

**Lake Sakakawea Site-specific  
Risk Assessment**



Prepared for:  
Hess Corporation

Prepared by:  
Stantec Consulting Services Inc.

February 4, 2014

Insert revision record


- 45 PU-15-32 Filed 04/17/2015 Pages: 20  
Exhibit 14  
Hess North Dakota Pipelines LLC
- 46 PU-15-31 Filed 04/17/2015 Pages: 20  
Exhibit 14  
Hess North Dakota Pipelines LLC



## Sign-off Sheet

This document entitled Lake Sakakawea Site-specific Risk Assessment was prepared by Stantec Consulting Services Inc. for the account of Hess Corporation. The material in it reflects Stantec's best judgment in light of the information available to it at the time of preparation. Any use which a third party makes of this report, or any reliance on or decisions made based on it, are the responsibilities of such third parties. Stantec Consulting Services Inc. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

Prepared by \_\_\_\_\_



(signature)

**Erik Page**

Reviewed by \_\_\_\_\_



**Heidi Tillquist**

# LAKE SAKAKAWEA SITE-SPECIFIC RISK ASSESSMENT

## Table of Contents

<b>ABBREVIATIONS</b> .....	<b>1</b>
<b>1.0 PURPOSE</b> .....	<b>1.1</b>
<b>2.0 BACKGROUND</b> .....	<b>2.1</b>
2.1 PIPELINE SPECIFICATIONS .....	2.1
2.2 SITE DESCRIPTION AND CROSSING METHOD .....	2.2
<b>3.0 SPILL FREQUENCY AND VOLUME</b> .....	<b>3.1</b>
<b>4.0 METHODOLOGY</b> .....	<b>4.1</b>
4.1 MUNICIPAL DRINKING WATER RESOURCES.....	4.1
4.2 WILDLIFE AND AQUATIC SPECIES .....	4.3
<b>5.0 RESULTS</b> .....	<b>5.1</b>
5.1 MUNICIPAL DRINKING WATER RESOURCES.....	5.1
5.2 WILDLIFE AND AQUATIC SPECIES .....	5.1
<b>6.0 DISCUSSION</b> .....	<b>6.1</b>
6.1 AQUATIC RESOURCES MODELING DISCUSSION.....	6.1
6.1.1 Interpretation of Municipal Drinking Water Resources Results.....	6.1
6.1.2 Interpretation of Wildlife and Aquatic Species results.....	6.1
6.1.3 Chronic Toxicity and Long-term Impacts.....	6.1
6.2 SPECIES OF CONCERN .....	6.2
6.2.1 Piping Plover.....	6.2
6.2.2 Interior Least Tern.....	6.3
6.2.3 Pallid Sturgeon .....	6.3
6.2.4 Protective Procedures .....	6.3
6.3 WINTER SPILL SCENARIO .....	6.4
6.4 FISH CONTAMINATION .....	6.4
<b>7.0 SUMMARY</b> .....	<b>7.1</b>
<b>8.0 REFERENCES</b> .....	<b>8.1</b>

# LAKE SAKAKAWEA SITE-SPECIFIC RISK ASSESSMENT

## LIST OF TABLES

Table 2-1	Pipeline Specifications .....	2.1
Table 3-1	Occurrence Interval by Spill Volume .....	3.1
Table 4-1	Distribution of Spill Volumes .....	4.3
Table 5-1	Results of Benzene Modeling in Water near Four Bears Village and Newtown .....	5.1
Table 5-2	Results of Benzene Modeling in Water 24 Hours After Release .....	5.1

## LIST OF FIGURES

Figure 4-1	Spill Impact Map.....	4.2
Figure 6-1	Bakken Crude and NGL Weathering <sup>1</sup> .....	6.2

# LAKE SAKAKAWEA SITE-SPECIFIC RISK ASSESSMENT

## Abbreviations

°C	degrees Celsius
bb1	barrels (42 gallons)
bpd	barrels per day
CFR	Code of Federal Regulations
CPM	computational pipeline monitoring
cSt	centistokes
FBE	fusion bond epoxy
FR	Federal Register
g	grams
Hess	Hess Corporation
L	liters
LC <sub>50</sub>	lethal concentration to 50 percent of test organisms within a specified time
m <sup>3</sup>	cubic meters
MCL	maximum contaminant level
MFWP	Montana Fish, Wildlife and Parks
mg	milligrams
mg/L	milligrams per liter, equivalent to parts per million
MOP	maximum operating pressure
NGL	natural gas liquids
OCC	Operations Control Center
OD	outside diameter
PHMSA	Pipeline and Hazardous Materials Safety Administration
ppm	parts per million
psig	pounds-force per square inch gauge
SCADA	Supervisory Control and Data Acquisition
ssp	subspecies
U.S.	United States
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
vol%	percent by volume
WT	wall thickness

## LAKE SAKAKAWEA SITE-SPECIFIC RISK ASSESSMENT

Purpose

February 4, 2014

### 1.0 Purpose

Lake Sakakawea is the United States' (U.S.) third largest manmade lake and has over 1,500 miles of shoreline in close proximity to a number of towns as well as sensitive habitat for federally listed threatened and endangered species. Hess Corporation (Hess) has proposed to construct a pipeline system connecting Bakken production fields south of Lake Sakakawea to existing processing facilities north of the lake. Due to the crossing of Lake Sakakawea, Hess has requested that Stantec Consulting Services Inc. identify the impacts of a pipeline release beneath the lake.

