

SWEET AND SOUR: A *UNIQUE CASE STUDY OF ORPHANED WELL ABANDONMENTS IN THE NORTHWEST TERRITORIES*

PRESENTED BY:

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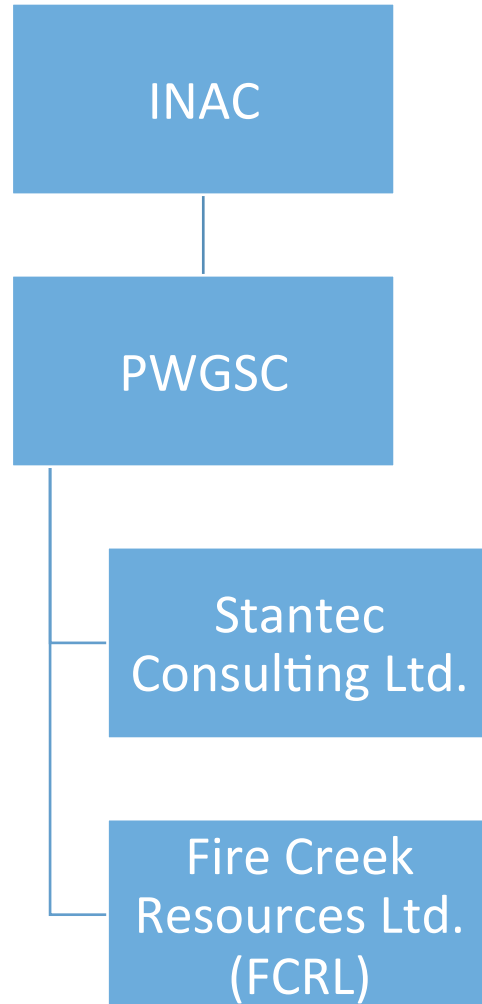


K'atl'Odeche First Nation



- Introduction/Overview
- Wells History and previous work
- Scope/Timeline/Logistics of work
- Procurement/Tender
- Successes/Results





- Indigenous and Northern Affairs Canada (INAC)
 - Emma Pike - Project Manager, Contaminants and Remediation Division (CARD), NWT Region, NAO INAC/ Government of Canada
- PWGSC - Northern Contaminated Sites
 - Matthew McElwaine, P. Eng. - Senior Environmental Engineer
- Departmental Representative - Stantec Consulting Ltd.
 - Michael Doucet - Environmental Project Manager
- Contractor - Fire Creek Resources Ltd (FCRL)
 - Dean Casorso, CET MBA – Senior Well Construction Specialist

Introduction - Project Summary

- The major scope of the project was the abandonment or re-abandonment of three sour gas* wells, requiring the mobilization of a drilling rig to re-drill 3 wells and abandon the wells properly.
- Other tasks included cut and cap the above 3 wells if successful, cut and cap 2 other wells that were properly abandoned and cleanup debris from around the area.

