

Logging Program			
Type Log Suite	Interval Top	Interval Bottom	Comments
GR MWD	KOP	TD	
CBL/VDL/CCL/GR	Surface	11,600'	~50' below KOP
COMMENTS: While drilling, a Gamma Ray (GR) log will be ran from the top of the build section (Kick-Off Point) to approximately the well TD (Lateral Toe) via the directional company MWD/LWD GR tool. Then later, when running the cement bond log for the intermediate casing, a GR log will be pulled from ~ 50' below KOP all the way to the surface (ground level). These two logging processes will ensure that there is a complete GR log from approximately well TD to ground level.			

Coring Program			
Core No.	Formation	Est. Depth	Core Length (ft)

DrillStem Test Program							
If Needed	Estimated Depth (ft)	Estimated Pressure (psi)	Cushion (ft)	Test Times (min)			
				Initial Flow	Initial Shut-In	Second Flow	Second Shut-In

Wellsite Geology				
Service	Description of Services	Start Depth	End Depth	
Mudlogger				
Wellsite Geologist	Wellsite geologist / Geosteering / Mudlogging	Surface	TD	

Sample Collection			
Depth Interval		Foot per Sample	Special Instructions
Top	Base		
Surface Casing	TD	30	30 feet per sample as ROP allows.

Offset Well Information						
Well Name	Well TD	Year Drilled	Latitude (NAD27)	Longitude (NAD27)	Vert / Hor	Comments
WRD 23-33 R	15,886 md	2012	40.096583	-108.284225	Hor	vert PH to Weber

ENGINEERING INFORMATION

Mud Program					
Interval	Mud Description	Viscosity	MW	pH	Wtr Loss
Surface	Freshwater with frequent sweeps of Gel and PHPA	28-32	8.4-8.8	9.0-10.5	No Control
Intermediate to ~10,000' TVD	Water-Based Mud System	34-42	8.8-10	9.0-10.5	<10
Build & Lateral	Oil Based Mud System	40-45	9.5-11.5	2+ lbs excess lime/ Bbl	10-20 (HTHP)

Sufficient quantities of mud materials will be maintained or readily accessible for the purpose of assuring well control during the course of drilling operations. We will have enough Barite on location to weight the entire mud system up 0.5 ppg.

Mud Monitoring Equipment: Visual mud monitoring equipment will be in place to detect volume changes indicating loss or gain of circulating fluid volume. If abnormal pressures are anticipated, electronic/mechanical mud monitoring equipment will be used, which will include a pit volume totalizer (PVT), stroke counter, and flow sensor. A mud test will be performed every 24 hours after mudding up to determine, as applicable: density, viscosity, gel strength, filtration, and pH. Gas detecting equipment will be installed in the mud return system beginning after surface casing to TD.

Lost Circulation Prevention
<ol style="list-style-type: none"> 1. While drilling, circulation losses will be treated by one or more of the following: <ol style="list-style-type: none"> a. Reduction of mud weight (where possible) to reduce the hydrostatic pressure across from any weak zone. b. For seepage, we will add the finer LCM's (calcium carbonate, mica, micro fibers, fine walnut shells, etc.). c. For more aggressive losses, we will add the larger LCM's (cotton seed hulls, cedar fiber, large walnut shells, sawdust, etc.). d. For complete losses, more aggressive steps will be taken. These steps include setting of high-concentration broad-spectrum LCM pills, squeezes of high-concentration broad-spectrum LCM pills and the use of water-absorbing polymers to lock up the loss zone. e. Ultimately, if needed, cement squeezes will be available to address the most difficult zone. 2. While cementing, circulation losses will be addressed by the use of one or more of the following: <ol style="list-style-type: none"> a. Use of LCM materials in the cement (celoflake, polyflake, gilsonite, etc.). b. Use of reactive spacers that will cause the cement to rapidly set in the loss zone. c. Light-weight, rheologically-friendly cement slurries that significantly reduce circulating pressures during the cement job. d. Two-stage cementing tools strategically placed in the casing string to enhance cement placement. e. Use of thixotropic (shear-thinning) cements. 3. It will always be AOC's goal to address losses aggressively during the Drilling Phase to enhance cement placement during the Cementing Phase.

