CNRL HZ ELM 9-33-66-5
STICK DIAGRAM / DRILLING PROGRAM - Montney HZ
AFE # DR250312

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If the planned scope of work or program changes in any way, STOP!
Code 99:communicate, collaborate with Calgary to ensure the risks, process and procedures are discussed, documented and approved before proceeding.

CNRL HZ ELM 9-33-66-5
STICK DIAGRAM / DRILLING PROGRAM - Montney HZ
AFE # DR250312

Canadian Natural

Basic Well Information

Rig:	**Savanna 651**	**Pad Drill Order:** 1
Supervisors:	**Mike Braun**	**(403) 556-9264**
	Justin Courtoreille	**(780) 512-4305**
	Chris Evanyshyn	**(403) 348-9003**
Well Name:	CNRL HZ ELM 9-33-66-5	
Surface Location:	09-31-066-05W6	
Bottom Hole Location:	100/09-33-066-05W6/00	
Licence No:	0508421	
Directional Job:	Phoenix	
Directional Plan:	3	
Survey Revision:	Compass R7 5/15/24	
GL:	**775.80**	
GL to KB:	**8.10**	
KB Elevation:	**783.90**	

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Contacts

AER:	**24hr Number**	**1-800-222-6514**
CNRL:	24hr Emergency	1-888-878-3700
Field Operations:	GP South	(780) 831-7475
Safety Coord:	Terron Velichka	(780) 876-2325
Prod. Foreman:	Ken Nixon	(780) 834-6346
Prod. Asst Foreman:	Ryan Astalos	(780) 897-2219
*** AER to be notified of spud via online reporting ***		
Construction:	Kirk Driscoll	(780) 402-1070 (cell)
Construction:	Ryan Hodgson	(403) 701-6383 (cell)
*** Notify at spud and drill out (Cuttings Analysis) ***		
Drilling Supt:	Don Grant	(403) 952-6835
Drilling Engineer:	Samir Sizine	(403) 371-0991
Drilling Tech:	Grince Varghese	(587) 834-1132
Drilling Ops Manager:	Gary Steinke	(403) 818-1169
Completions Eng:	Luke Bungay	(403) 370-3557
Area Geologist:	Jennifer Nistico	(403) 875-7804
Production Eng:	Harrison Duncan	(780) 516-0149
Waste Management:	Kyle Schachtel	(403) 813-4811

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Services & Pertinent Telephone Numbers

Drill Bits:	Halliburton	See Bit Program
	Smith	See Bit Program
	Ulterra	See Bit Program
	Reed / Baker	See Bit Program
Motors:	Phoenix	See Execution BHAs
Directional:	Phoenix	
Mud:	Secure	
Solids Control:	Apex	
Cement:	Sanjel	See attached program
Agitator:	TBD	
Camp:	N/A	
Casing Delivery:	Tenaris Rig Direct	(780) 766-0310
Floats/Centralizers:	CCA / Import	(780) 539 -5757
		(403) 540-7016
Casing Bowl:	StreamFlo	
Communications:	Pason	(877) 255-3158
Drilling Recorder:	Pason	(877) 255-3158
Tank Farm:	Strad	
Environmental:	Secure	(403) 650-8571
Bifuel:	Fuzion	

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Notifications

*** AER to be notified of spud via online reporting by WSS**
*** Notify at spud and drillout (Cuttings Analysis)**

Logging Program

MWD Logs

Logging Co.:	Phoenix
Logging Suite:	MWD gamma from drill out to TD

Wireline Logs

Logging:	na
Logging Interval:	na

Gas Detection Required From Surface Casing to TD

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Samples

AER:	Not required
CNRL:	Every 10m from Gething to the heel. Every 20m through the lateral.

Configuration, Tops, Pressures & H_2S

Surface Hole
311mm hole
244.5mm casing

A Class 1 Diverter will NOT be necessary while drilling the surface hole because S/C < 650mKB.

Surface Casing to be set at a minimum of 615m in order to cover ground water.

Pressure Gradients in blue text are based on expected MW as no XI pressure data is available. Max EMD Column is based off of XI pressure data.