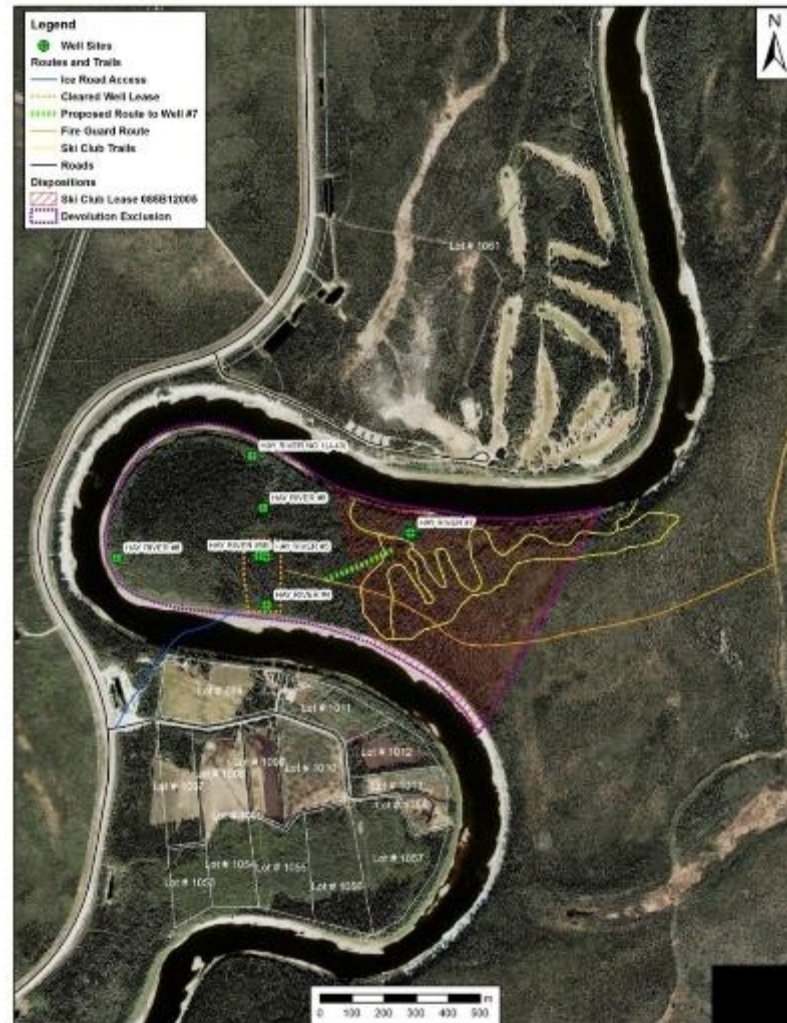
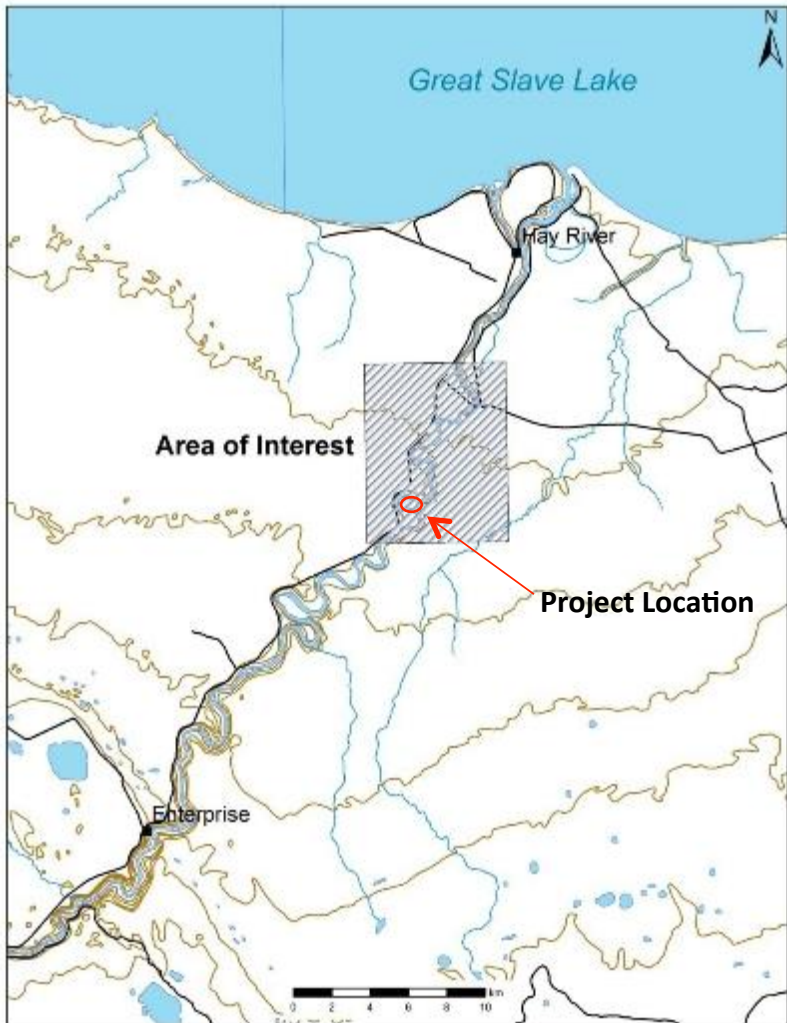
*Sour gas is natural gas or any other gas containing significant amounts of hydrogen sulfide H₂S. What is significant? Really any measured in ppm



