2-41, states the pipeline will be installed at a minimum depth of four feet under the bed of Lake Sakakawea.</p> <p>A scour analysis performed by OSE staff shows that during a 100-yr flood event, up to 79 feet of erosion could occur where the proposed pipeline crosses, the pre-dam Missouri River channel.</p> <p>The pipeline crossing is located in an area that has been inundated for nearly 60 years due to the construction and operation of Garrison Dam. U.S. Army Corps of Engineer's sediment range data from near the crossing location shows that the Missouri River channel bottom prior to inundation had an elevation of about 1777 feet (NGVD29). The most recent sediment range data from 2012 indicates that almost 20 feet of sediment has been deposited. Placing the pipeline at a shallow depth of four feet in unconsolidated material that is highly susceptible to erosion, as explained in the OSE scour analysis, would increase the likelihood of pipeline exposure when the lake environment transitions to a riverine environment. The minimum operating pool elevation of Garrison Dam is 1775 feet (NGVD29), which is lower than the pre-dam channel bottom elevation at the pipeline crossing location. In the event of a severe drought and drawdown of Lake Sakakawea to minimum operating pool, the pipeline crossing location would transition to a riverine environment. A riverine environment is more susceptible to erosion, especially during flooding conditions.</p> <p>When, not if, the Lake Sakakawea returns to a riverine system during a drought, the pipeline would be suspended - making it highly vulnerable to failure from a number of causes. This will place the reservoir and areas downstream of Garrison Dam at unacceptable risk of contamination.</p> <p>A recent example of such an event was the Bridger Pipeline failure on the Yellowstone River in January 2015 near Glendive, Montana. It is determined that river scour was the root cause of the pipeline failure and crude oil leak into the Yellowstone River.</p>	<p>The following paragraph has been added to Section 2.2.5.5, Waterbody Crossings and a new appendix (Erosion Monitoring Plan) has been added to the EA:</p> <p>"The following investigation and plan were completed to address potential impacts to the proposed pipeline at the proposed Lake Sakakawea crossing:</p> <ul style="list-style-type: none"> <li>• Geotechnical Investigation, BakkenLink Pipeline, Lake Sakakawea Crossing Shoreline Protection-Rev B, dated November 23, 2015, completed by SEH Engineering (Short, Elliot, and Hendrickson); and</li> <li>• BakkenLink Pipeline North Project, Lake Sakakawea Pipeline Crossing, Erosion Monitoring Plan, dated November 23, 2015, completed by Projecting Consulting Services (Appendix B).</li> </ul> <p>The purpose of the geotechnical investigation was to develop a plan for protection of the proposed pipeline against wave-induced damage at the north and south shorelines of Lake Sakakawea in Williams County and McKenzie County, North Dakota, respectively. The scope of work included evaluating the size and extent of riprap and cable-tied concrete mattresses that would be adequate to protect the pipeline and its associated trench backfill against wave-induced damage generated by a 100-year wind event. Wind frequency analysis was evaluated with the USACE Statistical software package, Automatic Coastal Engineering System (ACES). Wind-driven wave heights were also determined using the ACES computer program also.</p>

**Table G-1 USACE Responses to Comments on the December 2015 BakkenLink Dry Creek to Beaver Lodge Pipeline Project Draft EA**

Agency/ Organization	Comment No.	EA Section	Comment	USACE Response
North Dakota Office of State Engineer (Continued)	1-5	Section 2.2.2.5		<p>Waves generated by 50-year and 25-year events were also determined for comparison to a 100-year event. Riprap and cable-tied concrete mattresses were also evaluated for their resistance to ice -induced damage.</p> <p>The Erosion Monitoring Plan identified construction and monitoring actions at various lake levels for the proposed Project's crossing of Lake Sakakawea. The Erosion Monitoring Plan addressed lake levels from 1,824 feet NGVD29 down to 1,775 feet NGVD29. Measures taken during pipeline construction would provide protection of the pipeline for lake levels between 1,860 feet NGVD29 and 1,820 feet NGVD29 and are further addressed in the POD (Appendix X.E, Lake Sakakawea Work Plan). Both the Geotechnical Investigation Report and Erosion Monitoring Plan would be incorporated into BakkenLink's Operation and Maintenance (O&amp;M) Plan prior to commissioning of the proposed Project. The O&amp;M Plan, in part, would outline the process that would be followed to annually assess the condition of the pipeline and determine if additional riprap protection or initiation of "evacuate and shut-in" provisions, are needed. It is expected that annual meetings between the BLM, USACE, and BakkenLink would be conducted after the annual operating plan meetings held by the USACE Northwestern Division Water Management staff in the spring of each year."</p> <p>In addition, BakkenLink has presented to USACE the recently issued PHMSA Advisory Notice (Docket No. PHMSA-2015-0283) which outlines Pipeline Safety: Potential for Damage to Pipeline Facilities Caused by Flooding, River Scour, and River Channel Migration and with which BakkenLink will need to adhere.</p> <p>The following text was added to Section 2.2.5.5, Waterbody Crossings: "BakkenLink completed side-scan sonar and geotechnical evaluations of the proposed lake crossing and submitted the results to the USACE. Additional information on the methods and results of the evaluations is found in the POD (Appendix X.B-A, Lake Sakakawea Pipeline Crossing Report)."</p>
North Dakota Office of State Engineer	1-6	Section 2.2.2.5	<p>The EA pg. 2-46 states that a "pipeline protection system and shoreline stabilization" (i.e. riprap) will be placed over the pipeline alignment on the north and south shores of Lake Sakakawea between elevations 1820 and 1860feet (NGVD29). EA pg. 2-46, state available spoils would be used to fill the trench area. Riprap or cable tied concrete mattresses would be placed on top of the pipeline and soil cover to protect the pipeline. The majority of the soil from the trench created using the lowering sled construction method would be contained via the turbidity mats and silt curtains and redeposited on top of the pipeline. EA pg. 3.0-8 Section 3.23.2 discusses landslides. It states that there are landslide-prone areas on either side of the Lake Sakakawea crossing. EA pg. 3.4-4 Figure 3.1-4 is a map showing water erodible soils. These soils are prevalent on both sides of the proposed crossing.</p> <p>The record low elevation of Lake Sakakawea is 1805.8 feet (NDVD29) and the minimum operating pool is 1775 feet (NGVD29), both of which are well below an elevation of 1820 feet. Again, the drawdown of Lake Sakakawea below elevation 1820 feet would cause the pipeline alignment to be exposed, making it highly susceptible to current, shoreline erosion, ice action, and floating debris - including large trees.</p> <p>In the previous three sections there were short discussions regarding protecting the pipeline, landslides, and water erodible soils. These are all important issues, however, throughout the EA, there was little to no discussion regarding wave and ice action from Lake Sakakawea.</p> <p>What is the plan for protecting the shoreline around the pipeline? There are times on Lake Sakakawea when high winds and waves will erode up 2+ feet of shoreline per day.</p> <p>The same question is being posed for ice. There appears to be no serious consideration of how to prevent impacts from ice.</p>	Please see response to Comment No. 5.
