

Outline – Subsurface

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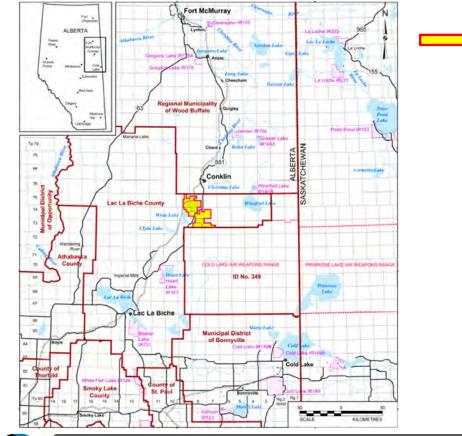


Outline – Surface

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Background Location of Kirby Project

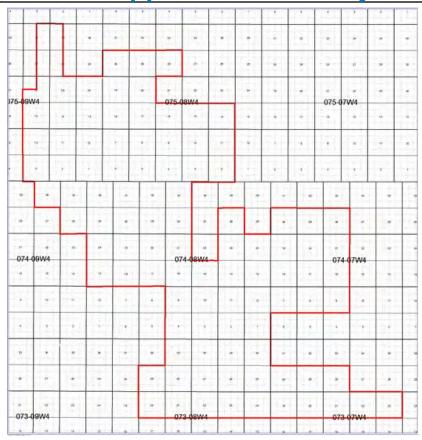


Approved Project Area

Canadian Natural

Slide 4

Background Scheme Approval 11475 Project Area



 Recovery Process: Steam Assisted Gravity Drainage (SAGD)

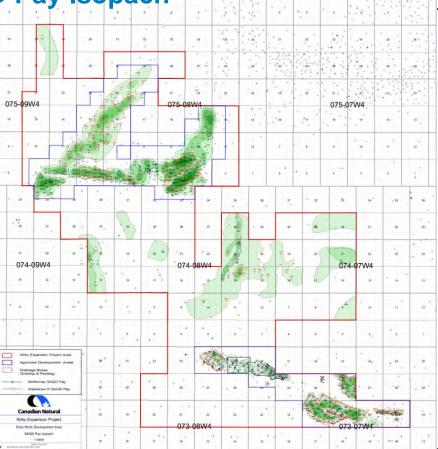


Slide 5



DIRECTIVE 54 SECTION 3.1.1 SUBSURFACE ISSUES RELATED TO RESOURCE EVALUATION AND RECOVERY

Geology Project Area SAGD Pay Isopach





Slide 7

Geology Project Area McMurray Volumetrics

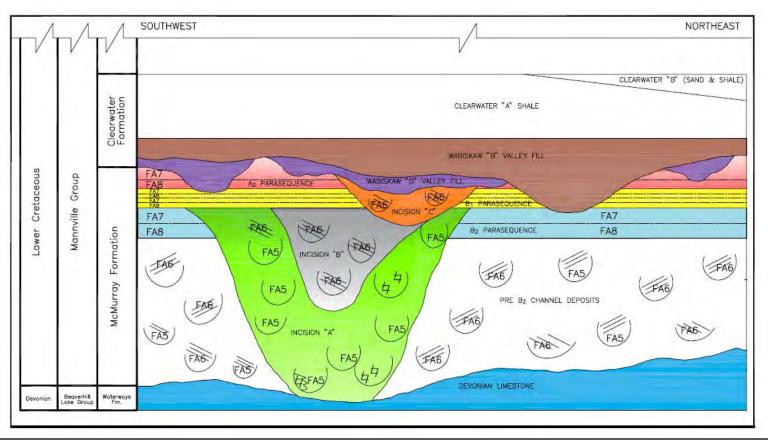
	Average Pay Thickness	Average Oil Saturation	Average Porosity	OBIP
	(m)	(%)	(%)	(e ³ m ³)
Kirby Approved Project Area	14.7	78.6	32.9	270,323

OBIP = Original Bitumen In Place

Volumetric calculation = Area within 10m contour x SAGD thickness x avg. oil saturation x avg. porosity

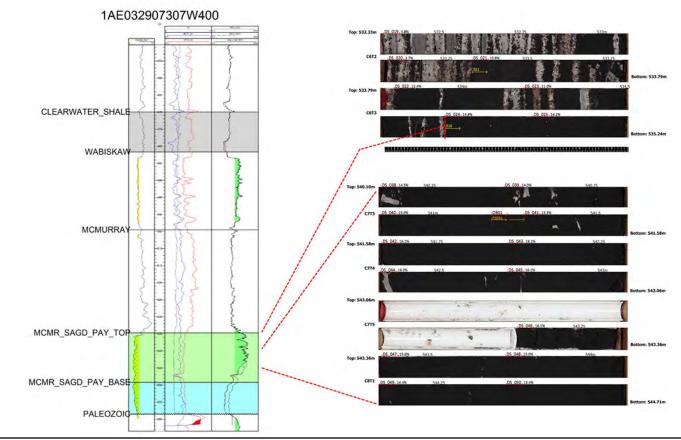


Geology Stratigraphic Schematic



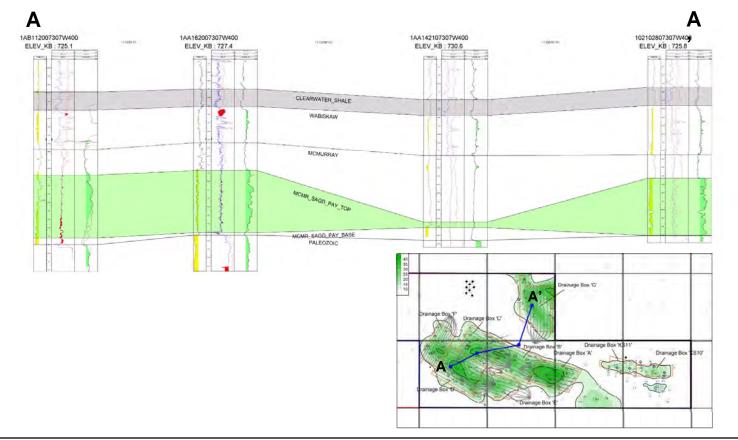


Geology Kirby South Type Log



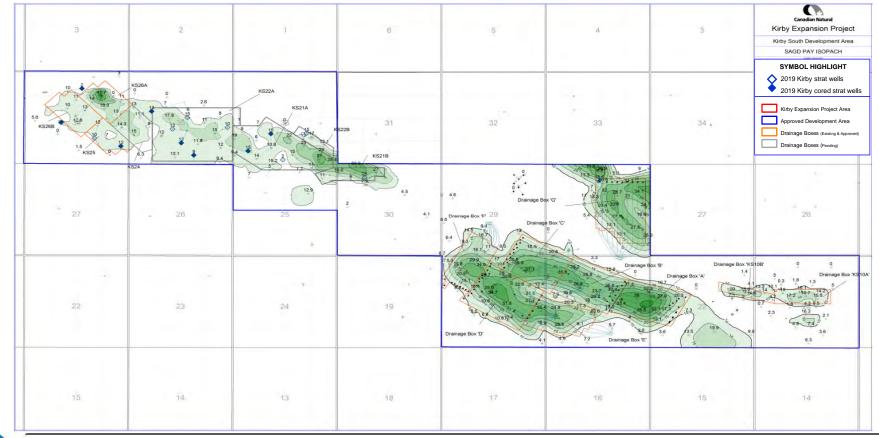


Geology Kirby South Structural Cross-Section



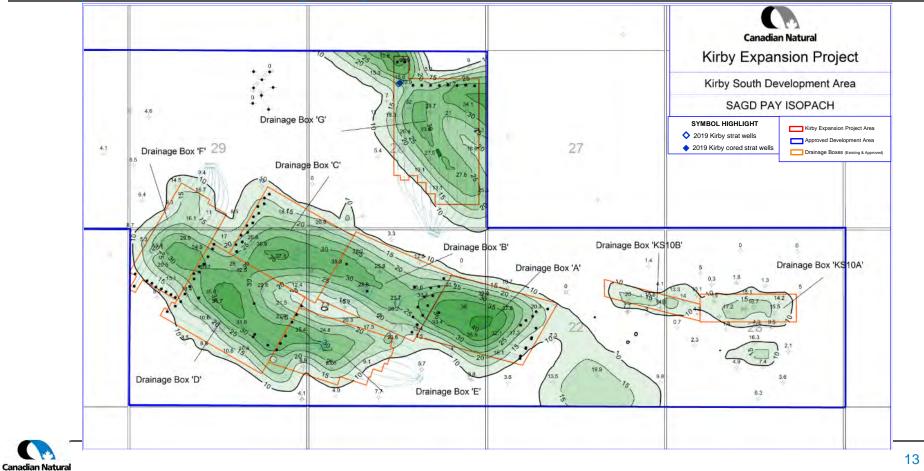


Geology Kirby South Development Area



Recovery Process: Steam Assisted Gravity Drainage (SAGD)

Geology Kirby South SAGD Pay Isopach



Geology Kirby South Development Area Volumetrics

	Average Pay	Average Oil	Average Porosity	OBIP
	Thickness (m)	Saturation (%)	(%)	(e ³ m ³)
Kirby South Approved Development Area	19.7	76.3	33.7	48,919

OBIP = Original Bitumen In Place

Volumetric calculation = Area within 10m contour **x** SAGD thickness **x** avg. oil saturation **x** avg. porosity



Geology Kirby South Drainage Area Volumetrics

Drainage Area	Area (m²)	Oil Saturation (%)	Porosity (%)	Pay Thickness (m)	DBIP (e ³ m ³)
		(70)	r 0103lty (70)	(11)	
A	625,017	67.9	33.3	28.3	4,000
В	669,345	75.4	32.8	23.4	3,880
с	629,989	78.3	33.4	25.4	4,180
D	809,000	79.5	33.3	26.3	5,610
E	502,828	75.5	34.2	23.1	3,000
F	462,018	77.6	33.3	21.0	2,510
G	822,445	82.9	33.2	23.9	5,410

DBIP = Developable Bitumen In Place

Volumetric calculation = Area within drainage box boundary and 10m contour x SAGD thickness x avg. oil saturation x avg. porosity



Geology Average Reservoir Properties

	Initial Reservoir Pressure (kPa)	Initial Bottom Water Pressure (kPa)	Temperature (°C)	Average Depth of Reservoir, McMR SAGD Pay Top (mTVD)	Average Pay Thickness (m)	Average Porosity, Φ (%)
Kirby South Operating Area	~2,600	~2,550	13	530	21.9	33.2
Kirby Approved Project Area	~2,600	~2,550	13	490	14.7	32.9

	Average Oil Saturation (%)	Average Water Saturation (%)	Average Horizontal Permeability from OB plugs, Kh (mD)	Average Vertical Permeability from OB plugs, Kv (mD)	Kv/Kh Ratio
Kirby South Operating Area	74.8	25.2	6,410	5,260	0.82
Kirby Approved Project Area	78.6	21.4	6,560	5,510	0.84

