
Jean Marie River Well Inspections

Jean Marie River, NT, July 21-23, 2014



The Office of the Regulator of Oil and Gas Operations

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Executive Summary

OROGO was informed of the concerns of members of the Jean Marie River First Nation about five wells on lands where they traditionally hunt and trap in late May 2014. The wells identified were drilled between 1952 and 1970 and were licensed to explore for hydrocarbons. The wells ranged in depth from approximately 1940 to 2580 feet. All of the wells were dry and abandoned¹.

From July 21 to 23, 2014 a team of technical experts from OROGO inspected the wells. The wells are located in muskeg and forested areas. Four of the five wells were found. At each of the wells that was found, testing for wellbore leakage was done using an electronic analyzer and physical observation. In one case, a Forward Looking Infra-red Camera (FLIR) was used.

Visual observations revealed that all vegetation in proximity to the wells was in a consistent state with surrounding vegetation. Based on a review of the well records and the inspection, OROGO is satisfied that the subject wells were abandoned in accordance with the regulatory requirements of the day and, at the time of the field study, appear to be in a safe condition (abandoned, cut, and capped). There were minor amounts of thermogenic gas detected at the Cdn Sup KMG JM B-48 well; however at this point in time there is extremely low risk to public safety and the environment. The results of the inspection are summarized in table 1.

¹ Dry and abandoned – terms used to describe a well that upon drilling was deemed incapable of commercial hydrocarbon production

Table 1: Well Inspection Results

Well Name	Wellbore Condition	Surrounding Area	Results
Jean Marie J-52	<ul style="list-style-type: none"> • No methane detected • Marker and casing cap in good condition 	<ul style="list-style-type: none"> • No signs of vegetation stress 	<ul style="list-style-type: none"> • Properly abandoned
Jean Marie B-48	<ul style="list-style-type: none"> • Minimal amounts of methane detected from top of marker • Wellhead marker at angle 	<ul style="list-style-type: none"> • No signs of vegetation stress 	<ul style="list-style-type: none"> • Thermogenic gas samples recovered • Recommended site visit during spring thaw
Jean Marie Creek No. 1	<ul style="list-style-type: none"> • No methane detected • Marker and casing cap in good condition 	<ul style="list-style-type: none"> • No signs of vegetation stress 	<ul style="list-style-type: none"> • Properly abandoned
Westerol 3-A	<ul style="list-style-type: none"> • No methane detected • No marker, casing cap in good condition 	<ul style="list-style-type: none"> • No signs of vegetation stress 	<ul style="list-style-type: none"> • Properly abandoned
Westerol No. 7-A	<ul style="list-style-type: none"> • Wellbore not located 	<ul style="list-style-type: none"> • Vegetation in area dense and overgrown 	<ul style="list-style-type: none"> • Wellbore not located

Members of the Jean Marie River First Nation provided essential support in locating the wells and sound historical background information. From the initial community meeting through to the guidance and support that members of the community provided, OROGO appreciated their initiative, contribution and effort.

1 Introduction

The Office of the Regulator of Oil and Gas Operations (OROGO) was established on April 1, 2014 in accordance with the Devolution Agreement. Of the many responsibilities of OROGO, one of the most important is to engage with communities throughout the Northwest Territories on the regulation of oil and gas activity – both existing operations and legacy infrastructure. As stated by the Honourable David Ramsay, the Regulator, “We want to ensure regulatory practices reflect the needs and priorities of NWT residents, provide industry with a clear outline of the territory’s regulatory process and support responsible development.” Consistent with this message, OROGO encourages members of the public to advise it if they have concerns or notice abnormal activity with respect to oil and gas operations or legacy infrastructure.

In April 2014, the Jean Marie River First Nation (JMRFN) raised concerns about the condition of five abandoned wells with Minister Ramsay during a community visit. The wells were drilled and abandoned between 1952 and 1970 in the traditional harvesting areas of the JMRFN. These concerns were relayed through the Client Service and Community Relations (CSCR) unit of Industry, Tourism and Investment (ITI) to Michael Vandell, Community Relations Advisor (ITI) to James Fulford the Executive Director of OROGO on May 27, 2014 at a meeting in Yellowknife. The community reported that concerns regarding these five wells had been brought to the attention of the National Energy Board and Aboriginal Affairs and Northern Development Canada, prior to the establishment of OROGO.