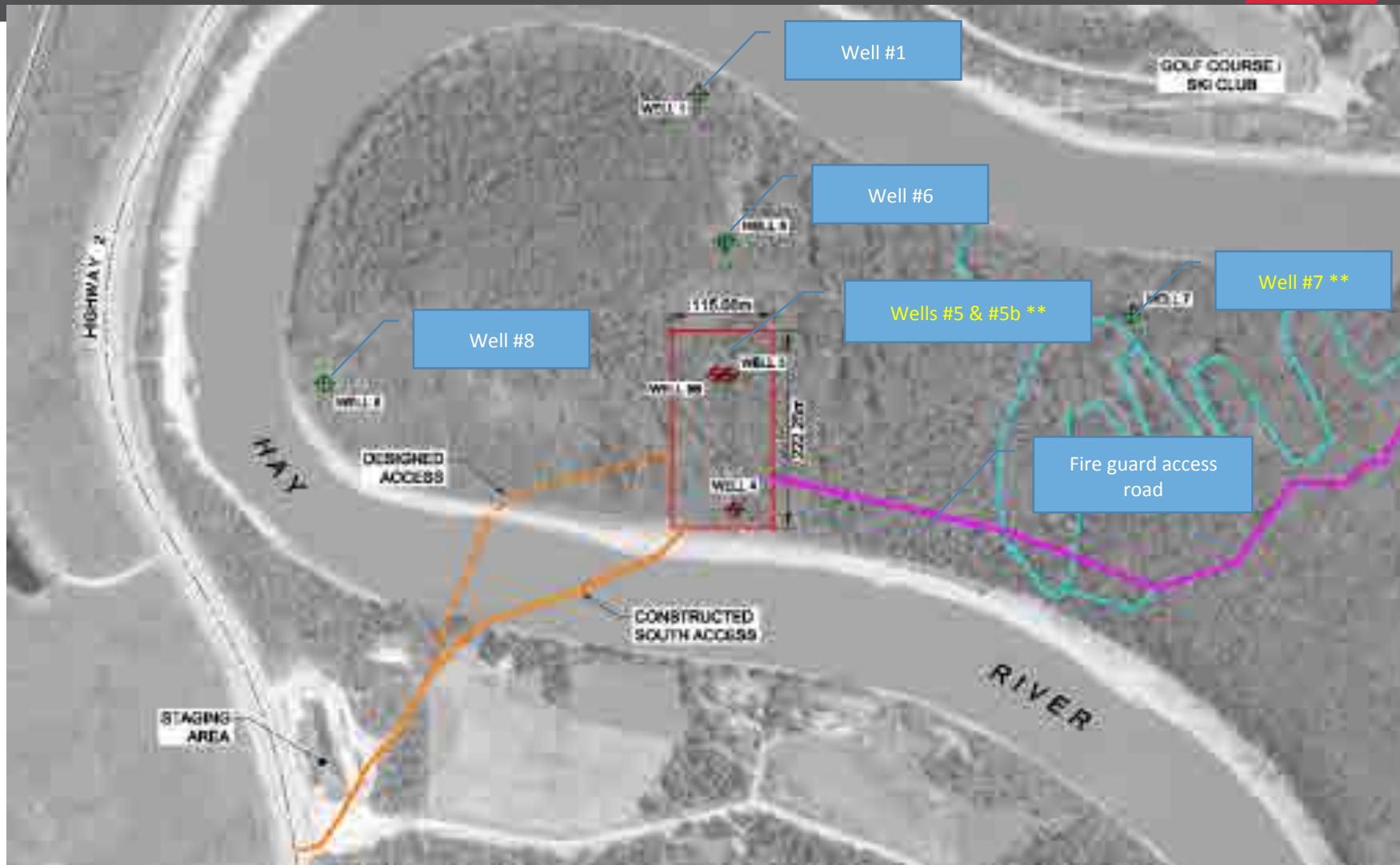
- There were 7 exploration wells were drilled between 1922 and 1947 by two companies, Beaver Oil Company Ltd. and Frobisher Exploration Company Ltd.
- In 2005, three wells were found to be leaking trace amount of H₂S or have the potential to leak H₂S Gas (#4, #5, #5B).
- No rightful successor was found to the former exploration companies and AANDC, as the manager of Crown Lands in the NWT, became responsible for the management of these “Orphan” Wells as per NEB direction.
- Note: Site on Crown land, excluded from Devolution. Access to site across GNWT Public Lands