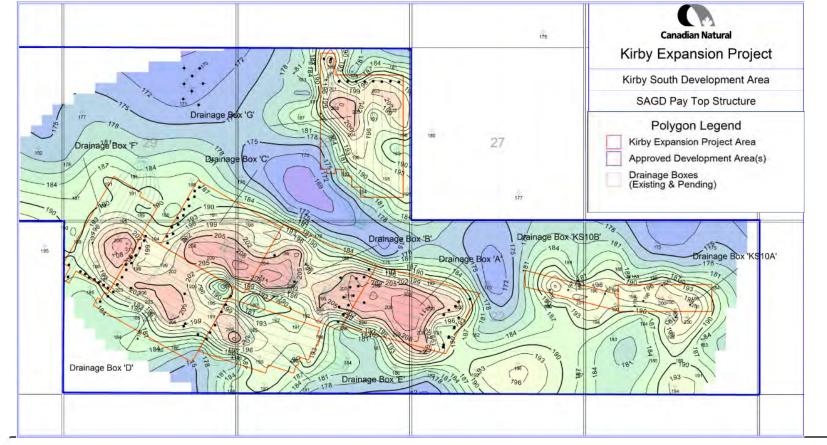


Geology Kirby South 2018 Special Core Analysis

• None

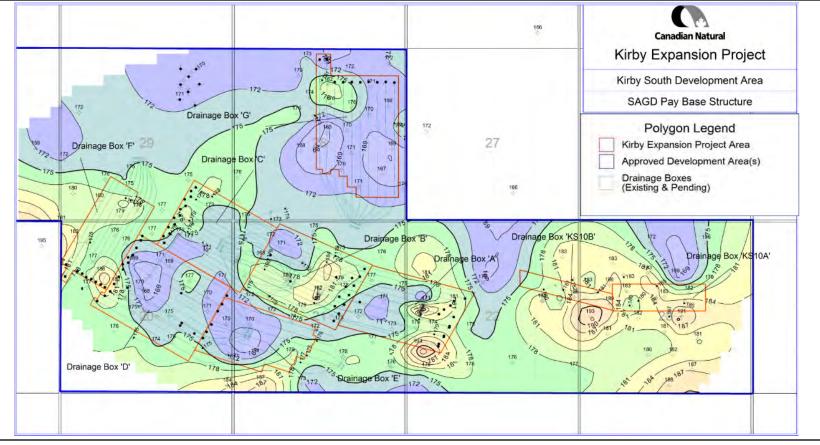


Geology Kirby South SAGD Pay Top Structure



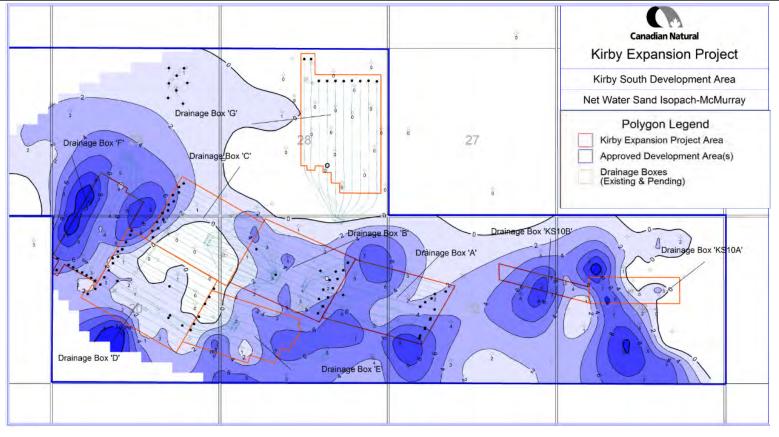


Geology Kirby South SAGD Pay Base Structure



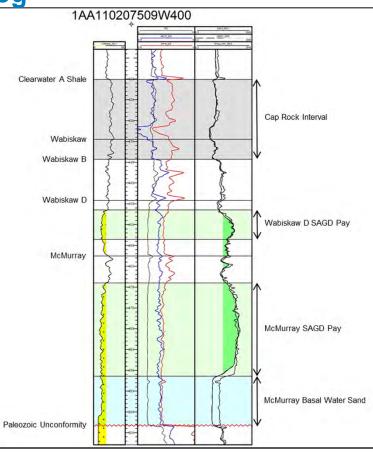


Geology Kirby South Net Water Sand Isopach



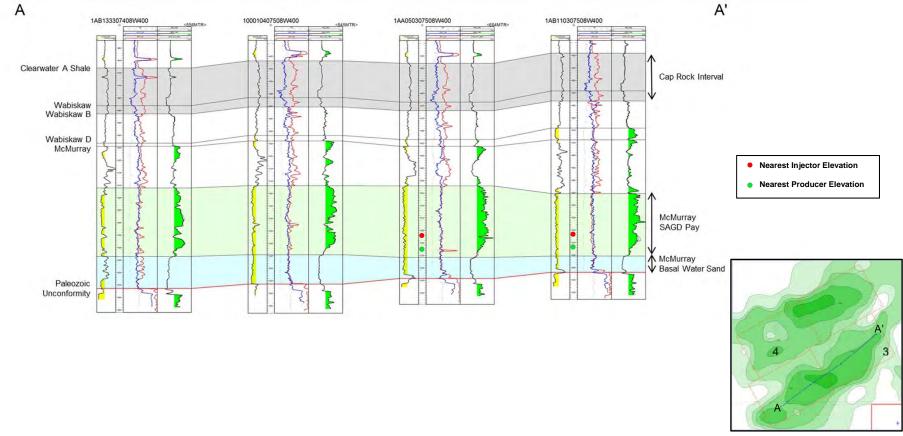


Geology Kirby North Type Log



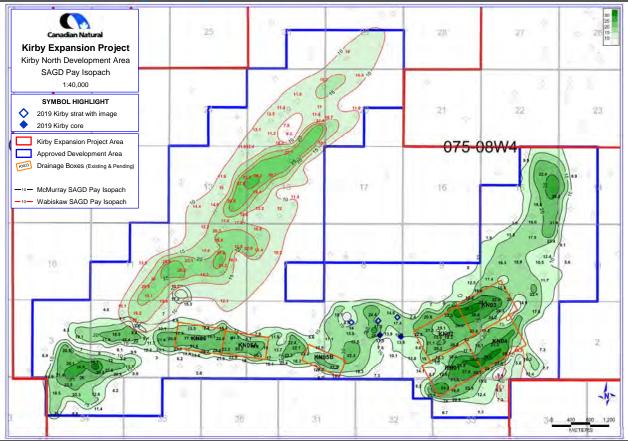


Geology Kirby North Structural Cross Section





Geology Kirby North SAGD Pay Isopach





Geology Kirby North Wabiskaw D Core Photos





Geology Kirby North 2019 Special Core Analysis

- Soluble ions
 - 1AC090507508W400
 - 1AC100507508W400



Geology Kirby North Development Area Volumetrics

	Average Pay Thickness (m)	Average Oil Saturation (%)	Average Porosity (%)	OBIP (e ³ m ³)
Wabiskaw D Reservoir	15.6	77.5	33	44,185
McMurray Reservoir	17.6	80.5	32.7	78,177
Kirby North Approved Development Area				122,362

OBIP = Original Bitumen In Place

Volumetric calculation = Area within 10m contour x SAGD thickness x avg. oil saturation x avg. porosity



Geology Kirby North Drainage Area Volumetrics

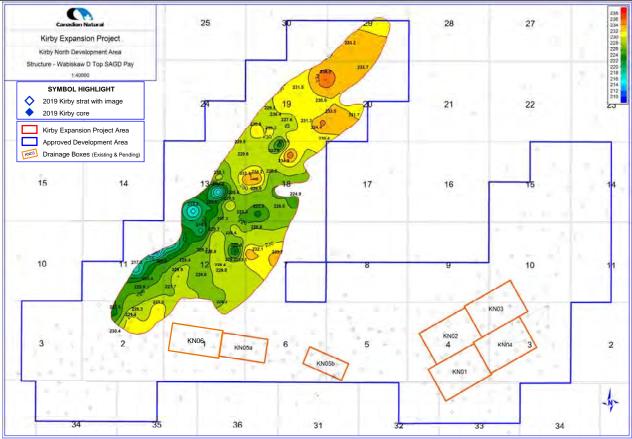
Drainage Area	Area (m2)	Oil Saturation (%)	Porosity (%)	Pay Thickness (m)	DBIP (e ³ m ³)
KN01	763,120	80.4	32.6	22.0	4,399
KN02	757,079	82.0	32.4	21.7	4,365
KN03	763,033	84.4	33.2	23.4	5,016
KN04	763,316	84.5	33.4	2.6	4,853
KN05a	443,723	81.1	33.5	19.9	2,398
KN05b	308,198	74.6	34.6	17.4	1,384
KN06	538,819	78.9	33.7	19.6	2,801

DBIP = Developable Bitumen In Place

Volumetric calculation = Area within drainage box boundary and 10m contour x SAGD thickness x avg. oil saturation x avg. porosity

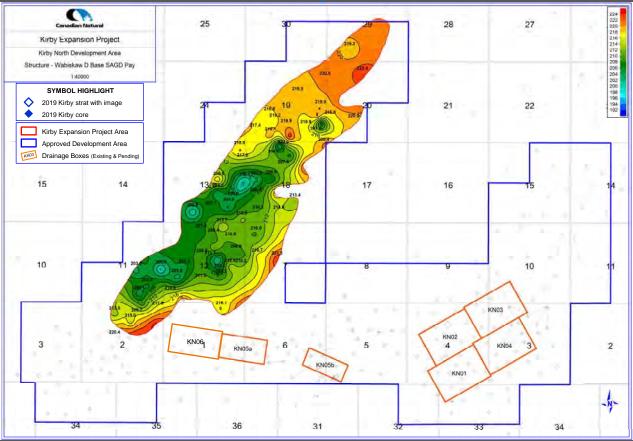


Geology Kirby North Wabiskaw D SAGD Pay Top Structure



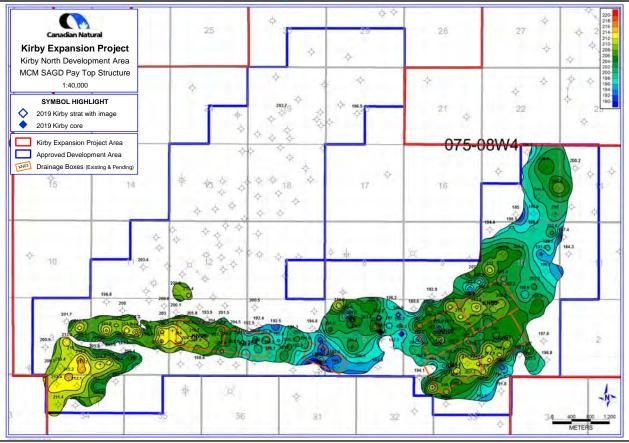


Geology Kirby North Wabiskaw D SAGD Pay Base Structure



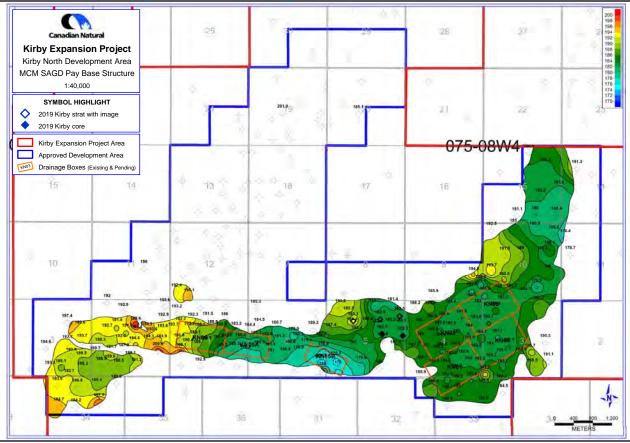


Geology Kirby North McMurray SAGD Pay Top Structure



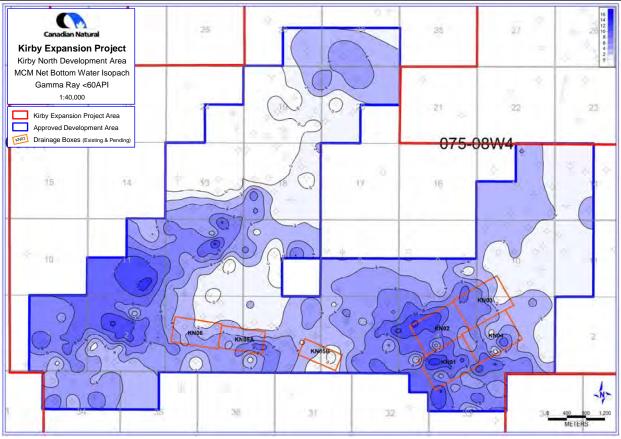


Geology Kirby North McMurray SAGD Pay Base Structure



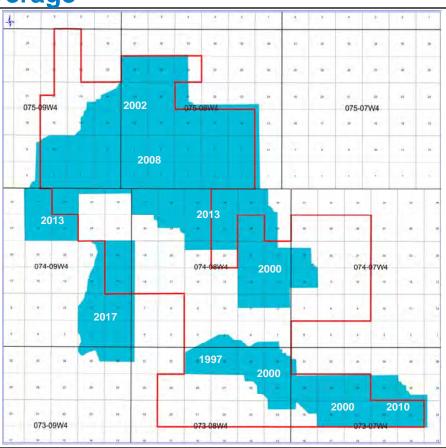


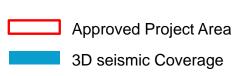
Geology Kirby North McMurray Net Bottom Water Isopach





Geology 3D Seismic Coverage

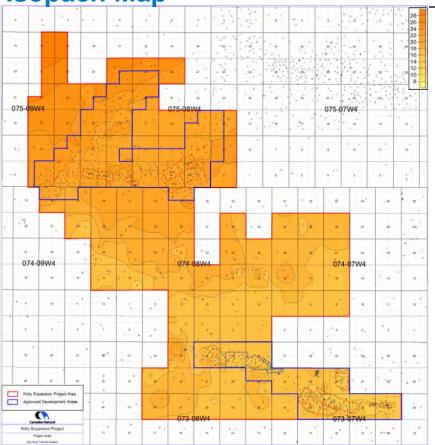




Note: 4D seismic was acquired over the Kirby South Pads A-F operational area in 2015. (No new 4D seismic has been shot since.)



Geology Cap Rock Interval Isopach Map



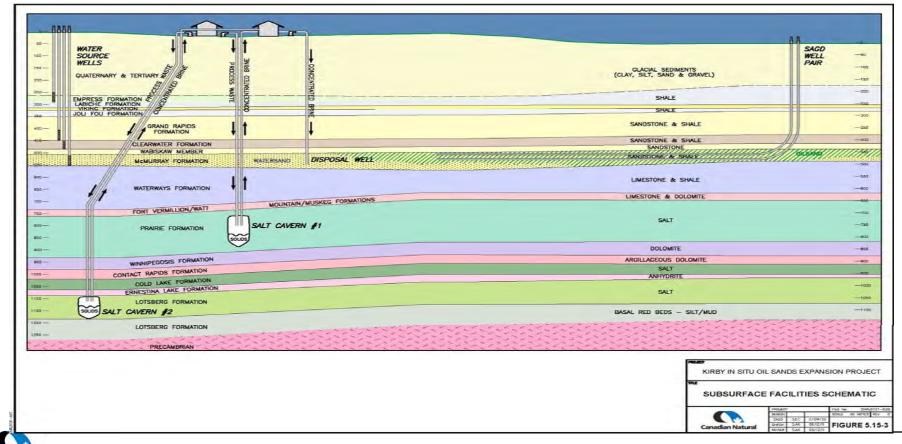


Kirby North Drilling Activity Update

- Completed Drilling operations:
 - New Drills:
 - KN02 1-12P&I, KN05 1-12P&I, KN01 1,2,6,8,10,12 P
- Remaining KN01 producers (6) and injectors (12) to be drilled in Q1 2020



Kirby South Formation and Well Placement Overview



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Completion Summary

• Production: Wells are equipped with either Electric Submersible Pumps (ESPs) or Rod Pumps

AL Type	Well Count	Lift Capacity (m³/d)	Operating Temperature (°C)
ESP	51	150-1000	<250
Rod Pump	18	0-450	<250

- Injection: Wells are completed with either a heel/toe string system or a single injection string with steam splitters.
- Completions are continually optimized as required by well behavior:
 - Outflow control devices are installed to improve steam distribution in the injector
 - Scab liners are installed to enhance toe production in the producer and reduce heel hot spots
 - Inflow control devices are installed to limit single point breakthrough and/or to control to wellbore hydraulics

Completion Tool	OCD	Scab Liner	ICD
Well Count	KN 36	KN 0	KN 13
	KS 22	KS 26	KS 26



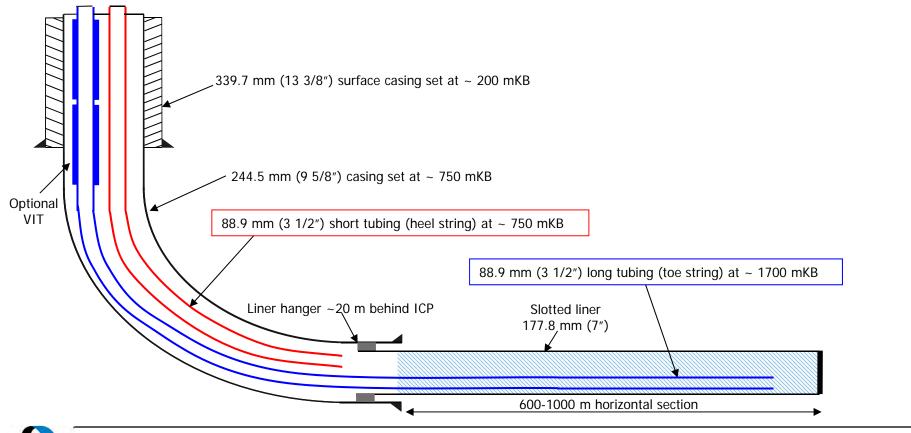
Some OCDs and ICDs are shiftable tools in the closed position.

Instrumentation Summary

- SAGD production and injection wells use blanket gas pressure to monitor bottom hole pressure.
- SAGD production wells use full-length fiber optic temperature monitoring (DTS).
- Observation wells gather multiple temperatures and pressures at various elevations.