North Dakota Office of State Engineer	1-7	Section 2.2.2.5	Is there a proposed inspection schedule for inspecting the shoreline areas? Is it easy to get a 404 permit on an emergency basis when high winds are occurring and emergency work need to be conducted to secure the pipeline?	Please see response to Comment No. 5.
North Dakota Office of State Engineer	1-8	Section 2.4.3	EA pg. 2-52 states that the truck alternative is unacceptable. Does this determination take into account the recent decrease in oil production?	This Project will originate in McKenzie County, which has the best well economics of the Bakken/Three Forks play. Even with lower oil prices, according to NDIC statistics, production in McKenzie County has increased in 2015 by 13 percent through October compared to calendar year 2014. According to a recent NDPA presentation (November 10, 2015), 892 trucks per day hauled crude oil in McKenzie County, which is approximately 44 percent of oil transported via truck in North Dakota.
North Dakota Office of State Engineer	1-9	Table 2-10	EA pg. 2-61 Chart discusses potential impacts resulting to surface water from the construction of the proposed action. The analysis of surface water impacts seems limited compared to the major impacts a spill could produce for the Missouri River system in North Dakota.	Please refer to Section 4.5, Water Resources for the further information on potential impacts to surface water as a result of construction and operation of the proposed Project. The analysis does not focus on the entire Missouri River system in North Dakota but rather focuses on downstream of the proposed Lake Sakakawea crossing.
North Dakota Office of State Engineer	1-10	Table 2-10	EA pg. 2-72 chart discusses potential impacts to the pallid sturgeon. The chart admits that there are possible direct impacts to the pallid sturgeon and its habitat. Since this is prime habitat for the pallid sturgeon, does the USFWS have concerns about the project and this endangered species?	While impacts to the pallid sturgeon are possible, discussions with the USFWS regarding the potential occurrence of pallid sturgeon at the proposed lake crossing determined that impacts are unlikely. This was due to the USFWS considering the main body of Lake Sakakawea to be only marginal habitat for the pallid sturgeon. The USFWS agreed with the BLM's determination in the Project's biological assessment of "may affect, but is not likely to adversely affect" for the pallid sturgeon.

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Agency/ Organization	Comment No.	EA Section	Comment	USACE Response
North Dakota Office of State Engineer	1-11	Chapter 3	EA pg. 3.0-1 (and other pages), asserts that the authorized purpose of "irrigation" would not be affected by this project. If there was a pipeline failure and water quality was degraded, the use of water for irrigation could be affected.	The following text has been added to Chapter 3, Section 3.5.1, Surface Water: "Based on review of the NDSWC database for Lake Sakakawea water permits near the proposed Project, 13 water intakes are located within 10 miles west (upstream) and 20 miles east (downstream) of the proposed crossing of Lake Sakakawea. Uses associated with the 13 water intakes include irrigation (4), industrial (7), and fish and wildlife management (2)."  The following text has been added to Chapter 4, Section 4.5.1, Surface Water: "In the event of a pipeline leak or rupture at the proposed Lake Sakakawea crossing, Lake Sakakawea water permit holders would be notified immediately as described in BakkenLink's ERP. Water withdrawal at the water intakes would be discontinued until crude oil clean-up activities have been completed and water withdrawal can be reinitiated."
North Dakota Office of State Engineer	1-12	Section 3.2 Geology and Minerals	EA pg. 3.2-4 Figure 3.2-3 outlines the Geology and Mineral resources in the area of the proposed BakkenLink pipeline. One of the geological features in the figure is "water." Is water supposed to be a geological element of the figure, or is there actual geological elements underneath the water that were not identified? Is seems like it should be something other than "water."	Figure has been revised. "Water" has been removed from the "Geology" heading in the legend.
North Dakota Office of State Engineer	1-13	NA	Analysis of surface water spills and spill response discussion/information seems to be really light throughout the EA.  Have approved Safety, Inspection, and Operations/Shut Down Plans been written and approved? These documents did not appear to be contained in the EA and these plans should be a condition of approving the EA. How often will the pipeline be inspected, and what triggers a shutdown, etc.?	As discussed in Section 2.2.6, Operation, "The pipeline operator also would develop a Pipeline IMP, which together with the ERP, outlines the preventative maintenance, inspection, line patrol, leak detection systems, SCADA and other pipeline integrity management procedures to be implemented during the operation of the Project." Per Department of Transportation (DOT) regulations the pipeline (preferred alternative) will be inspected 26 times per year not to exceed 3-week intervals. An alert from the Leak Detection System, an observed abnormal operating condition, precautionary situation such as high water flows, and many others would trigger a pipeline shutdown.  While not a condition of approving the EA, PHMSA and the Federal Agencies will review and approve the OMP, ERP, and other associated documents prior to commissioning of the project. The OMP and ERP will be included as required submittals under the Right of Way grant that will be issued by the BLM. In addition, BLM and the USACE will review and comment on the plans prior to submittal to PHMSA for final approval.
North Dakota Office of State Engineer	1-14	NA	Numerous ranchers around Lake Sakakawea rely on the uplands for grazing cattle and the freshwater resource for their cattle. The US Army Corps of Engineers administers a grazing lease program to area ranchers. Implications of a pipeline failure include the detriments to the rancher's finances and the health of their animals.	Please refer to Section 4.11, Land Use, where consideration was given to the potential impacts on livestock grazing. In the event of a spill on USACE-administered land, there would a temporary loss of forage available for livestock grazing. After cleanup and reclamation activities have been completed and vegetation reestablished, forage would once again be available for livestock grazing.
North Dakota Office of State Engineer	1-15	NA	As determined by FEMA, there may be floodplains identified on a Flood Insurance Rate Map (FIRM) where this proposed project is to take place. Areas designated to be within the Special Flood Hazard Area (all Zone As), must have a permit issued from the local permitting authority, before any work may begin. FIRMs may be viewed at <a href="http://www.msc.fema.gov">www.msc.fema.gov</a> .	As discussed in Section 3.7.3, Floodplains, "This area is considered the Missouri River floodplain; however, it has not been designated as a floodplain by FEMA." There are no other perennial waterbodies or FEMA-designated floodplains crossed by the Project. The USACE will require that the pipeline system facilities be elevated above or flood proofed to above 1855.5 feet NGVD29. The facilities include, but are not limited to, the mainline valves (MLV) for crude oil, electrical and communications equipment needed to operate the MLV and provide access to the sites.
North Dakota Office of State Engineer	1-16	NA	The State of North Dakota takes title to the bed and banks of the state's navigable waters up to the ordinary high water mark. The Missouri River is navigable in fact and therefore, the bed and banks are sovereign to the State of North Dakota. Any projects located partially or wholly on sovereign land requires authorization from the State Engineer prior to construction. BakkenLink Pipeline, LLC (BakkenLink) has submitted an application to the State Engineer for authorization to construct the subject pipeline on the bed of Lake Sakakawea (Missouri River). That application, Sovereign Land Permit No. S-1941, is pending.	BakkenLink Pipeline is working with the ND OSE on permit applications S-1941.
North Dakota Game and Fish Department	2-1	NA	The Department questions if other alternatives such as horizontal directional drilling were given serious consideration in order to minimize impacts to the aquatic environment?	For more information regarding other route alternatives that were evaluated and the feasibility of using the horizontal directional drilling construction method at alternative route crossings of Lake Sakakawea/Missouri River, please refer to Section 2.4, Alternatives Considered but Eliminated from Detail Analysis and Appendix B - Geologic and Horizontal Directional Drill Review of the Proposed Crossing and the Missouri River/Lake Sakakawea Crossing Alternatives.
