MONTHLY UPDATE REPORT - PRIMROSE SOUTH
09-21-067-04 W4M

NOVEMBER 18 TO DECEMBER 31, 2014

1 Introduction

The Canadian Natural Resources Limited Primrose South in situ oil sands project is located in the Cold Lake Air Weapons Range approximately 65 km north-northeast of Bonnyville, Alberta. Canadian Natural operations staff discovered a bitumen emulsion flow to surface (FTS) area at 09-21-067-04 W4M on June 24, 2013. The bitumen emulsion FTS area is beneath an unnamed water body within the Canadian Natural Primrose South production area.

On September 24, 2013, Alberta Environment and Sustainable Resource Development (ESRD) issued an Environmental Protection Order (EPO No. EPO-2013-33/NR), requesting the preparation of a Comprehensive Remedial Plan (CRP), as well as the preparation of a monthly progress report. This report addresses the requirement of the progress report and summarizes the progress towards the realization of the CRP and includes data collected and reported between November 18 and December 31, 2014.

2 Summary of Activities to Date

2.1 Individual Plan Submissions

As required by the EPO, the CRP includes the development, submission, and implementation of several specific plans. As of December 31, 2014, the status of these plans has not changed.

2.2 Water Management for Dewatering and Refilling

Activities related to dewatering and refilling were completed on June 22, 2014. There is no new information to report.

3 Water Body Monitoring

In accordance with the Water Body Restoration Plan (Matrix 2013), an extensive water quality and water quantity monitoring program was implemented on March 19, 2014. This program complements the ongoing water quality and quantity monitoring implemented in June 2013.

Details of the monitoring program are provided in the following subsections.

3.1 Water Quantity Monitoring

3.1.1 Basins 1, 3, and 4, Borrow Pit, and Downstream Fen

No new staff gauge readings were taken during this reporting period due to winter conditions.

3.1.2 Within Containment Structure

Water that seeped across the containment wall was collected and pumped from inside the containment wall back into Basin 1 from two sumps located on the north and south sides of the wall (Figure 1). Water was pumped using automated pumps that were intermittently operational throughout the reporting period. Sheen was observed in the south sump on December 13 to 16, 2014, and pumping was temporarily suspended. The sheen was removed using absorbent pads, and a vacuum truck was used to remove 26 m^3 of water from the south swale to keep water from overflowing the swale. Pumping into the water body resumed on December 15, 2014, when the laboratory reports were received. Daily monitoring of both the north and south sumps was conducted from November 18 to December 18, 2014.

With the fissure containment structures (FCSs) and access pad complete, and following the reinforcement of the containment wall (completed on December 18, 2014), the automated pumping systems and sumps were decommissioned. The area within the containment wall was allowed to naturally flood with water from the water body, restoring the water level in the contained area to that of the water body.

3.2 Water Quality Monitoring

Water quality was compared to the *Alberta Tier 1 Soil and Groundwater Remediation Guidelines* (ESRD 2014a) and/or *Environmental Quality Guidelines for Alberta Surface Waters* (ESRD 2014b).

3.2.1 Basins 1, 3, and 4, and Downstream Fen

The next scheduled sampling event is May 2015.

3.2.2 Containment Area

Samples of water from inside the north and south sumps (Figure 2) were obtained and tested in the laboratory for concentrations of petroleum hydrocarbons (PHCs). Results indicated that PHCs were not present at levels above relevant environmental guidelines, with the exception of pyrene in the south sump sample collected on December 13, 2014. Results are presented in Appendix A.

3.3 Aquatic Surveillance

Daily monitoring for bitumen emulsion and sheen within the water body was discontinued on November 8, 2014, due to freezing conditions. Monitoring for bitumen emulsion in the containment area dewatering sumps continued from November 18 to December 18, 2014.

3.4 Erosion and Sedimentation Prevention

The refilling activities were completed in accordance with the conditions specified in Extension 4 of the Water Body Restoration Plan (Matrix 2013).

- The erosion and sediment control monitoring was stopped due to winter conditions with the exception of turbidity monitoring related to dewatering of the containment area, which continued until December 18, 2014, when both automated pumping systems were decommissioned.

3.5 Bitumen Emulsion Containment

3.5.1 Containment of Bitumen Emulsion Seepage from Fissure

In early May 2014, the FCS was approved. A Canadian Natural construction crew built the FCS between May 4 and June 30, 2014. Following discussion with the Alberta Energy Regulator (AER) and ESRD, a revised design of the access pad was prepared and submitted to AER and ESRD for review and approval. Verbal approval to start construction was received and construction of the access pad over the FCS started on September 10, 2014. Construction of the pad was completed on October 26, 2014. As part of the design, bitumen emulsion recovery pipes were installed into the FCS.