On July 9, 2014, OROGO staff traveled to Jean Marie River for a planning meeting with Chief Stanley Sanguéz, band councilors and community members, along with staff from CSCR. The discussions were positive and Chief Sanguéz indicated a desire to partner with OROGO on the inspections, which were scheduled for late July. JMRFN was able to provide food and accommodations for the inspection team, guides, bear monitors and piloted boats to access the well sites.

2 Inspection Methodology

2.1 Inspection Team

The inspection team consisted of:

Brent McGarry (Sr. Technologist, Alberta Energy Regulator (AER)) – Brent has been with the AER for almost 15 years. He has an academic background in environmental sciences and has worked as an inspector with the AER focusing on drilling and servicing and facility inspections. In the past six years Brent has specialized in abandoned well gas migration testing in Alberta. Brent has tested hundreds of abandoned wells for surface casing vent flows and gas migration.

Al Duben (Sr. Technical Expert, AER) – Al has an extensive background of over 30 years in air quality testing both in B.C. and Alberta. Al has been the team leader of the AER's monitoring team for more than ten years. Al has worked on a number of the Alberta Airshed committees and on several of the AER's special assignments when there is a requirement for specialization in air quality testing.

Robin King (Executive Lead, AER) – Robin has diplomas in Petroleum Geology and Environmental Sciences. He has been with the regulatory agency in Alberta for 32 years. From 2005 to 2011 he was the Manager of Field Surveillance and Public Safety. In 2011 he became the Executive Manager/VP of Field Surveillance and Technical Operations and in 2014 became the Executive Lead of Corporate Initiatives in the Strategy and Regulatory Division.

Mischa Malakoe (Technical Specialist, OROGO) – Mischa recently earned a degree in Mechanical Engineering. Mischa has gained technical expertise in the oil and gas field with various co-operative work terms, notably as a Production Engineer and Field Operator.

The team was assisted with the local knowledge and expertise from JMRFN community members Mr. Angus Sanguiez and Mr. Richard Sanguiez, Elders Mr. Ernest Hardisty and Mr. Douglas Norwegian Sr. and Michael Vandell (ITI).

2.2 Monitoring Equipment Used

2.2.1 SENSIT Portable Methane Detector

The technical team used a portable methane detector (PMD) to measure any traces of methane escaping from the wellbore. The PMD isolates methane and filters out other gases in the ppm² range. The device can detect methane in amounts as small as 1

² Wikipedia - Parts per million (ppm) - *One part per million* (**ppm**) denotes one part per 1,000,000 parts, one part in 10⁶, $1/1,000,000 * 100\% = 0.0001\%$ (or $1\% = 10,000$ ppm), and a value of 1×10^{-6} . This is equivalent to one drop of water diluted into 50 liters (roughly the fuel tank capacity of a compact car) or about 32 seconds out of a year.

ppm. The PMD was used at each of the wells to detect even the slightest signs of methane. The photos below depict a PMD unit similar to the one used at the well sites.



Photo 1: SENSIT PMD [©SENSIT Technologies]³

2.2.2 FLIR Camera

The forward looking infra-red (FLIR) camera is used to observe gas leaks that are invisible to the human eye. The camera captures infrared radiation using imaging technology to create a picture for video output. The camera was used on one occasion to determine whether gas was coming up through the marker pipe or surrounding soil. The photo below shows a FLIR camera similar to the one used during the inspection.

³ SENSIT Technologies. (n.d.). SENSIT® PMD Portable Methane Detector. Retrieved July 30, 2014, from http://www.gasleaksensors.com/products/sensit_pmd.html



Photo 2: FLIR Camera [FLIR®]⁴

2.2.3 H₂S Monitors

Inspectors carried portable hydrogen sulphide monitors on their persons during the site visits. These are a precautionary measure to detect any sour gas. Based on the information in the well files, the occurrence of H₂S at any of these abandoned wells was judged extremely unlikely by the inspection team. No H₂S was detected during the inspections.