North Dakota Game and Fish Department	2-2	NA	Given the importance of Lake Sakakawea and the recent oil spills and pipe failures, the Department recommends additional precautions should be implemented into the design of pipes crossing under the State's waterways. One primary means of minimizing a potentially large pipeline failure is to incorporate pressure sensing valves on both sides of the water way. These valves should be placed as close to the waterway as possible yet out of the flood plain to reduce the potential to get damaged from ice and other floating debris.	As discussed in Section 2.2.1.3, Other Aboveground Facilities, "BakkenLink would install remotely controlled MLVs on both sides of Lake Sakakawea (i.e., double block valves) above the 500-year flood level for Lake Sakakawea (elevation 1,855.5 feet National Geodetic Vertical Datum of 1929 [NGVD29]) as well as at the southern boundary of USFS property."
North Dakota Game and Fish Department	2-3	NA	Additionally, a maintenance schedule needs to be developed to insure the integrity of the pipe for years and decades to come. Although this may mean the pipeline needs to be shut down for a period of time, it is important to minimize the risk to Lake Sakakawea and its resources.	Per DOT regulations the pipeline will have an Integrity Management Plan as well as an Operations and Maintenance Plan, which provides detail regarding inspection frequency and operational guidelines. USACE reviewed and approved an Erosion Monitoring Plan, which provides details regarding inspections of the pipeline protection system. The Erosion Monitoring Plan will be incorporated into the OMP which will be included as required submittals under the Right of Way grant that will be issued by the BLM. In addition to PHMSA, BLM, and the USACE will be required to review and approve the plans prior to commissioning of the line.
North Dakota Game and Fish Department	2-4	NA	The upper reaches of Lake Sakakawea have significant levels of sand and sediments that have been transported from the river reaches and dropped out into the old river channel due to reservoir levels. If reservoir levels are low and there are high inflows from the Yellowstone and Missouri Rivers, there would be potential for sediments to be transported farther down the reservoir leaving the pipeline susceptible for failure. The Department recommends a scour analysis be conducted to determine adequate depths for the pipe to be buried to reduce any future pipe failure caused by scour.	Please refer to response to State Water Commission/Office of the State Engineer Comment No. 5.

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Agency/ Organization	Comment No.	EA Section	Comment	USACE Response
North Dakota Game and Fish Department	2-5	NA	Required measures include removing any and all aquatic vegetation from vessels, motors, trailers, or construction equipment; all water shall be drained from bilge(s) or confined spaces on vessels, boat motors or construction equipment; all species of ANS (this list can be found on the North Dakota Game and Fish Department website) must be removed from vessels, motors, trailers or construction equipment; and water must be drained from confined spaces on vessels, boat motors or construction equipment. These ANS preventative measures extend to any and all vehicles, vessels, trailers, pumps and such equipment that will be used in the project or any/all construction efforts connected with this project in or on the waters of the State. This requirement should be included if occurring during the open water season or if the operation proceeds on the ice pack.	As discussed in Table 2-4, Summary of Environmental Protection Measures for the Project, "To control aquatic nuisance species, equipment and boats would be washed to remove all vegetative matter and aquatic nuisance species prior to arrival at the construction site and after constructing through waterbody crossings (e.g., Lake Sakakawea), where water is evident." and "To prevent the spread of aquatic nuisance species during construction and operation, BakkenLink would remove aquatic plants and animals from equipment prior to entering and before leaving any waterbody. Project staff would spray/wash equipment with high pressure hot water when leaving a wetland/waterbody, or would dry equipment for at least 5 days before use at a different wetland/waterbody."
North Dakota Game and Fish Department	2-6	NA	The contractor or his agents or subcontractors must provide the Department a reasonable opportunity to inspect any and all vehicles, vessels, pumps and equipment that will be used in the project in or on the waters of the state prior to those items being launched or placed in the waters of the state. A minimum of 72 hours notice must be provided to the Department for scheduling an inspection. The Department's ANS Biologist, Mr. Fred Ryckman, is to be contacted at the Riverdale Office (701- 770-0920) for equipment inspections or any additional information regarding ANS prevention protocols.	Text has been added to the ANS measures listed in Table 2-4, Summary of Environmental Protection Measures for the Project, "A minimum of 72 hours notice would be provided to the NDGFD for scheduling an inspection. The NDGFD's ANS Biologist, Mr. Fred Ryckman, would be contacted at the NDGFD Riverdale Office (701-770-0920) for equipment inspections or any additional information regarding ANS prevention protocols."
North Dakota Game and Fish Department	2-7	NA	Due to the nature of the proposed project, the Department suggests implementing the following recommendations to minimize impacts to fish and wildlife resources:  1. 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.  2. Disturbed areas should be planted to a native grass mixture.  3. If the project is permitted to utilize the jet sled, erosion control measures should be implemented to minimize the opportunity for sediments to drift.  4. We request work not take place within the lake from April 15 to June 1 to protect the aquatic environment.  5. During construction, the area needs to be marked and patrolled to assure safety for the boating public.	1) As discussed in Table 2-4, Summary of Environmental Protection Measures for the Project, "Trees and shrubs would be replaced in accordance with the PSC's tree and shrub mitigation specifications and the USACE's tree and shrub mitigation specifications (SOP #14 – Garrison Project Tree/Vegetation Mitigation) on USACE-administered land. BakkenLink would coordinate with the appropriate agencies to identify efficient restoration and mitigation measures following construction."  2) As discussed in Table 2-4, Summary of Environmental Protection Measures for the Project, "The USFS-approved revegetation seed mix for native prairie would be applied on federal lands. The USFS-approved seed mix would be applied on state and private lands unless state and private landowners request a different seed mix. The CMRP outlines the procedures to be followed for returning the land to pre-existing vegetative cover and land uses. All seed would be certified or registered by the State of North Dakota or the state of origin."  3) As discussed in Section 2.2.5.5, Waterbody Crossings, "The majority of the soil from the trench created using the lowering sled construction method would be contained via the turbidity mats and silt curtains and redeposited on top of the pipeline."  4) Stantec coordinated with the USFWS regarding this timing restriction related to the pallid sturgeon spawning period and concluded that it is not necessary for this portion of Lake Sakakawea, as the likelihood of pallid sturgeon occurring near the Project's lake crossing is very low.  5) As stated in the POD, Appendix X - Lake Sakakawea Pipeline Crossing Report, "The Spotter/Security vessel crew will install markers or buoys during the pull operation to identify a safe boating corridor to cross the pipeline pulling operation. The vessel will provide at-site directions to boaters to ensure the safety of the boating community and will have STOP authority (the pull operation) should a boat inadvertently enter an area that is considered hazardous."
