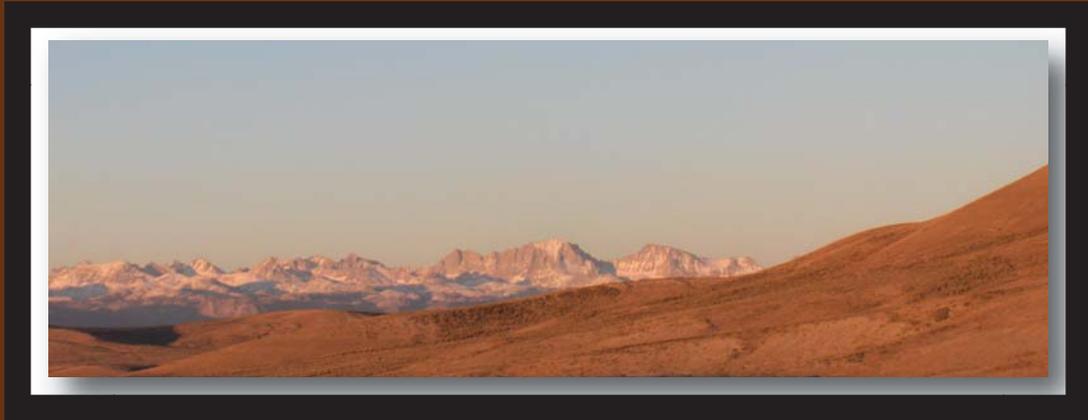


APPENDIX C



Study Well Lithologic Logs

AMEC Geomatrix

WELL LITHOLOGIC AND COMPLETION LOG

JOB NO: 013655.006.0 T4 WELL NO: T-1-SW

PROJECT: Pinedale Anticline Project Area: Hydro Data Gaps STATE: WY COUNTY: Sublette LOGGED BY: ANJ

LEGAL LOCATION: T 33N R 109W S 8 TRACT SW SE DESCRIPTIVE LOCATION: Near intersection of Pinedale South Rd. and Mesa Rd; Sherlock Fed. 15-8 pad

DATE STARTED: 7/30/2010 DATE COMPLETED: 7/31/2010 DRILLING CO/DRILLER: Thomas Drilling/ Bob Thomas (main borehole); Tyson Thomas (conductor)

DRILLING METHOD: Air Rotary w/ casing hammer BOREHOLE DIAM (IN): 16" (0-40')
10" (40'-160') DRILL FLUIDS USED: Air and water

CONDUCTOR/SURFACE CASING INSTALLED: 16" 0-10'; 12" 0-40'; INTERVAL PERFORATED FROM OR SCREENED (FT): 127
147 WELL DIAMETER: 4" CASING TYPE: PVC

TOTAL DEPTH DRILLED:	TOTAL DEPTH CASED:	DURING WELL CONSTRUCTION WAS/WERE:	YES	NO
<u>160'</u>	<u>147.5'</u>	Well Developed	X	
		Well Pumped		X
		Water Samples Collected		X
		Material Samples Collected	X	

METHOD OF PERFORATION: Open Hole
 Open Bottom
 Saw Slotted
 Factory 0.020 (size)
 Other: Roller Perf tool 1/2" x 1"; 4 rows

ANNULAR COMPLETION CHARACTERISTICS
WELL PROTECTOR: _____ LENGTH/DIAM: 6.5'/10"

LOCK NO: Geomatrix Master Lock #2190

SURVEYED LOCATION (m): Northing: 15562628.784 Easting: 1938523.785 WELL CASING ELEV. (ft): 7230.37' GROUND SURFACE ELEV.(ft): 7228.58'
SURVEYED DATUM: HORIZONTAL: UTM Zone 12 North, NAD83 VERTICAL: NAVD88

STATIC WATER LEVEL: 93.78' DATE: 9/25/2010 MEASURING POINT DESCRIPTION/ELEVATION: Top of PVC casing/ MEASURING POINT RELATIVE TO GROUND SURFACE (+/-) +1.8'

REMARKS: Schramm T555 Rotadrill; 1050 cfm at 350 psi and 1800 rpm

INTERVAL(FT)	LITHOLOGIC DESCRIPTION USCS NAME (USCS symbol): color, moist, % by weight, plasticity, consistency, structure, cementation, geology	REMARKS
below ground surface		
0 - 3	ML (gravelly silt w/sand); silt is dark yellowish brown (10YR 4/2); damp; 65% silt w/ some clay; 25% fine gravel; 10% sand; silt has mod. plasticity; soft; max. particle size 0.5 inches; [Fill]	Began drilling @ 1041 hrs w/ 16" tricone bit; 16" casing installed to ~7 ft. and then removed after cement pumped; water added beginning @ 40 ft.
3 - 15	ML (silt with sand); pale yellowish brown (10YR 6/2); dry; 85% silt; 15% fine to med. sand; contains some clay (some peds have mod. plasticity); [Weathered Wasatch Fm?]	
15 - 39	Shale/siltstone; dusky yellow (5Y 6/4) to grayish olive (10Y 4/2); damp; faint laminations; some chips appear massive; consolidated and hard; [Wasatch Fm]	
39 - 50	Sandstone/sand; fine-grained mod. cemented sandstone (30% of return) is dark yellowish orange (10YR 6/6); 70% of return is med. to coarse sand dominated by quartz; poorly graded; angular to subrounded; med. to coarse sand is non-consolidated	
50 - 55	Mixed sandstone/sand and shale/siltstone; moderate yellowish brown (10YR 5/4); lithologies as above (15'-39' and 39'-50')	
55 - 85	Sandstone and sand; sandstone as above; loose sand is medium to coarse and white/buff/gray; angular to subrounded; dominated by quartz but contains mafic minerals; 70% loose sand and 30% fine-grained sandstone at 47 ft.; 90% loose coarse sand by 60 ft.; loose sand is poorly graded; max. particle size 4 mm; contains fragments of iron-oxide-cemented coarse sand; coarse sand is likely sandstone in the formation that was disaggregated by drilling process; contains minor well-cemented	