The purpose of this report is to quantify the potential impacts of chemicals of concern to Lake Sakakawea water resources following a subsurface crude oil or natural gas liquid (NGL) pipeline rupture. Benzene was selected as the primary chemical of concern because it has: 1) relatively high water solubility compared to other hydrocarbon constituents; 2) the lowest drinking water standard; and 3) a substantially higher acute toxicity relative to other hydrocarbon constituents. This site-specific risk assessment provides a highly conservative estimation of benzene concentrations in water based on a hypothetical release into Lake Sakakawea.

# LAKE SAKAKAWEA SITE-SPECIFIC RISK ASSESSMENT

Background

February 4, 2014

## 2.0 Background

### 2.1 PIPELINE SPECIFICATIONS

Spill risk and potential environmental consequences described in this Risk Assessment are based on transportation of up to 76,000 barrels per day (bpd), depending upon the type of material transported. Key design parameters associated with the Project are identified in **Table 2-1**.

**Table 2-1 Pipeline Specifications**

Parameter	Crude Oil Pipeline	NGL Pipeline
New Pipe Specifications	Above ground (within facilities): A333, Gr 6 Below ground (along route): American Petroleum Institute 5L, X-52	Above ground (within facilities): A333, Gr 6
Coating	Fusion bond epoxy (FBE) coating	FBE coating
Maximum Operating Pressure	1000 pounds-force per square inch gauge (psig)	1250 psig
Maximum Throughput	<ul style="list-style-type: none"> <li>45,000 bpd base flow rate</li> <li>76,000 bpd maximum flow rate</li> </ul>	<ul style="list-style-type: none"> <li>6,000 bpd base flow rate</li> <li>30,000 bpd maximum flow rate</li> </ul>
Depth of Cover	Minimum 5 feet	Minimum 5 feet
Aboveground versus Belowground Piping	Pipe will be belowground except within supply and receipt facilities.	Pipe will be belowground except within supply and receipt facilities.
Pipe Wall Thickness	Trenched pipeline - 12.75" outside diameter (OD), 0.375" wall thickness (WT) Bored pipeline - 12.75" OD, 0.500" WT Above ground piping (within facilities) 12" piping, Sch 80, 0.688" WT 16" piping, Sch 80, 0.844" WT River crossing 8" pipe: 0.500" WT, GrB	Above ground piping (within facilities) 8" piping, Sch 80, 0.500" WT 10" piping, Sch 80, 0.594" WT River crossing 8" pipe: 0.500" WT, GrB
Pump Stations	No intermediate pump stations required	No intermediate pump stations required
Leak Prevention Program	<ul style="list-style-type: none"> <li>Multiple overlapping and redundant systems, including:</li> <li>FBE or other protective pipeline coating</li> <li>Cathodic protection</li> <li>Non-destructive testing of the girth welds per 49 Code of Federal Regulations (CFR) 195.234</li> <li>Hydrostatic testing to 125% of the maximum operating pressure (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</li> </ul>	<ul style="list-style-type: none"> <li>Multiple overlapping and redundant systems, including:</li> <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% 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>SCADA system</li> </ul>

# LAKE SAKAKAWEA SITE-SPECIFIC RISK ASSESSMENT

Background

February 4, 2014

**Table 2-1 Pipeline Specifications**

Parameter	Crude Oil Pipeline	NGL Pipeline
Leak Prevention Program (Continued)	<ul style="list-style-type: none"><li>• Operations Control Center (OCC) providing continuous monitoring of the pipeline, 24 hours a day, every day of the year</li></ul>	<ul style="list-style-type: none"><li>• 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>• Aerial or foot patrols 26 times per year, not to exceed 3 week interval</li><li>• Public awareness program</li></ul>	<ul style="list-style-type: none"><li>• Remote Monitoring with SCADA</li><li>• CPM per 49 CFR 195.444</li><li>• Aerial or foot patrols 26 times per year, not to exceed 3 week interval</li><li>• Public awareness program</li></ul>

## 2.2 SITE DESCRIPTION AND CROSSING METHOD

Lake Sakakawea is a reservoir crossed by the Project. Its normal volume is 12,800,000 acre-feet, with a maximum capacity of 23,800,000 acre-feet (U.S. Army Corps of Engineers 2007). The lake is used for drinking water, recreational activities, flood control, hydroelectric power, navigation, and irrigation. It also supports a cold water fishery.