FORMATION	MD (mKB)	SS Depth (mKB)	TVD (m-KB)	Max Press. (kPa)	Max GRAD (kPa/m)	Max EMD Per Fmn (kg/m³)	Expected MWT (kg/m³)	H_2S (%)
Belly River (Potential Loss Zone)	600	184	600	5,883	**9.8**	999	**1000**	
Surface Casing	**615**	**169**	**615**					
Nudge (2°/30m)	**645**	**139**	**645**					
Puskwaskau	943	-158	942	9,234	**9.8**	999	**1250**	
Chinook Zone	968	-183	967	9,475	**9.8**	999	**1250**	
Colorado	998	-213	997	9,774	**9.8**	999	**1250**	
Base of Groundwater	**1008**	**-224**	**-1008**					
Badheart	1123	-338	1,122	12,417	**11.1**	1128	**1250**	
Muskiki	1137	-352	1,136	11,130	**9.8**	999	**1250**	
Cardium	1175	-390	1,174	11,625	**9.9**	1009	**1250**	
Cardium Zone	1193	-408	1,192	11,798	**9.9**	1009	**1250**	
Kaskapau	1212	-427	1,211	14,121	**11.7**	1189	**1250**	
SWS Shale	1374	-589	1,373	3,323	**2.4**	247	**1250**	
Doe Creek	1541	-756	1,540	15,089	**9.8**	999	**1250**	
Dunvegan	1601	-816	1,600	12,318	**7.7**	785	**1250**	
Base of Fish Scales	1799	-1014	1,798	17,619	**9.8**	999		
Paddy	1894	-1109	1,893	19,629	**10.4**	1057	**1250**	
Cadotte	1907	-1122	1,906	15,493	**8.1**	829	**1250**	
Notikewin	1954	-1169	1,952	19,134	**9.8**	999	**1250**	
Falher	1999	-1214	1,998	16,185	**8.1**	826	**1250**	
Bluesky	2247	-1462	2,245	23,577	**10.5**	1070	**1250**	
Gething	2273	-1488	2,272	23,855	**10.5**	1070	**1250**	
KOP (4°/30m)	**2301**	**-1516**	**2,300**					
Cadomin	2380	-1595	2,378	22,072	**9.3**	946	**1250**	
Nikanassin (Potential Loss Zone)	2389	-1603	2,387	10,074	**4.2**	430	**1250**	
Fernie	2470	-1681	2,465	27,678	**11.2**	1145	**1250**	
Nordegg	2541	-1743	2,527	24,767	**9.8**	999	**1250**	
ICP (32° inc)	2556	-1756	**2,540**					
Charlie Lake	2570	-1768	2,552	26,283	**10.3**	1050	**1250**	0.08%
Build (9°/30m)	**2620**	**-1810**	**2,594**					
Halfway	2620	-1810	2,594	28,275	**10.9**	1111	**1250**	0.41%
Doig	2627	-1816	2,600	28,338	**10.9**	1111	**1250**	
Doig Phosphate	2670	-1847	2,631	28,680	**10.9**	1111	**1250**	
Tangent (30m @ 65°)	**2721**	**-1875**	**2,658**					
Montney	2680	-1854	**2,638**	29,013	**11.0**	1121	**1250**	3.00%
Montney D	2693	-1861	**2,645**	29,093	**11.0**	1121	**1250**	3.00%
Casing XO	**2765**	**-1892**	**2,676**					
Heel	**2831**	**-1904**	**2,688**					
Turn (4°/30m)	**2881**	**-1904**	**2,688**					
EOT	**2943**	**-1903**	**2,687**					
TD	**5771**	-1853	**2,637**	**29,006**	**11.0**	1121	**1250**	3.00%

Intermediate Hole (vertical/build)
222mm hole / 193.7mm casing

Potential for hole instability through the Belly River

Potential for hole instability through Fernie

Use wellbore stabilizing products while drilling Falher.

Hold pre-penetration meeting prior to drilling into 1st sour formation.