Three Affiliated Tribes	3-1	NA	The spill or release notification requirements and the emergency response actions must comply with Three Affiliated (TAT) Title 15, Chapter 15.1 and specifically with Section 19 of that Code. The "Bakken link" Emergency Response brochure does not acknowledge these requirements or list the Tribes as a party to be notified in the event of an emergency.	BakkenLink will be required to follow all applicable laws and regulations. They have also agreed to include Three Affiliated Tribes as a party to be notified in the event of an emergency along with other entities. This notification requirement will be added to the ERP, which is a submittal that will be approved prior to the commissioning of the pipeline.
Three Affiliated Tribes	3-2	NA	There should be third party oversight of the pipeline monitoring and maintenance program either by or in coordination with the Three Affiliated Tribes. The pipeline operator should provide the funding and resources for such oversight. Many of the more serious pipeline releases in recent years on the Ft. Berthold Reservation have been at least partly the result of inadequate actual maintenance or inspection programs that were not implemented in accordance with written plans.	PHMSA is the primary agency responsible for developing and enforcing regulations for the safe, reliable, and environmentally sound operation of this and other pipelines throughout the United States. Along with other applicable Federal Agencies, PHMSA will ensure that BakkenLink complies with the inspection and maintenance program, described in Chapter 2 of the EA and in the Risk Assessment and Environmental Consequences Analysis attached as Appendix A to the EA ("Risk Assessment"). First, BakkenLink proposes project design parameters that will protect the pipeline – see for example, EA Sections 2.2.1.3 through 2.2.1.6, describing mainline valves, internal inspections and cleaning, supervisory control and data acquisition system (SCADA), and corrosion protection. The pipeline would be monitored 24 hours a day, 365 days a year. In addition, BakkenLink would implement additional and multiple overlapping leak detection methods and systems, including remote monitoring using the SCADA system, volume-based monitoring, mass balance-based monitoring, Atmos Pipe leak detection system, gain/loss volume trending, and direct observation including aerial and ground patrols, as described in EA Section 2.2.6, Operation. Further, BakkenLink would periodically perform inspections, not to exceed 3-week intervals, as described in the Risk Assessment, Table 3-2, and would perform a higher level of inspection as required by USDOT regulations to protect high consequence areas, as described in the Risk Assessment Section 5.4.4. BakkenLink's pipeline safety program is summarized in the Risk Assessment Section 6.  BakkenLink would be responsible to implement these measures as provided.

**Table G-1 USACE Responses to Comments on the December 2015 BakkenLink Dry Creek to Beaver Lodge Pipeline Project Draft EA**

Agency/ Organization	Comment No.	EA Section	Comment	USACE Response
Three Affiliated Tribes	3-3	NA	The location and adequacy of emergency response equipment and supplies must be adequate to address a likely quantity and type of a release. This should be coordinated with the TAT Environmental Division as well as other local response agencies and all response agencies should be provided with the necessary training, equipment and supplies to ensure that any emergency response is timely and adequate in coordination with the Tribal emergency response authorities and resources. The TAT should be provided input to the emergency response planning and staging.	As described in the EA Section 2.2.1.4, Storage, Staging, and Access, BakkenLink would construct three emergency response equipment location storage areas: one at the Beaver Lodge receipt facility, the second on the south side of Lake Sakakawea (which would include a boat and equipment for winter/ice and summer spill response), and the third on the north side of Lake Sakakawea (which would include a spill response trailer). In addition, BakkenLink's agreement with Sakakawea Area Spill Response, LLC and oil spill response contract with Clean Harbors will provide access to additional spill response equipment and capabilities in the local area. The TAT will be included in emergency response planning.
Friends of Lake Sakakawea	4-1	NA	We realize that the original plan for crossing Lake Sakakawea was scrapped and replaced with the current plan because BakkenLink and a third party determined there was a high likelihood of failure. We believe that a jet sled approach to submerge the pipeline under Lake Sakakawea just four feet is also doomed for failure. Although the ND PSC Corridor Certificate only requires a four foot cover, we support the Corps of Engineers' recommendation that the trench be at least six feet deep.	The original plan for crossing Lake Sakakawea was not scrapped or replaced. Rather, the current plan implements the Dry Creek to Beaver Lodge portion of BakkenLink's original plan. The original plan proposed pipeline from Fryburg to Beaver Lodge, and was evaluated in a 2012 EA. However, the BLM initially approved only the Dry Creek to Fryburg segment, which does not cross Lake Sakakawea and which demonstrates independent utility, in order to obtain additional geotechnical data to evaluate feasibility of a horizontal direction drill (HDD) alternative crossing method of Lake Sakakawea at the proposed crossing location. BakkenLink performed extensive geotechnical analysis which determined that HDD is not feasible due to multiple factors, and indicated a very high likelihood of failure. Given this new information, BakkenLink amended its existing ROW to complete the project as originally proposed, crossing Lake Sakakawea using a jetting technique to install the pipeline in the lake bottom in a trench with a minimum 4 foot depth of cover, and terminating at Beaver Lodge Receipt Facility. The depth of the trench will be approximately 6 feet to accommodate a 16-inch pipe; this is consistent with current federal regulations.
Friends of Lake Sakakawea	4-2	NA	We are concerned about the spill response time and detection means for spills. A pipeline break and spill under the lake may not be detected for days or weeks with catastrophic results. An iced-over lake can complicate detection even further as we learned from the January 2015 Yellowstone spill when 50,000 gallons were detected when that massive cleanup effort began.	The BakkenLink Pipeline would be outfitted with a state of the art Supervisory Control and Data Acquisition system that would be monitored 24 hours a day, 365 days a year. Multiple overlapping leak detection methods and systems would be implemented, including software-based volume balance systems, a sophisticated mass balance system, and an acoustic monitoring system. Thus, if a release were to occur, it would be detected regardless of its location or the time of year in which it occurred. Furthermore, BakkenLink will have in its Operations and Maintenance Plan an "evacuate and shut in" provision. Triggered by a lake elevation or threat conditions they will close the valves on both sides of the lake and will evacuate the oil in between. When conditions warrant approval to start product flow, permission will be granted.
Friends of Lake Sakakawea	4-3	NA	If the project is approved, we recommend the PSC or COE require shut-off valves on either side of the lake. These valves can be remotely operated for quicker shut off There should also be shut off valves placed at regular intervals that can be remotely operated.	As discussed in Section 2.2.1.3, Other Aboveground Facilities, "Three MLVs would be spaced along the pipeline to meet or exceed the requirements of 49 CFR 195. BakkenLink has conducted a HCA analysis to identify locations of HCAs (Section 2.2.2) near the Project, which helped to refine appropriate placement of the MLVs to minimize potential environmental impacts in the event of a rupture or leak. BakkenLink would meet with the PHMSA to optimize MLV placement along the mainline and gain their concurrence with MLV locations. Additionally, BakkenLink would install communications equipment (Section 2.2.1.5) that would allow all valves to be operated remotely to minimize potential impacts of a spill. BakkenLink would install remotely controlled MLVs on both sides of Lake Sakakawea (i.e., double block valves) above the 500-year flood level for Lake Sakakawea (elevation 1,855.5 feet National Geodetic Vertical Datum of 1929 [NGVD29]) as well as at the southern boundary of USFS property."