AMEC Geomatrix

WELL LITHOLOGIC AND COMPLETION LOG

JOB NO: 013655.006.0 T4 WELL NO: T-1-RW

PROJECT: Pinedale Anticline Project Area: Hydro Data Gaps STATE: WY COUNTY: Sublette LOGGED BY: ANJ

LEGAL LOCATION: T 33N R 109W S 8 TRACT SW SE DESCRIPTIVE LOCATION: Near intersection of Pinedale South Rd. and Mesa Rd; Sherlock
Fed. 15-8 pad

DATE STARTED: 7/22/2010 DATE COMPLETED: 7/31/2010 DRILLING CO/DRILLER: Thomas Drilling/ Bob Thomas (main borehole); Tyson Thomas (conductor)

DRILLING METHOD: Air Rotary w/ casing hammer BOREHOLE DIAM (IN): 16" (0-39); 12" (39'-505'); 10" (505'-687') DRILL FLUIDS USED: Air, water, and foam

CONDUCTOR/SURFACE CASING INSTALLED: 16" 0-20'; 12" 0-40'; 10" 0-500' INTERVAL PERFORATED FROM OR SCREENED (FT): 620 WELL DIAMETER: 5" CASING TYPE: Steel

TOTAL DEPTH DRILLED: <u>687'</u>	TOTAL DEPTH CASIED: <u>652'</u>	DURING WELL CONSTRUCTION WAS/WERE:	YES	NO
----------------------------------	---------------------------------	------------------------------------	-----	----

METHOD OF PERFORATION:	<input type="checkbox"/> Open Hole <input type="checkbox"/> Open Bottom <input type="checkbox"/> Saw Slotted <input checked="" type="checkbox"/> Factory <u>0.020</u> (size) <input type="checkbox"/> Other: Roller Perf tool 1/2" x 1"; 4 rows	<input checked="" type="checkbox"/> Well Developed <input type="checkbox"/> Well Pumped <input type="checkbox"/> Water Samples Collected <input type="checkbox"/> Material Samples Collected	X	X
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SURFACE SEAL TYPE: <u>Type II cement pad</u>	Surface	
BACKFILL MATERIAL: <u>Bentonite grout</u>	FROM: <u>0</u>	TO: <u>196'</u>
HOLE PLUG: <u>Coated pellets</u>	FROM: <u>410'</u>	TO: <u>610'</u>
FILTER PACK TYPE: <u>10/12 silica sand</u>	FROM: <u>610'</u>	TO: <u>683'</u>

Installed backfill material, hole plug, and filter pack w/ tremmie pipe

ANNULAR COMPLETION CHARACTERISTICS

WELL PROTECTOR: LENGTH/DIAM: 500'/10" 4/8"

LOCK NO: Geomatrix Master Lock #2190

SURVEYED LOCATION (m): Northing: 15562642.709 Easting: 1938542.272 WELL CASING ELEV. (ft): 7230.149' GROUND SURFACE ELEV.(ft): 7228.847'
 SURVEYED DATUM: HORIZONTAL: UTM Zone 12 North, NAD83 VERTICAL: NAVD88

STATIC WATER LEVEL: 179.85' DATE: 9/25/2010 MEASURING POINT DESCRIPTION/ ELEVATION: Top of steel casing MEASURING POINT RELATIVE TO GROUND SURFACE (+/-) +1.30'

REMARKS: Schramm T555 Rotadrill; 1050 SCFM at 350 PSIG and 1800 rpm; after reaching TD of 687 w/ 9-7/8" bit, borehole collapsed to ~450 ft.. Overdrilled with 12 inch bit to 505 ft.; set 10" diam. Casing to 500 ft.; added cement; then drilled through plug w/ 9-7/8" bit. Casing to 505' is 10-1/4" ID, 10-3/4" OD, 0.25" thick.

INTERVAL(FT)	LITHOLOGIC DESCRIPTION USCS NAME (USCS symbol): color, moist, % by weight, plasticity, consistency, structure, cementation, geology	REMARKS	
below ground surface			
0 - 3	ML (gravelly silt w/sand); silt is dark yellowish brown (10YR 4/2); damp; 65% silt w/ some clay; 25% fine gravel; 10% sand; silt has mod. plasticity; soft; max. particle size 0.5 inches; [Fill]		
3 - 19	ML (silt with sand); moderate yellowish brown (10YR 5/4); dry; 80% silt; 20% fine sand; non-plastic; loose; [Weathered Wasatch Fm]?	Began drilling @ 1545 hrs w/ 16" tricone bit; 16" casing installed to ~10 ft.; water added at approx. 10 ft; foam added at 15 ft.	
19 - 38	Shale/siltstone; dark yellowish brown (10YR 4/2); wet from added water; slightly gritty surfaces of chips; appears massive to faintly laminated [Wasatch Fm]; dusky yellow (5Y 6/4) at 25 ft.; consolidated and hard.		
38 - 47	Sandstone; dark yellowish orange (10YR 6/6); appears massive; quartz, muscovite and dark (mafic) minerals; 90% quartz; fine-grained sand; poorly graded; subangular; poorly cemented		
47 - 84	Sandstone and sand; sandstone as above; loose sand is medium to coarse and white/buff/gray; angular to subrounded; dominated by quartz but contains mafic minerals; 70% loose sand and 30%		
(Drilling open hole)	fine-grained sandstone at 47 ft.; 90% loose coarse sand by 60 ft.; loose sand is poorly graded; max. particle size 4 mm; contains fragments of iron-oxide-cemented coarse sand; coarse sand is likely sandstone in the formation that was disaggregated by drilling process; contains minor well-cemented greenish gray (5GY 6/1) siltstone/claystone; minor light olive gray sandstone (5Y 5/2) at 80 ft.; fine-grained and poorly cemented.		
			9-7/8" tricone bit; driller reports hard drilling within this formation