Main Hole (build)
171mm hole
139.7mm casing

Main Hole (lateral)
159mm hole
114.3mm casing

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See Directional Plan for Lateral Control Points

*** Primary Target Zone**

*** Directional Information**

2,940 m Horizontal leg Cemented TD to Surface

Sour Well
EPZ = 0.96 km
Release Rate = 0.1174 m3/s
Max H2S Conc = 3.00%
Type C370, Level 1

Formation / Geology / Hard Boundary Notes

BOP Stack

279mm Class IV
34.5 MPa

Bits and BHA

Surface Hole

BHA #1: Surface - SCP
- 311mm 619 PDC
- Slick MM
  - 9" 7/8 7.0 stg, 1.83° Adj, 0.047 rev/L
- X/O Sub
- PHX Velocity
- Gap Sub
- NMDC
- X/O Sub
- 8 x 6.25" DC's
- Drilling Jars
- 114.3mm HWDP to surface

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Intermediate

BHA #2: Drill Out to ICP
- 222mm 616 PDC
- Slick MM
  - 6.5" 7/8 5.7 stg, 1.83° Adj, 0.064 rev/L
- Pony NMDC
- PHX Velocity - Duel Telem
- Gap Sub
- 3 x slick NM Collars
- X/O Sub
- 5 x 114.3mm HWDP
- Drilling Jars
- 55 x 114.3mm HWDP
- 114.3mm DP to Surface

Contingent BHA: KOP to ICP
- 222mm 616 PDC
- Slick MM
  - 6.5" 7/8 5.7 stg, 2.12° Adj, 0.064 rev/L
- Pony NMDC
- PHX Velocity - Duel Telem
- Gap Sub
- 3 x slick NM Collars
- X/O Sub
- 5 x 114.3mm HWDP
- Drilling Jars
- 55 x 114.3mm HWDP
- 114.3mm DP to Surface

Main Hole

BHA #3: ICP Drillout to EOT
- 171mm 613 PDC
- Slick MM
  - 5.76" 7/8 7.0 stg, 1.75° FBH, 0.127 rev/L
- PHX Velocity - Duel Telem
- Slick NM Tool Carrier
- 2x Flex NMDC
- 5x 114.3mm HWDP
- Drilling Jar
- 60x HWDP

BHA #4: Lateral
- 159mm 613 PDC
- Slick MM
  - 5.25" 6/7 8.8 stg, 1.5° FBH, 0.180 rev/L
- PHX Velocity - Duel Telem
- Flex NMDC
- 114.3mm DP
- Agitator (~800m back from bit)
- 114.3mm DP
- Agitator (~1500m back from bit)
- 114.3mm DP
- 114.3mm HWDP
- 114.3mm DP to Surface

It will likely take 2 or more runs.

Casing Bowl & Wellhead:

279mm x 244mm x 193.7mm x 139.7mm x 34.5 MPa
Streamflo Wellhead Assembly (Slips)
(SOUR SERVICE)

Casing and Cementing Information

SURFACE

Surface to SCP:	**244.5mm, 53.57kg/m, J55, LTC**
Shoe Track:	5K FS (CCAI), 1 x Csg Jt, 5K FC (CCAI), Csg Jts
Plug	CCAI Plug
Centralizers	CCAI Centralizers
Float Shoe:	1.5 m above on stop collar, Bow Spring
Float Collar:	1.5 m below and above, Bow Spring
0m - SCP:	1 every 50m (3 joints) to surface
Surface Cement	
Preflush:	4.0m³
Surface Blend:	**SURFACEmix LW PRO GP**
Density:	1550 kg/m³
Yield - Water:	1.212 m³/t - 0.857 m³/t
Excess:	75%
Working Time:	2:45 hrs

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Cement blend is thixotropic. Cement will set up if static. Do not let sit without pumping for more than 10 minutes.

INTERMEDIATE

Surface to ICP:	**193.68mm 39.29 kg/m P110-ICY BTC SC**
Centralizers	CCAI Centralizers
Surface To SCP:	1 per 3 joints, Bow Spring
Vertical Open Hole:	1 per 3 joints, Stand Off Band, floating
Build:	1 every joint, Stand Off Band, floating
Shoe Track:	Float Shoe (CCAI), Csg Jt, Float Collar (CCAI)
Thread Lock:	Float Shoe, shoe joint and float collar
Intermediate Cement	
Preflush:	4.0m³
Scavenger:	10m³ Scavenger @ 1350kg/m³
Lead Interval:	**0 - 2248mMD**
Lead Blend:	**ECOlite 1400**
Lead OH Excess:	115% (TBD w/ Calgary)
Yield - Water:	1.966 m³/t - 1.578 m³/t
Working Time:	5:05 hours @ 53ºC
Tail Interval:	**2248mMD - 2548mMD (300m)**
Tail Blend:	**ECOprime 1550kg/m3**
Tail OH Excess:	30% (TBD w/ Calgary)
Yield - Water:	1.186 m³/t - 0.802m³/t
Working Time:	5:12 hours @ 53ºC
Expected BHST	**67°C (Confirm while drilling)**

Run csg @ <20m/min to limit surge.