Three existing pipelines, which were installed using open cut techniques, have been hydrostatically tested to prove their integrity. The three lines would be converted to transport crude oil, NGL, and natural gas in order to reduce the need for trucking the liquids and flaring the natural gas.

## LAKE SAKAKAWEA SITE-SPECIFIC RISK ASSESSMENT

Spill Frequency and Volume

February 4, 2014

### 3.0 Spill Frequency and Volume

Because the Project has not yet been constructed in its entirety, it does not have an operational history from which to derive incident frequency rates. Consequently, a conservative approach was taken by determining the baseline incident frequencies from industry data (i.e., Pipeline and Hazardous Materials Safety Administration [PHMSA] data).

Baseline incident frequencies are derived from historical national pipeline incident data (PHMSA 2013). Because 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 the current regulatory requirements or best management practices. Further, these historical data do not account for supplemental protective measures that Hess will implement. Thus, these incident frequencies are conservative.

Given the incident frequency of 0.00211 incidents/mile-year (Section 4.1 of the Risk Assessment) and the Lake Sakakawea crossing distance of 2.5 miles, the baseline occurrence interval for a release on this portion of the line is 190 years (1 spill every 190 years). Occurrence intervals for specific spill sizes are presented in **Table 3-1**.

**Table 3-1 Occurrence Interval by Spill Volume**

Crossing Distance (miles)	Baseline Occurrence Interval (years)	Occurrence Interval (years) by Spill Volume (bbl)			
		4	50	1,000	10,000
2.5	190	380	950	3,790	37,920

## LAKE SAKAKAWEA SITE-SPECIFIC RISK ASSESSMENT

Methodology

February 4, 2014

### 4.0 Methodology

The model used to estimate benzene concentrations within the water column combines site-specific conditions (e.g., surface area of Lake Sakakawea, distance to drinking water receptors) as well as highly conservative modeling assumptions.

**Key Assumption 1:** The model assumed that all benzene within the spilled product would solubilize directly into the water. This is an extremely conservative assumption given that the dominating fate process of benzene is evaporation. Under field conditions, actual concentrations of benzene would not approach optimal solubility limits because benzene preferentially remains in the crude oil or evaporates, rather than dissolving into the water.

**Key Assumption 2:** The model assumed that the half-life of benzene in water 1 meter deep as a result of volatilization is 4.8 hours, based on empirical data (Kuykendall 2010).

**Key Assumption 3:** Bakken crude oil was assumed to spread at a rate of 300 meters per hour (Ramade 1978).

**Key Assumption 4:** The analysis assumes no emergency response containment or cleanup.

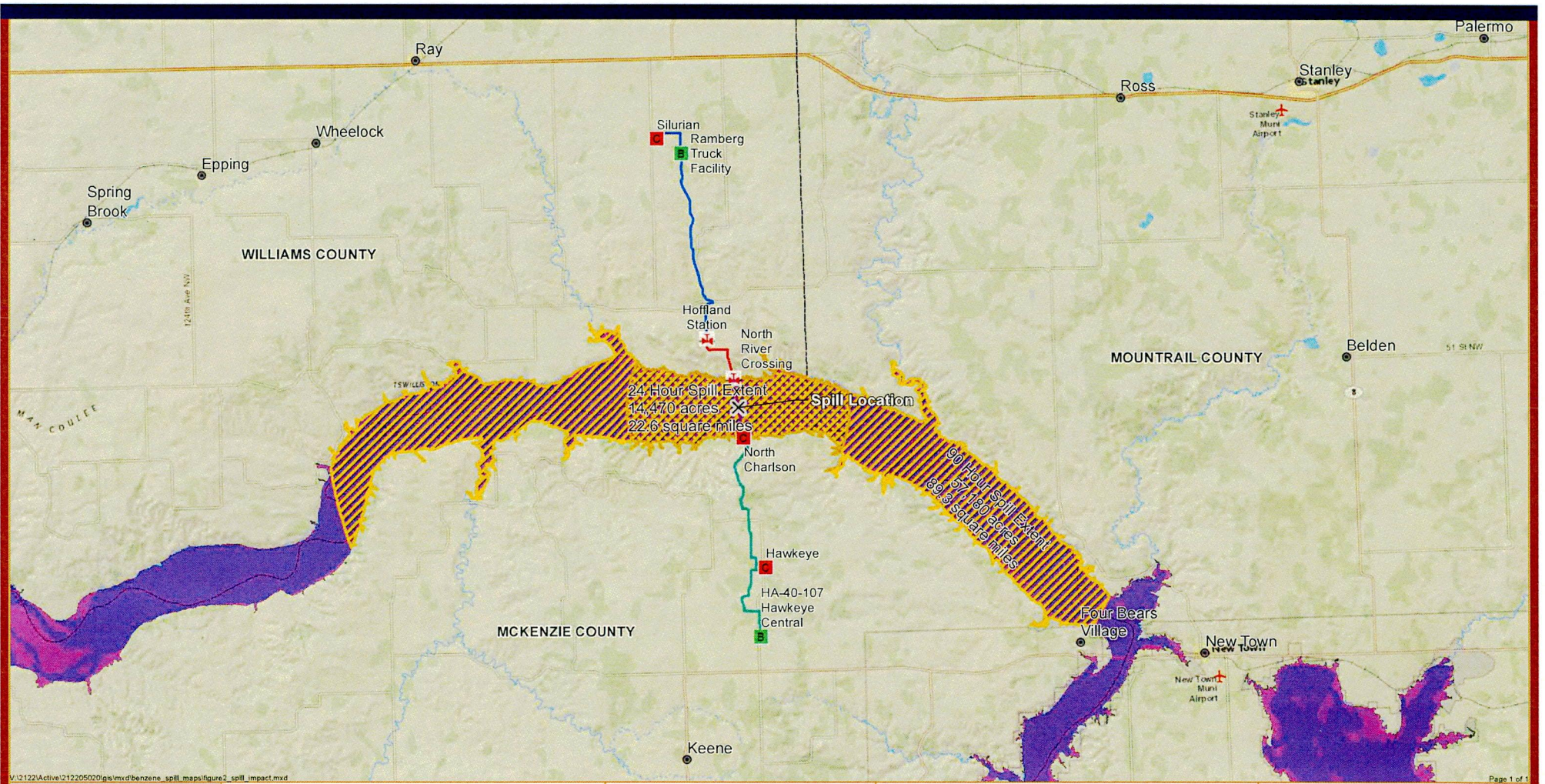
**Key Assumption 5:** The analysis did not account for evaporation from the oil's surface, even though this is the dominant fate process.