AMEC Geomatrix

WELL LITHOLOGIC AND COMPLETION LOG

JOB NO: 013655.006.0

PROJECT: Pinedale Anticline Project Area: Hydro Data Gaps

WELL NO: T-1-RW

INTERVAL(FT) below ground surface	LITHOLOGIC DESCRIPTION USCS NAME (USCS symbol): color, moist, % by weight, plasticity, consistency, structure, cementation, geology	REMARKS
84 - 98	Sandstone as above; contains ~15% silt; dusky yellow (5Y 6/4)	Driller reports easier drilling
98 - 105	Sandstone and shale; shale is dark greenish gray (5G 4/1); sandstone may be from borehole wall above; shale is poorly cemented; moderate consistency	
105 - 115	Sandstone; medium bluish gray (5B 5/1); appears massive; poorly cemented; subangular fine-grained quartz and minor mafic materials; 90% quartz; poorly graded; ~20% of fragments are moderately cemented at 110 ft.	Slow drilling; hard drilling
115 - 119	Sandstone; fine to coarse; fine sandstone as above (105'-115'); coarse sand same as 47'-84	
119 - 134	Shale/siltstone; olive gray (5Y 4/1); mod. hard to hard; appears massive; from 120'-125', contains approx. 5% coal (?) fragments (black, low density, friable).	
134 - 140	Sand/sandstone; clear to white (largely quartz); 90% sand/sandstone; loose sand grains up to 3 mm long; angular to subrounded; poorly graded; 10% olive gray shale/siltstone as above	Stopped at 125' to airlift; Est. 4-5 gpm after 5 min. of blowing Relatively rapid drilling
140 - 145	Shale/siltstone with sandstone/sand; 60% shale/siltstone; dark greenish gray (5G 6/1); 40% med. to coarse sand (same as 134'-140')	
145 - 151	Sand/sandstone as above (134'-140'); 90% sand; 10% shale/siltstone as above (140'-145')	Est. 6-7 gpm at 165'
151 - 172	Shale; dark gray (N3); hard; appears massive; well consolidated; 10% med. to coarse quartz-rich sand (151'-155'); 20% sand (155'-158'); 50% sand and 50% shale at 160'; contains grayish red purple (5RP 4/2) shale at 160'; shale (50% of total) is half dark greenish gray and half grayish red purple	
172 - 178	Shale/siltstone; dark greenish gray (same as 140'-145')	
178 - 182	Sand/ sandstone; coarse; white to gray (largely quartz; contains mafic minerals; medium to coarse loose sand; angular to subrounded; poorly graded	
182 - 204	Shale/siltstone; dusky brown (5YR 2/2); appears massive; hard; contains dark greenish gray shale from 195'-204'	Est. 8-10 gpm at 205'
204 - 207	Sandstone/ sand with shale/ siltstone; 70% med. Coarse sand (same as 178'-182'); 30% dark greenish gray (5G 4/1) shale	
207 - 225	Shale/siltstone; same as 182'-204'	
225 - 230	Sandstone/sand as above (178'-182')	
230 - 235	Transition to shale/siltstone	
235 - 245	Shale/siltstone; dusky brown (5YR 2/2); appears massive; hard; well consolidated	
245 - 255	Sandstone/sand; mostly white to gray quartz; minor mafic minerals (chlorite?); subrounded to subangular; loose (non-cemented); poorly graded med. to coarse sand up to 3 mm long	