PRODUCTION

Surface to ~70°:	**139.7mm 34.23kg/m T95-EY 94%RBW W461**
~70° to TD:	**114.3mm 22.47kg/m P110-ICY TXP BTC**
Centralizers	
Vertical Hole:	1 per 3 joints, spiral SOB (floating)
Build Centralization:	1 per 2 joint, spiral SOB (floating)
Hz Centralization:	1 per joint, SOB (floating)
Float Equipment	
Shoe:	NOV 15k Float Shoe
Float Collar:	Import 10k Latch-Down Float Collar
Float Sub:	NOV URFC II
Cement Plug:	Import 5.5"x4.5" triple stack latch-down
Marker Joints:	KOP
	Landing and then every 1000m in lateral.
Liner Equipment	2 NOV iOpener Toe Ports (csg jt between)
Production Cement	
Preflush:	6m3
Lead Interval:	**Surface to 50m inside ICP**
Blend:	**ECOlite 1400**
Lead Excess:	0%
WT:	4:35
TT:	6:30
Tail Interval:	**TD to 50m inside ICP**
Blend:	**ECOprime 1550kg/m3**
Tail OH Excess:	30%
WT:	6:15
TT:	8:25
Expected BHST	**93°C (Confirm while drilling)**

Run csg @ 25-30m/min to limit surge.

Mud

Surface Hole

System:	Polymer
Density:	1080 - 1150 kg/m³
Viscosity:	Drilling 40 - 55 s/L
	Gravel/Sand 80+ s/L
	Casing 75+ s/L
	Cementing 42 - 45 s/L
pH:	Neutral
Fluid loss:	No Control

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* Have a good stock of gel & LCM on location prior to spud (Sawdust , Primaseal M and Cellophane)

*****Losses Possible*****

* See Drilling Fluid Program for details.

Intermediate Hole

Interval:	**Drill Out to ICP**
System:	CaCl2 Brine
Density:	1250kg/m³
Viscosity:	31-33 s/L
pH:	10 - 11
Hydro Ci:	5L/m³ (mass balance)
Chlorides:	>215k gm/L
Fluid loss:	<20 cc/30min
LGS:	0.2 - 0.7%
Dissolved O_2:	<0.8 mg/L

* See Drilling Fluid Program for details.

Main Hole

Interval:	**Drill Out to TD**
System:	CaCl2 Brine
Density:	1250kg/m³
Viscosity:	31-35 s/L
pH:	10 - 11
Hydro Ci:	5L/m³ (mass balance)
Chlorides:	>215k gm/L
Fluid loss:	<20 cc/30min
LGS:	0.2 - 0.7%
Dissolved O_2:	<0.8 mg/L

* See Drilling Fluid Program for details.

Well Control Barriers Required Prior to Nipple Down of BOPs:

Dual Barrier Requirements:
Prior to rig release at the end of the well, there must be two barriers to flow on the production casing. Two scenarios:

1) Pressure Test Passes:
First Barrier: Cemented casing
Second Barrier : WH cap

2) Pressure Test Fails:
First Barrier: WR Bridge Plug
Second Barrier: WH cap

Contact Calgary if any issues arise.

PLEASE NOTE: Well will be limited to a single barrier of well control (either the liner system or WR bridge plug after confirming seal with pressure test) for a brief time taken to nipple down BOP's and install wellhead cap (or isolation valve, TBC based on availability/wellhead design).

Well Design: 2 String Slim Bore

Target Zone: MNTN-M / MNTN-GNDY / GNDY-U

TOURMALINE HZ TOWN C-073-B/094-B-16

Well Type: Horizontal Producer

Well Information

Rig	Precision 531		
Unique ID	UWI: 200A052B094B16000		
Surface Location	c-73-B/94-B-16		
Licence #	WA: 48098	Lahee Class	Development
AFE #	25D2935	AFE Amount	$3,174,906
Planned Spud to RR	11.97		
Confidential Status	Non-Confidential		

NAD83 Coordinates:	Northing	Easting
Surface Location	6297066.265	551231.401
End of Turn	6297041.446	551372.953
Toe	6294673.957	552482.299