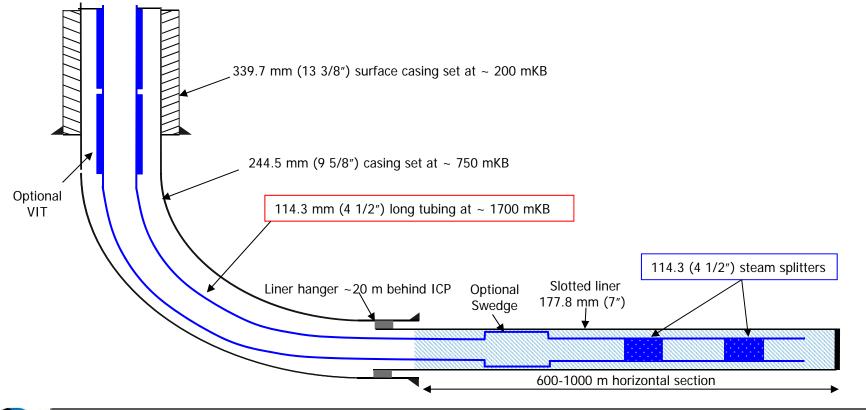


Well Schematics Injection Well (Dual String)



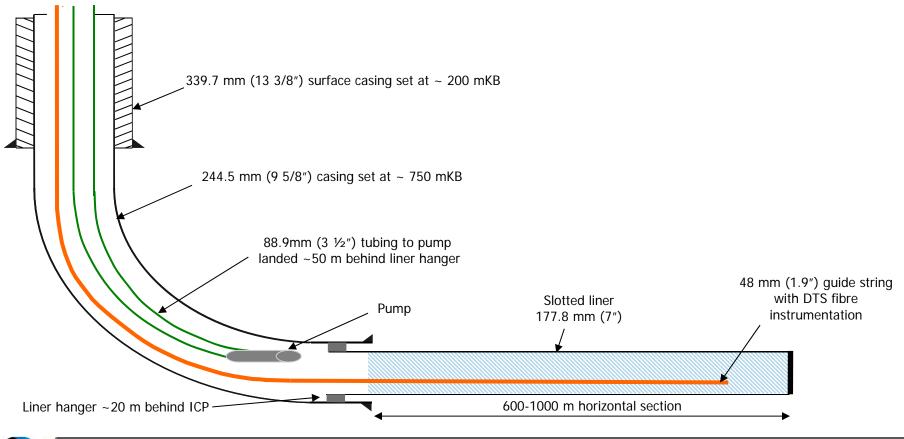


Well Schematics Injection Well (Single String)



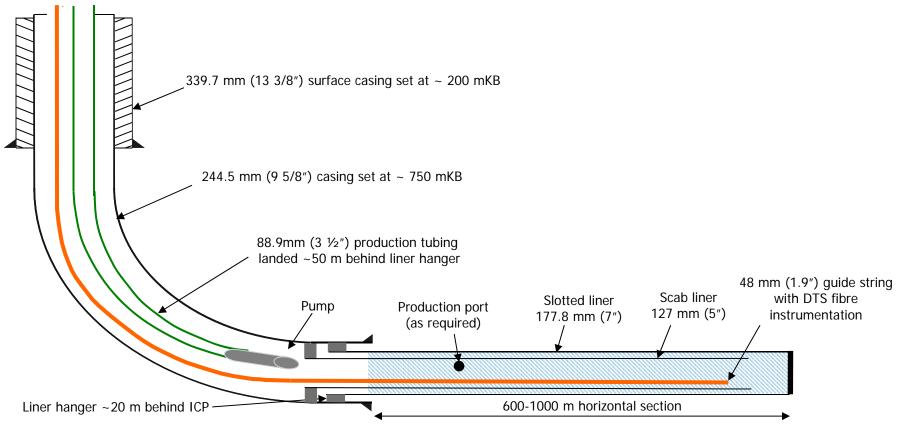






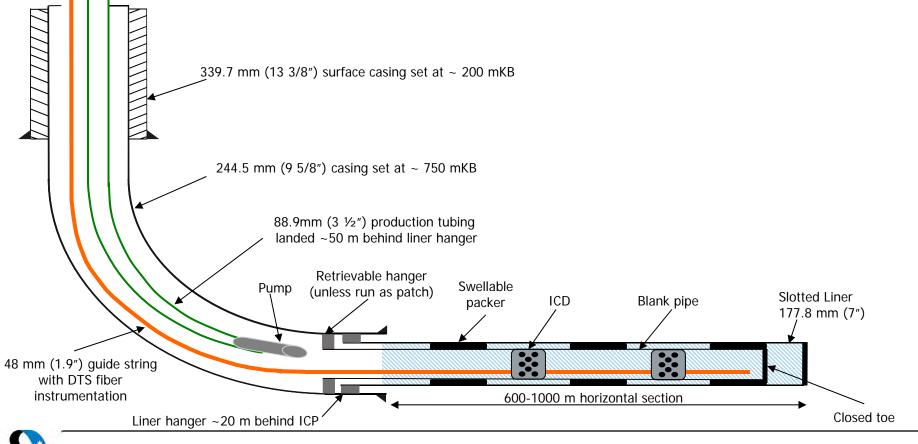




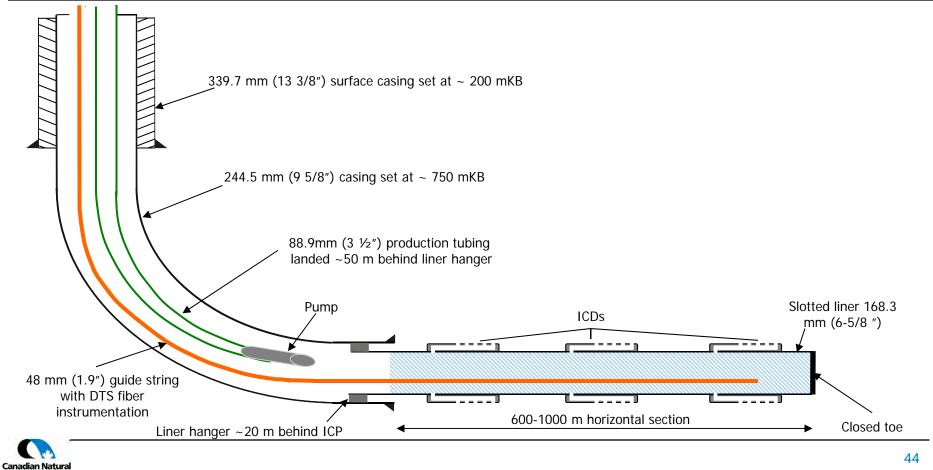




Well Schematics Production Well (Tubing Deployed ICDs)



Well Schematics Production Well (Liner Deployed ICDs)

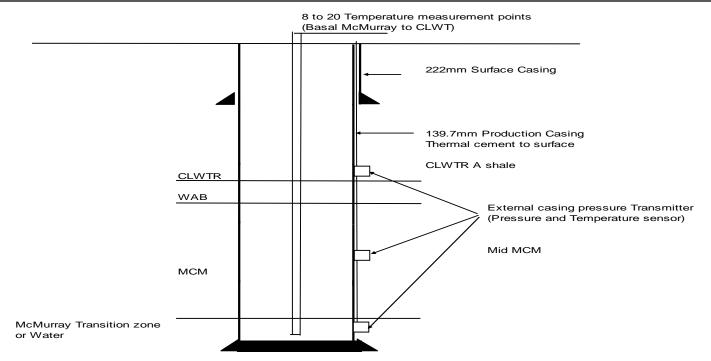


Completion Optimization

- Steam splitter and scab liner installations/removals are selected based on specific opportunities for each well:
 - Steam splitters target a stream distribution in the injector
 - Scab liners encourage toe development and minimize heel temperature variations due to high, localized drawdown. Scab liner removals promote heel development after toe fluids are mobile.
- ICDs and swellable packer strings are used to limit single point breakthrough and/or to control wellbore hydraulics.



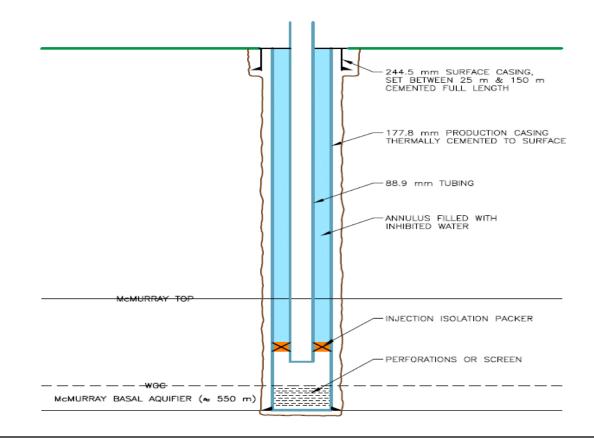
Well Schematics Observation Well



Note: Schematic for 2011-2013 drilled observation wells, as previous wells don't have external casing transmitters



Well Schematics Disposal Well





Operational Strategy SAGD

• Injection strategy:

- Steam down heel and toe string or single injection string to maintain desired reservoir pressure
- Steam chamber pressure is measured by blanket gas pressure in the annulus
- Pressure targets are set to balance with bottom water (where present) or to optimize production. Typical pressures range from 2.5-3.5MPa.

• Production strategy:

- Pump fluid from producer using artificial lift (rod lift or ESP)
- Operate wells based on a target subcool drawdown



Operational Strategy SAGD Continued

- Subcool = saturated temperature at producer pressure
 - highest temperature along the producer lateral
 - Target is set to maximize production, while protecting the wellbore from the influx of steam
- To optimize pressure and subcool target, a combination of parameters are monitored, including:
 - Water retention in reservoir
 - Chlorides concentration in produced water
 - Steam Oil Ratio (SOR)
 - Bottom hole pressures



Kirby South Drilling Activity Update

No changes to report



Kirby Maximum Operating Pressures

- The maximum operating pressure for Kirby South pads A-G is 6.0MPa
- The maximum operating pressure for Kirby North pads 2, 3 and 5 is 7.0 Mpa
 - The maximum BHP of 7.0 Mpa may be reached for short durations (24 hrs) in order to initiate circulation
- Wells that were approved for circulation had temporary approval to 7.0MPa to gain circulation which included well pairs D9, D10, F8, F9, G9, G10 and the well A6PI
- Operating pressures range from 2500-3000kPa, typically in balance with bottom water



Kirby Flow Control Learnings

- Production inflow control devices:
 - Liner deployed flow control devices have been shown to accelerate ramp-up on wells which receive an initial bullhead steam cycle prior to production
 - Inflow control devices installed in virgin reservoir have had mixed success in preventing steam breakthrough events
 - Tubing deployed inflow control devices not currently used as a remediation technique due to reoccurring loss of sand control.
- Steam distribution outflow control devices:
 - New wells have steam distribution devices as a standard completion
 - Mid-recovery SAGD wells have seen success in reduction of hot locations due to the movement of steam distribution or change over from heal toe to steam distribution devices



SAGD Wel	I Spacing
-----------------	-----------

Pad	Number of Wellpairs	Number of Infills	SAGD Wellpair Spacing (m)
А	6	3	100
В	6	4	100
С	7	7	100
D	10	2	80
E	6	0	80
F	9	0	50
G	10	0	80
KN02	12	0	60
KN03	12	0	60
KN05	12	0	60



- Original wellpair spacing on Pads A, B, & C were 100 m.
- Well spacing was optimized from 100 m to 80 m to achieve improved CDOR, SOR and recovery factors for wells with less bottom water influence.
- F Pad spacing was decreased to 50 m where thicker bottom water exists to lessen the slumping of oil, and therefore improve CDOR, SOR and recovery factor.
- Infills are drilled half way between offsetting SAGD wellpairs.
- Kirby North well pair spacing has been optimized from Kirby South learnings and reduced to 60m

Kirby South Performance

Pad Recoveries

Pad	DBIP (E3m3)	Estimated Ultimate Recovery (E3m3)	Cumulative Oil (E3m3)	RF (%)
А	4,000	2,608	1,030	25.8%
В	3,880	2,755	1,502	38.7%
С	4,180	2,851	1,927	46.1%
D	5,610	4,140	1,640	29.2%
E	3,000	1,920	1,233	41.1%
F	2,510	1,596	851	33.9%
G	5,410	3,976	1,693	31.3%
Total	28,590	19,846	9,876	34.5%

Recovery as of August 15, 2019

DBIP = Developable Bitumen In Place

Volumetric calculation = Area within drainage box boundary and 10m contour x SAGD thickness x avg. oil saturation x avg. porosity



Kirby North Performance Pad Recoveries

Pad	DBIP (E3m3)	Estimated Ultimate Recovery (E3m3)	Cumulative Oil (E3m3)	RF (%)
KN02	4,365	2,200	2	0.0
KN03	5,016	2,500	14	0.3
KN05a	2,398	1,200	5	0.2
KN05b	1,384	700	3	0.2
Total	13,163	6,600	24	0.2

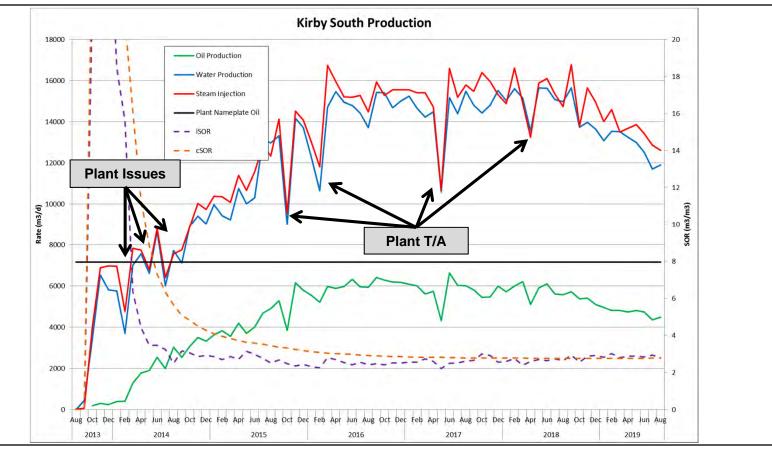
Recovery as of August 15, 2019

DBIP = Developable Bitumen In Place

Volumetric calculation = Area within drainage box boundary and 10m contour x SAGD thickness x avg. oil saturation x avg. porosity

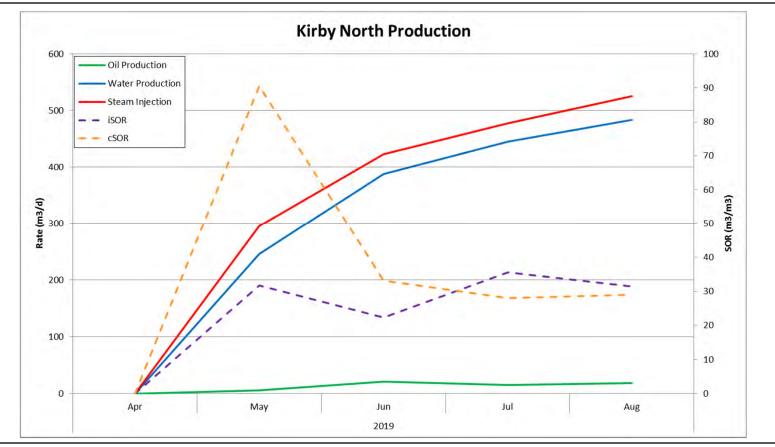


Kirby South Performance Kirby Field Production





Kirby North Performance Kirby Field Production





Steady plant performance since start up.

Kirby South Performance Summary

- Reservoir performance is similar to expectations, currently optimizing well-pair conformance.
- Plant turnarounds:
 - October 2018: Evap 2 and Boiler 5 turnaround
 - March 2019: Kirby North shipping tie-ins
 - March 2019: Evap 3 turnaround
 - April 2019: Evap 1 turnaround
 - July 2019: Evap 2 lay-up due to reduced steam demand
- 8 wells lost sand control, two of which were remediated.
 - Remediation techniques used were a high temperature patch and thermal plug.