AMEC Geomatrix

WELL LITHOLOGIC AND COMPLETION LOG

JOB NO: 013655.006.0

PROJECT: Pinedale Anticline Project Area: Hydro Data Gaps

WELL NO: T-1-RW

INTERVAL(FT) below ground surface	LITHOLOGIC DESCRIPTION USCS NAME (USCS symbol): color, moist, % by weight, plasticity, consistency, structure, cementation, geology	REMARKS
255 - 263	50% shale/siltstone (same as 235'-245'); 50% sandstone/sand (same as 245-255)	7/21/2010- using second air compressor (Sullair 900 XH); 900 cfm at 350 psig Driller prefers not to estimate discharge at 405' to avoid hole collapse; flow to the hole is likely increasing slightly with each drill rod 409'-438' is a mixture of grain sizes; driller thinks we are in sand Difficult discharge to measure; ~5 gpm is being added; est. 20+ gpm at 465'; significant gw in borehole blown out after adding rod (480-500)
263 - 275	Siltstone and shale; 70% siltstone; dark greenish gray (5G 4/1); 30% shale; grayish red (5R 4/2); siltstone appears massive and shale is fissile; contains minor quartz sand; at 270': 70% shale and 30% siltstone	
275 - 295	Shale/siltstone; brownish gray (5YR 4/1); massive to laminated/fissile; moderately hard; dark greenish gray at 279'; finely laminated and fissile at 279'	
295 - 312	Sandstone/sand and shale/siltstone; 60% sandstone/sand (as in 245'-255); 40% shale/siltstone; dark greenish gray (5G 4/1); contains some dark red siltstone; sand angular to subangular; up to 4 mm long	
312 - 338	Shale; dark gray (N3); fissile; laminated; hard; well consolidated; particles up to 1" long; approx. 20% greenish gray (5GY 6/1) shale at 320 ft.; all dark greenish gray at 323; largely silt-sized particles at 330'; 10% sand at 335'	
338 - 356	Sand/sandstone and shale/siltstone; approx. 50% of each; med. to coarse sand as above; dark greenish gray shale/siltstone (5G 4/1)	
356 - 359	Shale/siltstone; dark greenish gray (5G 4/1); appears massive; hard	
359 - 363	Sand/sandstone and shale/siltstone (same as 338'-356')	
363 - 374	Shale/siltstone; blackish red (5R 2/2); appears massive	
374 - 387	Shale/siltstone; dark greenish gray (5G 4/1); hard; contains ~20% med. to coarse sand	
387 - 393	Sand/sandstone; white to gray; quartz dominant; angular to subrounded and up to 3 mm long; poorly-graded; med. to coarse sand	
393 - 402	Siltstone/shale; dark greenish gray (5G 4/1); appears massive (mudstone?); hard; brownish black (5YR 2/1) at 397'	
402 - 407	Shale/siltstone and sand/sandstone as above (338'-356')	
407 - 409	Shale/siltstone; greenish black (5G 2/1); massive to laminated; hard	
409 - 438	Same as 402'-407'; percent sand increasing to ~75% at 435'	
438 - 449	Shale/siltstone; blackish red (5R 2/2); massive to laminated; hard; mixed blackish red and greenish gray (5G 4/1) at 445'; minor moderate olive brown (5Y 4/4) claystone at 440'	
449 - 454	As above ~15% coarse sand	
454 - 477	Shale/siltstone as above (445'); mixed colors; grayish black (N2) at 468'; dark greenish gray at 475' (softer at 475')	
477 - 484	Sandstone/sand with siltstone/shale; 70% quartz sand (med. to coarse; gray to white); 30% shale/siltstone; dark greenish gray (5G 4/1)	

AMEC Geomatrix

WELL LITHOLOGIC AND COMPLETION LOG

JOB NO: 013655.006.0

PROJECT: Pinedale Anticline Project Area: Hydro Data Gaps

WELL NO: T-1-RW

INTERVAL(FT)	LITHOLOGIC DESCRIPTION USCS NAME (USCS symbol): color, moist, % by weight, plasticity, consistency, structure, cementation, geology	REMARKS	
below ground surface			
484 - 489	Siltstone/shale as above (475')	At 520', driller reports rig response is consistent with shale; driller reports sand at 524'	
489 - 498	Same as 477'-484'		
498 - 524	Siltstone/shale with sandstone/sand; same lithology as 477'-484' but 85% siltstone/shale and 15% sand; siltstone is greenish black (5GY 2/1); 65% siltstone/shale and 35% sand at 510'; brownish gray (5YR 4/1) and dark greenish gray (5G 4/1) at 510'; back to 85% siltstone/shale at 517'		
524 - 540	Same as 477'-484'; some shale is blackish red (5R 2/2)		
540 - 545	Sandy shale/siltstone; dark greenish gray (5G 4/1) and minor dusky yellowish brown (10YR 2/2); fragments contain fine to medium sand		
545 - 550	Sandstone/sand with siltstone/shale; 60% sand; quartz-rich; med. to coarse; gray to white; 40% siltstone/shale; dark greenish gray (5G 4/1)		
550 - 579	Siltstone/shale with sandstone/sand; 80% dark greenish gray (5G 4/1) to blackish red (5R 2/2) shale; 20% quartz sand as above; 10% sand at 570'		
579 - 590	Shale/siltstone; dark greenish gray (5G 4/1); relatively soft; largely silt-sized particles; trace quartz sand; cuttings at 585' contain minor amounts of fine-grained sand		
590 - 597	Siltstone; colors as in 550'-579'		Driller reports harder drilling at 595' and 606'
597 - 607	Siltstone; colors as in 550'-579'; largely silt-sized particles; no sand		
607 - 621	Cuttings return is same as 579'-590' but contain minor amounts of very fine-grained sandstone; light gray (N7); hard and well-cemented; quartz with minor mafic minerals; grain size too small to see shape; poorly graded		
621 - 625	Shale/siltstone as in 550'-579'; sandstone/sand as in 545'-550'; roughly 50% of each		Noticable increase in discharge at ~628 ft.; possibly 100+ gpm; driller concurs ~100 gpm
625 - 648	Sandstone/sand; largely quartz; gray to white; medium- to coarse-grained; angular to subrounded; contains siltstone/shale (likely contamination from shallower intervals)		
648 - 660	Siltstone/shale as in 550'-579'; contains some med. to coarse sand		
660 - 675	Siltstone/shale as above (550'-579'); ~20% sand		
675 - 680	Siltstone/shale; blackish red (5R 2/2)		
680 - 687	Sandstone/sand and siltstone/shale; ~50% of each; sandstone as in 625'-648'; siltstone as in 550'-579'		
687	Bottom of boring		

AMEC Geomatrix

WELL LITHOLOGIC AND COMPLETION LOG

JOB NO: 013655.006.0 T4 WELL NO: T-2-SW

PROJECT: Pinedale Anticline Project Area: Hydro Data Gaps STATE: WY COUNTY: Sublette LOGGED BY: T.M.