Surveyed GLE	753.80m
Estimated KBE	759.73m
Survey Plan	WS2112956_R4
Directional Plan	34359

EPZ = 1.83 km (Sour Gas Well) **Release Rate = 0.7102 m^3/s**

Geological Information

Formation	Depth (mMD)	Depth (mTVD)	Pressure (kPa)	EMD (kg/m^3)	H_2S (%)
Entire interval above the Bluesky			Less than 1000 kg/m^3		
Bluesky	1,069	1,068	8,019	766	-
Gething	1,079	1,078	8,094	766	-
Cadomin	1,167	1,166	9,093	795	0.60%
Nikanassin	1,191	1,190	8,626	739	0.60%
Fernie	1,204	1,203	11,034	935	-
Nordegg	1,280	1,279	9,859	786	7.73%
Baldonnel	1,309	1,308	10,462	815	7.73%
Charlie Lake	1,320	1,319	9,233	714	11.99%
Boundary Lake	1,409	1,409	9,860	714	11.99%
Blueberry Mbr	1,481	1,480	11,099	765	11.99%
Z Marker	1,591	1,590	18,300	1,173	11.99%
Artex	1,617	1,616	18,599	1,173	-
Halfway	1,634	1,633	17,960	1,121	11.50%
Doig	1,700	1,699	20,215	1,213	-
Doig Phosphate	1,769	1,767	21,026	1,213	-
Montney	1,794	1,791	22,384	1,274	0.01%
Upper Dawson Mbr	1,841	1,832	22,904	1,274	0.01%
Middle Dawson Mbr	1,863	1,851	23,134	1,274	0.01%
Lower Dawson Mbr	1,890	1,872	23,397	1,274	0.01%
Mid Montney Mkr	1,890	1,872	24,332	1,325	0.01%
Mid Montney Pay	1,959	1,917	24,924	1,325	0.01%
Mid Montney Target	1,980	1,928	25,070	1,325	0.01%
Gundy Mbr	2,059	1,959	25,463	1,325	0.01%
HZ Heel	2,124	1,968	25,580	1,325	0.01%
HZ TD	4,552	1,980	25,736	1,325	0.01%

Hard Boundary at the Toe

OH logs are required on this well. Run OH logs in invert after TOOH for casing. See Weatherford logging program for more information.

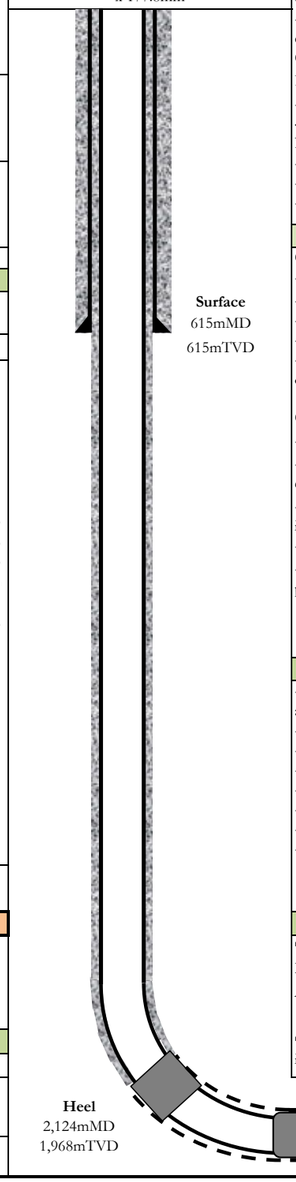
Formation Evaluation

Gas Detection	Spud to TD
Samples	TOU & BCER Required: 20m intervals from KOP to Heel 50m intervals from Heel to TD
OH Logs	Run #1: MWD GR f/ SCP point to TD Run #2: See WFD logging program for full suite.