Wellsite Locations



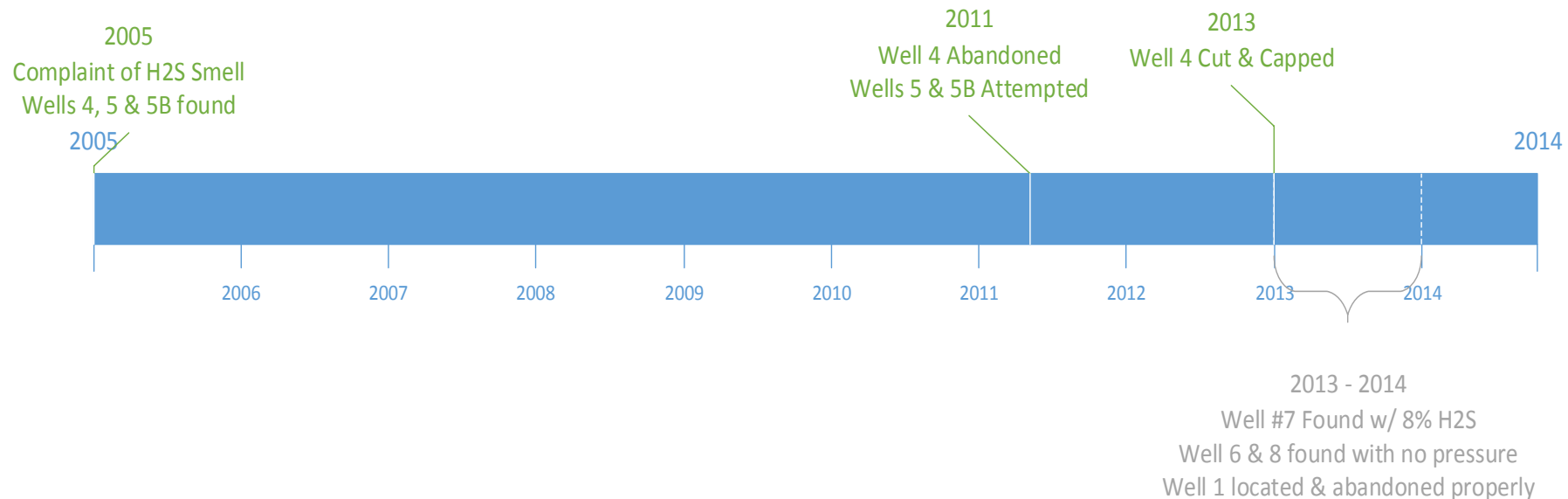
Location of Wells



**Sour gas wells

Work Completed 2005 to 2014

- 2011 – Abandonment Program - Wells #4, #5 and #5b were re-entered resulting in the abandonment of Well #4.
- 2013 – Well #4 was cut, capped and properly abandoned.
- 2013 & 2014 investigations found:
 - Well #7 contained 8% H₂S with a corroded well casing. An H₂S sensor was installed and an attempt at flaring resulted in a pressure bled off to zero.
 - Wells #6 and #8 were found to have no pressure; gas migration tests were negative.
 - Well #1 was located and found to be properly abandoned.