LEGAL LOCATION: T 32N R 109W S 16 TRACT SE¼ DESCRIPTIVE LOCATION: Questar Mesa 15-16 Pad

DATE STARTED: 6/27/2010 DATE COMPLETED: 6/29/2010 DRILLING CO/DRILLER: Thomas Drilling/ Bob Thomas

DRILLING METHOD: Air rotary/casing hammer BOREHOLE DIAM (IN): 16" (0-40); 10" (40-395') DRILL FLUIDS USED: Water, foam

CONDUCTOR/SURFACE CASING INSTALLED: 16" (0-20') 10"(0-40') INTERVAL PERFORATED FROM OR SCREENED (FT): 335 375 WELL DIAMETER: 4" CASING TYPE: Sch. 80 PVC

TOTAL DEPTH DRILLED:	TOTAL DEPTH CASED:	DURING WELL CONSTRUCTION WAS/WERE:	YES	NO
<u>395'</u>	<u>375'</u>	Well Developed	<input type="checkbox"/>	<input checked="" type="checkbox"/>
		Well Pumped	<input type="checkbox"/>	<input checked="" type="checkbox"/>
		Water Samples Collected	<input type="checkbox"/>	<input checked="" type="checkbox"/>
		Material Samples Collected	<input type="checkbox"/>	<input checked="" type="checkbox"/>

METHOD OF PERFORATION: Open Hole
 Open Bottom
 Saw Slotted
 Factory 0.020 (size)
 Other: Roller Perf tool 1/2" x 1"; 4 rows

ANNULAR COMPLETION CHARACTERISTICS
WELL PROTECTOR: _____ LENGTH/DIAM: 5/8"

LOCK NO: Geomatrix Master Lock #2190

SURVEYED LOCATION (m): Northing: 15527442.627 Easting: 1952566.690 WELL CASING ELEV. (ft): 7459.967' GROUND SURFACE ELEV.(ft): 7458.481'
SURVEYED DATUM: HORIZONTAL: UTM Zone 12 North, NAD83 VERTICAL: NAVD88

STATIC WATER LEVEL: Dry DATE: 9/24/2010 MEASURING POINT DESCRIPTION/ELEVATION: North Side top well casing MEASURING POINT RELATIVE TO GROUND SURFACE (+/-): 1.49'

REMARKS: See associated boring T-2-RW for further information regarding the lithology at this location

INTERVAL(FT)	LITHOLOGIC DESCRIPTION USCS NAME (USCS symbol): color, moist, % by weight, plasticity, consistency, structure, cementation, geology	REMARKS
below ground surface		
0 - 17	Gravel (GW): brown 10YR 4/3; subangular to rounded; angular drilling fractures up to 45 mm in diameter; quartzite; well graded; trace silt fines; some to trace sands, fine to medium grained	
17 - 51	Siltstone; 10YR 6/2 light brown; some fine to medium sands; trace gravels as above	
51 - 68	Siltstone and shale; trace clay; laminated; 5YR 5/3 reddish brown to 10 YR 5/3 brown	
68 - 135	Shale and sandstone; some to trace clay; shale friable 5YR 6/3 light reddish brown; sands fine grained; trace biotite mica (black); sands 10YR 6/2 brownish gray	
135 - 155	Siltstone; trace fine sandstone; trace shale; trace to some coal (black); 5YR 6/3 reddish brown to Gley 2 4/1 bluish gray; some pyrite; Shale/coal seam (black) with some pyrite at 142 ft.	
155 - 270	Siltstone and sandstone; Gley 2 3/1 dark bluish gray; sands are fine grained; trace medium grained with some coarse; some black carbon material with trace pyritization	
270 - 308	Shale and siltstone; Gley 2 4/1 bluish gray; trace very fine grained sandstone; some black coal/shale fragments	
308 - 395	Sandstone; medium to coarse; trace fines; 10YR 6/1; trace to some mudstone and siltstone which is Gley 2 3/1; siltstone layer from 350 to ~365 ft.; Gley 2 3/1 bluish gray	At 350' pump/evacuate water from boring; >1gpm
395	End of boring	