3 Well Inspections

Jean Marie River community members and elders had raised concerns to Jean Marie River First Nation leadership regarding the conditions of five abandoned wells within the traditional hunting and fishing lands near the community. Joined with the assistance of JMRFN members, the inspection team visited JMR from July 21-23, 2014 to locate and inspect the abandoned wells. Using the GPS coordinates and with the knowledge of

⁴ FLIR Systems, Inc. (n.d.). Thermal Imaging for Natural Gas Detection. Retrieved July 30, 2014, from <http://www.flir.com/thermography/americas/ca/view/?id=49562>

local guides, the inspection team set out to locate and determine the current condition of these wells. It was established that two of the wells are in remote areas and require access by helicopter. The three remaining wells are accessible from the Mackenzie River by boat to reach the banks where the team could then hike in to each well.

Historical well records for two of the wells showed that at the time of drilling no gas was recovered during the tests and that all of the wells inspected were deemed “dry” post drilling operations. As a result, they were subsequently abandoned shortly after they were finished being drilled. The following section explains the information obtained from the well file prior to the visit, along with information gathered from the inspection of each well. A map showing the following five wells of concern can be found in Appendix A.

3.1 Jean Marie J-52

3.1.1 Technical Information

Cdn Sup KMG JM J-52

Lat: 61° 31' 30" N

Long: 120° 25' 00" W

Drilled: Jan 23, 1970

Abandoned: Feb 6, 1970

Open Hole Completion

Total Depth: 2200 ft

Surface Casing: 460 ft

3.1.2 Background Information

Well J-52 is located east and slightly south of the community of JMR on the east side of the Mackenzie River. The well is only accessible by helicopter in the summer months and is approximately 11kms from the community.



Photo 3: Jean Marie J-52 Well

3.1.3 Inspection Results

The well is surrounded with secondary growth and located on solid ground (approximately 25m radius). Beyond the well site is muskeg and dense vegetation. The well site was located by local guide (Mr. Ernest Hardisty). The site was situated on solid ground at the edge of a muskeg clearing. The well was marked with a 2.5m steel pipe (5cm diameter) welded to the cap. The well site can be seen in photo 3, with additional photos in Appendix B.

Monitoring was conducted using a Portable Methane Detection unit (PMD). The ground surface was tested using the PMD wand, no methane was detected within proximity of the

wellbore. The soil was also tested for methane using monitoring cups⁵ in several locations surrounding the casing. No evidence of methane was present.

A visual inspection showed signs of healthy vegetation in all surrounding areas. There was no apparent evidence of vegetation stress. A 0.75m section of hydraulic hose was discovered approximately 15m from the well site (photos in Appendix B).

⁵ Round metal cups dug into soil to gather gas reading for PMD (photos in Appendix B)

3.2 Jean Marie B-48

3.2.1 Technical Information

Cdn Sup KMG Jm B-48

Lat: 61° 27' 10" N

Long: 120° 38' 16" W

Drilled: March 4, 1969

Finished Drilling: March 14, 1969

Open Hole Completion

Total Depth: 2576 ft

Surface Casing: 463 ft

3.2.2 Background Information

Well B-48 is located south and slightly west of the community of JMR (approximately 8kms). The well is located proximal to the intersection of two cut-lines (one running NE-SW and the other running NW-SE). The well was accessed by helicopter.

3.2.3 Inspection Results

From the air, the well seemed to be located in a flat open area, however, at ground level, the area was vegetated with willows and smaller shrubbery. The well marker was discovered to be surrounded by a large ant hill. The 2m steel pipe identifying the well was at a slight angle (see photo 4).



Photo 4: Jean Marie B-48 Well

Methane detection was conducted using a Portable Methane Detection unit (PMD). The ground surface was tested using the PMD wand, no methane was detected within

proximity of the wellbore. The soil was then tested using monitoring cups in several locations surrounding the casing. No evidence of methane was present.

The wand was then held on top of the steel marker pipe and a peak reading of 500 ppm of methane was taken. To obtain a gas sample, the top of the pipe was taped shut for five minutes and a sample was then collected. A very small amount of gas was released when the tape was lifted, and the gas quickly dissipated. A forward looking infra-red (FLIR)⁶ camera was used to observe the gas exiting the pipe. The volume of gas released was extremely small, making it difficult to capture the release on the FLIR camera.