3.6 Wildlife Management

No injured, distressed, or deceased wildlife were observed within or around the water body during this reporting period.

3.7 Waste Management

The recovery of fluids from the FCSs began on December 19, 2014. Approximately 511 m^3 of fluid was collected from the FCSs in vacuum trucks and transported to the Tervita Lindbergh facility during this reporting period.

4 Conclusions

The work conducted at the 9-21 FTS site from November 18 to December 31, 2014, included the following:

- removing water from within the containment area
- ongoing monitoring for signs of bitumen emulsion and sheen, discharge point erosion, and sedimentation related to dewatering of the containment area
- completing construction of the access pad over the fissure containment structures
- monitoring wildlife activity near the water body
- winterizing the site
- decommissioning the automated pumping systems and removing the south and north sumps within the containment area
- reinforcing the wall to maintain structural integrity throughout the winter

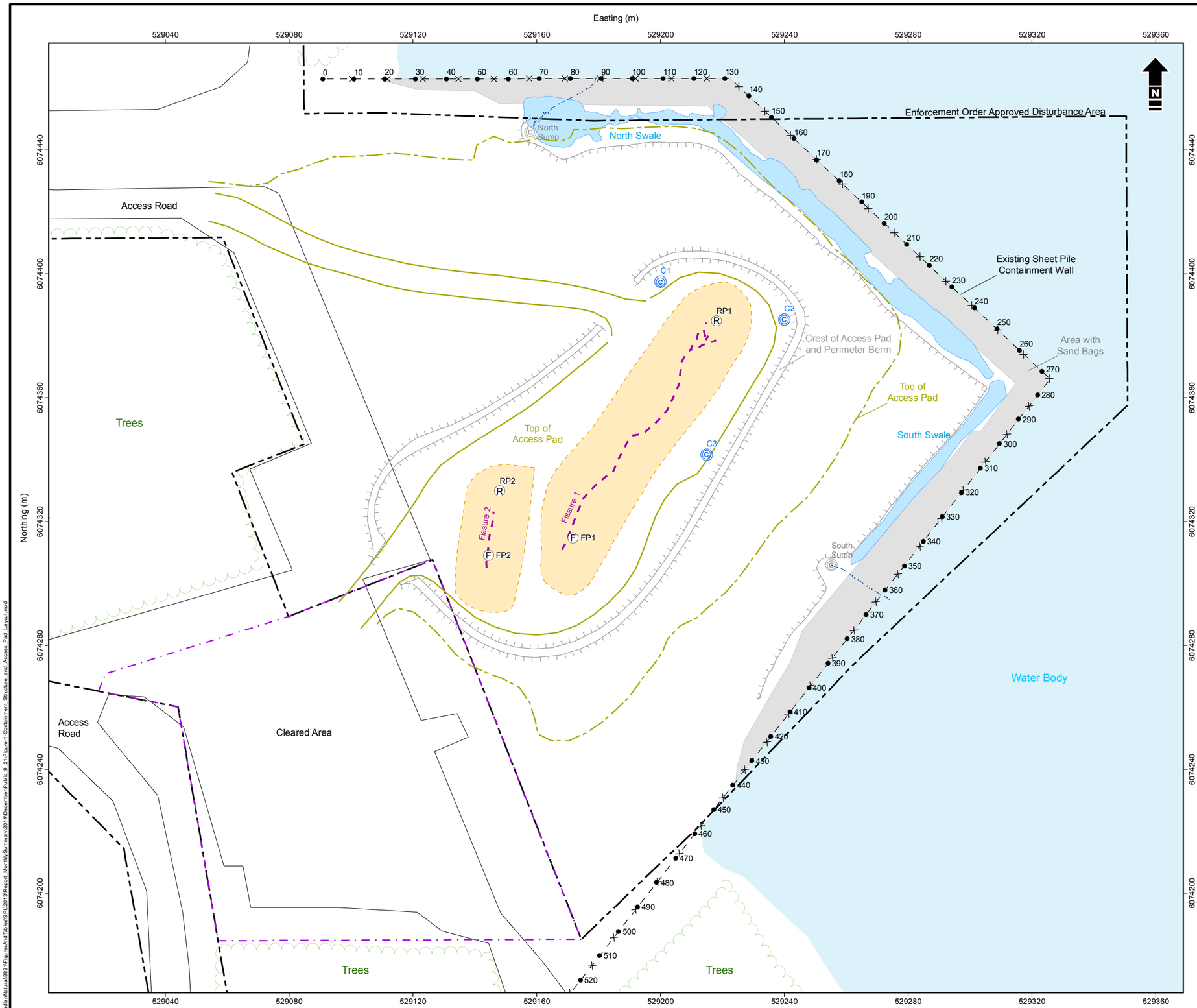
The work is progressing as planned and the objectives, as required by the EPO, are being achieved within the required time frame.