Friends of Lake Sakakawea	4-4	NA	There are also concerns about the impact to the north and south shores at point of entry. Erosion of the banks is of a grave concern to our stakeholders. We ask that the supervising agency oversee the operation to ensure that impact of the construction is minimized.	As discussed in Section 2.2.5.5, Waterbody Crossings, "In order to prevent shoreline erosion and possible pipeline exposure in the long term, BakkenLink would install a pipeline protection system and shoreline stabilization for the excavated areas on the north and south shorelines of Lake Sakakawea. The pipeline protection system and shoreline stabilization would be placed between elevations 1,820 feet NGVD29 and 1,860 feet NVGD29 and would utilize Class I riprap stone cover (Figure 2-22). The riprap on the north and south shorelines would cover an area 30 feet by 359 feet and 30 feet by 756 feet, respectively (Figure 2-22). The riprap would extend slightly beyond Lake Sakakawea's full pool elevation of 1,854 feet NGVD29 and consist of angular shape, hard, granite bases, non-corrosive, and non-magnetic material. The top of the riprap in the pipeline protection system would be level with the lakebed. The Federal agencies will oversee construction.
Friends of Lake Sakakawea	4-5	NA	Lastly, the plans for concrete mattresses over exposed pipelines (because of fully saturated soil that makes jetting impossible) are concerning. If it is impossible to determine where the soil is fully saturated until the jetting begins, then we question how agency consent will be achieved quickly and the pipeline will be protected from physical abrasions during the delays.	The riprap and concrete mattresses designs for the pipeline protection system have both been analyzed so that either protection system can be utilized to best protect the pipeline. In most cases riprap protection will be used.
North Dakota Chapter of The Wildlife Society	5-1	NA	Many items of concern are addressed in this document and actions are proposed to be taken to reduce the risks and impacts to fish and wildlife resources. These items include wildlife escape ramps in trenches, attempts to minimize tree clearing during the nesting season, pre-construction surveys of sharp-tailed grouse leks and raptor nests, eagle nest monitoring, and taking appropriate measures if Threatened and Endangered Species are identified. The proposed items and actions stated in the Draft EA are to be commended. However, the Chapter questions with whom the monitoring of these actions lie to ensure the public and our natural resources are protected by the proposed measures stated? Recent declines in oil prices have likely resulted in companies trying to save costs wherever possible. Therefore, the expectations and accountability of the contractors and subcontractors that will be implementing the proposed actions need to be clearly identified and addressed.	Environmental compliance monitoring would be completed during Project construction to ensure that erosion control measures would be implemented to minimize erosion along the shorelines of Lake Sakakawea. Environmental compliance monitoring would be conducted as specified in the ROW grant issued by the BLM (supervising agency). Environmental compliance monitors would be approved by the BLM.

**Table G-1 USACE Responses to Comments on the December 2015 BakkenLink Dry Creek to Beaver Lodge Pipeline Project Draft EA**

Agency/ Organization	Comment No.	EA Section	Comment	USACE Response
North Dakota Chapter of The Wildlife Society	5-2	Section 2.2.5.5	2.2.5.5. Lake Sakakawea Crossing. Pipelines have been known to fail and leak due to several factors including lightning strikes, improper seals and connections, rubbing on rocks in the soil strata, corrosion, pipeline age and fatigue, erosion and other external forces. We question the ability to detect rocks in the substrate under Lake Sakakawea which could potentially rub and cause leaks. Jet trenching and burying the pipeline under 4 feet of substrate beneath Lake Sakakawea without assurances of proper pipeline bedding and pipeline integrity cause the Chapter significant concern.	The lake crossing pipeline segment not only has the greater 0.500-inch wall thickness, but it also will be installed with a 2-inch thick Concrete Weight Coating (CWC) to provide adequate impact and abrasion protection as documented within the Lake Sakakawea Design Basis document, submitted as Appendix X.F of the POD. The completed pipeline system will be subjected to a hydrostatic pressure test, thereby proving its initial integrity. The system will be monitored on an ongoing, operational basis for leaks in accordance with the BakkenLink Operations and Maintenance Plan, as well as the Integrity Management Plan. Mainline valve assemblies will be installed on both sides of the lake, allowing isolation of the lake crossing segment. Finally, the system will be periodically inspected, visually and with smart pig technology, in accordance with DOT requirements.  The following text was added to Section 2.2.5.5, Waterbody Crossings: "BakkenLink completed side-scan sonar and geotechnical evaluations of the proposed lake crossing and submitted the results to the USACE. Additional information on the methods and results of the evaluations is found in the POD (Appendix X.B-A, Lake Sakakawea Pipeline Crossing Report)."
North Dakota Chapter of The Wildlife Society	5-3	Section 2.2.5.6	2.2.5.6. Wetlands. Because of their international importance to breeding waterfowl and other water birds, as well as to non-migratory species -all wetlands should be protected. Open trenching wetlands that are dry during installation periods will impact hydrology, siltation, function, and plant composition. The small temporary and seasonal wetlands in North Dakota often go dry, but this drying period sets the stage for wet spring invertebrate production, plant growth, and other life cycle needs essential for the regions wildlife. Therefore, we recommend that all wetlands be horizontal directional drilled and that no wetlands are allowed to be open trenched.	As discussed in Section 4.7, Wetlands and Floodplains, the majority of wetlands would be crossed using the HDD construction method. However, this construction method could not be used at some wetland crossings due to terrain constraints, construction obstacles, and required workspaces needed for HDD construction equipment.
North Dakota Chapter of The Wildlife Society	5-4	Section 2.2.6	2.2.6. Operation. There appears to be no regulatory requirements for pipeline monitoring of volumes and pressures that could possibly indicate leaks in a timely fashion. The recent loss of over a 600 barrels of oil in an agricultural field near Tioga, ND and 70,000 barrels of saltwater into Blacktail Creek north of Williston, ND clearly demonstrate companies are not monitoring pipelines in a manner demonstrating that pipelines can be shut down before significant amounts of oil or saltwater are lost.  The proposal in 2.2.6 includes utilizing an Operations Control Center using SCADA system, which can detect rates down to 25-30% of flow rate, and also model based leak detection systems, Altmos Pipe detections system, and computer based gain/loss monitoring. However, monitoring that is only capable of recognizing leaks down to 1.5 -2% of flow rate of the proposed 100,000 barrels per day in the pipeline could result in leaks less than 1,500 -2,000 barrels not being detected. Therefore, a small leak below detectable limits could leak for months or years into Lake Sakakawea, and is unacceptable. The Chapter recommends that the project develop and implement technology to detect any loss of oil in the pipeline segment buried beneath Lake Sakakawea.	The BakkenLink Pipeline would be outfitted with a state of the art Supervisory Control and Data Acquisition system that would be monitored 24 hours a day, 365 days a year. Multiple overlapping leak detection methods and systems would be implemented, including software-based volume balance systems, a sophisticated mass balance system, and an acoustic monitoring system. Thus, if a release were to occur, it would be detected regardless of its location or the time of year in which it occurred. Furthermore, BakkenLink will have in its Operations and Maintenance Plan an "evacuate and shut in" provision. Triggered by a lake elevation or threat conditions they will close the valves on both sides of the lake and will evacuate the oil in between. When conditions warrant approval to start product flow, permission will be granted.