Gas samples from the B-48 well marker were collected and forwarded to GCHEM Ltd. for analysis, characterization and classification. High resolution compositional analysis (HRCA) of the soil gas samples indicated the presence of elevated (above expected baseline) levels of light alkane hydrocarbons⁷. This well is impacted by leaking natural gas from a thermogenic source⁸. The gas samples were highly degraded by the time they arrived at the laboratory, potentially as a result of active microbial activity. Therefore, a particular geologic formation from which the gas originated could not be determined.

The well file indicated that a steel plate was welded to the casing of the well and a steel pole was erected as an ID marker. The wellbore and the steel pipe/marker should not

⁶ See Section 2 for a description of the FLIR.

⁷ Light alkane hydrocarbons include the petroleum gases: methane, ethane, propane, butane.

⁸ Biogenic vs. Thermogenic gas: Biogenic referring to anaerobic **bacterial decomposition**. Thermogenic referring to the thermal cracking at high temperatures of sedimentary organic matter into **hydrocarbon liquids and gas**.

be connected in a way that would allow gas to escape through the marker. It is curious as to where the gas in the steel pipe could be originating. Given the fact the marker pipe was at a slight angle, the pipe may have detached from the steel plate.

Aerial reconnaissance showed a low-lying area near the wellbore which could be the remnants of a drilling sump used when drilling the subject well. The low-lying area identified from the air, located approximately 15m from the well, was found to have abundant vegetation. There were no signs of hydrocarbons and no sheen present on the surface of the water.

A visual inspection showed signs of healthy vegetation in all surrounding areas. There was no apparent evidence of vegetation stress. A small section of hydraulic hose was found 200m from the well site.

3.3 Jean Marie Creek No.1 (B-43)

3.3.1 Technical information

BA HB JM Creek #1
Lat: 61° 32' 00" N
Long: 120° 38' 15" W
Drilled: Aug 20, 1953
Open Hole Completion
Abandoned: Sept 30, 1953
Total Depth: 2111 ft
Surface Casing: 91 ft

3.3.2 Background information

JMC No.1 Well is located in proximity of the community of Jean Marie River. Roughly a kilometer away and across the Jean Marie Creek, the well is found within meters of a wood cutting trail. The trail is used by community members in the winter time to cut and gather firewood. The well site was accessed by boat on the shore of the Mackenzie

and a hike approximately 300m down the trail. The well may be accessed by snowmobile in the winter.

3.3.3 Inspection results

With the help of local guide (Mr. Angus Sanguéz), the well was discovered amongst a clump of spruce trees. A 1m steel pipe (5cm diameter) was welded to the cap of the well. The rusted steel pipe proved to be very difficult to see between trees of similar

diameter as (see photo 5).