**Key Assumption 6:** The model assumes that the 300-meter-per-second spread rate of crude oil will be the primary driver in environmental transport of crude oil, thereby overriding winds and current.

#### 4.1 MUNICIPAL DRINKING WATER RESOURCES

Four Bears Village and New Town are the nearest communities to Hawkeye Pipeline's crossing of Lake Sakakawea. The surface area of Lake Sakakawea between the pipeline and the communities was calculated by Geographic Information System (assuming uniform spread east and west of the pipeline). This surface area was then converted to a volume of water in cubic meters, assuming that the benzene solubilizes to a depth of 1 meter. Although Lake Sakakawea is much deeper than 1 meter at the project area, this assumption is realistic due to the buoyancy of Bakken crude and NGL and is conservative in that it maximizes benzene concentrations.

Based on a transport rate of 300 meters per hour from a hypothetical rupture point at the center of the lake crossing, it would take 90 hours for a spill to reach Four Bears Village and New Town, as diagrammed in **Figure 4-1**.



V:\2122\Active\212205020\gis\mxd\benzene\_spill\_maps\figure2\_spill\_impact.mxd

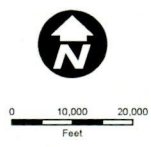
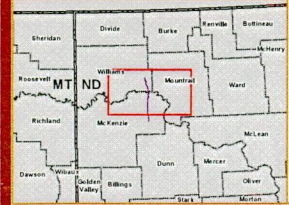


Figure 4-1. Spill Impact Map  
Hess Corporation  
Hawkeye Pipeline Project

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

**Project Information**  
Project Number: 212205020  
Last Modified: June 25, 2013



- Legend**
- Pipeline Segments
    - Segment A
    - Segment B
    - Segment C
    - Segment D
  - Battery
  - Compressor
  - Valve Set
  - Spill Location
  - USFWS Critical Piping Plover Habitat
  - 24-Hour Spill Extent
  - 90-Hour Spill Extent (Time to reach Four Bears Village and City of New Town)

Data Sources include: NDSM, Stantec, USGS, USFWS, and ESRI.

Prepared by:	Initials	Date
Peer Review by:	BLC	06/25/2013
Final Review by:		

**DRAFT**

The information on this map is subject to change without notice. Stantec makes no representations or warranties, express or implied, as to accuracy, completeness, timeliness, or rights to the use of such information.

stantec.com

## LAKE SAKAKAWEA SITE-SPECIFIC RISK ASSESSMENT

Methodology

February 4, 2014

After this calculation was completed, the volume and weight of benzene within each release volume in **Table 4-1** were determined based on the benzene content of Bakken crude (0.27 percent by volume) and NGL (0.559 percent by volume). Release volumes modeled were 4, 50, 1,000, and 10,000 barrels (bbl) (**Table 4-1**). The spill volumes examined range from the median spill volume of 4 bbl up to 10,000 bbl, representing the most common spill size to rare occurrences (0.5 percent of all spills), respectively, based on PHMSA data.

**Table 4-1 Distribution of Spill Volumes**

Spill Volume (bbl)	% of Spills Smaller <sup>1</sup>
4	50%
50	79%
1,000	95%
10,000	99.5%

<sup>1</sup> Values derived from PHMSA historical incident data.