North Dakota Chapter of The Wildlife Society	5-5	Section 4.9.2	4.9.2. Impacts to wildlife. The proposal identifies that 393.6 acres of potential wildlife habitat will be disturbed and permanent disturbance of 61.5 acres of wildlife habitat would result from this project. Significant actions must be taken to replace these losses.	As part of consultation with the USFWS regarding MBTA, federally listed species, and loss of native prairie habitat, BakkenLink developed an Impact Assessment, Mitigation, and Voluntary Conservation Plan for the Project (Carlson McCain 2015). A major component of this plan includes compensatory mitigation for the loss of native prairie, non-native grasslands, wetland/waterbody habitat, and woodlands associated with the construction and operation of the Project. Based on agreed upon ratios with the USFWS, a total of 460 acres of habitat would be purchased in the form of grassland easements through the USFWS's conservation easement program.
North Dakota Chapter of The Wildlife Society	5-6	Section 4.9.3	4.9.3. Mitigation. A mitigation plan, equal to or greater than the identified impacts for fish and wildlife should be included in the project plan.  It appears that trees that are destroyed will be mitigated, but the Chapter recommends that impacted wildlife habitat spanning the entire project area be mitigated.	Please refer to response to NDGFD Comment No. 2-7 Part 1.
North Dakota Chapter of The Wildlife Society	5-7	Section 5.3.9	Cumulative Impacts 5.3.9. Wildlife and Fisheries. Cumulative impacts occur due to habitat loss, fragmentation, wildlife displacement, and direct and indirect mortalities result in the reduction of wildlife carrying capacities as a result of loss of cover, forage, and breeding areas for wildlife. The statement "many local wild life populations that occur in the CESA likely would continue to occupy their respective ranges and breed successfully, although population numbers may decrease relative to the amount of cumulative habitat loss and disturbance from incremental development" is accurate.  The impacts to wildlife and fisheries from this project are likely to be temporary and anticipated to be low. However, the cumulative impacts to wildlife and fisheries in this region are staggering due to the oil and gas development and cumulative impacts are not addressed. This project proposes no additional mitigation measures to offset the impacts to fish and wildlife resources and is one of thousands of such projects that have or will occur that are affecting fish and wildlife. Therefore, the Chapter recommends that mitigation occur not only for the direct impacts to wildlife and habitat, but also for the cumulative impacts.	Environmental protection measures and mitigation measures for wildlife and fisheries habitat have been developed specifically for this Project. It is beyond the scope of this NEPA document to include environmental protection measures or mitigation measures for impacts to wildlife and fisheries habitat from other projects in the CESA.
U.S. Environmental Protection Agency	6-1	Section 3.5.1	Section 3.5.1 Surface Water  We recommend that Table 3.5-1 be expanded to identify Clean Water Act Section 303(d) impaired or threatened waterbodies within and downstream of the project area. Specifically, we recommend including the waterbody segment identification number, impairment status, and cause of the impairment according to North Dakota's most recent Integrated Report (2014), along with a link to North Dakota's report. If the project has the potential to contribute pollutants related to an existing impairment, then it will be important to collaborate with the North Dakota Department of Health to ensure that the project is implemented in a manner consistent with their requirements and to prevent any worsening of the impairment.	A footnote has been added to Table 3.5-1 stating "Lake Sakakawea is a CWA Section 303(d) impaired water based on elevated levels of methyl mercury in relation to fish consumption."

**Table G-1 USACE Responses to Comments on the December 2015 BakkenLink Dry Creek to Beaver Lodge Pipeline Project Draft EA**

Agency/ Organization	Comment No.	EA Section	Comment	USACE Response
U.S. Environmental Protection Agency	6-2	Section 4.5.1.1	<p><b>Section 4.5.1.1 Surface Water</b></p> <p>Contaminants from surface events such as spills and pipeline leaks have the potential to enter and impact surface water resources if these events occur in close proximity to water bodies. We note that the proposed pipeline crossing traverses rugged and remote topography on both sides of the Lake Sakakawea crossing. Spills in such locations are difficult to remediate, and impacts to aquatic ecosystems can be significant. While we recognize that BakkenLink proposes to use a greater wall thickness for the Lake Sakakawea crossing as a protective measure (i.e., 0.50-inch pipeline wall thickness across the Lake versus 0.312-inch wall thickness for the majority of the rest of the pipeline route), EPA recommends that BakkenLink consider construction of a double-walled pipeline through Lake Sakakawea and other sensitive ravines and ecosystems. A double-walled pipeline would provide secondary containment in the event of a product leak.</p>	<p>It has been assumed that casings would protect the surrounding environment from a leaking or ruptured pipeline. In the current era of modern transmission pipelines, the industry has found casings to be the cause of many problems and not a solution as once thought. A large percentage of the pipeline maintenance budgets are spent each year repairing pipelines at casings. The reality is that the factor of safety provided by a casing is not outweighed by the negative effect that a casing has on the overall reliability of the carrier pipe. The common problems associated with cased crossings include:</p> <ul style="list-style-type: none"> <li>• Metallic contact between the casing and the carrier pipe grounds the cathodic protection system and eliminates the protection provided to the carrier pipe. In some cases, it may not be easy to fix, detect, and eliminate the electrical short since some shorts are intermittent, may be in the middle of the lake crossing, or are difficult to excavate.</li> <li>• Atmospheric corrosion, which cannot be addressed with cathodic protection, is observed in many cases of sealed end casings (used to prevent groundwater infiltration or flow). When equipped with the required vents, the casing will contain water after a period of time as cold air entering the vent will condense moisture.</li> <li>• Ineffective cathodic protection is encountered as the annulus between the casing pipe shields the carrier pipe from the protective current.</li> </ul> <p>Therefore, instead of double-walled pipe, the lake crossing pipeline segment will have a 0.500-inch wall thickness pipe, installed with a 2-inch thick Concrete Weight Coating (CWC) to provide adequate impact and abrasion protection as documented within the Lake Sakakawea Design Basis document, submitted as Appendix X.F of the POD.</p>
U.S. Environmental Protection Agency	6-3	Section 4.5.1.1	<p><b>Section 4.5.1.1 Surface Water</b></p> <p>We also recommend that consideration be given to mitigation measures in these sensitive areas, such as installation of additional automated mainline valves or other appropriate measures to minimize releases. Although the EA describes the risk of a spill as low, the proximity of the pipeline to drinking water sources and sensitive ecosystems makes it prudent that pipelines crossing Lake Sakakawea include the current state-of-the-art precautions and preventative measures to protect these resources.</p>	<p>As discussed in Section 2.2.1.3, Other Aboveground Facilities, "Three MLVs would be spaced along the pipeline to meet or exceed the requirements of 49 CFR 195. BakkenLink has conducted a HCA analysis to identify locations of HCAs (Section 2.2.2) near the Project, which helped to refine appropriate placement of the MLVs to minimize potential environmental impacts in the event of a rupture or leak. BakkenLink would meet with the PHMSA to optimize MLV placement along the mainline and gain their concurrence with MLV locations. Additionally, BakkenLink would install communications equipment (Section 2.2.1.5) that would allow all valves to be operated remotely to minimize potential impacts of a spill. BakkenLink would install remotely controlled MLVs on both sides of Lake Sakakawea (i.e., double block valves) above the 500-year flood level for Lake Sakakawea (elevation 1,855.5 feet National Geodetic Vertical Datum of 1929 [NGVD29]) as well as at the southern boundary of USFS property."</p>