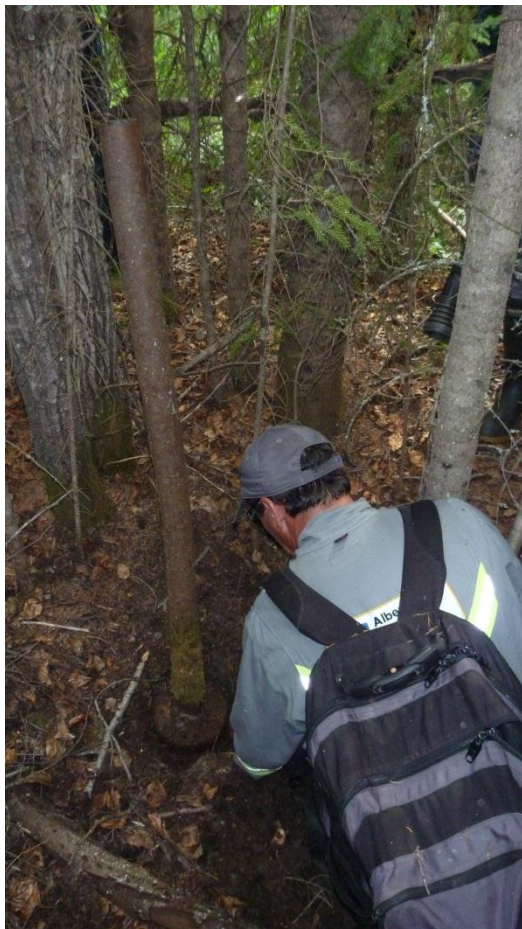


Photo 5: Jean Marie Creek No.1 Well

Methane detection was conducted using a Portable Methane Detection unit (PMD). The ground surface was tested using the PMD wand, no methane was detected within proximity of the wellbore. The soil was then tested using monitoring cups in several locations surrounding the casing. No evidence of methane was present. A visual observation of the surrounding site was conducted by the team members. There were no obvious signs of vegetation stress either in the trees or low-lying shrubs. There was no other evidence of drilling activity in the area such as a drilling sump or left over materials.

3.4 Westerol 3-A (G-77)

3.4.1 Technical Information

Westerol 3-A

Lat: 61° 46' 26" N

Long: 120° 43' 48" W

Drilled: July 1, 1952

Open Hole Completion

Abandoned: July 31, 1952

Total Depth: 2422 ft

Surface Casing: approx. 300-400 ft

3.4.2 Background information



Photo 6: Westerol No. 3-A Well

Westerol 3-A is located downstream of JMR on the west bank of the Mackenzie River. The well is almost directly across from the mouth of Rabbit-Skin River. The well is at the top of a steep bank and is accessible by boat and a hike onto the flats in a densely treed area.

3.4.3 Inspection Results

The well was marked with a surveying stake, not with a steel pipe/marker as was seen on the previous wells. The wellbore was difficult to locate without a steel pipe to stand out among the thick brush (photo 6).

Methane detection was conducted using a Portable Methane Detection unit (PMD). The ground surface

was tested using the PMD wand, no methane was detected within proximity of the wellbore. The soil was then tested using monitoring cups in several locations surrounding the casing. No evidence of methane was present. A visual inspection showed signs of healthy vegetation in all surrounding areas. There was no apparent evidence of vegetation stress. Some corroded metal cans were discovered 15m from the well site (photos in Appendix B).

3.5 Westerol No. 7A (A-80)

3.5.1 Technical information

Westerol No. 7-A (Petcal Ltd.)
Lat: 61° 39' 13" N
Long: 120° 43' 34" W
Drilled: July 20, 1952
Open Hole Completion
Abandoned: Aug. 20, 1952
Total Depth: 1940 ft
Surface Casing: 91 ft

3.5.2 Background Information

Westerol No. 7A is located downstream from JMR on the Mackenzie River. The well is on the west bank of the river and upstream from Westerol 3-A.

3.5.3 Inspection Results

The inspection team, along with local guides, searched the vicinity but was unable to locate the well marker. The suspected area where the well is located was covered in thick deadfall and brush growing underneath. There were no signs of any disturbance or evidence of drilling activity in the general area where the well is believed to be. It should be noted that Westerol No. 7A was drilled in the same year as Westerol No. 3-A with similar open hole completions and abandonment operations.