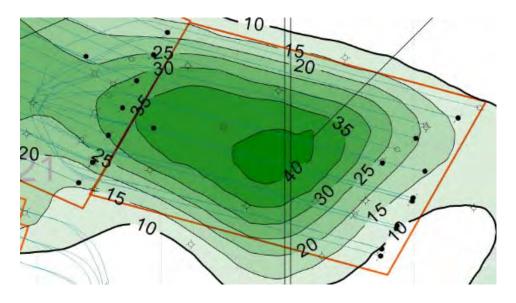


Kirby North Performance Summary

- Reservoir performance is similar to expectations
- Currently optimizing circulation operations
- No major planned or unplanned events



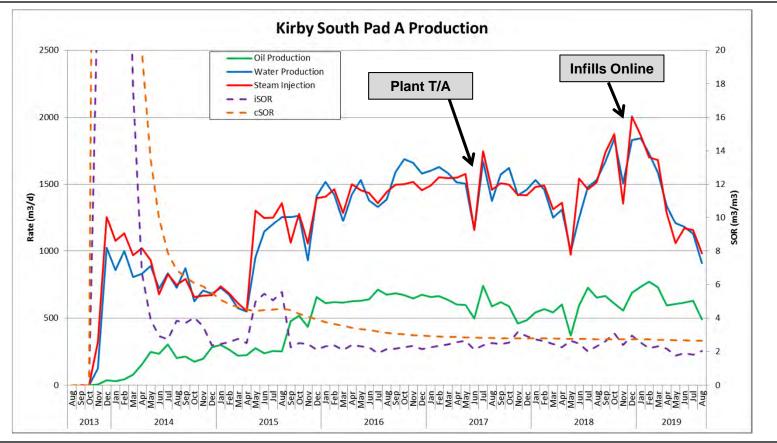
Kirby Performance – Low Recovery Kirby South A Pad



- SAGD well pairs: 6
- First steam: October 2019
- Inter-well pair spacing: 100 m
- Avg. net pay: 28 m
- Avg. So: 68%
- Avg. porosity: 33%
- Current RF: 26%

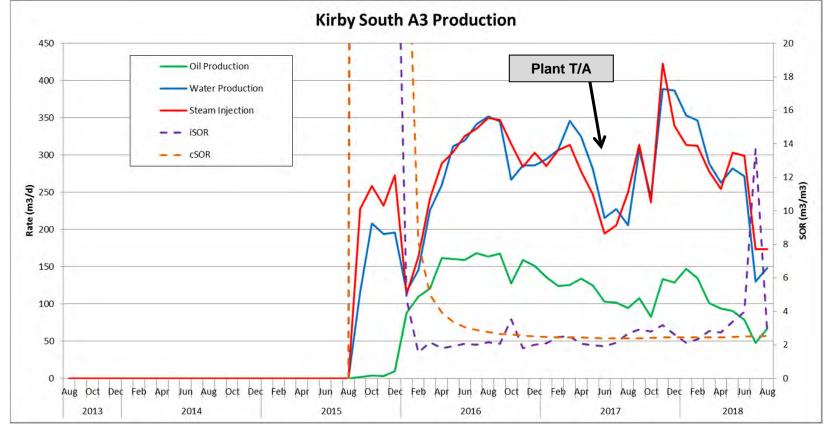


Kirby Performance Pad A Production





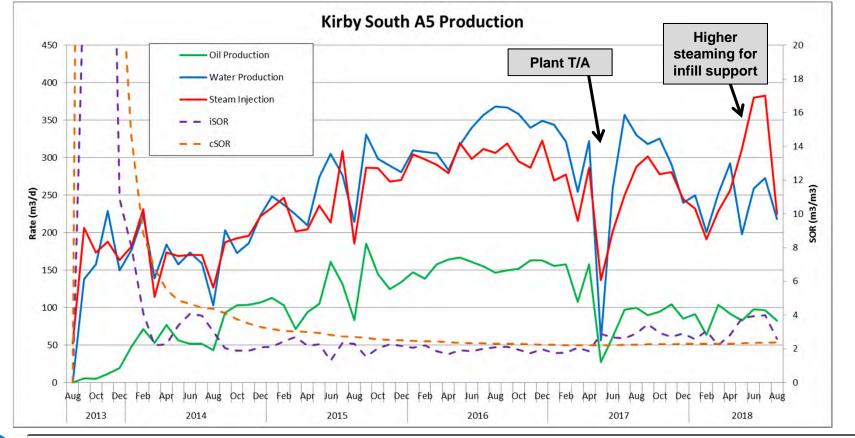
Kirby Performance High Recovery Pad A Wellpair



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Well re-drilled into better geometry in August 2015.

Kirby Performance Low Recovery Pad A Wellpair



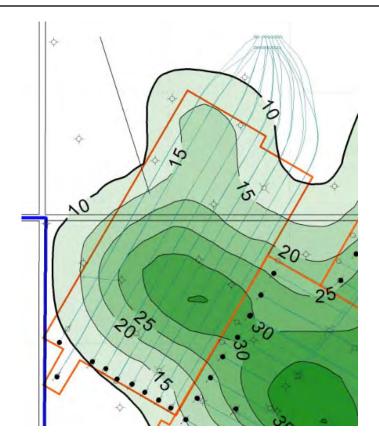


Kirby Performance Pad A Key Learnings

- Pad A reservoir performance is meeting expectations.
- Communication seen between SAGD wellpairs and offsetting infill producers online in 2018.
 - Injector drill planned for A7I (injector for A6PI step-out infill which was found to not be in communication with steam chamber)



Kirby Performance – Mid Recovery Pad F

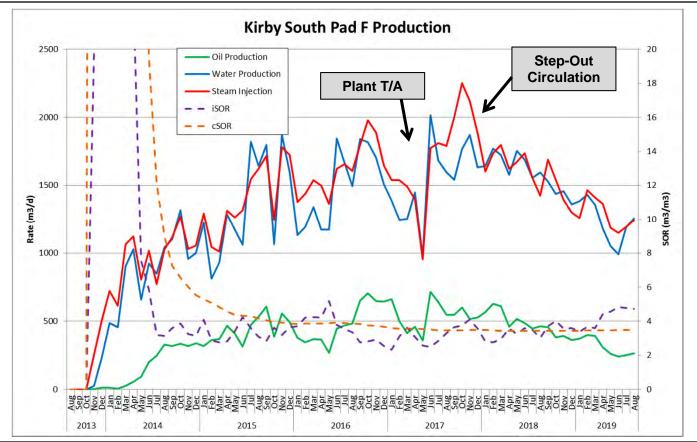




- First steam: November 2013
- Inter-well pair spacing: 50 m
- Avg. net pay: 21 m
- Avg. So: 78%
- Avg. porosity: 33%
- Current RF: 34%



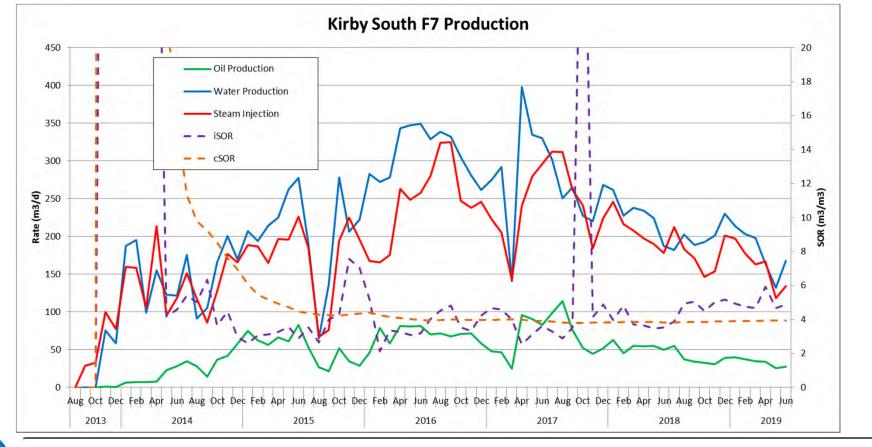
Kirby Performance Pad F Production



Canadian Natural

Liner failures have effected F Pad rate of recovery.

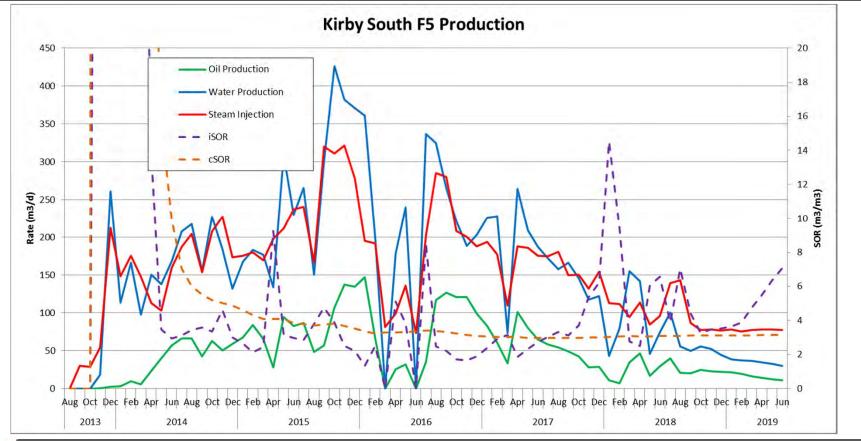
Kirby Performance High Recovery Pad F Well Pair





F7 is in final decline after continued strong performance.

Kirby Performance Low Recovery Pad F Well Pair



Canadian Natural

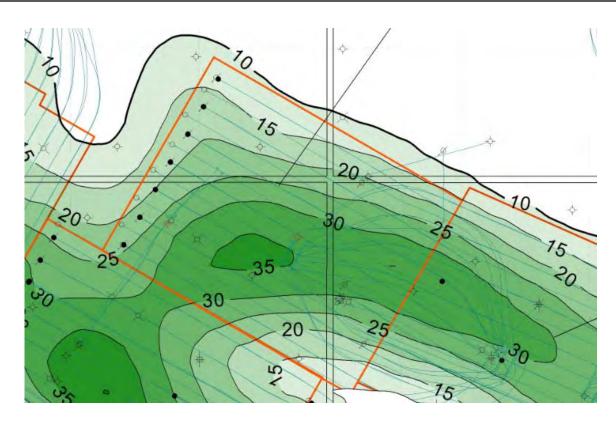
Inflow degradation is under investigation.

Kirby South Performance Pad F Key Learnings

- Pad F reservoir performance is meeting expectations.
- New step-out wells have offset declining production.
 - F8P suspected mechanical liner failure under investigation.



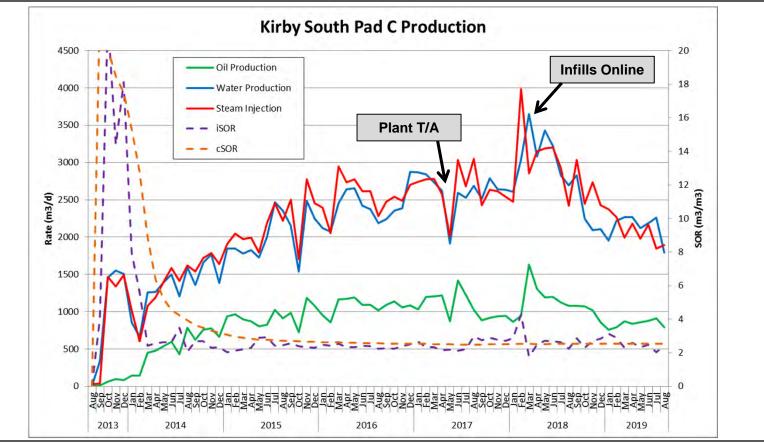
Kirby Performance Pad C – High Recovery Pad



- SAGD well pairs: 7
- First steam: Sept. 2013
- Inter-well pair spacing: 100 m
- Avg. net pay: 25 m
- Avg. So: 78%
- Avg. porosity: 33%
- Current RF: 46%



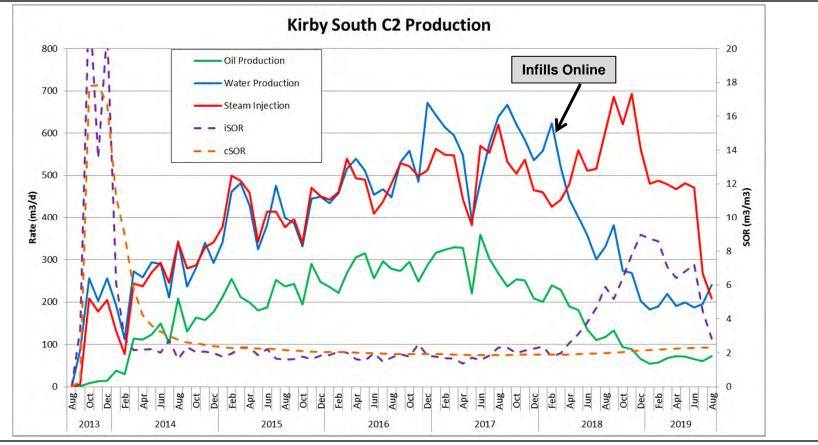
Kirby Performance Pad C Production





Infill production has offset base declines.

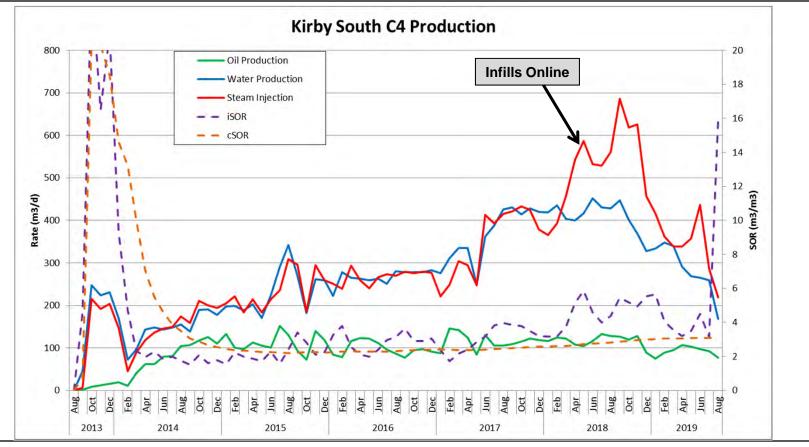
Kirby Performance High Recovery Pad C Well Pair





Offsetting infills have reduced C2 production.

Kirby Performance Low Recovery Pad C Well Pair





Continued steady production, but lower than original reservoir expectations.

Kirby Performance Pad C Key Learnings

- C Pad reservoir performance is meeting expectations.
- Communication seen between SAGD wellpairs and offsetting infill producers online in 2018.



Kirby Performance

5 Year Outlook – Pad Abandonments

• No expected pad abandonments planned in the next 5 years.

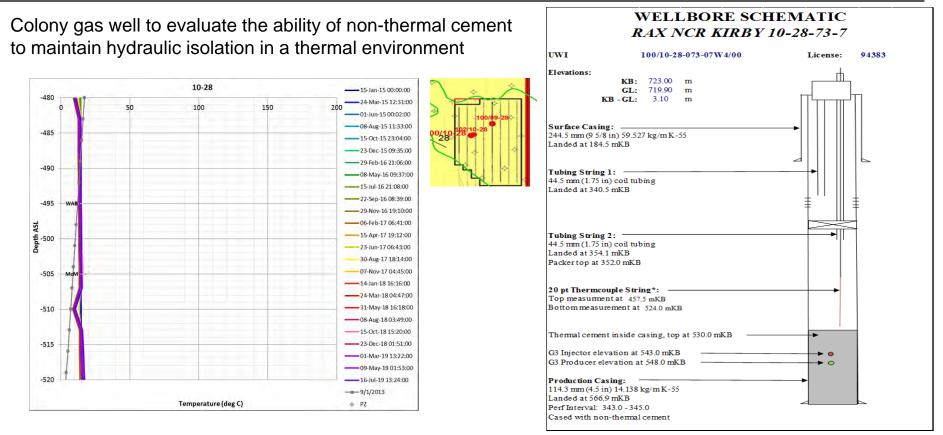


Kirby Performance Wellhead Steam Quality

- During steady operations, wellhead quality should be 95% or greater
- There is some evidence that certain pads and wells have experienced slightly lower quality during start-up
 - This is not expected to have an impact on recovery



Kirby South Observation Well Results 100/10-28-073-07W4 – 4 m From G3





No thermal impacts seen to date.