- Mobilize to site by ice bridge or longer winter road route
- Re-Abandonment of Sour Gas Wells
 - Well 5
 - Well 5B
- Abandonment of Sour Gas
 - Well #7
- Cut and Cap properly abandoned Wells:
 - Well #6
 - Well #8
- Well #1 – Debris removal
- Drilling and demobilization will be completed by March 31, 2015
- Cut and Cap if abandonments are successful, Summer 2015

- Construction began on Feb. 4 – clearing, profiling, flooding
- Ice Bridge Suitable for Heavy Traffic – Feb 27
- Rig move across the Hay River - Feb 27
 - Rig was moved to staging area prior to moving across the Hay River
- Decommissioning of the Ice Bridge & Snow Ramps to the area – Mar 29 – Apr 1



- Problem Presented:
 - An abandonment of the well was attempted in 2011. The well continued to leak from the surface casing.
- Timeline
 - Started Rig Move – Feb 27
 - Finished Drilling – Mar 6
- Casing was set in this well to total depth.
- A small leak persisted and a cement squeeze was completed – Mar 29
- Gas Migration testing & Surface Casing Vent Flows completed and passed – Sept 10
- Cut and Cap completed - Oct 2



- Problem Presented:
 - An abandonment of the well was attempted in 2011. The well continued to leak from the outside surface casing.
- Timeline
 - Started Rig Move – Mar 7
 - Finished Drilling – Mar 11
- Casing was set in this well to total depth.
- A small leak persisted and a cement squeeze was completed – Mar 29
- Gas Migration testing & Surface Casing Vent Flows completed and passed – Sept 10
- Cut and Cap completed - Oct 2



- Well 7 presented with the existing casing in the well with sour gas leaking at low pressures.
- Freezing the well to gain control of the gas:



- Conductor installed over the old casing.



- Timeline:
 - Attempts to kill the well started – Mar 6
 - Freezing Operations – Mar 12 to Mar 13
 - Rig on Well – Mar 13
 - Fishing Operations – Mar 13 to Mar 15
 - Finish Drilling and casing well – Mar 17
- Gas Migration testing & Surface Casing Vent Flows completed and passed – Sept 10
- Cut and Cap completed - Oct 2