Casing Program							
Hole Size (in)	Casing Size (in)	Casing Weight & Grade	Thread	Setting Depth (ft)		Length (ft)	Notes
26	20	52.78# A53b	Welded	0'	- 80'	80'	Grouted to surface
17 1/2	13 3/8	61# J-55	STC	0'	- 2,000'	2,000'	Guide shoe, 2 joint shoe track, float collar and then casing to surface. One bowspring (bs) centralizer stop-locked on the first joint. Then one bs centralizer for the next two joints. Then one bs centralizer every third joint to surface.
17 1/2	13 3/8	68# HCN-80	STC	2,000'	- 3,005'	1,005'	Total BS centralizers (approx.): 23 Top cmt plug used. No bottom plug. Top of tail slurry at 2,405'
12 1/4	9 5/8	47# P-110	LTC	0'	- 7,000'	7,000'	Float shoe, 2-jnt shoe track, float collar, casing to surface. One BS centralizer on first four joints beginning at the float shoe. Then one BS centralizer every third joint to 100' above TOC.
12 1/4	9 5/8	53.5# P-110	LTC	7,000'	- 10,047'	3,047'	Total BS centralizers (approx.): 57 Estimated TOC @ 2,805'. Estimated top of tail @ 9,447'
8 1/2	7	26# HCP-110	BTC	9,847'	- 12,509'	2,662'	Float shoe, 3 jnt shoe track, float collar, casing to 200' above 9 5/8" intermediate csg shoe. Liner hanger set at 200' above 9 5/8" intermediate csg shoe. One rigid centralizer per joint from the float shoe to 150' above KOP. One BS centralizer every fourth joint from 150' above KOP up to liner hanger. Total BS centralizers (approx.): 7 Total rigid centralizers (approx.): 25 Estimated top of tail @ 11,909'.
6 1/8	4 1/2	15.1# P-110	CDC	12,009'	- 19,878'	7,869'	Float shoe, 1 jnt, float collar, 2 jnts, baffle collar, casing to liner hanger, liner hanger Liner hanger set at 45 degrees into the build. No centralization on the first 3 jnts. Then, one rigid centralizer every other joint up to liner hanger. Total rigid centralizers (approx.): 86
Inside of 7" casing	4 1/2	15.1# P-110	LTC	0'	- 12,009'	12,009'	Tie-back frac string. Will be removed after stimulation.

Casing Design Assumptions and Minimum Safety Factors (Bureau of Land Management - See Attached)

Casing String	Min Burst SF	Min Collapse SF	Minimum Tension	Assumptions
Surface	1.2	1.1	1.6 and/or 100 klbs overpull	BURST - FG = 0.8 psi/ft + 1 ppg injection pressure SF at shoe, casing evacuated to gas (gradient 0.115 psi/ft), back-up freshwater gradient = 0.433 psi/ft COLLAPSE - Max collapse with cement on backside that never set up with zero back-up inside csg
Intermediate	1.2	1.1	1.6 and/or 100 klbs overpull	BURST - Fixed end point casing design with csg shoe set at injection pressure and surface set at rated working pressure of surface equipment and/or Limited Kick Design assuming 100 bbl kick; FG = 0.9 psi/ft + 1 ppg injection pressure SF, 0.115 psi/ft gas gradient, back-up freshwater gradient = 0.433 psi/ft COLLAPSE - Well pumped down dry inside during production with heaviest fluids (mud & cement) on backside
Production	1.2	1.1	1.6 and/or 100 klbs overpull	BURST - Max Surface Treating Pressure during completion + hydrostatic of heaviest frac fluid & highest prop concentration, freshwater back-up gradient COLLAPSE - Heaviest mud weight casing is run in on outside with zero back-up inside casing

AOC casing design generated using standards found in ANSI/API TECHNICAL REPORT 5C3, FIRST EDITION, DECEMBER 2008.