5 References

Alberta Environment and Sustainable Resource Development (ESRD). 2014a. *Alberta Tier 1 Soil and Groundwater Remediation Guidelines, 2014 and Updates*. Final Draft. Land and Forestry Policy Branch, Policy Division. Edmonton, Alberta. May 23, 2014. http://esrd.alberta.ca/lands-forests/land-industrial/inspections-and-compliance/documents/AlbertaTier1Guidelines-May23-2014.pdf

Alberta Environment and Sustainable Resource Development (ESRD). 2014b. *Environmental Quality Guidelines for Alberta Surface Waters.* Water Policy Branch, Policy Division. Edmonton, Alberta. July 14, 2014. ISBN: 978-1-4601-1524-4. http://esrd.alberta.ca/water/education-guidelines/documents/EnvironmentalQualitySurfaceWaters-Jul14-2014.pdf

Matrix Solutions Inc. (Matrix). 2013. *Water Body Restoration Plan Under EPO-2013-33/NR – Extension 4 – 2014 Erosion and Sedimentation Control.* Letter report prepared for Alberta Environment and Sustainable Resource Development on behalf of Canadian Natural Resources Limited. Calgary, Alberta. March 27, 2013.



Swale
Fissure Containment Structure
Berm
Former Discharge Line
Fissure within Containment Structure
Bitumen Recovery Pipe
Flush Pipe
Sheet Pile Wall Reference Station ID
Former Sump with Automated Pump
Water Collection Trench Recovery Sump

1:1,250
m
10 0 10 20

Reference: Site features provided through Matrix Solutions Inc. field efforts.

NAD 1983 UTM Zone 12N

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Primrose 09-21-067-04 W4M

Site 9-21 Containment Structure and Access Pad Layout

Date:	Project:	Technical:	Reviewer:	Drawn:
15 Jan 2015	8881-523	E. Henson	H. de Pennart	R. Keller

3
1

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Easting (m)

528400 528800 529200 529600 530000 530400 530800 531200 531600 532000 532400

Northing (m)

6076400 6076000 6075600 6075200 6074800 6074400 6074000 6073600 6073200

N

Decommissioned PIW System and Decommissioned Containment Cells D and E

Basin 4

Basin 3

Decommissioned Containment Cell C

Basin 1

Borrow Pit

Ken Baker Road

Decommissioned Containment Cells A and B

Pad AC21

North Sump

South Sump

- Borrow Pit
- Water Body
- Enforcement Order Approved Disturbance Area
- Additional Approved Area Under EO
- Road
- Watercourse
- Containment Wall
- Top of Access Pad
- Surface Water Sample Location

1:15,000 m

100 0 100 200

NAD 1983 UTM Zone 12N

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Primrose 09-21-067-04 W4M

Monitoring Plan Overview

Date:	Project:	Technical:	Reviewer:	Drawn:
15 Jan 2015	8881-523	E. Henson	H. de Pennart	R. Keller

Figure 2

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APPENDIX A
Water Quality Results

APPENDIX A1.

WATER QUALITY RESULTS - DISSOLVED HYDROCARBONS

Canadian Natural Resources Limited

09-21-067-04 W4M

Sample Point	Sample Date	Benzene mg/L	Toluene mg/L	Ethylbenzene mg/L	Xylenes mg/L	F1 C_6-C_{10} - BTEX mg/L	F2 $C_{>10}$-C_{16} mg/L	F3 $C_{>16}$-C_{34} mg/L	F4 $C_{>34}$-C_{50} mg/L
North Sump	04-Dec-14	<0.00040	<0.00040	<0.00040	<0.00080	<0.10	<0.10	---	---
South Sump	04-Dec-14	<0.00040	<0.00040	<0.00040	<0.00080	<0.10	<0.10	---	---
South Sump	13-Dec-14	<0.00040	<0.00040	<0.00040	<0.00080	<0.10	<0.10	<0.20	<0.20
South Sump	14-Dec-14	<0.00040	<0.00040	<0.00040	<0.00080	<0.10	<0.10	<0.20	<0.20
Minimal Detection Limit		**0.0004**	**0.0004**	**0.0004**	**0.0008**	**0.1**	**0.1**	**0.2**	**0.2**
Alberta Tier 1 - Coarse Grained Soils - Natural Areas*		**0.005^{P,MAC}**	**0.024^{P,AO}**	**0.0024^{P,AO}**	**0.3^{P,AO}**	**2.2^{P}**	**1.1^{P}**	**NS**	**NS**
ESRD Freshwater Aquatic Life*		**0.04**	**0.0005**	**0.09**	**0.03**	**NSST**	**NSST**	**NS**	**NS**

Notes:

NS - not specified

A - indicates guideline for Aquatic Life exposure pathway

P - indicates guideline for Potable Groundwater exposure pathway

AO - aesthetic objective

MAC - maximum acceptable concentration based on health effects

ST - see applicable guidelines for short-term exposure guideline

* - *Alberta Tier 1 Soil and Groundwater Remediation Guidelines* (AENV 2010)

** - Environmental Quality Guidelines for Alberta Surface Waters (ESRD 2014)

Italics - values do not meet applicable ESRD guidelines

APPENDIX A2.