- Fish pulled from the well



Wells 1, 6 & 8

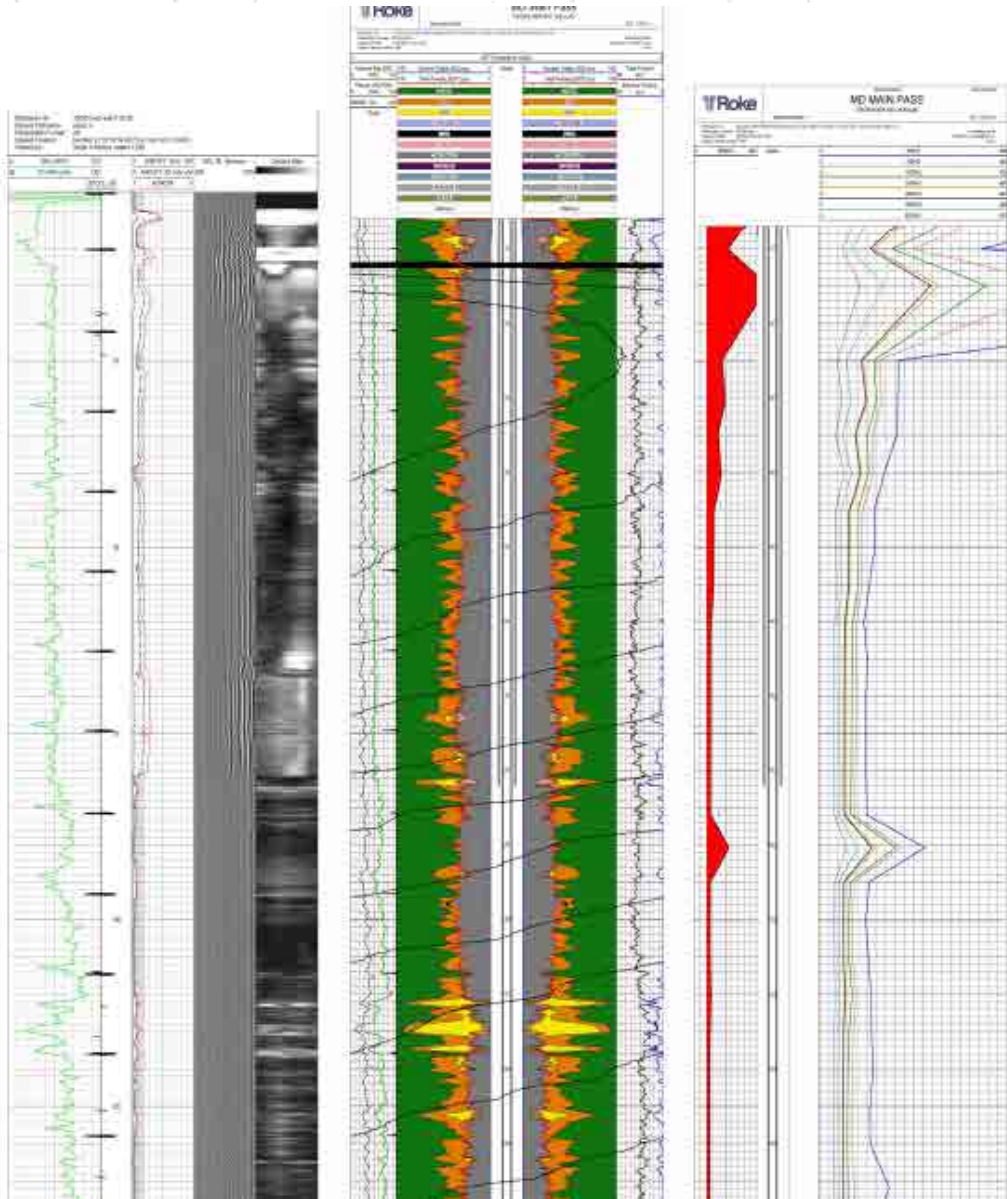
- Cut and Cap Completed
 - Well #8 – Mar 10
 - Well #6 – Mar 13
- Cleanup around well 1
 - The metal and other debris from around well 1 was removed.