Cementing Program			
String	Cement Depth (ft)		Type and Amount
20" Conductor	0'	- 80'	Run trimmie pipe and grout to surface
Surface	0'	- 3,005'	Lead Slurry - 12.0 ppg ALTCem S100-12 (TM). Slurry to contain 2 lb/sk ACL-10 (Accelerator), 5% ACL-20 (Accelerator), 0.03 gal/sk ADF-20 (Defoamer), 0.13 lb/sk ALC-10 (Lost Circ), 2 lb/sk AXE-30 (Extender). Slurry yield - 2.52 cuft/sx. Water requirements - 14.8 gal/sx. TOTAL (Lead): 1330 sxs 596.9 Bbls Excess: 100%
			Tail Slurry - 12.5 ppg ALTCem S100-12 (TM). Slurry to contain 2 lb/sk ACL-10 (Accelerator), 5% ACL-20 (Accelerator), 0.03 gal/sk ADF-20 (Defoamer), 0.13 lb/sk ALC-10 (Lost Circ), 2 lb/sk AXE-30 (Extender). Slurry yield - 2.22 cuft/sx. Water requirements - 12.5 gal/sx. TOTAL (Tail): 410 sxs 162.1 Bbls Excess: 100%
Intermediate	2,805'	- 10,047'	Lead Slurry - 12.7 ppg ALTCem I100-X1 (TM). Slurry to contain 0.3% ABX-30 (Bond Enhancer), 0.03 gal/sk ADF-20 (Defoamer), 0.1% ADS-10 (Dispersant), 0.5% AFL-50 (Fluid Loss), 0.5% AR-10 (Retarder), 0.1% AVS-10 (Viscosifier). Slurry yield - 1.97 cuft/sx. Water requirements - 11.0 gal/sx. TOTAL (Lead): 1320 sxs 463.1 Bbls Excess: 25%
			Tail Slurry - 13.5 ppg ALTCem ACG-10 (TM) with AFA-10 & AXE-20 Extender. Slurry to contain 0.2% ABX-30 (Bond Enhancer), 0.4% AFL-10 (Fluid Loss), 0.3% AR-10 (Retarder), 25% ASR-20 (Strength Retrogression), 6% AVS-50 (Viscosifier). Slurry yield - 1.90 cuft/sx. Water requirements - 9.5 gal/sx. TOTAL (Tail): 145 sxs 49.1 Bbls Excess: 25%
Intermediate Liner & Build Section	9,847'	- 12,509'	Lead Slurry - 12.7 ppg ALTCem I100-X1 (TM). Slurry to contain 0.3% ABX-30 (Bond Enhancer), 0.03 gal/sk ADF-20 (Defoamer), 0.1% ADS-10 (Dispersant), 0.5% AFL-50 (Fluid Loss), 0.5% AR-10 (Retarder), 0.1% AVS-10 (Viscosifier). Slurry yield - 1.97 cuft/sx. Water requirements - 11.0 gal/sx. TOTAL (Lead): 170 sxs 59.6 Bbls Excess: 25%
			Tail Slurry - 13.5 ppg ALTCem ACG-10 (TM) with AFA-10 & AXE-20 Extender. Slurry to contain 0.2% ABX-30 (Bond Enhancer), 0.4% AFL-10 (Fluid Loss), 0.3% AR-10 (Retarder), 25% ASR-20 (Strength Retrogression), 6% AVS-50 (Viscosifier). Slurry yield - 1.90 cuft/sx. Water requirements - 9.5 gal/sx. TOTAL (Tail): 70 sxs 23.7 Bbls Excess: 25%
Lateral	12,009'	- 19,878'	Tail Slurry (only) - 13.5 ppg ALTCem P50-31™ with AFA-10 Extender. Slurry to contain 3% ABX-20 (Bond Enhancer), 0.03 gal/sk ADF-20 (Defoamer), 0.70% AFL-10 (Fluid Loss), 0.60% AR-20 (Retarder), 20% ASR-20 (Strength Retrogression), 0.15% AVS-10 (Viscosifier), 5 lb/sk AXE-20 (Extender). Slurry yield - 1.85 cuft/sx. Water requirements - 9.1 gal/sx. Total (Tail): 490 sxs 161.5 Bbls Excess: 20%
WATER SOURCE for Cementing Program	Anschutz is proposing two options for drilling water and cement mix: a. <u>Option 1</u> : Anschutz plans on obtaining fresh water for drilling and cement from a non-municipal source. If this option is chosen, a water quality analysis will be performed before use. b. <u>Option 2</u> : Anschutz will obtain water for drilling and cement from the City of Meeker, CO or City of Rangely, CO municipal water source.		

Cuttings Management		
Approximate Cuttings Volume (cuft)	Approximate Drying Agent Volume (cuft)	Approximate Volume of Cuttings & Drying Agent (cuft)
16,117	19,340	35,457
Pit Depth (ft)	Pit Width (ft)	Pit Length (ft)
10	16	320
Cuttings will be disposed of according to all applicable rules and regulations. We will maintain 2' of freeboard in the cuttings pit. When we reclaim the pit we will have 4' of cover over the cuttings. Cuttings pit will be located in cut section of pad.		

Completion Program
AOC plans to hydraulically fracture this lateral with current and appropriate technologies that will maximize the hydrocarbon producing potential. Geology, wellbore mechanics, in house experience and current industry standards will drive these designs. Each well will be extensively thought out. The completion methodology (cemented plug and perf/sliding sleeves), proppant type and mesh size, as well as the use of Acid, clay stabilizers and other frac chemicals, will be carefully considered.

Pressure and Pressure Control			
Max Anticipated BHP (psi)	6,648	Max Hydrostatic BH Mud Weight Pressure	7,228
		Max Anticipated BH Temp (°F)	233
<p>Max Anticipated Bottom-Hole Pressure is listed above. This BHP was derived using offset pressure information (DST's, frac's, pressure surveys, etc). Additionally, the Maximum Mud Weight is listed in the Mud Program above.</p> <p>The Max Hydrostatic BH Mud Weight Pressure calculated by using the Maximum Mud Weight is significantly greater than the Maximum Anticipated BHP. These two bottom-hole pressure numbers are not in conflict with each other. Rather, the significantly higher Max Hydrostatic BH Pressure calculated by using mud weight is a cushion above the Maximum Anticipated BHP. This 'cushion' is safety margin that will allow tripping, running casing and other well activities to be completed in a safe manner.</p> <p>In determining what BOPE to use, max surface pressure was calculated by subtracting a hydrostatic mud column assuming 50% evacuation with a gas gradient of 0.12 psi/ft from the max anticipated BHP. The result was safely below 5,000 psi, hence our selection of 5,000 psi BOPE.</p> <p>See attached "AOC Piceance Well Control Plan".</p>			

Other Potential Risks/Hazards
No H2S is anticipated in this well.

Special Instructions:

Prepared By:

Department	Name & Title	Date
Geology	Flemming Mengel, Senior Geologist	1/5/2017
Seismic		
Completions		
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