WATER QUALITY RESULTS - POLYCYCLIC AROMATIC HYDROCARBONS

Canadian Natural Resources Limited

09-21-067-04 W4M

Sample Point	Date	Acenaphthene µg/L	Acenaphthylene µg/L	Acridine µg/L	Anthracene µg/L	Benz[a]anthracene µg/L	Benzo[b+j]fluoranthene µg/L	Benzo[k]fluoranthene µg/L	Benzo[g,h,i]perylene µg/L	Benzo[c]phenanthrene µg/L	Benzo[a]pyrene µg/L	Benzo[e]pyrene µg/L	Chrysene µg/L	Dibenz[a,h]anthracene µg/L	Fluoranthene µg/L	Fluorene µg/L	Indeno[1,2,3-cd]pyrene µg/L	Naphthalene µg/L	2-Methylnaphthalene µg/L	Perylene µg/L	Phenanthrene µg/L	Pyrene µg/L	Quinoline µg/L	TOTAL PAH µg/L
North Sump	04-Dec-14	<0.10	<0.10	<0.20	<0.010	<0.0085	<0.0085	<0.0085	<0.0085	<0.050	<0.0075	<0.050	<0.0085	<0.0075	<0.010	<0.050	<0.0085	<0.10	<0.10	<0.050	<0.050	<0.020	<0.20	ND
South Sump	04-Dec-14	<0.10	<0.10	<0.20	<0.010	<0.0085	<0.0085	<0.0085	<0.0085	<0.050	<0.0075	<0.050	<0.0085	<0.0075	<0.010	<0.050	<0.0085	<0.10	<0.10	<0.050	<0.050	<0.020	<0.20	ND
South Sump	13-Dec-14	<0.10	<0.10	<0.20	<0.010	<0.0085	<0.0085	<0.0085	<0.0085	<0.050	<0.0075	<0.050	<0.0085	<0.0075	<0.010	<0.050	<0.0085	<0.10	0.15	<0.050	<0.050	***0.026***	<0.20	0.176
South Sump	14-Dec-14	<0.11	<0.11	<0.22	<0.011	<0.0093	<0.0093	<0.0093	<0.0093	<0.055	<0.0082	<0.055	<0.0093	<0.0082	<0.011	<0.055	<0.0093	<0.11	<0.11	<0.055	<0.055	<0.022	<0.22	ND
Minimal Detection Limit		**0.1**	**0.1**	**0.2**	**0.01**	**0.0085**	**0.0085**	**0.0085**	**0.0085**	**0.05**	**0.0075**	**0.05**	**0.0085**	**0.0075**	**0.01**	**0.05**	**0.0085**	**0.1**	**0.1**	**0.05**	**0.05**	**0.02**	**0.2**	**-**
Alberta Tier 1 - Coarse Grained Soils - Natural Areas*		**5.8[A]**	**46[A]**	**NS**	**0.012[A]**	**0.018[A]**	**0.48[A]**	**0.48[A]**	**0.17[A]**	**NS**	**0.015[A]**	**NS**	**1.4[A]**	**0.26[A]**	**0.04[A]**	**3[A]**	**0.21[A]**	**1.1[A]**	**NS**	**NS**	**0.4[A]**	**0.025[A]**	**NS**	**0.01[P]**
ESRD Freshwater Aquatic Life*		**5.8**	**NS**	**4.4**	**0.012**	**0.018**	**NS**	**NS**	**NS**	**NS**	**0.015**	**NS**	**NS**	**NS**	**0.04**	**3**	**NS**	**1**	**NS**	**NS**	**0.4**	**0.025**	**3.4**	**NS**

Notes:

--- - not analyzed

ND - not detected

NS - not specified

A - indicates guideline for Aquatic Life exposure pathway

P - indicates guideline for Potable Groundwater exposure pathway

* - *Alberta Tier 1 Soil and Groundwater Remediation Guidelines* (AENV 2010)

** - Environmental Quality Guidelines for Alberta Surface Waters (ESRD 2014)

Italics - values do not meet applicable ESRD guidelines