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

OCTOBER 21 TO NOVEMBER 17, 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 that requirement and summarizes the progress towards the realization of the CRP and includes data collected and reported between October 21 and November 17, 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 October 20, 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. No new information to report.

3 Water Body Monitoring

In accordance with the Water Body Restoration Plan (Table 1, Item 9), 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 from the two sumps using automated sump pumps that were operational throughout the reporting period. A sheen was observed in the south sump on November 10, 2014 and pumping was suspended temporarily and the sheen was removed using absorbent pads. Sheen was not observed in the north sump or swale. Samples of water from inside the south and north sumps as well as from the south swale upstream of the south sump, were obtained and tested in the laboratory for concentrations of petroleum hydrocarbons (PHC). Results from the south sump, north sump and south swale upstream of the south sump (Upstream South) indicated that PHCs were not present. Results are presented in Appendix A1 and A2. Pumping into the water body resumed on November 12, 2014 when the analytical results were received. Daily monitoring of both the north and south sumps is being conducted and sheen has not been observed since November 10, 2014.

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, Containment Cells, and Potentially Impacted Water System

No water was treated and released through the Potentially Impacted Water (PIW) system during the reporting period as it was decommissioned on October 19, 2014.

3.3 Aquatic Surveillance

Daily monitoring for signs of bitumen emulsion (pellets or sheen) within Basins 1 and 3 of the water body was conducted and documented by third-party contractors engaged by Canadian Natural. The monitoring was completed by walking the shoreline and by boat on the water body. Monitoring for bitumen emulsion was discontinued on November 8, 2014 due to freezing conditions (Figure 3). Monitoring for bitumen emulsion in the containment area dewatering sumps will continue as long as pumping continues.

Sheen and bitumen emulsion pellets were observed in Basin 1 in the water body intermittently during the reporting period. The source of the sheen and pellets was attributed to small amounts of bitumen emulsion that were not cleaned from the water column and sediment after the original cleanup of bitumen emulsion release. All observed bitumen emulsion pellets and sheen were collected, using absorbent material, and disposed in the onsite hazardous waste bin. Over the reporting period, less than 0.5 L of bitumen emulsion has been collected from Basin 1.

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 (Table 1, Item 9).

- In order to winterize the site, all silt booms, baffles and Clearflow sediment control systems were removed from the water body and from the swales inside the containment area. The dewatering hoses were heat traced and a heater placed inside each sump to extend the pumping period into the winter months.

- 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 will continue as needed.

3.5 Bitumen Emulsion Containment

3.5.1 Containment of Bitumen Emulsion Seepage from Fissure

In early May 2014, the fissure containment structure (FCS) was approved. A Canadian Natural construction crew built the FCS between May 4 and June 30, 2014. Following discussion with 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. Bitumen recovery pipes were installed into the FCS. .

3.6 Wildlife Management

No injured or distressed wildlife was observed during this reporting period. From October 23 to October 24, 2014, wildlife deterrents and noise deterrents were removed from within the water body. Additional wildlife deterrents were removed from October 24 to 31, 2014. During the reporting period, no wildlife mortality was noted within or around the water body.

3.7 Waste Management

Transportation of materials temporarily stored in lined containment Cells C and D to the Tervita Bonnyville landfill for disposal started in August 2014. All waste material in the cells had been removed for disposal as of November 10, 2014. Between October 23 and November 11, 2014 all containment cells were decommissioned and their perimeter berms removed. The potentially impacted water treatment system at Cell D was decommissioned and removed between October 19 and 30, 2014. Post-construction confirmatory soil samples collected from the former containment cells and potentially impacted water system locations indicated that there were no impacts to the native soil from these temporary facilities.

4 Conclusions

The work conducted at the 9-21 FTS site from October 21 to November 17, 2014 included:

- transporting dewatered material from containment Cells C and D to the landfill for disposal
- decommissioning and removing two containment cells and the PIW treatment system
- 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 contained area
- completing construction of the access pad over the fissure containment structures
- monitoring wildlife activity near the water body
- winterizing the site

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

Easting (m)

529040 529080 529120 529160 529200 529240 529280 529320 529360

Northing (m)

6074440 6074400 6074360 6074320 6074280 6074240 6074200

N

Enforcement Order Approved Disturbance Area

North Sump

Access Road

Existing Sheet Pile Containment Wall

C1 C2 C3

RP1 RP2

Crest of Access Pad and Perimeter Berm

Area with Sand Bags

Toe of Access Pad

Top of Access Pad

Trees

Fissure 1 Fissure 2

FP1 FP2

South Sump

Water Body

Access Road

Cleared Area

Trees Trees

Swale
Fissure Containment Structure
Berm
Discharge Line
Direction of Flow
Fissure within Containment Structure
Bitumen Recovery Pipe
Flush Pipe
Sump with Automated Pump
Water Collection Trench Recovery Sump

1:1,250

m 10 0 10 20

NAD 1983 UTM Zone 12N

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

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Primrose 09-21-067-03 W4M

Containment Structure Sump Locations and Access Pad Layout

Date:	Project:	Technical:	Reviewer:	Drawn:
25 Nov 2014	8881-523	A. Ward	P. Hum	R. Keller

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Figure 1

I:\CanadianNatural\8881\FiguresAndTables\SPL\2013\Report_Monthly\Summary\2014\November\Public_9_21\Figure-1-Containment_Structure_Sump_Locations_and_Access_Pad_Layout.mxd

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

Upstream South

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

Reference: Data obtained from AltaLIS © Government of Alberta and GeoBase® used under license. GDM transportation infrastructure data provided by IHS © 2014 used under license. Site features provided through Matrix Solutions Inc. field efforts. Imagery (September 2014) obtained from Canadian Natural Resources Limited used under license.