Future Plans – Approved Drills

- Continue to optimize SAGD pairs
- Approved wells to be drilled in the next year:
 - KN01
 - 18 wells (injectors/producers) to be drilled in Q1 2020
 - 6 Producers have been drilled in Q4 2019



Future Plans Kirby South

- Pending favorable economic conditions, the following future plans are under evaluation:
 - Re-Drills:
 - C6P & F8P Re-Entries
 - New Drills:
 - A7I
 - Scheme Amendments:
 - KS 10A/B project amendment approved October 2018
 - KSW pad amendment submitted July 2019



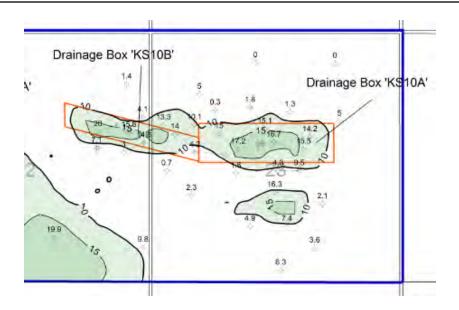
Future Plans Continued Kirby North

- Circulation
 - Optimize and complete circulation operations on Pads KN02, KN03 and KN05
 - KN04 circulation Q4 2019
 - KN01 drill and start up 2020
- Conversion of pads KN02, KN03 and KN05
 - Ramp up wells to peak production rates
 - Optimize SAGD well pairs
- Evaluation of on going trials including VIT, ICDs and Krohne multiphase flow metering



Future Plans - KS10 Series

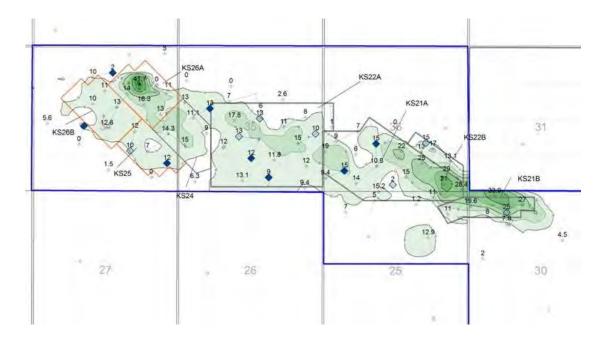
- 2 SAGD drainage boxes from 1 surface pad site
 - KS10A: 5 well pairs, 875m length
 - KS10B: 3 well pairs, 900m length
- 50m spacing
- Scheme amendment approved October 2018





Future Plans – KS20 Series

- 9 SAGD drainage areas in prior scheme approval
 - Amendment submitted July 2019 date to 8 drainage boxes





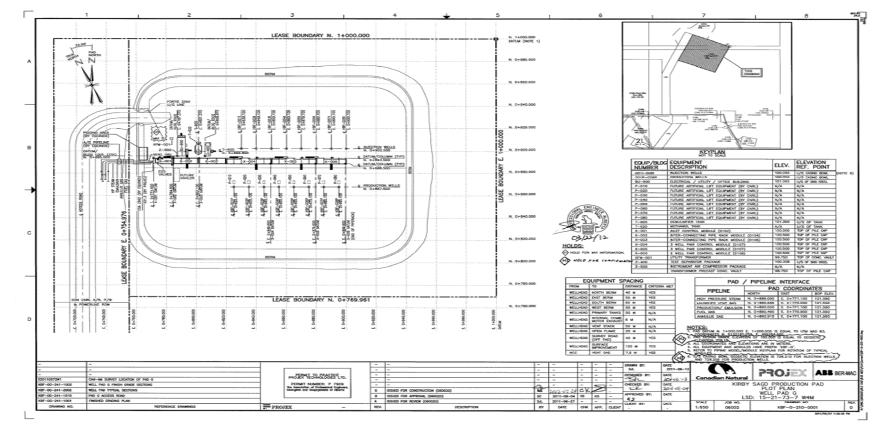


Surface Facilities Overview Plot Plans

- Detailed Site Plot Plans:
 - Kirby SAGD Production Pad Plot Plan
 - Dwg No. KBF-G-210-0001 Rev.0
 - Dwg No. KNF-K03-210-0001 Rev.0
 - Kirby South Central Plant Plot Plan
 - Dwg No. KBP-00-210-0002 Rev.3
 - Dwg No. KNP-100-210-0002 Rev.2
- Simplified Schematic:
 - Kirby In-Situ Oil Sands Project Simplified Schematic



Surface Facilities Overview Kirby South SAGD Production Pad Plot Plan

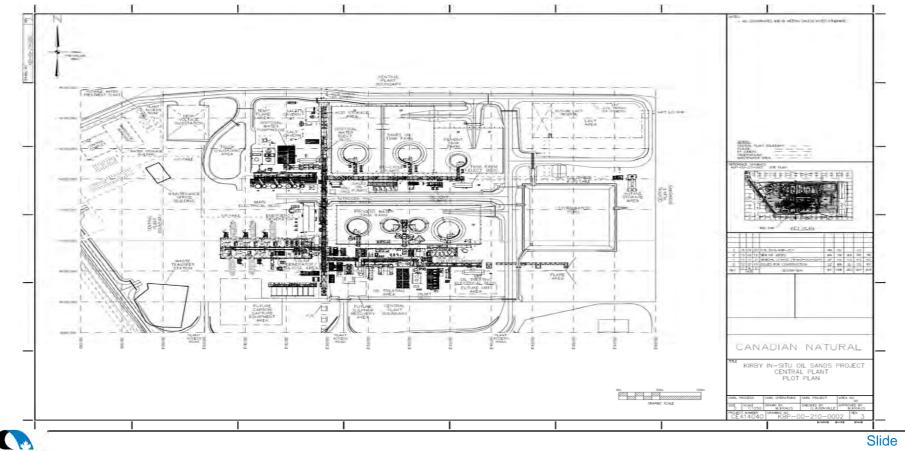




Slide 85

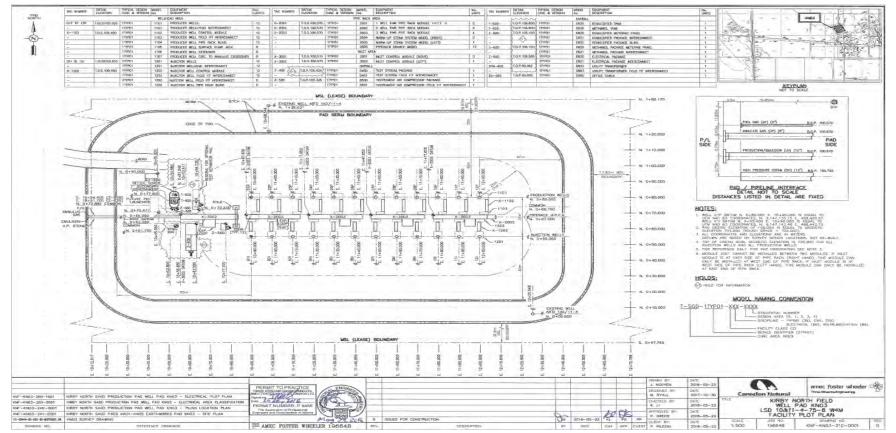
Surface Facilities Overview Kirby South Central Plant Plot Plan

Canadian Natural



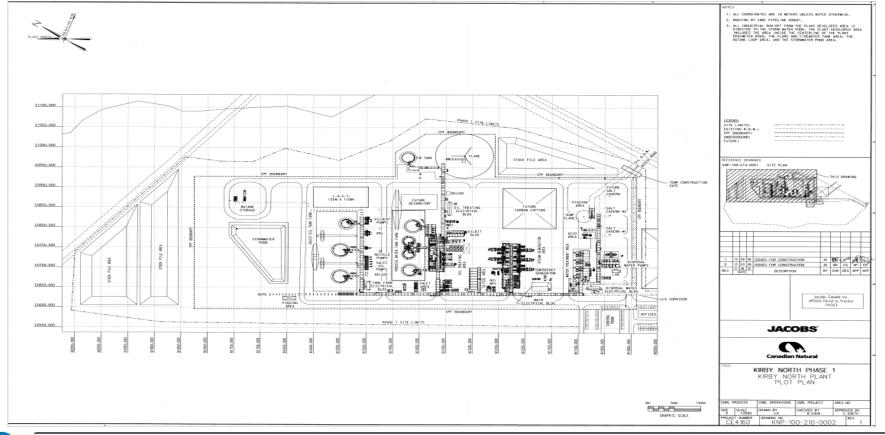


Surface Facilities Overview Kirby North SAGD Production Pad Plot Plan



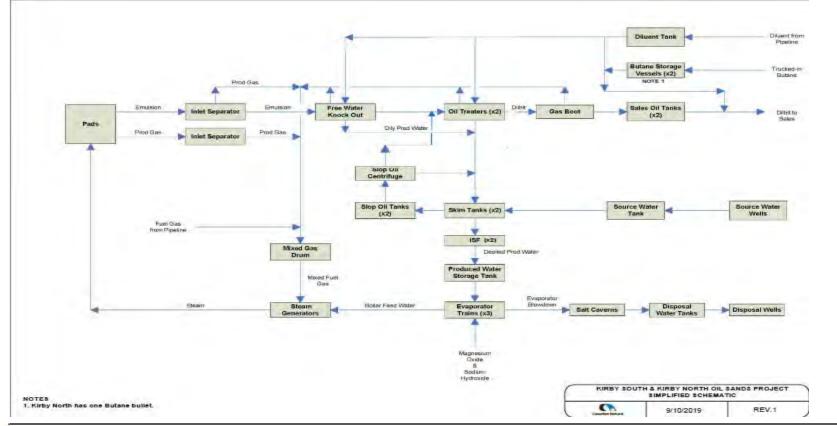


Surface Facilities Overview Kirby North Central Plant Plot Plan





Surface Facilities Overview Kirby Simplified Schematic



Kirby South Facility Performance -Oil Treating/Produced Water De-oiling Area

- Summary of Modifications since August 2018
 - Construction completed on Pad G and Kirby South Plant for Solvent Injection Project
- Oil Treating/Produced Water De-oiling Area
 - Overall water quality and oil treating targets have been met
 - Oil Treating is running very stable. Short term upsets from well startups are managed by new chemical program and change in well kill fluid procedure.
 - Optimization work continues on the chemical program and pressure optimization trials
 - Low pH acid stim flow backs are flown to temporary tanks in order to prevent plant upsets, tanks are removed after flow back. Optimizing flow back procedure.
 - Produced water de-oiling upsets leading to evaporator fouling and additional cleanings has been eliminated due to new chemical program.



Kirby South Facility Performance Water Treatment Area & Boilers

Water Treatment:

- Continuing to optimize Evaporator design to further increase the run time.
- Modelling of the mist eliminator led to modification during the last turn around. Modifications look promising to further extend Evaporator run time.
- Trial of new style cavern injection pump, was successful. Pump run time has been greatly increased.

Boilers:

• No tubing failures or casing failures since August 2017.



Kirby South Facility Performance Power Consumption

Month	Total Power Consumption (kWh)
August-18	20,148,458
September-18	20,930,526
October-18	19,639,394
November-18	19,993,194
December-18	20,230,384
January-19	19,713,515
February-19	18,175,460
March-19	19,352,086
April-19	18,062,349
May-19	18,770,522
June-19	17,788,642
July-19	17,711,912



Kirby South – Greenhouse Gas Emissions

- Kirby South Greenhouse Gas Emissions
 - 2018 emissions are actuals
 - 2019 emissions are estimates
 - Will be verified Q1 2020

Month	2018/2019 (tCO2e)			
September	64,592			
October	55,466			
November	61,587			
December	61,962			
January	58,864			
February	54,249			
March	55,299			
April	53,797			
Мау	55,916			
June	53,461			
July	55,082			
August	54,750			



Kirby South Facility Performance Gas Usage

• Gas Usage on a monthly basis

Total Purchased Gas		Total GasTotal SolutionProducedGas to Flare		Solution Gas Recovered	Total Flare Gas	Total Gas Vented	
Month	e3m3	e3m3	e3m3	%	e3m3	e3m3	
August-18	25,671	1,333	20.3	98.48	128	0	
September-18	29,191	1,100	13.6	98.76	119	0	
October-18	24,485	1,169	13.5	98.85	124	0	
November-18	27,330	1,378	15.4	98.88	123	0	
December-18	27,458	1,344	22.1	98.36	139	0	
January-19	25,964	1,214	14.7	98.79	130	0	
February-19	24,213	1,084	13.1	98.79	120	0	
March-19	23,942	1,439	18.6	98.71	131	0	
April-19	23,460	1,236	16.1	98.70	116	0	
May-19	24,240	1,500	18.2	98.79	116	0	
June-19	22,943	1,434	25.8	98.20	126	0	
July-19	22,830	1,937	27.9	98.56	113	0	



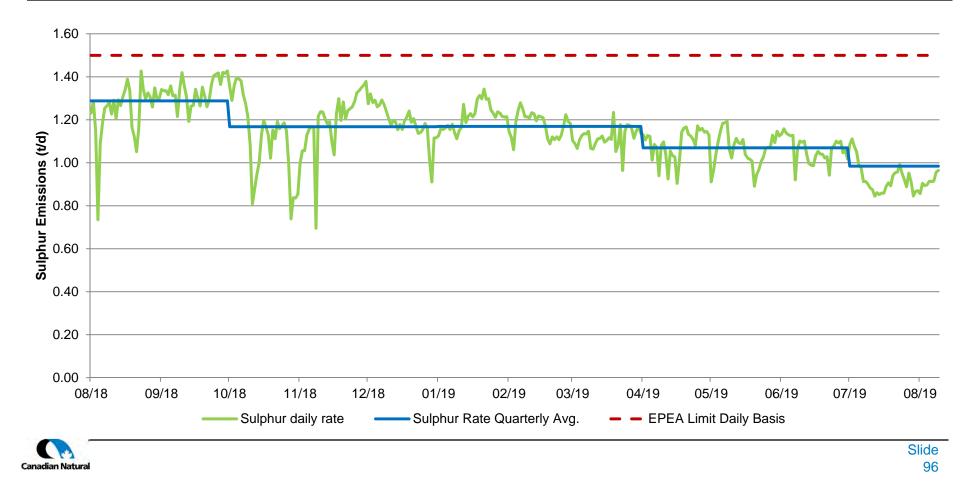
Recovering greater than 98% solution gas

Kirby South Facility Performance Emissions

- Kirby Sulphur Emissions
 - Received 12 month temporary waiver on the ID 2001-3 requirement's until the end of Q4 2019
 - No exceedance of the EPEA daily SO_2 emissions limit (3 t/day).



Kirby South Facility Performance Sulphur Emissions



Kirby North Facility – Summary of Modifications

• Start Up

- Kirby North first steam on May 1st 2019 with a total of 36 well pairs circulating, currently in the process of SAGD conversion.
- All systems have been commissioned and in service with no major issues.
- Summary Modifications
 - A list of changes were implemented at Kirby North to improve plant reliability and runtime of the plant using Kirby South lessons learned. Below are listed some of the changes:
 - Seals pumps upgrades
 - BFW HEX upgrades
 - Instrumentation added to monitor HEX and vessels/tanks performance
 - Boilers Upgrades, such as: Modification of the furnace floor and Header refractory installation
 - Evaporators retrofits and piping modifications to reduced the impact on the BFW during outages and cleanings
 - Improvements made at the skid filters and new filters installed at the well head to collect more solids at the disposal system
 - Second ISF addition to maintain quality of the produced water from the de-oiling train avoiding OIW excursions



Kirby North Facility Performance Oil / Water Treatment Area

- Oil Treating/Produced Water De-oiling Area
 - Plant inlet very stable, experiencing slugs when wells are coming into circulation/SAGD.
 - Overall water quality and oil treating targets have been met.
 - Oil Treating is running very stable, short term upsets from well startups were experienced
 - Optimization work continues on the chemical program and pressure optimization as flow increases
 - One treater online 101-V-160, the other one 101-V-170 in standby.
 - PW on target no major upsets.
 - Daily desanding ongoing.
 - ISFs repairs were made to internal eductors (failed welds from manufacturer). Both vessels in service.
 - IPL shipment scheduled weekly.
- All 3 evaporators are commissioned
 - 2 of 3 Evaporators in service meeting BFW demand, one in stand by.
 - Optimization work continues on the chemical injection.
 - Working to address minor operational issues.