Well 6 – Cut and Capped



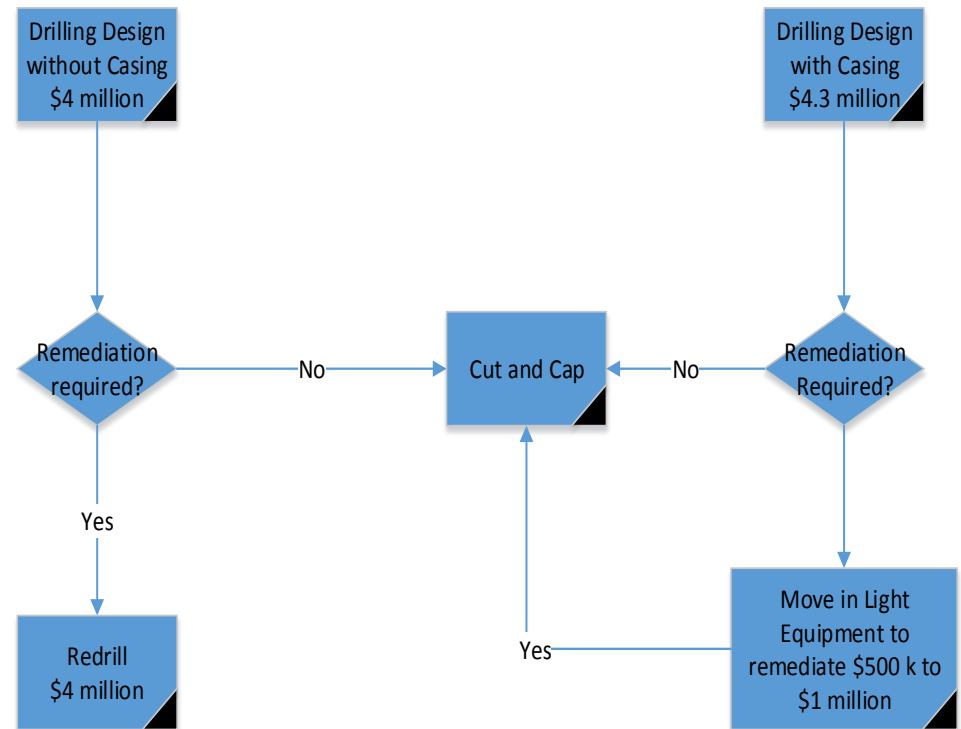
Well 8 – Cut and Capped



- Cement becomes the only barrier to prevent gas from flowing to surface once the well is abandoned.
- Operators differ in their approach in shutting off gas migration / SCVF issues, however there seems to be consensus on shutting off the leak at the source is the key criteria in fixing these flows.