Well Configuration

Class C BOP Stack
279mm x 34.5 MPa

34.5MPa **Slip-Lock Casing Bowl** - 279mm x 177.8mm



Casing and Cementing

Surface - 251mm Hole

Casing
- 177.8mm, 34.22 kg/m L80-IC LTC
- 1 BS every 2nd joint in vertical, every joint in nudge
- 406mm bow spring below casing bowl landed in the conductor

Cement
Preflush: 5 m^3 fresh water
- 1550 kg/m^3 SURFACEmix LW PRO/ 60% OH excess
- Displace/chase plug with fresh water

Pressure Tests
- Casing: Low 1,400 kPa & High 30,000 kPa
- BOP: Low 1,400 kPa & High 34,500 kPa
- Annular: Low 1,400 kPa & High 24,500 kPa

Production - 159mm Hole

Casing
- 114.3mm, 22.47 kg/m TN110S TXP-BTC
- 4.5" Bowspring run every 2nd joint from surface to KOP
- 4.5" Polymer SOB every joint from KOP to Initiation Sub
- No centralizers between stages
- OH Ball Drop Completion System w/ WFD P110 sleeves & Interra equipment with stage tool cement job

Cement (TOC @ Surface)
- Preflush: 8 m^3 of 1550 kg/m^3 Visweep DM IS
- Lead: 1650 kg/m^3 ECOprime + Additives @ 60% OH excess
- Tail: 1750 kg/m^3 ASC IV + Additives - 5.7 m^3 (500m interval with base @ stage tool with 20% OH excess).
- Flush surface lines prior to dropping plug
- 5 m^3 inhibited water with cement retarder chasing cement plug. See cement program for specific additives.

Mud

Surface - 251mm Hole

Type: **Floc Water**
Density: 1020-1050 kg/m^3
Viscosity: 29-32
PH: Neutral

Type: **Polymer**
Density: 1200-1250 kg/m^3
Viscosity: 45-60
PH: Neutral

Production - 159mm Hole

Brine:
Density: 1350 kg/m^3
Viscosity: 31-33 sec/L
Chlorides: > 230,000 mg/l
pH 10-10.5

Invert:
Density: 1450 kg/m^3
Viscosity: 50 - 70 sec/l
Yield Point: 4-6 Pa
PV 25-35 mPa.s
Chlorides: > 235,000 mg/l
Fluid Loss: < 8.0 cm^3/30 min
Stability: > 800 volts
Oil/Water: 90 – 10

Operational Notes

- A diverter and gas detection are required on this surface hole.
- Surface losses are not anticipated on this pad based on offset research. Displace to polymer mud and treat with LCM if losses are encountered.
- Surface gas is not anticipated on this pad based on offset research.
- Spud & drill to SCP with floc water. At SCP displace to +/- 1200 kg/m^3 polymer mud to clean the hole and run surface casing.
- Displace back to floc water prior to cementing surface casing.
- Displace cement job at 1.0 m^3/min (or as high pump rate as possible).
- Displace plug with fresh water.
- Align casing bowl valves with notch/mark on gribbing, valves are to be aligned parallel to well row.

- Drill out with 1350 kg/m^3 $CaCl_2$ brine with 3-4 daN for first 100m and ensure that centrifuge hand is on location to keep brine as clean as possible to prevent bit balling. Increase pump rate to 1.3 m^3/min once out of shoe.
- Charlie Lake & Boundary Lake losses are anticipated based on offset research. Attempt to drill ahead into the Blueberry prior to TOOH for LCM cement plugs if losses are encountered.
- Attempt to drill to TD with $CaCl_2$ brine. Swap to invert while drilling if required for T&D or well control issues.
- Potential for fractures in the Doig formation. Watch for signs of over-pressured formation or depletion. Swap to invert if required.
- Montney expected to be stable.
- Activate dart-drop on demand agitator when sliding becomes difficult.
- At TD, displace the well to +/- 1450 kg/m^3 invert and perform high speed rotary clean up cycles @ 1.3m^3/min - 100 RPM prior to TOOH to run casing.
- Spot a lube pill in the lateral section if required prior to TOOH for casing.

Offset Well Review - Best Practices:

- Pay close attention to PVT volumes when drilling the lateral section, and ensure all gain/loss alarms are active.
- Watch for drilling breaks and pay close attention to connection / bottoms-up gas readings.
- Connection gas and hole instability are concerns in this area based on offset research.
- Conduct clean up cycles while drilling in the lateral section if necessary to mitigate T&D.
- High-pressure Doig fractures are prevalent in this field.
- High Montney gas levels are also anticipated while drilling.
- When in doubt, shut in the well and notify the superintendent.
- Flip to invert if needed to reduce torque and drag or to mitigate gas issues.