Kirby North Facility Performance Boilers

- All 5 boilers are commissioned
 - All in service meeting steam demand.
 - Boiler tuning ongoing
 - Boiler fuel gas heating value optimization ongoing as produced gas and diluent flashing increases
 - Vibrations issues optimization ongoing. Flame stability design upgrades have been proven successful, these will be implemented to all 5 boilers.
 - Repaired leak on economizer tube weld on Boiler 3. Repair plan approved by ABSA.
 - CEMS Flow RATA has been completed



Kirby North Facility Performance Power Consumption

Month	Total Power Consumption (kWh)
August 2018	1,870,206
September 2018	1,882,538
October 2018	2,017,067
November 2018	2,346,134
December 2018	2,101,450
January 2019	2,363,636
February 2019	2,245,375
March 2019	2,722,722
April 2019	7,364,652
May 2019	11,576,932
June 2019	12,321,310
July 2019	12,905,479



Kirby North – Greenhouse Gas Emissions

- Kirby North Greenhouse Gas Emissions
 - 2019 emissions are estimates
 - Will be verified Q1 2020

Month	2018/2019 (tCO2e)			
September				
October				
November				
December				
January				
February				
March				
April	3,662			
Мау	14,018			
June	18,970			
July	21,684			
August	24,999			



Kirby North Facility Performance Gas Usage

• Gas Usage on a monthly basis

Note: Total Gas Produced on table below is being produced from the Brackish Water Wells

Month	Total Purchased Gas e3m3	Total Gas Produced e3m3	Total Solution Gas to Flare e3m3	Solution Gas Recovered %	Total Flare Gas e3m3	Total Gas Vented e3m3
Aug-18	24	59	59	0	94	0
Sep-18	21	104	104	0	116	0
Oct-18	106	59	59	0	78	0
Nov-18	217	31	31	0	65	0
Dec-18	502	52	52	0	62	0
Jan-19	917	59	59	0	77	0
Feb-19	888	29	29	0	35	0
Mar-19	983	0	0	0	24	0
Apr-19	2,708	0	0	0	222	0
May-19	7,339	2	0	100	435	0
Jun-19	9,994	9	0	100	622	0
Jul-19	10,954	8	0	100	461	0

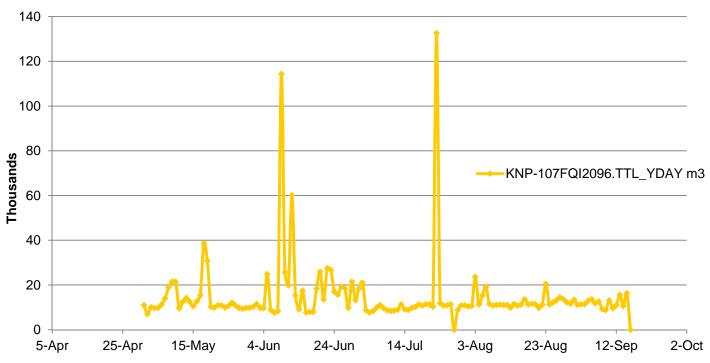


Kirby North Facility Performance Flaring Activities During Startup

- Due to the Kirby North injector wells new completion design (VITs) it was anticipated that the wells will require higher lift gas rates (up to 15 e3m3/d per well pair) during circulation
 - It was estimated that the lift gas returning to the CPF would be higher than the boiler consumption during circulation as the number of wells in circulation increased
- Canadian Natural applied and received a Kirby North CPF temporary flaring approval on May 15, 2019 for the period of May 15 to September 15, 2019
 - Data acquired during circulation indicated that each well pair required an average of 7 e3m3/d lift gas and not 15 e3m3/d that was conservatively estimated pre-startup
- Note the Kirby North CPF experienced two plant trip's (June and July 2019) which resulted in non-routine flaring operations
 - In the shutdown situation all gas is temporarily routed to flare until the situation is brought under control
 - Monthly flaring totals to were reported to AER one stop as per standard procedure.
 - These events were not associated with the temporary flaring approval.



Kirby North Facility Performance Flaring Activities During Startup



KN Flared Gas Daily Volumes (m3)



Kirby North Facility Performance Flared Gas Composition

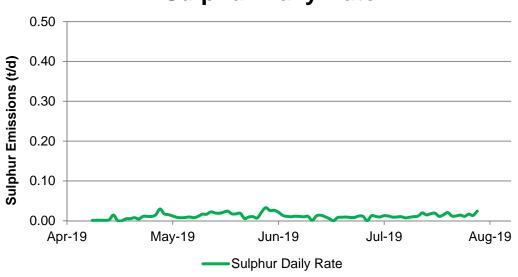
	9-08-01	15:00		2019-08-02		19-08-09			
Date Sampled (Y-M-D) Time Sampled		Petroleum	Date Received (Y-M-D) Date Reported (Y-M-D)		Date On	Date Off			
Comp.		raction Acid Gas Free	Liquid Content mL/m ³	Gross Heating Value, MJ/m ³ AGA #5 AGA #5 GPA 2172 As Received Acid Gas Free As Received		Pseudocritical Properties Pressure, kPa Temperature, K			
H2	0.0008	0.0008		40.26	40.40	40.26	4601	200.2	
He	0.0002	0.0002			Ideal Gas (A		Density Real Gas (GPA 2172)		
N2	0.0054	0.0054		Absolute, kg		Relative	Absolute, kg/m ³	Relative	
CO2	0.0036	0.0000		0.744		0.608	0.746	0.609	
H2S	0.0001	0.0000		Relative Molecular Mass Total Gas C7+		Mass C7+	Mole Fraction C7+	Vapour Pressure Pentanes Plus, kPa	
C1	0.9209	0.9244		17.60		105.82	0.0005	90	
C2	0.0492	0.0494	174.8				C7+ Fraction As Gas C7+ Density Liquid		
C3	0.0131	0.0131	48.1	Relative Den		IV (MJ/m ^a)	Relative	kg/m*	
iC4	0.0016	0.0016	7.0	3.653		223.77	0.696	696	
nC4	0.0022	0.0022	9.3	н	Hydrogen Sulfide		Compressibility Z		
iC5	0.0010	0.0010	4.9		g/m³		AGA #5	GPA #2172	
nC5	0.0009	0.0009	4.4	1	0.08		0.99763	0.99760	
C6	0.0005	0.0005	2.7			Hydrogen			
C7+	0.0005	0.0005	3.2	ppm (mol/mol)		Method	Field Value (ppm) 70.0	Field Method Stain Tube	
Total	1.0000	1.0000	254.4	56.70 Chromatography SCI		ography SCD	70.0	Stain Tube	

Results are not consistent with historical data.
 Results are not consistent with historical data.



Kirby North Facility Performance Emissions

- Kirby Sulphur Emissions
 - No exceedance of the EPEA daily SO_2 emissions limit 2 t/d



Sulphur Daily Rate



Measurement and Reporting Summary

- MARP approved in October 2011. New updates has been added to the MARP document updated, last submission to AER was in January 2019. See updates below:
 - At Kirby North and future Kirby South pads, there is no test separator. Fluid rates are measured using a multiphase mass flow meter. The gas content is sufficiently low such that the water cut (AGAR) probe remains accurate.
 - Solution Gas to Flare equation updated.
 - Inlet cavern flow calculation updated with the bypass meter addition at Kirby South and Kirby North.
- Methods for estimating well production and injection volumes:
 - Produced emulsion from the scheme is commingled at the battery. Bitumen and water production from the battery will be prorated to each well using monthly proration test data and proration factors
 - Total Battery Oil (Water) / Total Test Oil (Water) at Wells = Oil (Water) Proration Factor
 - Oil (Water) Proration Factor * Each Well Test Oil (Water) Volume = Oil (Water) Allocated to Each Well
 - Gas is allocated to each well using a Field GOR
 - Total Solution Gas Produced + Total Co-injected Produced Gas/ Total Battery Oil = Gas Oil Ratio
 - Gas Oil Ratio * Oil Allocated to Each Well = Gas Allocated to Each Well
 - Injected steam volumes will be continuously measured at the wellhead and prorated to the total steam leaving the injection facility
- Test Durations
 - Based on operating experience to date, most wells have 1-2 hour proration test durations. All wells on a pad are cycled through the test systems. Depending on the number of wells on a pad, the test duration is selected to provide a balance between test variability and frequency.
- Kirby South and North Facilities are in compliance with the Directive 017 requirements.



Future Plans – Surface Kirby South Planned 2019 – 2020 Activities

- Central Plant
 - Emulsion/BFW heat exchanger, sales tanks and diluent tank turnaround scheduled in 2020.
 - Evaporator cleaning scheduled in 2020.
- Pads
 - Strategic drills on existing wells
 - New Kirby South West Pads drill

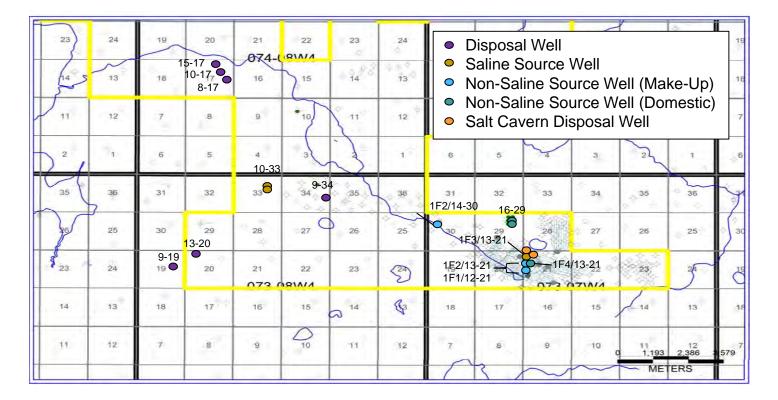


Future Plans – Surface Kirby North Planned 2019 – 2020 Activities

- Central Plant
 - Chemical optimization.
 - Alarm Rationalization.
- Pads
 - Continue converting KN03, KN05 and KN02 wells pairs to SAGD.
 - Begin circulation on pad KN04 in Q4 2019.
 - Complete KN01 drilling and pad construction activities starting January, 2020.



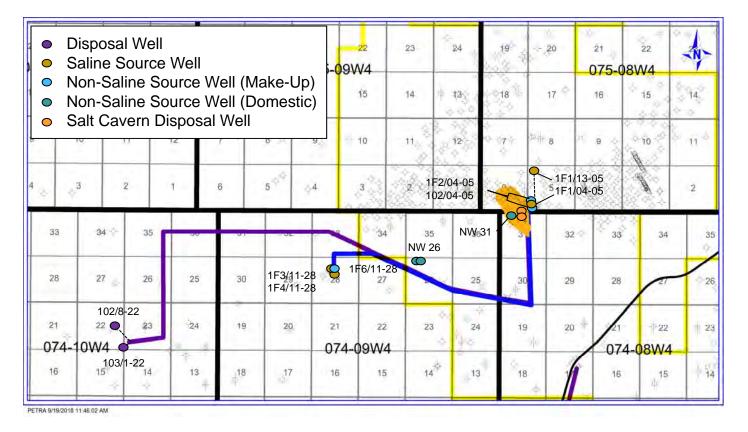
Kirby South Source and Disposal Well Map





Slide 110

Kirby North Source and Disposal Well Map





Slide 111

Kirby South Source Wells - Saline

Well Name	Use	Unique Well Identifier		
McMurray Source Wells				
CNRL WSW MC01 Kirby 10-33-73-8	Make-up	1F1/10-33-73-8 W4M		
CNRL WSW MC02 Kirby 10-33-73-8	Make-up	1F2/10-33-73-8 W4M		
Grand Rapids Source Well				
CNRL WSW GR01 Kirby 13-21-73-7	Make-up	1F3/13-21-073-07W4M		



Kirby South Source Wells – Non-Saline

Well Name	Use	Unique Well Identifier
GRAND RAPIDS Formation Source Well	•	
CNRL WSW02 Kirby 14-30-73-7	Industrial (Make-up)	1F2/14-30-73-8W4M
EMPRESS Formation Source Wells	•	
CNRL WSW Kirby 13-21-73-7	Industrial (Make-up)	1F2/13-21-73-07W4M
CNRL WSW EMP03 12-21-73-7	Industrial (Make-up)	1F1/12-21-73-07W4M
MURIEL LAKE Formation - Source Wells		
CNRL WSW ML03 Kirby 13-21-73-7	Domestic	1F4/13-21-73-7W4M
ETHEL LAKE Formation - Source and Standby Wells	·	
CNRL WSW EL01 Kirby 16-29-73-7	Domestic	1F1/16-29-73-7W4M
CNRL WSW EL02 Kirby 16-29-73-7	Domestic	No UWI No drill license required



Kirby North Source Wells - Saline

Well Name	Use	Unique Well Identifier		
McMurray Source Wells				
CNRL WSW MCM01 KIRBY 11-28-74-9	Cavern Wash, Shut-in (09/18)	1F3/11-28-074-09W4M		
CNRL WSW MCM02 KIRBY 11-28-74-9	Cavern Wash, Zone abandonment (10/18)	1F4/11-28-074-09W4M		
Clearwater Source Wells				
CNRL WSW CW02 DEVENISH 4-5-75-8	Cavern Wash, Make-up	1F1/04-05-075-08W4/00		
CNRL WSW HZ CW06 DEVENISH 13-5-75-8	Cavern Wash, Make-up	1F1/13-05-075-08W4/00		

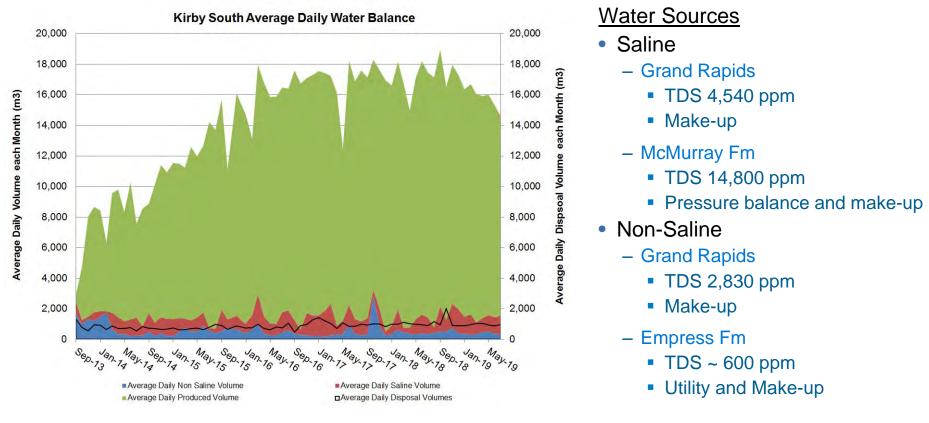


Kirby North Source Wells – Non-Saline

Well Name	Use	Unique Well Identifier					
EMPRESS Unit 1 Formation - Source Well							
CNRL WSW EMP04 KIRBY 11-28-74-9	Other (make-up, cavern wash and utility)	1F6/11-28-074-09W4/00					
EMPRESS TERRACE Formation - Source	Wells						
CNRL WSW EMP02 DEVENISH 4-5-75-8	Other (cavern wash, plant commission), Industrial (make-up and utility)	1F2/04-05-075-08W4/00					
CNRL OBS EMP01 DEVENISH 4-5-75-8	Other (cavern wash, plant commission), Industrial (make-up and utility)	102/04-05-075-08W4/00					
ETHEL LAKE Formation - Source Well		•					
CNRL WSW QT01 KIRBY NW-31-74-8	Domestic	No UWI No drill license required					
BONNYVILLE Formation - Source and St	andby Wells						
CNRL WSW BNY01 KIRBY NW-26-74-9	Domestic	No UWI No drill license required					
CNRL WSW BNY02 KIRBY NW-26-74-9	Domestic	No UWI No drill license required					