AMEC Geomatrix

WELL LITHOLOGIC AND COMPLETION LOG

JOB NO: 013655.006.0

PROJECT: Pinedale Anticline Project Area: Hydro Data Gaps

WELL NO: T-2-RW

INTERVAL(FT)	LITHOLOGIC DESCRIPTION USCS NAME (USCS symbol): color, moist, % by weight, plasticity, consistency, structure, cementation, geology	REMARKS
below ground surface		
155 - 268	Siltstone and sandstone; Gley2 3/1 dark bluish to gray; sands fine to coarse; trace black carboniferous material; trace pyritization	Rig chatter with hard drilling from 160 - 168 ft. Hard drilling at 280 ft.
At 195	More sandstone; medium grained; some siltstone	
At 200	Trace yellowish brown (10 YR 4/4), fine grained sands	
At 205	Yellowish brown sandstone (10 YR 4/4); fine to coarse, trace siltstone	
268 - 305	Shale and siltstone; Gley 2 4/1 bluish gray; some trace black coal or shale fragments; trace very fine grained sandstone	
At 285	Fragments of competent fine grained sandstone; 5 YR 4/1 dark gray	
At 290	Sandstone; gray; medium to coarse grained; trace fines; trace siltstone	
At 295	Shale; Gley 2 4/1 to Gley 2 3/1 dark bluish gray; trace medium to coarse sandstones; trace siltstone	
At 300	Shale as above; more competent; laminated in parts; friable; trace mudstone	
305 - 317	Shale and mudstone; Gley 2 4/1 to 7.5 YR 4/3 bluish gray to brown; friable; waxy texture; trace to some black carbon coating on bedding surfaces at 315 ft.; loose, very friable black fragments of coal or shale?	
317 - 350	Sandstone; light gray (10YR 6/1); some mudstone; trace pyritization; medium to coarse sand; trace fines; trace mudstone/siltstone; dark bluish gray (Gley 2 3/1)	
350 - 370	Siltstone; Gley 2 3/1 dark bluish gray; trace medium to coarse sands	
370 - 375	Sandstone; light gray (10YR 6/1); medium to coarse grains; trace mudstone	
375 - 500	Sandstone; gray (10YR 6/1); coarse to medium grained; trace fines; angular to subrounded grains; well graded; trace siltstone/shale; Gley 2 3/1 to 10YR 5/2; dark bluish gray to grayish brown; trace pyrite; trace mudstone	
At 390	Dark bluish gray siltstone layer	
At 405	Dark bluish gray siltstone layer	
At 435	Dark bluish gray siltstone layer	
At 475	Sand; fine grained; trace coarse sand; 10YR 5/1 gray	
At 480	Mudstone; dark bluish gray Gley 2 3/1	
500 - 505	Mudstone/siltstone with shale; Gley 2 3/1 to 10YR 4/2 dark bluish gray to dark brown; some to trace medium to coarse sand; shale is moderately competent; 10YR 6/2 light brownish gray	Small increase in formation water at 470 ft.? Formation water increases at 515 ft. Q = ~25 - 50gpm
505 - 520	Very fine grained sandstone/siltstone; 10YR 5/1; trace shale 10YR 6/2; trace bluish and brown siltstone; sandstone becomes more competent and dense with depth	
520 - 530	Sandstone; medium to coarse grained; trace fine; gray (10YR 8/1); trace shales and siltstones	
530 - 618	Shale/siltstone; Gley 2 3/1 bluish gray; trace to some medium to coarse sandstone; trace light brown (10YR 6/1) shale; trace black coal/carbon fragments; trace pyrite	

AMEC Geomatrix

WELL LITHOLOGIC AND COMPLETION LOG

JOB NO: 013655.006.0 T4 WELL NO: T-3-SW

PROJECT: Pinedale Anticline Project Area: Hydro Data Gaps STATE: WY COUNTY: Sublette LOGGED BY: L. McKay

LEGAL LOCATION: T 30N R 1078W S 15 TRACT SW NE DESCRIPTIVE LOCATION: Ultra Warbonnet 7-15D pad; 50 feet from pad entrance; well is on south side

DATE STARTED: 6/24/2010 DATE COMPLETED: 7/31/2010 DRILLING CO/DRILLER: Thomas Drilling/Tyson Thomas

DRILLING METHOD: Mud Rotary; Tri-Cone Bit BOREHOLE DIAM (IN): 10" (40-465') DRILL FLUIDS USED: Cetco guar gum and water

CONDUCTOR/SURFACE CASING INSTALLED: 16" (0-10') 12" (0-40') INTERVAL PERFORATED FROM OR SCREENED (FT): 405 WELL DIAMETER: 5" CASING TYPE: Steel

TOTAL DEPTH DRILLED: 465' TOTAL DEPTH CASIED: 446' DURING WELL CONSTRUCTION WAS/WERE:

	YES	NO
Well Developed	X	
Well Pumped		X
Water Samples Collected		X
Material Samples Collected		X

METHOD OF PERFORATION: Open Hole
Open Bottom
Saw Slotted
 Factory 0.020 (size)
Other: Roller Perf tool 1/2" x 1"; 4 rows

ANNULAR COMPLETION CHARACTERISTICS
WELL PROTECTOR: _____ LENGTH/DIAM: 4/10"
SURFACE SEAL TYPE: Type II cement pad Surface 60'
BACKFILL MATERIAL: Bentonite grout FROM: 60' TO: 398'
HOLE PLUG: Coated pellets FROM: 393' TO: 398'
FILTER PACK TYPE: 10/12 silica sand FROM: 398' TO: 460'
Installed backfill material, hole plug, and filter pack w/ tremmie pipe

LOCK NO: Geomatrix Master Lock #2190

SURVEYED LOCATION (m): Northing: 15466481.050 Easting: 1990349.705 WELL CASING ELEV. (ft): 7358.960' GROUND SURFACE ELEV.(ft): 7357.369'
SURVEYED DATUM: HORIZONTAL: UTM Zone 12 North, NAD83 VERTICAL: NAVD88

STATIC WATER LEVEL: 355.43' DATE: 9/22/2010 MEASURING POINT DESCRIPTION/ELEVATION: North side, top of casing MEASURING POINT RELATIVE TO GROUND SURFACE (+/-): 1.59'

REMARKS: See associated boring T-3-RW for additional information regarding lithology at this location

INTERVAL(FT)	LITHOLOGIC DESCRIPTION USCS NAME (USCS symbol): color, moist, % by weight, plasticity, consistency, structure, cementation, geology	REMARKS
below ground surface	[Borehole previously drilled and cased to 40 ft bgs]	
45 - 50	Shale; 50% clay, 30% silt, 20% medium to fine sand; wet; low plasticity; poor to moderately sorted grayish red (10R 4/2)	
50 - 55	Sandy shale; 35% clay; 40% silt; 25% coarse, medium and fine-grained sand; wet; v. low plasticity; poorly sorted; sand is subrounded to subangular; mostly light olive gray (5Y 5/2) with some grayish red (10R 4/2)	
55 - 65	Sandstone; mostly coarse- to medium- grained; ~10% fines; angular to subrounded; mostly QTZ, contains feldspar; yellowish gray (5Y 7/2)	
At 60	As above w/ larger sand grains (~2-5 mm); color is light olive gray (5Y 5/2)	
65 - 72	Siltstone; poorly sorted; 50% silt, 35% sand, 15% clay; sand is fine- to medium-grained; angular to subrounded, grayish brown (5YR 3/2), light olive gray, silty clay @ 70' bgs.	
72 - 82	Sandstone; moderately sorted; ~80% QTZ; contains feldspar and lithics; trace fines; subangular to sub-rounded; moderate yellowish brown (10YR 5/4); mostly coarse- to medium-grained sand; increase in silty fines at 80 ft bgs	Driller reports easier drilling