To establish conservative benzene concentrations in the water at Four Bears Village and New Town, the amount of benzene from each of the four release volumes was divided by the volume of water into which the chemical would solubilize and adjusted to account for the 4.8-hour half-life of benzene in a column of water 1 meter deep.

The analysis did not account for evaporation from the oil's surface or emergency containment and cleanup.

The results of this analysis are benzene concentrations in the water surrounding Four Bears Village and New Town that were compared with the U.S. Environmental Protection Agency (USEPA) drinking water maximum contaminant level (MCL). Results are presented in Chapter 5.0.

### 4.2 WILDLIFE AND AQUATIC SPECIES

To assess the potential impacts of a subsurface crude oil or NGL release to wildlife and aquatic species, the same methods detailed in Section 4.1, Municipal Drinking Water Resources, were utilized but for a smaller 24-hour spread due to the proximity and mobility of wildlife and aquatic receptors rather than the 90-hour spread necessary for a release to reach Four Bears Village and New Town. This resulted in a smaller volume of contaminated water with a higher concentration of benzene, which was then compared to acute toxicity levels for various aquatic species. Results are presented in Chapter 5.0.

# LAKE SAKAKAWEA SITE-SPECIFIC RISK ASSESSMENT

Results

February 4, 2014

## 5.0 Results

### 5.1 MUNICIPAL DRINKING WATER RESOURCES

Results of the modeling of benzene concentrations in water surrounding Four Bears Village and New Town following hypothetical crude oil and NGL releases are provided in **Table 5-1**.

**Table 5-1 Results of Benzene Modeling in Water near Four Bears Village and Newtown**

Spill Volume (bbl)	Benzene Concentration in Water near Four Bears Village and New Town (milligrams per liter [mg/L])	
	Crude Oil <sup>1</sup>	Natural Gas Liquids <sup>2</sup>
4	1.5E-11	3.1E-11
50	1.8E-10	3.8E-10
1,000	3.7E-09	7.6E-09
10,000	3.7E-08	7.6E-08

<sup>1</sup> Based on a benzene concentration of 0.27 percent by volume, the arithmetic mean of assay results for Prosser, Swenson, Rofson, Hawkeye Central Bakken, and Budahn A crude oils.

<sup>2</sup> Based on a benzene concentration of 0.559 percent by volume per assay result.

### 5.2 WILDLIFE AND AQUATIC SPECIES

The results of the modeling of benzene concentrations in affected water 24 hours after hypothetical crude oil and NGL releases are provided in **Table 5-2**.

**Table 5-2 Results of Benzene Modeling in Water 24 Hours After Release**

Spill Volume (bbl)	Benzene Concentration in Water 24 Hours After Release (mg/L)	
	Crude Oil <sup>1</sup>	Natural Gas Liquids <sup>2</sup>
4	8.0E-07	1.7E-06
50	1.0E-05	2.1E-05
1,000	2.0E-04	4.2E-04
10,000	2.0E-03	4.2E-03

<sup>1</sup> Based on a benzene concentration of 0.27 percent by volume, the arithmetic mean of assay results for Prosser, Swenson, Rofson, Hawkeye Central Bakken, and Budahn A crude oils.

<sup>2</sup> Based on a benzene concentration of 0.559 percent by volume per assay result.

## LAKE SAKAKAWEA SITE-SPECIFIC RISK ASSESSMENT

Discussion

February 4, 2014

### 6.0 Discussion

#### 6.1 AQUATIC RESOURCES MODELING DISCUSSION

##### 6.1.1 Interpretation of Municipal Drinking Water Resources Results

The results of the 90-hour spill model indicate that, assuming benzene is solubilized completely into the water and accounting only for the half-life of benzene within the water column, the estimated benzene concentration would be significantly below the USEPA's MCL of 0.005 mg/L. Thus, the model results indicate that benzene arising from a crude oil or NGL release would not threaten Four Bears and New Town municipal drinking water resources. After 90 hours, a worst-case scenario release into the lake will produce benzene concentrations well below the USEPA MCL of 0.005 mg/L, even when assuming that benzene will solubilize completely from the released material into the water (USEPA n.d.).

##### 6.1.2 Interpretation of Wildlife and Aquatic Species results

The results of the 24-hour spill model indicate that, assuming benzene is solubilized completely into the water and accounting only for the half-life of benzene within the water column, the estimated benzene concentration would be orders of magnitude below levels capable of causing toxicity to sensitive aquatic species.

The acute toxicity level of benzene in rainbow trout (*Oncorhynchus mykiss*), one of the most sensitive species of freshwater fish, is 7.4 mg/L over a 4-day exposure period (**Table 5-4** in the Risk Assessment). Although not present in Lake Sakakawea, rainbow trout are toxicological test organisms frequently used to evaluate toxicity because they generally are the most sensitive aquatic species to many chemicals. Thus, the use of rainbow trout is a conservative and appropriate model organism for toxicity.