Kirby South Produced and Make-up Water Usage



Canadian Natural

Kirby South Make-up and Produced Water Usage

Month	Non-saline Groundwater	Saline Groundwater	Non Saline Make-Up Percentage	Produced Water	Injection	Produced Water Recycled
Aug-18	12,706	11,768	51.9	506,741	35,632	93.0
Sep-18	15,677	48,538	24.4	503,985	28,425	94.4
Oct-18	15,409	24,256	38.8	472,870	62,069	86.9
Nov-18	22,187	47 , 559	31.8	468,627	26,892	94.3
Dec-18	11,834	48,435	19.6	475 , 959	27,194	94.3
Jan-19	10,407	35,085	22.9	461,811	27,384	94.1
Feb-19	9,009	36,246	19.9	422,180	26,607	93.7
Mar-19	9,570	24,707	27.9	463,067	31,774	93.1
Apr-19	14,246	27,407	34.2	435 , 996	31,064	92.9
May-19	15,141	33,296	31.3	446,957	28,896	93.5
Jun-19	10,544	32,535	24.5	416,054 26,209		93.7
Jul-19	9,284	38,833	19.3	404,590	29,643	92.7
2018-2019 Totals	156,015	408,664	27.6	5,478,836	381,789	93.0

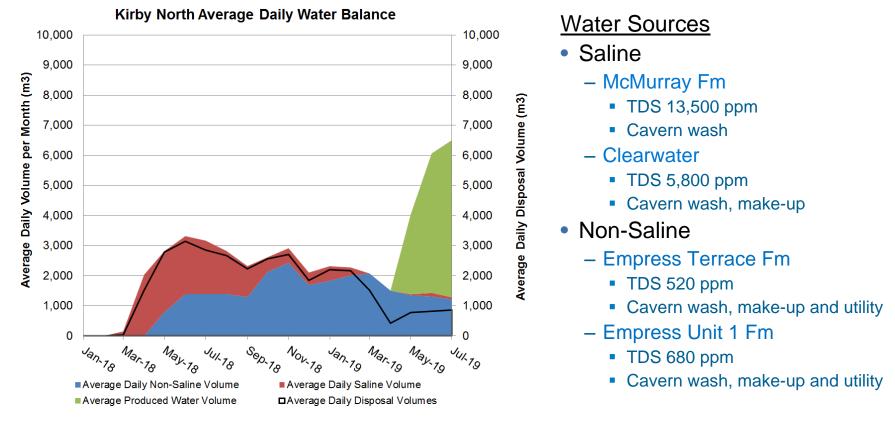
• Decreased non-saline usage over 2019. High produced water recycle rates.

• Potable Water

– A total of 30,043 m³ of water was used to supply Kirby South camp and office complex



Kirby North Water Usage – Cavern Wash and Circulation Phases





Kirby	North	Water	Usage
--------------	-------	-------	-------

Month	Non-saline Groundwater	Saline Groundwater	Non Saline Make-Up Percentage	Produced Water	Injection	Produced Water Recycle	
Aug-18	43,111	44,325	49	-	82,733	-	
Sep-18	38,766	30,773	56	-	69,087	-	
Oct-18	66,051	14,982	82	-	79,410	-	cavern washing
Nov-18	73,266	14,577	83	-	83,853	-	cavern washing
Dec-18	52,425	13,290	80	-	57,166	-	
Jan-19	56,781	14,986	79	-	68,219	-	
Feb-19	56,193	7,440	88	-	60,576	-	n
Mar-19	64,234	0	100	-	46,916	-	plant commissioning
Apr-19	45,119	0	100	-	12,663	-	
May-19	41,731	1,121	97	82,395	24,075	71	circulation starts
Jun-19	39,227	3,585	92	139,094	24,522	82	
Jul-19	37,548	2,109	95	162,038	26,643	84	
2018-2019 Totals	614,454	147,187	95	383,526	635,864	79	

- Limited deliverability of saline groundwater sources
 - McMurray Fm. source wells shut-in, Clearwater Fm. production decreasing
- Potable water

- A total of 13,116 m³ of groundwater was used to supply Kirby North camp and office complex



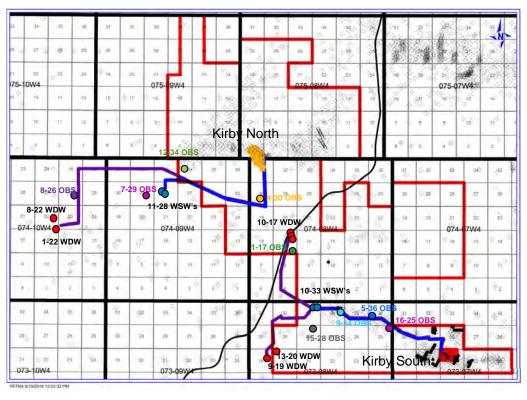
Kirby Project - D81 Disposal Limit Calculation

	Kirby South Non- Saline	Kirby North Non- Saline	Total Non- Saline	Kirby South Saline	Kirby North Saline	Total Saline	Kirby South Produced Water	Kirby North Produced Water	Total Produced Water	South Injection	North Injection	Total Injection		
	m3	m3	m3	m3	m3	m3	m3	m3	m3	m3	m3	m3	%	%
Aug-18	12,706	-	12,706	11,768	-	11,768	506,741	-	506,741	35,632	-	35,632	6.7	10.4
Sep-18	15,677	-	15,677	48,538	-	48,538	503,985	-	503,985	28,425	-	28,425	5.0	11.9
Oct-18	15,409	-	15,409	24,256	-	24,256	472,870	-	472,870	62,069	-	62,069	12.1 *	11.0
Nov-18	22,187	-	22,187	47,559	-	47,559	468,627	-	468,627	26,892	-	26,892	5.0	11.9
Dec-18	11,834	-	11,834	48,435	-	48,435	475,959	-	475,959	27,194	-	27,194	5.1	12.1
Jan-19	10,407	-	10,407	35,085	-	35,085	461,811	-	461,811	27,384	-	27,384	5.4	11.6
Feb-19	9,009	-	9,009	36,246	-	36,246	422,180	-	422,180	26,607	-	26,607	5.7	11.8
Mar-19	9,570	-	9,570	24,707	-	24,707	463,067	-	463,067	31,774	-	31,774	6.4	11.1
Apr-19	14,246	-	14,246	27,407	-	27,407	435,996	-	435,996	31,064	-	31,064	6.5	11.2
May-19	15,141	41,731	56,872	33,296	1,121	34,417	446,957	82,395	529,352	28,896	24,075	52,971	8.5	10.7
Jun-19	10,544	39,227	49,771	32,535	3,585	36,121	416,054	139,094	555,147	26,209	24,522	50,732	7.9	10.9
Jul-19	9,284	37,548	46,832	38,833	2,109	40,942	404,590	162,038	566,627	29,643	26,643	56,286	8.6	11.1
2018-2019 Totals	156,015	118,507	274,522	408,664	6,815	415,478	5,478,836	383,526	5,862,362	381,789	75,241	457,030	7.0	11.3

* Higher disposal rates during Kirby South plant turnaround.

• Directive 81 Disposal Limit = 11.3 %, Actual Disposal = 7.0% from Aug 2018 to July 2019



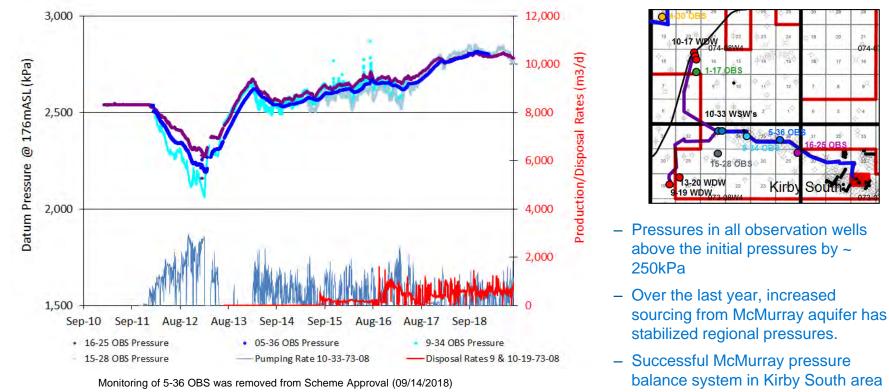


McMurray Source, Disposal and Observation Well Map



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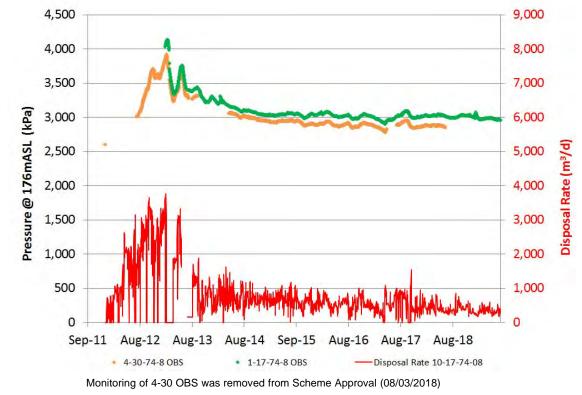
McMurray Fm Basal Aquifer pressures Kirby South 10-33 well area

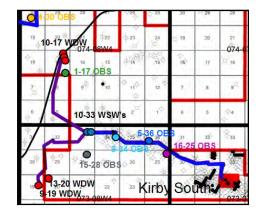




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• McMurray Fm Basal Aquifer pressure near 10-17-74-8 disposal area



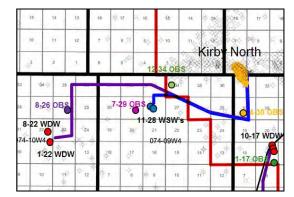


- Pressure increased early on during cavern washing
- Stabilized around ~3,000kPa (1-17 OBS) and holding since 2014
- Approximately 300kPa above original static pressure



McMurray Fm Basal Aquifer pressures Kirby North





- Cavern washing began March 2018
- Pressures decreased 500 to 600 kPa near the 11-28 WSW's.
- Pressures increased slightly at 8-26 OBS near 8-22 WDW.
- Minimal hydraulic connection between disposal and reservoir areas - pressure balance system in Kirby North area not required



- Chemistry analysis
 - All saline water source wells (annually)

	1F1/10-33-073-08W4 (McMurray) Kirby South	1F3/13-21-73-07W4 (Grand Rapids) Kirby South	1F1/13-05-075-08W4 (Clearwater) Kirby North	1F1/04-05-075-08W4 (Clearwater) Kirby North
Date	September 3, 2019	September 3, 2019	September 3, 2019	September 3, 2019
Total Dissolved Solids	14,800 mg/L	4,540 mg/L	5,750 mg/L	5,800 mg/L

McMurray source wells in Kirby North were shut-in September 2018.

- McMurray Observation wells (every five years)

	100/15-28-073-08W4 Kirby South	100/01-17-074- 08W4 Kirby South	100/08-26-074-10W4 Kirby North	100/07-29-074-09W4 Kirby North
Date	March 10, 2014	March 16, 2014	January 1, 2018	January 18, 2018
Total Dissolved Solids	16,800 mg/L	12,500 mg/L	10,900 mg/L	13,000 mg/L

Requested 15-28 and 1-17 observation wells be sampled by February 2020. Following sampling event scheduled for 2024.



Kirby Pressure Balance Groundwater Flow Models

- The McMurray Kirby South pressure balance numerical model was updated in October, 2018 and results were presented to AER in June 2019.
- Data used to update the numerical model
 - Model updated with production and disposal volumes up to August 31, 2018
 - History match conducted using pressure data from KS observation wells up to September 27, 2018
- History match exercise validated the existing model no geology or boundary condition changes were needed.
- Calculated pressure responses in observation wells match new observation well data.
- The McMurray Kirby North numerical model was built in January 2019. The conceptual model, model construction and calibration results presented to AER in June 2019.
 - Pressure data from KN observation wells was used for model calibration and to understand regional flow system.

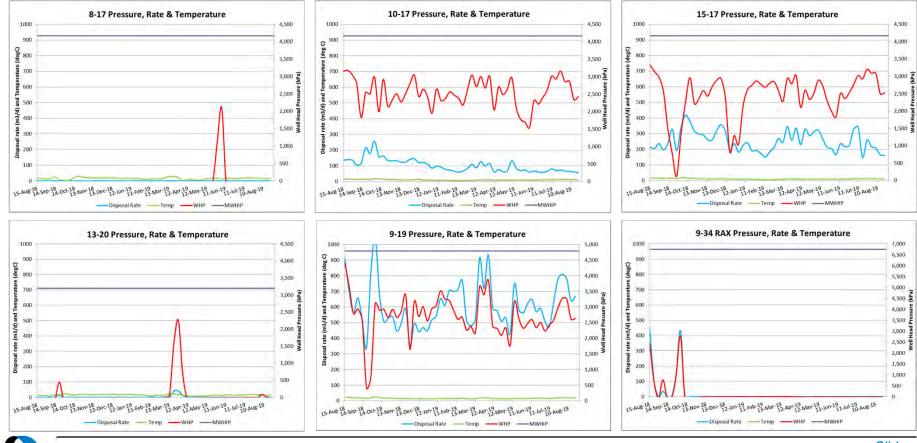


Kirby South Disposal Wells

Well Name	Use	Unique Well Identifier		
McMurray Disposal Wells	· · ·			
RAX Kirby 9-34-73-8	Disposal (used periodically)	100/09-34-073-08W4M		
CNRL WDW01 Kirby 8-17-74-8	Disposal	100/08-17-074-08W4M		
CNRL WDW02 Kirby 10-17-74-8	Disposal	102/10-17-074-08W4M		
CNRL WDW03 Kirby 15-17-74-8	Disposal	100/15-17-074-08W4M		
CNRL WDW HZ MCM05 Kirby 13-20-73-8	Disposal	100/13-20-073-08W4M		
CNRL WDW MCM06 Kirby 9-19-73-8	Disposal	100/09-19-073-08W4M		

Salt Cavern Wells		
CNRL CAVERN VERT KIRBY 13-21-73-7	Prairie Evaporate	100/13-21-073-07W4M
CNRL CAVERN DD KIRBY 4-28-73-7	Lotsberg	100/04-28-073-07W4M





Kirby South Disposal

Canadian Natural

Gradual injectivity decline visible. Occasional acid jobs used to deal with the problem

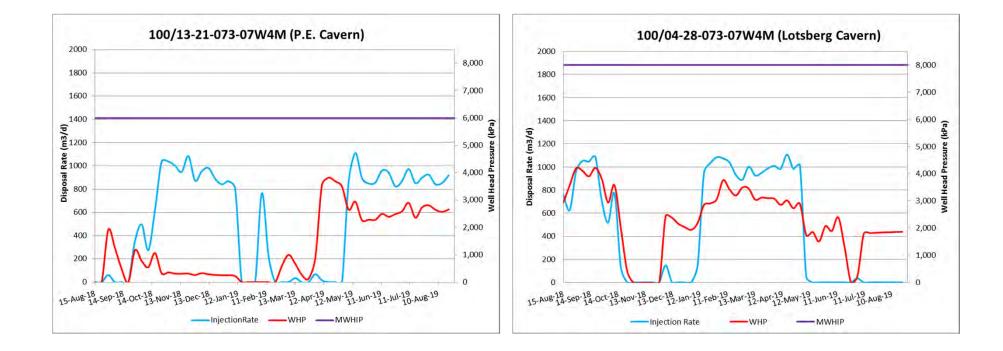
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Kirby South Facility Performance Salt Caverns