U.S. Environmental Protection Agency	6-4	Section 4.5.1.1	<p><b>Construction:</b> We support the Draft EA's turbidity monitoring program to be implemented during construction. We suggest that the USACE continue the water quality monitoring beyond the construction phase to ensure that the lake returns to pre-construction conditions.</p>	<p>The water quality of Lake Sakakawea is regularly sampled under the Omaha District's Water Quality Management Program. Water quality monitoring in the upper reaches of Lake Sakakawea includes monthly (May through September) sampling at RM1553 (Missouri River at Williston), RM1512 (Lake Sakakawea at White Tail Bay), and RM1481 (Lake Sakakawea at New Town). White Tail Bay is near the construction site. The monthly monitoring includes the field measurement of turbidity at the surface and at 1-meter depth increments from the surface to the bottom at the reservoir sites. This monitoring will be conducted in 2016. Water quality conditions monitored in 2016, including turbidity, can be compared to recently monitored conditions in Lake Sakakawea back to 2003. It is noted that turbidity conditions in the upper reaches of Lake Sakakawea are significantly impacted by the turbidity of the inflowing Missouri and Yellowstone Rivers, especially during spring snowmelt conditions.</p>
U.S. Environmental Protection Agency	6-5	Section 4.5.1.1	<p><b>Operation:</b> We support the emergency response and spill prevention measures identified in the Draft EA. Based on lessons learned from recent spills into the Yellowstone River in Montana, we have recommendations for additional measures that are important for consideration in the BakkenLink proposal.</p> <p>In responding to both the January 2015 Bridger Poplar Pipeline and the July 2011 Exxon Silvertip Pipeline spill incidents, we learned that depth of cover surveys on a trenched pipeline during or immediately after significant hydrological events would be beneficial. Such surveys for this project could be triggered by a historically high or low river stage or the observation of ice damming at the location of the pipeline crossing. We recognize that the proposed Lake Sakakawea crossing would occur in the reservoir section of the river where flows are generally slower and less scour is likely to occur in high water events; nonetheless, we recommend that the Draft EA assess and discuss the potential for scour and consider the inclusion of on-going depth of cover surveys associated with hydrological events.</p>	<p>Please refer to response to State Water Commission/Office of the State Engineer Comment No. 1-5.</p>

**Table G-1 USACE Responses to Comments on the December 2015 BakkenLink Dry Creek to Beaver Lodge Pipeline Project Draft EA**

Agency/ Organization	Comment No.	EA Section	Comment	USACE Response
U.S. Environmental Protection Agency	6-6	Section 4.5.1.1	Contingency Planning: The Draft EA notes that although the total release volume of a spill likely would be four barrels or less, downstream drinking water intakes could be temporarily impacted by a crude oil release. While the probability of a significant oil spill may be small, our experience in spill response indicates that a break or leak in product pipelines often result in releases greater than four barrels. In addition, for the Mid-Missouri Sub-Area Contingency Plan, the EPA estimated the transport of oil from a break at a pipeline that crosses Lake Sakakawea close to the BakkenLink proposed crossing. It was estimated that oil would travel approximately 41 miles over 27 hours and reach the New Town water intake within approximately 13 hours.	Based on PHMSA onshore liquid pipeline incident data between 2002 and 2014, 4 bbl represents the median spill volume. Therefore, during this time period, 50% of spills were 4 bbl or less and 50% of spills were larger than 4 bbl. In the extremely unlikely event of a catastrophic full bore rupture of the pipeline, spill volume would be larger than 4 bbl. However, small leaks, though still unlikely, are more common than catastrophic failures. Nonetheless, the BakkenLink Risk Assessment and Environmental Consequence Analysis (Appendix A of the EA) analyzes a range of spill volumes between 4 bbl and 10,000 bbl, which is larger than the calculated worst case discharge from the Project. Therefore, despite referencing the median historical spill volume of 4 bbl, the Risk Assessment analyzes the full range of spills that could occur due to the Project.  In the unlikely event of a spill in Lake Sakakawea, the trajectory of crude oil would depend largely on specific atmospheric and environmental conditions at the time of the spill in addition to the speed and efficacy of emergency response. The Risk Assessment utilized a conservative methodology to overestimate the speed and distance with which crude oil could spread across the lake. This methodology utilized a NOAA-developed oil weathering model and also considered historical case studies to confirm estimated travel times and distances. The initial goal of emergency responders would be to isolate crude oil and prevent it from spreading within the lake to avoid widespread effects. Emergency response techniques would be fully addressed within BakkenLink's Emergency Response Plan.
U.S. Environmental Protection Agency	6-7	Section 4.5.1.1	While EPA has not estimated the potential transport from the BakkenLink pipeline specifically, we can reasonably assume a similar timeframe for a spill from this line to arrive at the intake. Despite the low probability of a significant spill to the lake, we recommend that BakkenLink adequately plan, prepare and train for such an event and that the EA include information on drinking water intake locations downstream of the project (e.g., surface water intakes for Mandaree, Four Bears, Twin Buttes, White Shield and Parshall).	Information on municipal drinking water intakes and other high consequence area data cannot be published in public documents due to homeland security concerns. However, the BakkenLink Risk Assessment and Environmental Consequence Analysis considers the locations of municipal drinking water intakes for the towns of New Town and Four Bears Village. While the Draft EA discusses BakkenLink's emergency response plan at a high-level, the review and approval of the specific content of the ERP is the responsibility and jurisdiction of the PHMSA. They will ensure that BakkenLink's ERP aligns with the Federal regulations (49 CFR 194) which specify the minimum requirements. The ERP will also align with the content and directions identified in the Mid-Missouri Sub-Area Contingency Plan. PHMSA must review and approve the ERP before a pipeline is commissioned and begins operations.
U.S. Environmental Protection Agency	6-8	Section 4.5.1.1	Winter Spill Scenario: In responding to the 2015 Bridger Poplar Pipeline spill, we noted that the prolonged oil/water contact and lack of evaporative loss due to ice cover caused a much larger than expected concentration of dissolved-phase organics making it to the subsurface intake at the water treatment plant. This is likely a unique situation to Bakken crude released into an iced-over waterbody. Therefore, we recommend that this section of the Draft EA be revised to clarify that a winter response on ice for a spill scenario involving Bakken crude actually can be more difficult than a "typical" ice response.	The USEPA is correct in stating that the dissolved organic concentrations were unexpectedly high in the 2015 Bridger Pipeline spill. Prolonged oil/water contact and reduced evaporative loss were exacerbating factors, as was ice breakup and extreme turbulence due to high flow conditions within a constrained river channel. The latter factor was considered to be extremely important and would not be present at a spill within Lake Sakakawea. While the type of oil released (Bakken crude) was a contributing factor, the unique environmental conditions present at the time of the spill were considered to be the overriding factors that led to elevated dissolved hydrocarbon concentrations.  Recognizing the interaction of these contributing factors is important in winter spill scenarios and should be addressed within BakkenLink's ERP. The BakkenLink ERP will identify a local OSRO and must meet response capabilities identified by federal regulations (49 CFR 194, PHMSA, and the Mid-Missouri Contingency Plan). As stated previously, the PHMSA is the regulatory agency responsible for the review and approval of the ERP, which must occur prior to operation of the pipeline.