The model results indicate that benzene will not be of acute toxicological concern to aquatic organisms within Lake Sakakawea. After 24 hours, a worst-case scenario release into the lake will produce benzene concentrations well below acute aquatic organism toxicity thresholds, even when assuming that benzene will solubilize completely from the oil into the water.

##### 6.1.3 Chronic Toxicity and Long-term Impacts

Chronic toxicity levels, although lower than acute toxicity levels, are based upon 7-day exposure periods. Due to the ephemeral nature of benzene, chronic toxicity levels will not be sustained over the periods necessary to raise concern.

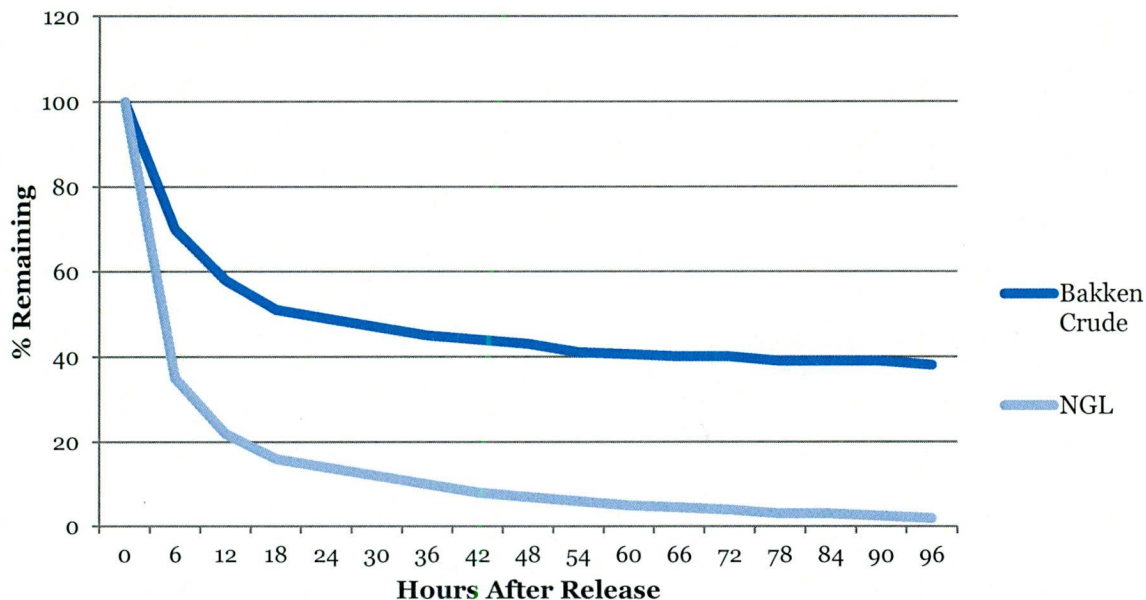
Additionally, due to the low probability of a spill, the high probability that any spill will be relatively small (50 bbl or less in 80 percent of cases), and the requirement for containment and cleanup, the potential for significant long-term impacts is very low. Additionally, the weathering of crude oil and NGL due to natural processes (e.g., evaporation, photodegradation, biodegradation, etc.) dictates that any lingering material will naturally dissipate to a fraction of its original volume within a matter of days (**Figure 6-1**).

# LAKE SAKAKAWEA SITE-SPECIFIC RISK ASSESSMENT

Discussion

February 4, 2014

Figure 6-1 Bakken Crude and NGL Weathering<sup>1</sup>



<sup>1</sup> Calculated using National Oceanographic and Atmospheric Administration Automated Data Inquiry for Oil Spills oil weathering model.

## 6.2 SPECIES OF CONCERN

Lake Sakakawea provides habitat for many wildlife species, several of which are federally listed threatened (piping plover) and endangered (interior least tern, pallid sturgeon).

### 6.2.1 Piping Plover

Although the piping plover (*Charadrius melodus*) was listed as endangered December 11, 1985, the populations near Lake Sakakawea fall under the threatened classification (50 Federal Register [FR] 50726; U.S. Fish and Wildlife Service [USFWS] 2009). Piping plover nesting occurrence in the Project area is unknown, though consultation with the USFWS identified suitable breeding and critical habitat within the Project area at Lake Sakakawea (67 FR 57638).

Piping plover feed by probing the sand and mud for insects, small crustaceans, and other invertebrates in or near shallow water (Sherfy et al. 2012). These tendencies could lead to contact with a crude oil spill, resulting in adverse effects such as oiling of plumage, ingestion of crude oil from contaminated plumage and prey, transfer of crude oil to eggs and young, and inhalation of volatile organic compounds.

Although benzene does not bioaccumulate or biomagnify, consumption of fresh oil directly from plumage or contaminated prey could potentially lead to acute toxicity, if ingested in sufficient amounts. Severe adverse impacts to the piping plover are most likely to occur due to physical impacts, such as oiling of feathers, rather than toxicological impacts. Because piping plover are not piscivorous and often feed on the shore, physical impacts to this species may be less severe compared to those of interior least tern, as piping plover are less likely to dive through the oil slick while gathering prey.