AMEC Geomatrix

WELL LITHOLOGIC AND COMPLETION LOG

JOB NO: 013655.006.0

PROJECT: Pinedale Anticline Project Area: Hydro Data Gaps

WELL NO: T-3-SW

INTERVAL(FT) below ground surface	LITHOLOGIC DESCRIPTION USCS NAME (USCS symbol): color, moist, % by weight, plasticity, consistency, structure, cementation, geology	REMARKS
82 - 103	Siltstone; ~50% silt; 35% sand; 15% clay; poorly sorted; medium-grained sand is subangular to subrounded; light olive gray (5Y 5/2) with minor grayish brown (5YR 3/2)	Harder drilling
At 90	Less sand; trace of lithic sandstone	
At 95	As above; slight color change to dark yellowish brown (10YR 4/2)	
103 - 118	Interbedded sandstone; ~70% sand, 20% silt; 10% clay; poorly sorted; sand is subangular to subrounded; medium- to coarse-grained; mostly QTZ w/ some lithics and pyritization; color is greenish gray (5G 6/1) to dark greenish gray (5G 4/1)	Drilling rate:10 ft/hr
At 110	As above; increasing silt and fine-grained sand, increasing clay @ 115'	
118 - 142	Siltstone; mostly silt w/ medium-grained sand; contains clay; trace lithics; poorly sorted; dominate color is grayish brown (5YR 3/2) with some light olive gray (5Y 5/2); fine- to medium-grained sand increases at 128 ft bgs	
142 - 154	Shale; ~55% clay; 30% silt; 15% fine- to medium-grained sand; poorly to moderately sorted; slightly plastic; grayish green color (5G 5/2)	Drilling rate: 5 ft/hr
154 - 165	Interbedded sandstone; 40% sand; 40% clay; 20% silt; poorly sorted; sand is angular to subrounded, medium- to coarse-grained; mostly QTZ; grayish green (5G 5/2)	
165 - 235	Siltstone; increasing clay and silt; grayish green (5G 5/2) thin blocky shale unit at 187 ft bgs	
At 200	Shale/siltstone; trace red oxidized material (pyrite?)	Slow drilling; good return; cuttings very clayey
235 - 254	Siltstone; 50% sand; 30% silt; 20% clay; fine-grained sand w/ abundant black grains (biotite); moderately to poorly sorted; greenish gray to dark greenish gray (5GY 6/1 - 5GY 4/1)	
At 245	Shale; slight color change to grayish green	
254 - 260	Silty shale; moderately sorted; grayish red (10R 4/2) and grayish green (5G 5/2)	
260 - 290	Interbedded siltstone/ shale; moderately sorted; mostly fine-grained sand and silt; contains biotite; greenish gray (5GY 6/1) to dark greenish gray (5G 4/1); contains medium- to fine-grained sandstone fragments at 208 ft bgs	
290 - 294	Blocky shale; moderately sorted, contains silicious siltstone and minor fine-grained sand; poorly indurated; dark greenish gray (5Y 5/2); contains grayish red siltstone/ shale chips (10R 4/2)	
294 - 330	Fine-grained sandstone; mostly silicious w/ some muscovite and biotite; contains silt; poorly to moderately sorted; light olive gray (5Y 5/2); contains shale/siltstone fragments; increasing grain size and trace pyritization at 323 ft bgs	