- Salt caverns continue to manage evaporator blowdown solids
- Caverns are operated in single mode
 - 100/13-21 volume (as for September 2019) 143,436 m³
 - 100/04-28 (as for July 2019) 139,709 m³
- Periodically caverns are switched
- Integrity test (MIT) on 100/04-28 completed successfully in June 2019
- 2018/2019 Sonar Logging
 - 100/13-21 completed in July 2018 and September 2019
 - 100/04-28 completed in October 2018 and in July 2019



Kirby South Facility Performance Salt Caverns





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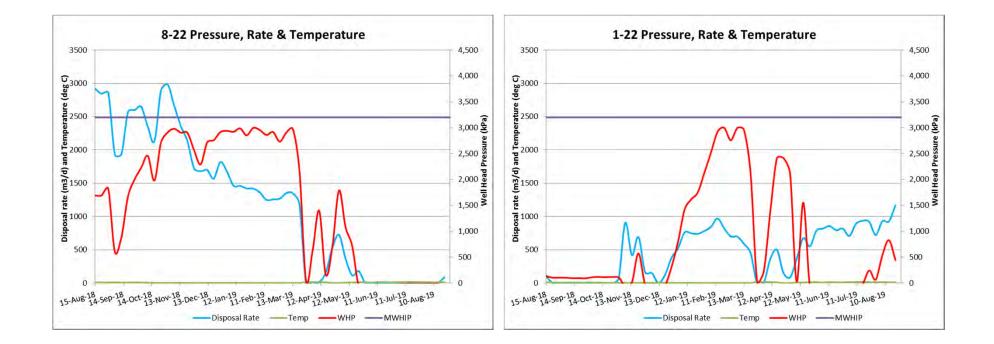
Kirby North Disposal Wells

Well Name	Use	Unique Well Identifier	
McMurray Disposal Wells			
CNRL WDW HZ MCM03 KIRBY 8-22-74-10	Disposal	102/08-22-074-10W4M	
CNRL WDW MCM04 KIRBY 1-22-74-10	Disposal	103/01-22-074-10W4M	

Salt Cavern Wells		
CNRL CAVERN DD DEVENISH 1-6-75-8	Prairie Evaporate	100/01-06-075-08W4M
CNRL CAVERN VERT DEVENISH 1-6-75-8	Lotsberg	102/01-06-075-08W4M



Kirby North Disposal



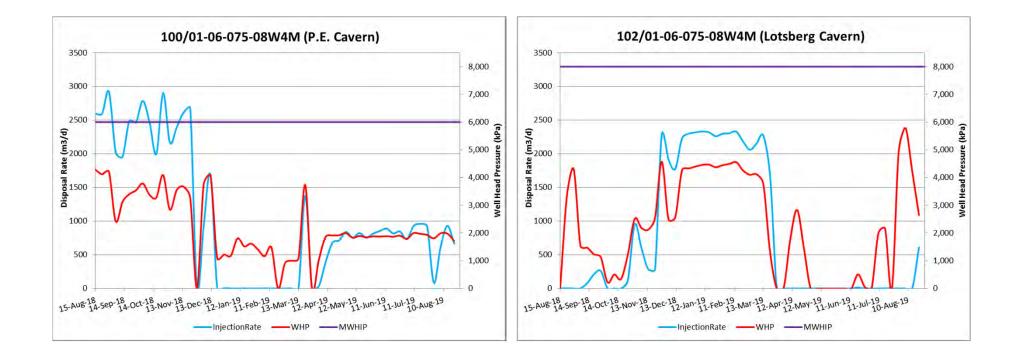


Kirby North Facility Performance Salt Caverns

- 100/01-06 evaporator blowdown solids injection started in April 2019
- 102/01-06 wash is progressing
- Integrity test (MIT) on 100/01-06 completed successfully in February 2019
- Integrity test (MIT) on 102/01-06 completed successfully in August 2019
- Caverns are operated independently
 - 100/01-06 volume (as for December 2018) 38,500 m³
 - 102/01-06 volume (as for April 2019) 36,130 m³
- 2018/2019 Sonar Logging
 - Sonar logging on 100/01-06 completed in December 2018, another sonar logging scheduled November 2019
 - Sonar logging on 102/01-06 completed in April 2019, another sonar logging scheduled December 2019



Kirby North Facility Performance Salt Caverns





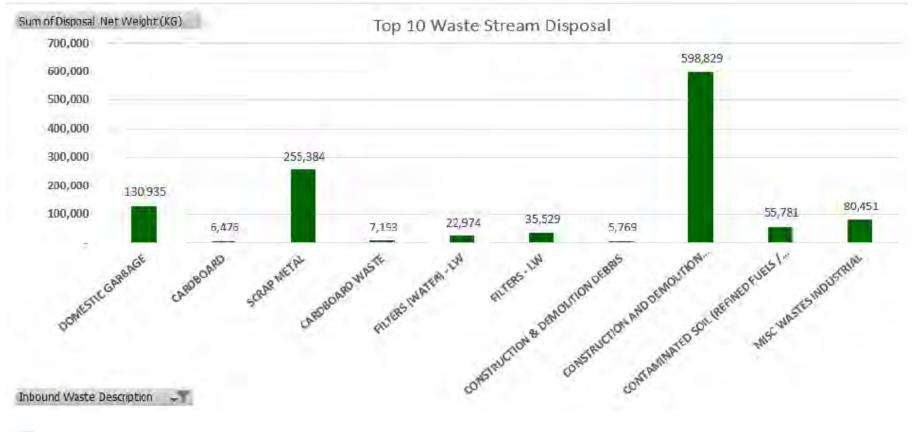
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Kirby South Waste Disposal September 2018 through August 2019





Kirby North Waste Disposal September 2018 through August 2019





- Wildlife Mitigation Plan and Monitoring Program
 - Monitoring mitigation efficacy (aboveground pipelines, barriers to wildlife movement, effects of human presence)
 - 27 remote cameras deployed throughout the project
 - 13 species detected, including three provincially sensitive species and one federally threatened species (woodland caribou)
 - 23 camera stations monitoring linear deactivation (initiated in Feb 2015)
 - 10 mammal species recorded
 - Noted correlation between low carnivore detections along treated lines
 - 22 species of concern (17 bird species, 5 mammals) observed in the Kirby Project area in 2015
 - Second comprehensive wildlife report to be submitted May 2020



- Wetland and Waterbody Monitoring Program
 - Two monitoring stations showed water level response is sensitive to discharges of industrial waste water from nearby pads or the Kirby South CPF.
 - Culvert audit completed in 2019.
 - Mitigation work scheduled for late September/early October
 - Mitigation measures to be applied to most problematic culverts following the surveys.
 - Additional mitigation measures being applied throughout the year to meet target of repairing all damaged culverts within one year from time of assessment.
 - Roadway drainage assessment completed July 2019 to identify root cause of tree stress and mortality zones
 - Submitted to AER and planned mitigation to be implemented fall 2019
 - Bathymetry survey completed for Edwards Lake in October 2018



- Kirby South Groundwater Monitoring Program
 - Well pad monitoring program to monitor potential effect of steam injection on mineral solubility and mobilization of trace elements
 - 1 shallow monitoring well on each Pad B, Pad D, Pad F, 3 deep monitoring wells on Pad F
 - Impacts to shallow groundwater quality being investigated at D-Pad.
 - Sub-regional groundwater monitoring focused on deeper, Quaternary- and Tertiary-aged aquifers.
 - Groundwater quality and quantity have not been impacted by project related activities
 - Central Plant monitoring program monitors groundwater conditions within shallow sediments
 - 20 groundwater monitoring wells at CPF
 - Continued monitoring to evaluate water quality trends at monitoring well P12-06.
- Kirby North Groundwater Monitoring Program
 - Establish groundwater monitoring networks
 - 24 groundwater monitoring wells at CPF, 3 shallow monitoring wells on pads KN01, KN02 and KN05, 4 deep sub-regional groundwater monitoring wells near pads KN01- KN04
 - Baseline sampling on-going



- Air Monitoring
 - Source Monitoring
 - Kirby North certification RATA and operational test period completed in Aug 2019
 - All Kirby North stack tests completed within 6 months of commissioning plant
 - CEMS at steam generators measures SO₂ and NO₂
 - Two cylinder gas audits are scheduled for Kirby South and one for North.
 - One manual stack survey conducted at Kirby South on Generator 2 in 2019
 - No significant trends in emissions data



- Air Monitoring
 - Ambient Air Monitoring
 - 2019 Air Quality monitoring trailer operation
 - January to April at Kirby South
 - Ongoing operation since May at Kirby North
 - There were no SO2, H2S, or NO2 monthly readings above the Alberta Ambient Air Quality Objective between August 2018 to August 2019
 - Five passive monitoring stations located around the Kirby South plant site
 - All passive exposure monitoring results for SO₂, H₂S, NO₂ and O₃ were low for the monitoring period
 - Four passive monitoring stations installed in 2018 and located around the Kirby North plant site
 - All passive exposure monitoring results for SO₂, H₂S, NO₂ and O₃ were low for the monitoring period



Environmental Summary Reclamation Activities

- Reclamation Activities
 - Re-vegetation Program consisted of reforesting 47.65ha in summer 2019
 - 94,525 trees planted across 9 separate borrow pits
 - Reclamation certificate application submitted for SML100131
- Reclamation Monitoring
 - Objectives are to ensure:
 - land is reclaimed to an equivalent land capability
 - appropriate replacement of all salvaged topsoil on re-contoured areas
 - sustainable, diverse vegetation growth on all disturbed areas
 - pre-disturbance wildlife carrying capacities are obtained
 - Regular site monitoring throughout reclaimed areas within the Project Area
- Reporting
 - 2018 Annual C&R Report was submitted on May 30, 2019
 - Extension to Mar 31 deadline approved by AER
 - PLRCP and RMP submitted to AER and approved on June 17, 2019 and July 16, 2019



Environmental Summary Provincial/Federal Programs/Regulations

- Lower Athabasca Regional Plan (LARP)
 - Participation in the South Athabasca Oil Sands (SAOS) area for Groundwater Management
- Provincial and Federal Woodland Caribou Recovery Policies
 - Participating in GOA processes to develop and implement range-level caribou recovery plans
 - Participating in research related to caribou recovery (COSIA, RICC, FLMF)
 - Engaging with the GOA and Government of Canada to understand opportunities for stewardship actions to help enable caribou recovery (CAPP).
- Alberta Wetland Policy
 - Participating in discussions with AEP and the AER regarding implementation of the policy in the Green Area of Alberta (CAPP)
- Alberta's Technology Innovation and Emissions Reduction (TIER)
 - Participating in AEP consultation process related to the Technology Innovation and Emissions Reduction (TIER) program that is intended to replace the current large-emitter greenhouse gas policy (CCIR).



Approvals Commercial Oil Sands Scheme

Commercial Oil Sands Scheme		
11475BB	October 2018	Kirby South A7 Injector Kirby South Phases 10a/b
11475CC	November 2018	KN Warm Solvent Assisted Start Up
11475DD	November 2018	Kirby South Temporary ID 2001 Waiver
11475EE	January 2019	Kirby North KN06
11475FF	May 2019	Kirby North SAGD Circulation



Approvals EPEA and Water Act

	Environme	ntal Protection and Enhancement Act	
237382-00-00	April 2011	Approval of Kirby In Situ Oil Sands Project	
237382-00-01	July 2014	Approval of Kirby In Situ Oil Sands Expansion Project	
237382-00-02	February 2015	Amend Kirby South steam generator NOx limit to include efficiency credit	,
237382-00-03	February 2017	Kirby South Daily Sulphur Dioxide Limit	
Water Act			
00334375-00-00 (Kirby South)	August 2013	Groundwater diversion license, Empress Unit 1 and Grand Rapids Formation	
00334375-01-00 (Kirby South)	August 2015	Renewal of Groundwater diversion license	
00334375-01-01 (Kirby South)	March 2017	Amendment to include drilling, construction, ice-roads and dust cor	ntrol
00288494-00-00 (Kirby South)	April 2011	Groundwater diversion license, Ethel Lake Formation	
00327156-00-00 (Kirby South)	August 2013	Industrial surface runoff diversion license	
00303825-00-00 (Kirby North)	July 2014	Preliminary Certificate groundwater diversion, Empress Terrace Formation	
		In Compliance	Slid

Approvals EPEA and Water Act

Water Act		
00303820-00-00 (Kirby North)	September 2014	Industrial surface runoff diversion license
00297299-00-00 (Kirby South)	December 2011	Groundwater diversion license, Muriel Lake Formation
00297299-00-01 (Kirby South)	November 2014	Amendment to decrease allocation
00390209-00-00 (Kirby North)	May 2017	Groundwater diversion license, Bonnyville Formation
00391822-00-00 (Kirby North)	May 2017	Groundwater diversion license, Ethel Lake Formation
00413863-00-00 (Kirby North)	May 2018	Temporary groundwater diversion license, Empress Terrace Formation, Cancelled and new TDL No. 00424514 issued
00424514-00-00 (Kirby North)	November 2018	Temporary groundwater diversion license, Empress Terrace Formation, Expired May 2019
00435093-00-00 (Kirby North)	April 2019	Temporary groundwater diversion license, Empress Unit 1 Formation
00434675-00-00 (Kirby North)	May 2019	Groundwater diversion license, Empress Terrace Formation
In Compliance		



Approvals Disposal

Class 1b Cavern Disposal		
11716	November 2011	Kirby South Cavern Solution Mining
11716A	July 2013	 Class 1b Cavern Disposal Prairie Evaporite formation through well 00/13-21-073-07W4 Lotsberg formation through well 00/04-28-073-07W4
11716B	June 2015	Modify testing requirements. Approval modified to reference CSA Z341.4
12465A	November 2015	Kirby North Cavern Solution Mining
11716D	February 2019	 Class 1b Cavern Disposal – Addition of 2 wells Prairie Evaporite formation through well 00/01-06-075-08W4 Lotsberg formation through well 02/01-06-075-08W4
In Compliance		



Approvals Disposal

	Class Ib Disposal		
11761	December 2011	Class Ib Disposal • 00/08-17-74-08W4 • 02/10-17-74-08W4 • 00/15-17-74-08W4	
11761A	April 2013	Modify pH requirements	
11761B	March 2014	Amend MWHIP	
11761C	May 2015	 Additional Kirby South disposal well 100/13-21-73-08W4 Additional Kirby North disposal well 02/08-22-74-10W4 	
11761D	July 2016	 Conversion of existing observation well to disposal well 100/09-19-73-8W4 	
11761E	May 2018	Additional Kirby North disposal well 03/01-22-74-10W4 	
	In Compliance		



Approvals Disposal (continued)

	Class II Disposal		
9113	June 2002	Class II Disposal • 00/08-22-074-10W4/0 • 00/09-34-073-08W4/0	
9594	September 2003	Transferred to Canadian Natural from Rio Alto Exploration	
9594A	December 2011	Approval of Kirby In Situ Oil Sands Project	
9594B	May 2014	Approval of Kirby In Situ Oil Sands Expansion Project	
In Compliance			



Compliance Summary

- Reportable Spills
 - One reportable spill at Kirby North on March 23rd, 2019 release of disposal fluid off site. Remediation complete
- EPEA Contraventions
 - EPEA contravention, Kirby South failure to meet 90% up time on AQM trailer January & February 2019
 - EPEA contravention, Kirby South AMD #1 form reporting deadline
- Water Act

None





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