## LAKE SAKAKAWEA SITE-SPECIFIC RISK ASSESSMENT

Discussion

February 4, 2014

### 6.2.2 Interior Least Tern

The interior least tern (*Sterna antillarum* ssp. *athalassos*) was listed as endangered on May 28, 1985 (50 FR 21784). Although breeding habitat for the interior least tern generally is restricted to less altered river segments, it has been known to breed on the shores of Lake Sakakawea. The interior least tern also is piscivorous, feeding in shallow waters of rivers, streams, and lakes. These characteristics could lead to physical contact with a spill, resulting in adverse effects such as oiling of plumage, ingestion of crude oil or NGL from contaminated plumage and prey, and transfer of crude oil or NGL to eggs and young.

Although benzene does not bioaccumulate or biomagnify, consumption of fresh oil directly from plumage or contaminated prey could potentially lead to acute toxicity, if ingested in sufficient amounts. Severe adverse impacts to the interior least tern are most likely to occur due to physical impacts, such as oiling of feathers, rather than toxicological impacts.

### 6.2.3 Pallid Sturgeon

The pallid sturgeon (*Scaphirhynchus albus*) was listed as endangered on September 6, 1990 (55 FR 36641). Although pallid sturgeon are extremely rare, they have a relatively wide distribution in the U.S., particularly in the Missouri and Mississippi river basins. The North Dakota Game and Fish Department has found larval and mature pallid sturgeon in parts of Lake Sakakawea, therefore leading the USFWS to identify the lake crossing as potential habitat for pallid sturgeon.

Despite this designation, it is unlikely that a spill into Lake Sakakawea would result in acute benzene toxicity to pallid sturgeon. Even following a worst-case scenario spill volume, benzene levels in affected areas are not expected to raise benzene concentrations to a level sufficient to cause acute toxicity in the most sensitive fish species, such as rainbow trout.

### 6.2.4 Protective Procedures

Although the chance of a release into Lake Sakakawea is low (as presented in **Table 3-1**), there is a small probability that a release may occur while piping plover and interior least tern are in the area. The USFWS has determined that these species are likely to be in the area between April 1 and August 31. Based on the spill frequency of 0.00211 incidents/mile\*year, it is estimated that a spill could occur from either the crude oil or NGL pipelines while piping plover and interior least tern are in the area approximately once every 247 years.

To mitigate the potential for impacts to interior least tern and piping plover, Hess will incorporate the following mitigation measures into its Emergency Response Plan:

If a spill occurs between April 1 and August 31: 1) Contact the USFWS; 2) Deploy a trained wildlife biologist to the site to determine if either species is present and to locate aggregation and potential nesting areas; 3) If approved by USFWS, employ scare tactics at the spill site to ward birds away from the site without disrupting nesting behavior; 4) Capture, clean, and rehabilitate oiled wildlife; and 5) Deploy boom to protect these species' nesting areas.

## LAKE SAKAKAWEA SITE-SPECIFIC RISK ASSESSMENT

Discussion

February 4, 2014

### 6.3 WINTER SPILL SCENARIO

During the winter, Lake Sakakawea freezes over with a layer of ice that, in very cold years, can be as thick as 36 to 48 inches. This layer of ice will trap oil released below the lake's surface and prevent benzene evaporation from occurring. Therefore, during the winter, evaporative loss will be negligible, and will allow a longer contact between the crude oil and the water column, potentially causing very localized impacts to organisms in prolonged contact with the near-surface water (e.g., phytoplankton). However, surface ice will greatly reduce the spreading rate of product across a waterbody due to the presence of under-ice depressions, which collect oil and limit the area affected by a release, facilitating cleanup actions (Dickens 2011). Fish deeper in the water column likely would not experience adverse impacts.

The natural containment of winter releases facilitates cleanup efforts as the pockets of oil can be drilled to and removed using vacuum trucks. Thus, winter releases are predicted to have lower impacts, particularly with respect to area of extent, as compared to releases occurring during the warmer seasons.

### 6.4 FISH CONTAMINATION

In the event of a spill, the concentration of contaminants in fish flesh would be examined as part of the human health impact assessment. Because benzene does not bioaccumulate or biomagnify, concentrations in fish are not likely to cause human health effects. However, it is possible that a precautionary fish consumption advisory would be put into effect following a spill into Lake Sakakawea.

Following the Enbridge oil spill in the Kalamazoo River and the ExxonMobile oil spill in the Yellowstone River, the Michigan Department of Community Health and Montana Fish, Wildlife and Parks [MFWP], respectively, issued precautionary fish consumption advisories for the regions affected by the spills (MFWP 2011; Minicuci 2012). Both agencies tested fish to establish chemical concentrations present within the flesh and, based on these results, lifted the advisories (Montana Sport Fishing Consumption n.d.; Minicuci 2012). Therefore, it is probable that a similar precaution would be taken for Lake Sakakawea, though the threat of fish contamination is unlikely.