1:15,000 m

100 0 100 200

NAD 1983 UTM Zone 12N

Canadian Natural

Canadian Natural Resources Limited

Primrose 09-21-067-04 W4M

Monitoring Plan Overview

Date:	Project:	Technical:	Reviewer:	Drawn:
25 Nov 2014	8881-523	E. Henson	P. Hum	C. Curry

Disclaimer: The information contained herein may be compiled from numerous third party materials that are subject to periodic change without prior notification. While every effort has been made by Matrix Solutions Inc. to ensure the accuracy of the information presented at the time of publication, Matrix Solutions Inc. assumes no liability for any errors, omissions, or inaccuracies in the third party material.

Figure 2

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Easting (m)

528880 528960 529040 529120 529200 529280 529360

Northing (m)

6074560 6074480 6074400 6074320 6074240 6074160

Enforcement Order Approved Disturbance Area

Trees

Access Road

North Sump

Existing Sheet Pile Containment Wall

Crest of Access Pad and Perimeter Berm

Top of Access Pad

Toe of Access Pad

South Sump

Water Body

Access Road

Cleared Area

Trees

Trees

N

Fissure Containment Structure
Berm
Fissure within Containment Structure
Bitumen Sheen Detected
Bitumen Detected
Sump with Automated Pump

1:2,000

20 0 20 40 m

NAD 1983 UTM Zone 12N

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

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Primrose 09-21-067-04 W4M

Aquatic Surveillance Site Plan

Date:	Project:	Technical:	Reviewer:	Drawn:
25 Nov 2014	8881-523	A. Ward	P. Hum	C. Curry

Figure 3

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Easting (m)

532080 532120 532160 532200 532240 532280 532320

Northing (m)

6076560 6076520 6076480 6076440 6076400 6076360

N

14-DP5 14-DP6 14-DP4 14-DP3 14-DP7 14-DP1 14-DP2

15-26 14-dis 2 15-26 14-dis 4 15-26 14-dis 1 15-26 14-dis 3

Trees

Trees

Mineral Surface Lease

C-Ring Storage Tank

Tanks

Pump

Treatment Building

Containment Cell E

Containment Cell D

Access Road

Trees

Discharge Area
Discharge Line
Intake Line
Soaker Line
Berm
Drivepoint Monitoring Well
Baseline Soil Sample Location
Post-Discharge Soil Sample Location
Pump

1:1,000

10 0 10 20 m

NAD 1983 UTM Zone 12N

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

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Primrose 09-21-067-04 W4M

Former PIW System Overview

Date:	Project:	Technical:	Reviewer:	Drawn:
25 Nov 2014	8881-523	A. Ward	P. Hum	C. Curry

Figure 4

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APPENDIX A
Water Levels and Pump Volumes

TABLE A1.

WATER QUALITY RESULTS - DISSOLVED HYDROCARBONS

Canadian Natural Resources Limited

09-21-064-04 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	10-Nov-14	<0.00040	<0.00040	<0.00040	<0.00080	<0.10	<0.10	<0.20	<0.20
South Sump	10-Nov-14	<0.00040	<0.00040	<0.00040	<0.00080	<0.10	<0.10	<0.20	<0.20
Upstream South**	10-Nov-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**
ESRD Freshwater Aquatic Life*		**0.04**	**0.0005**	**0.09**	**0.03**	**NSST**	**NSST**	**NS**	**NS**
ESRD Agriculture - Irrigation*		**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**
ESRD Agriculture - Livestock*		**NS**	**0.024**	**0.0024**	**NS**	**NS**	**NS**	**NS**	**NS**

Notes:

--- - not analyzed

NS - guideline not specified

ST - see applicable guidelines for short-term exposure guideline

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

** - location in south swale upstream of south sump

Italics - indicates values do not meet applicable guidelines

TABLE A2.

WATER QUALITY RESULTS - POLYCYCLIC AROMATIC HYDROCARBONS

Canadian Natural Resources Limited

09-21-064-04 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	10-Nov-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	10-Nov-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
Upstream South**	10-Nov-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
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**	**-**
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**
ESRD Agriculture - Irrigation*		**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**
ESRD Agriculture - Livestock*		**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**

Notes:

--- - not analyzed

NS - not specified

ND - not detected

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

** - location in south swale upstream of south sump

Italics - indicates values do not meet applicable guidelines