4 Conclusions and Recommendations

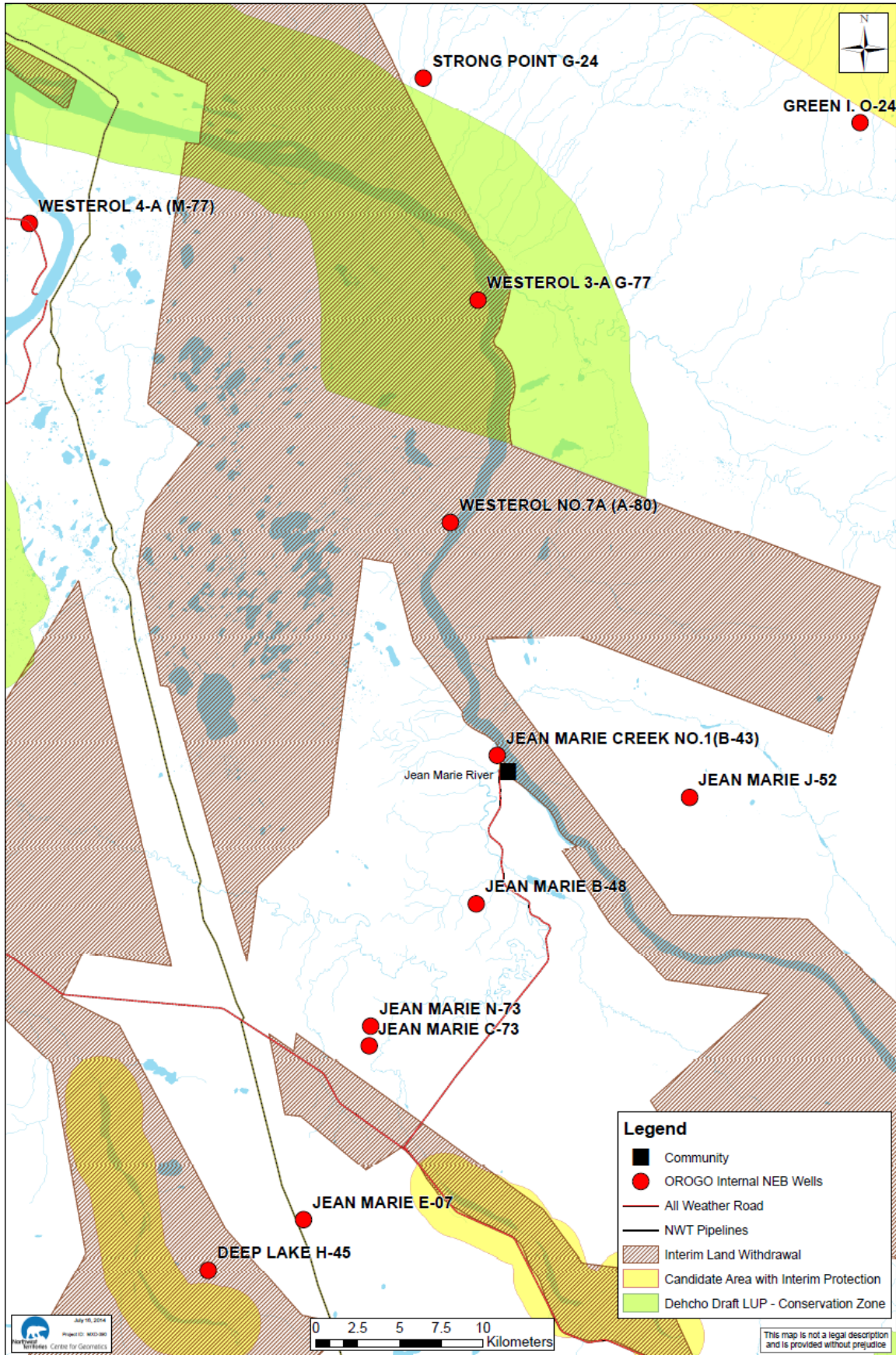
Based on the testing conducted by the team, the visual observations and the review of the well files, the team has determined that:

- Three of the four wells which were inspected were abandoned in accordance with the requirements at the time of abandonment and are at extremely low risk for migration of liquids or gases from the wellbore.
- Further testing and monitoring is recommended for the fourth well (B-48).

All but one of the wells tested during the subject inspections had zero readings of methane. For Jean Marie B-48, the findings on July 21 recovered a very small amount of methane gas. Given that the well is in a remote area and the volume of gas detected is extremely low, the current situation is a low risk to public safety and environmental impact. Further testing is recommended to confirm the source and determine if the rate of release of gas varies with time.

The area surrounding the recorded location of Westerol No. 7-A, which was not located, showed no signs of any disturbance or stressed vegetation. A drill stem test conducted in 1952 (prior to abandonment) showed no signs of gas in the wellbore in question (Westerol 7-A). Based on this and similar abandonment protocol to Westerol No. 3-A (and date drilled), the two wells are thought to be in similar condition with extremely low risk of gas migration.