## LAKE SAKAKAWEA SITE-SPECIFIC RISK ASSESSMENT

Summary

February 4, 2014

### 7.0 Summary

Concentrations of benzene in water were modeled for hypothetical crude oil and NGL releases originating from the Hawkeye Pipeline crossing of Lake Sakakawea. Benzene was chosen as the primary contaminant of concern due to its relatively high toxicity and solubility, which results in the highest relative toxicity of crude oil hydrocarbons.

Results indicate that by the time a release reaches Four Bears Village and New Town, benzene concentrations in the water are highly unlikely to exceed water quality standards even when conservative assumptions are utilized. Evaporative loss and emergency containment and cleanup would further reduce the potential for impacts to water quality. Consequently, crude oil, NGL, and the benzene that these compounds contain do not pose a significant or reasonable threat to water quality adjacent to Four Bears Village and New Town.

Similarly, benzene concentrations would be orders of magnitude lower than those required to cause adverse impacts to aquatic species during open water conditions. Under ice conditions, very localized impacts to aquatic biota occupying the near surface, such as phytoplankton, might occur, but are not anticipated for pelagic (open water) or benthic (bottom) dwelling species. Widespread toxicity to aquatic organisms is unlikely to occur following a release of Bakken crude or NGL into Lake Sakakawea, regardless of spill volume.

## LAKE SAKAKAWEA SITE-SPECIFIC RISK ASSESSMENT

References

February 4, 2014

### 8.0 References

- Dickins, D. 2011. Behavior of Oil Spills in Ice and Implications for Arctic Spill Response. Offshore Technology Conference.
- Federal Register (FR). 1990. Endangered and Threatened Wildlife and Plants; Determination of Endangered Status of Pallid Sturgeon. Final Rule. Federal Register 55(173):36641-36647.
- \_\_\_\_\_. 1985. Endangered and Threatened Wildlife and Plants; Determination of Endangered and Threatened Status for Piping Plover. Final Rule. Federal Register 50:50726-50734.
- \_\_\_\_\_. 1985. Endangered and Threatened Wildlife and Plants; Interior Population of Least Tern to be Endangered. Final Rule. Federal Register 50(102):21784-21792.
- \_\_\_\_\_. 2002. Endangered and Threatened Wildlife and Plants; Designation of Critical Habitat for the Northern Great Plains Breeding Population of the Piping Plover. 67 FR 57638.
- Kuykendall, J. R. 2010. Benzene. In E. Jorgensen (Ed.), *Ecotoxicology* (pp. 210-215). Amsterdam, Netherlands: Academic Press.
- Minicuci, A. 2012. MDCH lifts "do not eat" fish consumption advisory for the Kalamazoo River. June 28, 2012. Internet website: <http://www.michigan.gov/mdch/0,4612,7-132--282243--,00.html>.
- Montana Sport Fishing Consumption Guidelines. No Date. Internet website: <http://fwp.mt.gov/fwpDoc.html?id=28187>. Accessed June 26, 2013.
- Montana Fish, Wildlife, and Parks (MFWP). 2011. MFWP issues fish-consumption advisory below oil spill. July 25, 2011. Internet website: [http://fwp.mt.gov/news/newsReleases/fishAndWildlife/nr\\_0291.html](http://fwp.mt.gov/news/newsReleases/fishAndWildlife/nr_0291.html).
- Pipeline and Hazardous Materials Safety Administration (PHMSA). 2013. Significant Pipeline Incidents. <http://primis.phmsa.dot.gov/comm/reports/safety/sigpsi.html>
- Ramade, F. 1978. Elements d'ecologie Appliquee Action du l'homme sur la Bioshere. Ediscience, Paris. In: Patin, Stanislav. 1998. Oil Spills in the Marine Environment.
- Sherfy, M. H., M. J. Anteau, T. L. Shaffer, M. A. Sovada, and J. H. Stucker. 2012. Foraging Ecology of Least Terns and Piping Plovers Nesting on Central Platte River Sandpits and Sandbars. Open-File Report 2012-1059, 50pp.
- United States Army Corps of Engineers. 2007. Garrison Dam and Lake Sakakawea. Internet website: <http://www.nwo.usace.army.mil/Missions/DamandLakeProjects/MissouriRiverDams/Garrison.aspx>.
- United States Environmental Protection Agency (USEPA). No Date. *Technical Factsheet on: BENZENE: National primary drinking water regulations*. U.S. Environmental Protection Agency.

## LAKE SAKAKAWEA SITE-SPECIFIC RISK ASSESSMENT

References

February 4, 2014

U.S. Fish and Wildlife Service (USFWS). 2009. Piping Plover (*Charadrius melodus*). 5-Year Review: Summary and Evaluation. 214 pp.