Shoe Track & Casing Design:

- WFD float shoe, pup joint, WFD float collar, pup joint, KLC sub, pup joint, WFD toe port #1, WFD toe port #2, pup joint, casing and stages to the heel

- Float sub (if ran), 1 full length joint, Stage Tool, full length casing joint, Isolation Packer #1, full length casing joint, Isolation Packer #2, full length casing joint, Debris Sub

- 40 WFD P110 stages supplemented with Interra equipment

Additional Notes

▪ Full BOP test is required every 30 days of service or at the start of a new pad as per the BCER Chapter 8 - Well Activity Drilling Regulation

Hard boundaries: There is a hard boundary at the toe on this well. See Phoenix directional plan for more information.

Anti-collision: There are offset wells from the a-51-B pad to the East of this pad. There are no anti-collision concerns on this pad.

▪ Floation collar position will be determined by T&D modelling (if ran) ▪ 10k psi aluminum eccentric nose float shoe and 10k psi float collar are to be used for floating in production casing.

Office Contacts

Position	Name	Office	Phone #
BCER	Fort St. John	250.794.5200	250.794.5200
Chief Operating Officer	Earl McKinnon	403.767.3530	403.620.1913
Drilling Ops Manager	Dave Hauck	403.767.5947	403.554.4528
Drilling Engineer	Austin Beswick	587.467.3452	403.837.2094
Drilling Superintendent	Nick Johnson	403.515.2896	780.722.8071
Geologist	Britany Gilbreath	403.767.3544	403.998.2557
Construction	Derrick Kosiorek	403.767.3563	403.651.4995
Exploit Engineers	Bryce Scherschel	403.515.2840	587.832.3701
	Kim Parenteau	403.767.3541	403.620.6475

Service Contacts

Service	Company	Contact	Phone #
Drilling Fluids	Blackstone	Mitch Mcleod	403.499.8110
Cement	Sanjel	Jeremy Smith	403.461.6081
Casing	Tenaris	GP Dispatch	403.766.0310
Casing	Tenaris	Sean Scott	403.827.7042
Directional	Phoenix	Steve Pfeiffer	403.464.6200
Wellhead	StreamFlo	FSJ Dispatch	250.785.9500
Completion Equipment	Weatherford	Patrick Browne	403.200.2424
	Interra	Jon Malin	403.809.1735
Logging	Weatherford		

Offset Pad Information & Hole Problems:

TOU d-04-G/94-B-16 Pad - 3.0 km N
- Encountered a fracture @ ~1000mTVD in the Buckinghorse on 7 of 11 wells on this pad. Mitigation methods included gas blocking cement plugs and displacing to 1460 kg/m^3 invert to manage gas levels and flow spikes on bottoms-up.
- Encountered severe-to-total Charlie Lake losses @ ~1320-1360mTVD on 8 of 11 wells on this pad. Boundary Lake losses were also encountered on some wells in addition to CL losses. Mitigation methods included drilling into anticipated loss zone with a slick assembly, use of a PBL sub on drill out BHAs to spot LCM slugs if needed, and multiple LCM and stability cement plugs with varying densities, blend types and additives. See offset research for full description of events.

TOU a-51-B & b-60-A /94-B-16 Pads - 3.2 km SE
- No major drilling issues or losses reported on the majority of wells. 2 wells were displaced to invert early for T&D issues. Encountered a suspected fault/fracture on the b-L060-A well @ 3937m in the Montney as well as multiple subsequent fractures fr/ 3987m onwards (suspected to be fractures from offset completed/producing wells from previous phases) causing losses up to 18 m^3/hr eventually diminishing to 3 m^3/hr with LCM additions and control drilling. Total estimated volume lost was 90-95 m^3. Circulated bottoms-up @ 4227m due to flow spikes and gas readings >10,000 units. Weighted brine up to 1375 kg/m^3 and drilled ahead with sustained 0-5 m^3/hr losses. Shut-in well @ 4783m after 0.4 m^3 pit gain with initial shut-in pressures: SICP = 350 kPa, SIDPP = 540 kPa. Circulated Driller's Method Step #2 and displaced well to 1450 kg/m^3 invert. Increased weight to 1530 kg/m^3 during clean-up cycles and again to 1565 kg/m^3 prior to TOOH due to gas spikes after circulating flow checks bottoms-up. No additional issues reported with casing or cement, no bottoms-up gas after landing casing.