APPENDIX A: JMR Map



APPENDIX B: Inspection Photos



J52 Well: Hydraulic hose found near well



J52 Well: Methane detection



J52 Well: Well-site vegetation



J52 Well: Wellhead marker pipe



J52 Well: Methane detection



J52 Well: Showing scale of vegetation



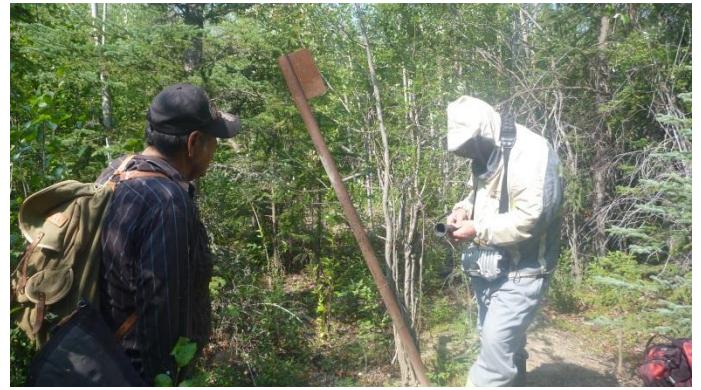
B-48 Well: Wellbore marker



B-48 Well: Wellbore marker tag



Team during helicopter safety orientation



B48 Well: Methane monitoring



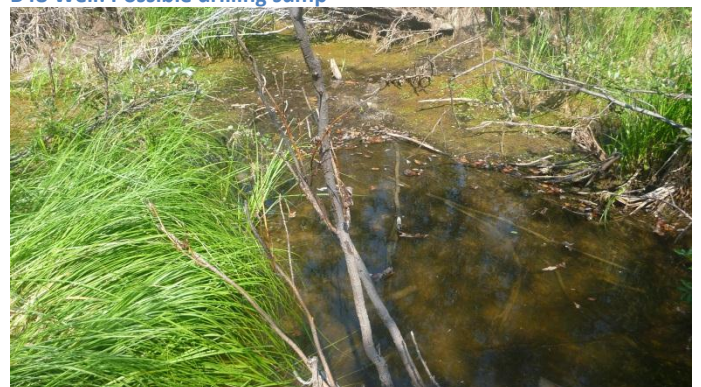
J52 Well: Well-site vegetation



B48 Well: Possible drilling sump



Team in helicopter travelling from J52



B48 Well: Possible drilling sump



Team in helicopter travelling from J52



B48 Well: Possible drilling sump



Team on Mackenzie River



Team on Mackenzie River



Team on Mackenzie River



Team on Mackenzie River



Team on Mackenzie River



Team on Mackenzie River



JMR No. 1 Well: Uncovering wellhead and cap



JMR No. 1 Well: Methane detection



JMR No. 1 Well: Dense vegetation



JMR No. 1 Well: Dense vegetation



Returning to JMR on Mackenzie



Jean Marie River Community



Jean Marie River Community



Old rusted drums found near Westerosl 3A site



Old rusted drums found near Westerosl 3A site



Westerol 3A Well: Uncovered wellbore cap



Westerol 3A Well: Vegetation near the wellbore



Westerol 3A Well: Unearthed wellbore cap



Westerol 3A Well: Wellhead with soil detector cap



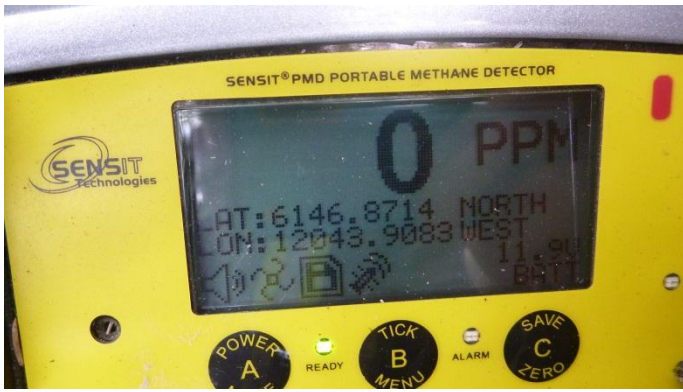
Westerol 3A Well: Methane detection



Westerol 3A Well: Vegetation around wellbore



Westerol 3A Well: Nearby slough and vegetation



PMD Display



Westerol 3A Well: Nearby slough and organic matter



Westerol 3A Well: Nearby slough and vegetation



Black bear on bank of Mackenzie



Coast Guard headed down Mackenzie



Eagle on bank of Mackenzie



Returning to JMR on river