U.S. Environmental Protection Agency	6-9	Section 4.5.1.1	In addition, we recommend that BakkenLink include planning for winter response scenarios in their oil spill contingency plans, including measures to ensure that staff are adequately trained for a potential winter response and that an oil spill response organization with winter response capabilities has been identified.	Winter spill scenarios and the planning and training they require should be addressed within BakkenLink's ERP. BLM notes that the BakkenLink ERP will identify a local OSRO and must meet response capabilities identified by federal regulations (49 CFR 194, PHMSA, and the Mid-Missouri Contingency Plan). As stated previously, PHMSA is the regulatory agency responsible for the review and approval of the ERP, which must occur prior to operation of the pipeline.
U.S. Environmental Protection Agency	6-10	Section 3.5.2	Groundwater Resources  Section 3.5.2 Groundwater: It appears that the proposed pipeline crosses a number of shallow and surficial aquifers which are used as a source of drinking, stock, and irrigation water. It also crosses within close proximity to permitted domestic groundwater wells. In addition to the map showing locations of public water supply Wellhead Protection Areas, we recommend the EA include a map and relevant information regarding private water wells in the project area (available from the North Dakota State Engineer's Office) including depths of screened interval(s). We recommend including this information in the Final EA to ensure that these sensitive areas are adequately described and identified for appropriate protection measures.	Domestic and stock wells have been added to Figure 3.5-3. In addition, a new table (Table 3.5-2) has been added to Section 3.5, Water Resources, which will describe domestic and stock wells within 1 mile of the proposed route. Information in Table 3.5-2 includes, well index well log ID, county, aquifer, lithology, purpose, distance to centerline, depth of screened interval, and static water level.

**Table G-1 USACE Responses to Comments on the December 2015 BakkenLink Dry Creek to Beaver Lodge Pipeline Project Draft EA**

Agency/ Organization	Comment No.	EA Section	Comment	USACE Response
U.S. Environmental Protection Agency	6-11	Section 4.5.3	<p><b>Groundwater Resources</b></p> <p>Section 4.5.3 Mitigation: A potential spill or leak from the proposed pipeline would pose a serious risk to drinking water supplies in sensitive groundwater areas. We note that the BLM's 2012 FONSI on the original BakkenLink Pipeline proposal included two mitigation measures to protect groundwater resources in the central segment of the line. Specifically, BakkenLink was required to (1) install an additional mainline valve to protect the Cherry Creek aquifer near Highway 23 and (2) implement North Dakota Department of Health recommendations for groundwater protection measures for segments of the pipeline that traverse the Cherry Creek and Tobacco Garden aquifers. We recommend that similar consideration be given to mitigation measures to protect the shallow and surficial aquifers currently in use for domestic, stock and irrigation water that would be traversed under the current pipeline segment proposal.</p>	<p>BakkenLink has evaluated the location of aquifers underlying the Project route and strategically placed valves to afford protection to groundwater resources and other sensitive receptors. It has been determined that additional valves would not result in a substantive reduction in worst-case spill volumes and thus, would not afford additional protection to groundwater resources. Additionally, BakkenLink would have the ability to isolate pipeline segments between the valves currently proposed in order to protect the aquifers crossed by the Project route. A review of the NDSWC database of domestic and stock wells within 1 mile of the Project route has determined that two wells classify as shallow wells (static water level is less than 100 feet bgs) in the Dry Fork Creek Aquifer. However, these wells are located approximately 0.84 mile west of the Project route.</p> <p>Furthermore, the existing BakkenLink Fryburg to Dry Creek Pipeline included valves to protect the Cherry Creek Aquifer, which is a shallow aquifer that supplies municipal water for Watford City, North Dakota. Municipal water intakes qualify as High Consequence Areas (HCAs) under 49 CFR 195.6 and therefore, under certain circumstances, justify additional valves. The wells associated with aquifers crossed by this Project route are domestic and stock wells, which do not qualify as HCAs under 49 CFR 195.6.</p> <p>BakkenLink has consulted and will continue consulting with the NDDH, Water Quality Division, and will implement ground water protection measures as directed (or recommended) by NDDH for segments of the proposed Project that traverse the Keene and Dry Fork Creek aquifers.</p>
U.S. Environmental Protection Agency	6-12	NA	<p>Documentation of the U.S. Fish and Wildlife Service's Recommendations: The Draft EA identifies numerous special status species in the project area, including Endangered Species Act-listed endangered species (e.g., interior least tern, whooping crane, and pallid sturgeon) and threatened species (e.g., northern long-eared bat, piping plover, rufa red knot, and Dakota skipper), and proposes that implementation of the project would have low impacts on protected species with appropriate agency consultation and implementation of environmental protection measures.</p> <p>Although the Draft EA notes that informal and formal discussions and meetings occurred with the U.S. Fish and Wildlife Service (USFWS) during development of the proposal, it does not identify the USFWS's recommendations for the proposed project. The BLM's 2012 FONSI for the full pipeline route specifically excluded the Lake Sakakawea crossing segment due to the "potential adverse effects to special status wildlife species (i.e., pallid sturgeon, piping plover, interior least tern) and designated critical habitat for the piping plover." Therefore, it is particularly important that the EA for the current proposed Lake Sakakawea crossing segment clearly state whether the USFWS concurred with the wildlife impact analysis and whether the USFWS provided recommendations that were incorporated into the design features included in Table 2-4 Summary of Environmental Protection Measures for the Project. Documentation of the USFWS's consultation and concurrence, along with its recommendations for project design criteria, mitigation, and monitoring will be a valuable addition to the Final EA.</p>	<p>The following text has been added to Section 1.10.1, Agency Involvement: "As part of the ESA Section 7 consultation process with the USFWS, the BLM submitted a biological assessment (BA) for the proposed Project to the USFWS on January 23, 2015. Additionally, on March 2, 2015, the BLM submitted a letter to the USFWS requesting initiation of formal consultation for the proposed Project, specifically for piping plover critical habitat and the Dakota skipper. In response to the BLM's two submittals, the USFWS provided a concurrence letter dated March 26, 2015 (USFWS 2015). The concurrence letter stated that the USFWS agreed with the BLM's determinations in the BA of "No Effect" (gray wolf and black-footed ferret), "May affect, but is not likely to adversely affect" (pallid sturgeon, whooping crane, interior least tern, piping plover, rufa red knot, and northern long-eared bat), and "May affect, is likely to adversely affect (piping plover critical habitat and Dakota skipper). Based on the BLM's request for initiation of formal consultation and the determination in the BA of "May affect, is likely to adversely affect" for piping plover critical habitat and the Dakota skipper, formal consultation was initiated for the proposed Project.</p> <p>On August 10, 2015, the USFWS issued their biological opinion for the proposed Project regarding piping plover critical habitat and the Dakota skipper, therefore concluding formal consultation. As a result of the formal consultation process, recommendations from the USFWS regarding avoidance, minimization, and mitigation measures for federally listed species have been incorporated into Chapter 2.0 and Chapter 4.0."</p>