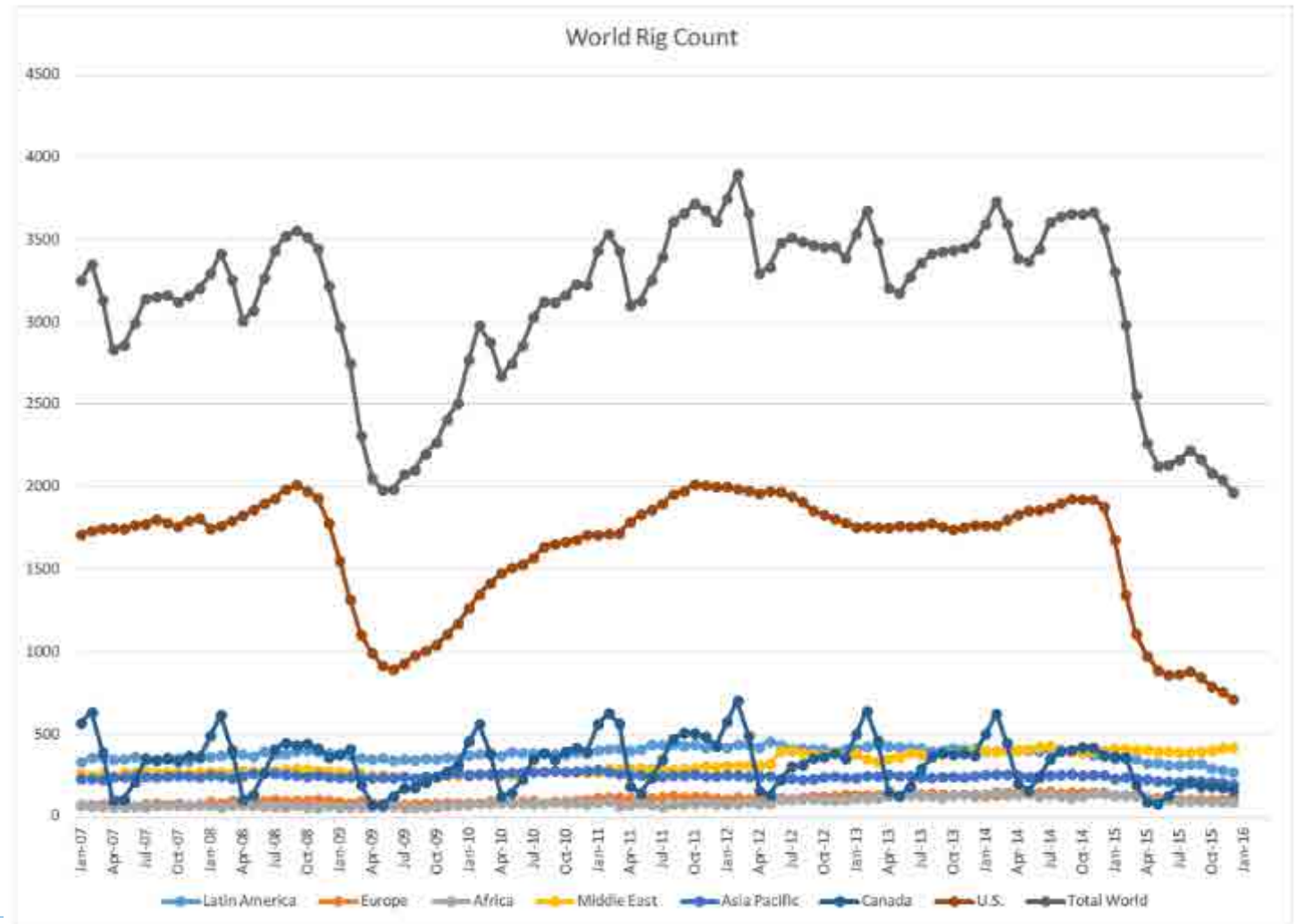
Well Design and potential variations

- Deviations from standard well design may need to be considered based on location.
- Typically, running a cement plug in a leaking well after re-drilling it, would be acceptable.
- In this case, we did not feel the cement plug fit the risk profile of this project, even though it was asked of us. For approximately 7% increase to the budget, we reduced the cost of a potential 3rd remediation for \$4 to \$1 million.











Contracting Challenges

- RFP tendering process with ASP, mostly lump sum with PAW
- Figure demonstrates rig access challenges for winter work in Canada – both people and equipment.
- Balancing - rig availability not confirmed until released from other work, but government contracting works on a different time scale with limited flexibility
- Approvals through NEB much longer than AER – need longer lead time
- Drilling companies not familiar with government contracting – lump sum contract style (vs cost plus) and the administrative/ reporting burden; advertise in Daily Oil Bulletin to drum up interest
- Contract changes need quick turnaround, especially when rig on site



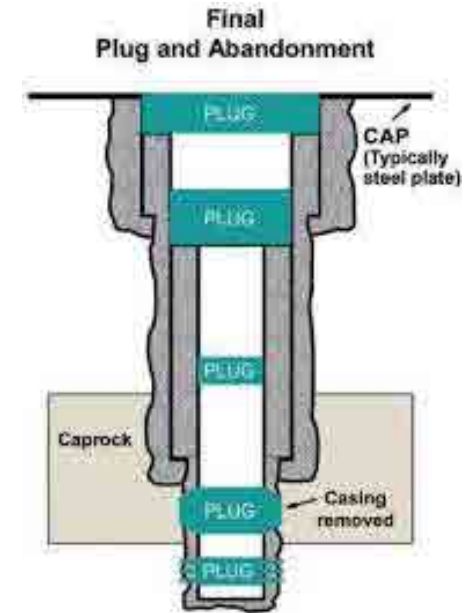
Procurement Industry and The Federal Government

CONTRACT TYPE		
LUMP SUM		
TIME AND MATERIALS		
HYBRID		



LUMP SUM

1. MOBILIZATION
2. STRAIGHT FORWARD ABANDONMENT
3. DEMOBILIZATION



TIME AND MATERIALS WITH UPPER LIMIT



- HSE – beyond industry standards
 - Real-time H2S monitors when no site presence
 - 0 reportable spills, 6 minor ones
 - 0 NLTI, 1 Medical aid, 2 near misses
- Socio-economic benefits
 - 49.7% costs spent on Northern businesses
 - 10.8% costs spent on Aboriginal sub-contractors
 - 50% work hours by Northerners
 - 32% work hours by Aboriginal people
- Innovation – unique drill bit design
- Final inspections and community celebration



Additional Lessons Learned

- Providing access options to potential contractors ensured all risks were evaluated for implementation
- Although sour gas was the primary concern, still should have completed environmental investigation (barium soil, sump)
- Before completing an abandonment program, a drilling assessment program would have added value/certainty
- Ensure the H₂S risk is sufficiently quantified so the appropriately sized BOP can be planned for and therefore determine the most cost effective drill rig for the program.
- For historical wells, additional contingency measures/equipment should be on site to address uncertainty of downhole conditions.