TOU c-02-G/94-B-16 Pad - 2.8 km NE
- Encountered a high-pressure Doig fracture on multiple wells on Phase 1, with one well requiring up to 1740-1780 kg/m^3 invert to drill and trip out of the lateral section. All wells on Phases 1 & 2 were displaced to invert at or above the Doig formation due to fracture pressure, hole instability or lateral Montney gas levels. There is heavy seismic sturcture towards the East side of the c-02-G pad.

Section #1 – Stick Header – Low Importance

1. AFE # is required for some clients but not all (would be put in the programming template). I would like to store this information in a database.
2. Other information is redundant in section #1 (assuming information is found in Section #2).
3. Jeremy: In some stick diagrams, the header is where one would find the well name and UWI

Section #2 – Basic Well Information – High Importance

1. Drilling Rig Information (would be put in the programming template). I would like to store this information in a database.
2. OSR Contacts (useful if you need to contact the rig directly). Don't think this needs to be stored in a database.
3. Well Name, Pad Location, UWI, License (would be put in the programming template). I would like to store this information in a database.

Section #3 – Contacts – Medium Importance

1. Client information (would be put in the programming template). I would like to store this information in a database.
2. Emergency contacts for well site. Don't think this needs to be stored in a database.

Section #4 – Services & Pertinent Telephone Numbers – Low Importance

1. List of all the service providers. Helpful so you can determine if you have worked with the service providers before and if not, then the contact information is there to call and ask questions. Not sure if it is important enough to store this data.

Section #5 – Notifications/Logging Program – Low Importance

1. Usually not much is useful for us in notifications.
2. In logging you would be able to see if they planned to CBL the well or are logging for useful data to Sanjel (i.e. temperature log, caliper log, etc.). Could get valuable data from the client based on the logs performed. Not sure if it is important enough to store this data.
3. Jeremy: I feel it could be useful to record all the types of logs done on certain wells.

Section #6 – Configuration, Tops, Pressures & H2S – High Importance

1. All formation information is important (Formation name, TMD, TVD, Maximum pressure, Maximum pressure gradient, Maximum estimated mud density, expected mud density, H2S, Loss circulation zone, and over-pressure zone). Use this

information to design the proper cement slurries to meet the needs of the well (information is input into CEMENTICS). I would like to store this information in a database.

2. Directional or casing depth information is important (Surface casing TMD/TVD, Intermediate Casing TMD/TVD, Total Depth TMD/TVD, Heel TMD/TVD, KOP TMD/TVD, Directional Build rates (°/m), Directional Tangents, Directional Turns). Use this information to estimate temperature based on depth and whether the cement needs free water control or not (input some of this data into the program and into CEMENTICS). I would like to store this information in a database.
3. The well picture also helps identify which casing strings will be cemented. It is important to visualize what the well plan is.

Section #7 – Bits and BHA – High Importance

1. Has the open hole size drilled via the bit sizes and to what point in the well (would be put into the programming template). I would like to store this information in a database.
2. It has drill pipe information which can be used for cement plugs or liners (would be put into the programming template or CEMENTICS). I would like to store this information in a database.
3. Information that is of low importance would be the drilling motors used and the makeup of the BHA. May not currently be important to us but may in the future so very low importance.

Section #8 – Casing and Cementing Information – High Importance

1. Casing information per string (would be input into both program and CEMENTICS). I would like to store this information in a database.
    a. Casing size, weight, grade, thread.
    b. Wiper plug type and supplier
    c. Centralizer supplier, type(s), spacing, etc.
    d. Completions system being used.
2. Cement Details (would be input some of this information into both programming template and CEMENTICS). I would like to store this information in a database.
    a. Preflush Type and volume.
    b. Cement blend name, density, and interval that it is placed.
    c. Cement Excess requested.
    d. Expected Temperatures.

Section #9 – Mud – High Importance

1. Mud systems, density, oil to water ratio, salt concentrations, etc (used to design our preflush system which is input into the programming template and to potentially tell if specialty cement is required). Has a spot below each section to show if contingencies are needed for losses or over-pressured zones in each section of the well. I would like to store this information in a database.

Section #10 – Offset Pad Information & Hole Problems – High Importance

1. Does not have a stand-alone section in CNRL's stick but does on Tourmalines. Will give us an idea of what was seen during drilling of previous pads or wells. Could need to provide contingency lost circulation plug programs or potentially design multiple cement blend density options depending on what was experienced (use this data to enhance or contingency plan around those problems). I would like to store this information in a database.