AMEC Geomatrix

WELL LITHOLOGIC AND COMPLETION LOG

JOB NO: 013655.006.0

PROJECT: Pinedale Anticline Project Area: Hydro Data Gaps

WELL NO: T-3-SW

INTERVAL(FT)	LITHOLOGIC DESCRIPTION USCS NAME (USCS symbol): color, moist, % by weight, plasticity, consistency, structure, cementation, geology	REMARKS	
below ground surface			
330 - 334	Shale; blocky texture; poorly indurated; well sorted; dark greenish gray (5GY 4/1)	Penetration rate: 10 - 15 ft/hr	
334 - 345	Sandstone; poorly to moderately sorted; grains are silicious w/ biotite and muscovite, fine to very fine; light olive gray (5Y 6/1); contains shale fragments with black, planar organics		
345 - 355	Siltstone; well sorted; contains fine-grained sand; dark greenish gray (5G 4/1); at 351 grades to poorly sorted; dark greenish gray (5Y 4/1)		
355 - 370	Interbedded sandstone; very fine- to fine-grained; poorly to moderately sorted; silicious grains w/biotite; light olive gray (5Y 6/1); dark greenish gray (5G 4/1) shale/ siltstone unit at 365; blocky, well sorted		
370 - 375	Siltstone; poorly sorted; contains medium-grained sand; dark greenish gray (5GY 4/1); grades to very fine sandstone at 375 ft bgs;		
375 - 385	Sandstone; fine-grained; large (1-5 mm) rounded QTZ grains common; pyritization from 375 ft; contains green siltstone		
386 - 388	Sandstone; 60% QTZ; 20% feldspar; 10 % siltstone lithics (large chips); 5% moderate greenish yellow mineral (epidote?); 5% pyrite; poorly sorted; mostly coarse-grained subangular to rounded		Driller reports losing ~1000 gal of mud
388 - 420	Interbedded siltstone; poorly sorted; contains fine- to very fine- sand grains; high clay content; dark greenish gray (5G 4/1); very thin fine- to medium-grained, subangular sandstone lenses at 395 and 403 ft bgs		
420 - 432	Interbedded sandstone; very poorly sorted; contains silt and medium to coarse subangular to subrounded grains; abundant dark greenish gray (5G 4/1) siltstone chips		
432 - 444	Interbedded siltstone; poorly sorted; contains fine- to medium-grained sand; mostly dark greenish gray (5G 4/1) w/ abundant brownish gray (5YR 4/1) siltstone chips		
444 - 452	Sandstone; very poorly sorted, fine- to coarse-grained sand; subangular to subrounded; contains greenish gray siltstone; mostly QTZ, minor FSP and biotite		
452 - 465	Sandy siltstone/shale; moderate to poorly sorted; contains fine- to medium-grained sand; dark greenish gray (5G 4/1)	Penetration rate: ~10 ft/hr	
465	End of boring		

AMEC Geomatrix

WELL LITHOLOGIC AND COMPLETION LOG

JOB NO: 013655.006.0 T4 WELL NO: T-3-RW

PROJECT: Pinedale Anticline Project Area: Hydro Data Gaps STATE: WY COUNTY: Sublette LOGGED BY: L. McKay

LEGAL LOCATION: T 30N R 1078W S 15 TRACT SW NE DESCRIPTIVE LOCATION: Ultra Warbonnet 7-15D pad; 50 feet from pad entrance; well is roughly 15 feet south of T-3-SW

DATE STARTED: 7/7/2010 DATE COMPLETED: 7/17/2010 DRILLING CO/DRILLER: Thomas Drilling/Tyson Thomas

DRILLING METHOD: Mud Rotary; Tri-Cone Bit BOREHOLE DIAM (IN): 16" (0-40); 10" (40-770) DRILL FLUIDS USED: Cetco guar gum, bentonitic mud, water

CONDUCTOR/SURFACE CASING INSTALLED: 10" (0-40) INTERVAL PERFORATED FROM: 620 WELL DIAMETER: 5" OR SCREENED (FT): 650 CASING TYPE: Steel

TOTAL DEPTH DRILLED:	TOTAL DEPTH CASED:	DURING WELL CONSTRUCTION WAS/WERE:	YES	NO
<u>770'</u>	<u>747'</u>	Well Developed	<input type="checkbox"/>	<input checked="" type="checkbox"/>
		Well Pumped	<input type="checkbox"/>	<input checked="" type="checkbox"/>
		Water Samples Collected	<input type="checkbox"/>	<input checked="" type="checkbox"/>
		Material Samples Collected	<input checked="" type="checkbox"/>	<input type="checkbox"/>

METHOD OF PERFORATION: X Factory 0.020 (size) Other: Roller Perf tool 1/2" x 1"; 4 rows

SURFACE SEAL TYPE: Type II cement pad Surface TO: 140'
 BACKFILL MATERIAL: Bentonite grout FROM: 140' TO: 667'
 HOLE PLUG: Coated pellets FROM: 667' TO: 677'
 FILTER PACK TYPE: 10/12 silica sand FROM: 677' TO: 770'
Installed backfill material, hole plug, and filter pack w/ tremmie pipe

ANNULAR COMPLETION CHARACTERISTICS

WELL PROTECTOR: LENGTH/DIAM: 4/10"

LOCK NO: Geomatrix Master Lock #2190

SURVEYED LOCATION (m): Northing: 15466496.235 Easting: 1990347.238 WELL CASING ELEV. (ft): 7358.927' GROUND SURFACE ELEV.(ft): 7357.324'
 SURVEYED DATUM: HORIZONTAL: UTM Zone 12 North, NAD83 VERTICAL: NAVD88

STATIC WATER LEVEL: 409.49 DATE: 9/22/2010 MEASURING POINT DESCRIPTION/ ELEVATION: North side Top of Casing MEASURING POINT RELATIVE TO GROUND SURFACE (+/-) -1.60'

REMARKS: See associated boring T-3-RW for additional information regarding lithology at this location. Shale samples collected from 435' - 455' gas-bearing zone.

INTERVAL(FT)	LITHOLOGIC DESCRIPTION USCS NAME (USCS symbol): color, moist, % by weight, plasticity, consistency, structure, cementation, geology	REMARKS
below ground surface		
0 - 5	Pad material; mostly coarse-grained sand and gravel; subangular to sunbrounded; very poorly sorted; yellowish gray (5Y 7/2); contains very poorly sorted, grayish brown siltstone (5YR 3/2)	Air rotary w/ water from 0 to 40 ft bgs
5 - 12	Siltstone; very poorly sorted; abundant coarse-grained angular to subangular sand; dark yellowish brown (10YR 4/2) on weathered surfaces and dusky yellow green (10YR 3/2) on fresh surfaces.	
12 - 20	Interbedded sandstone; very poorly sorted; subrounded to subangular; medium to coarse sand composed of QTZ and FSP; contains dark yellowish brown siltstone (10YR 4/2); dusky yellow overall (5Y 6/4)	Drillers add foam @20'
20 - 27	Poorly sorted sandstone; grains medium to coarse, subrounded to subangular; contains siltstone fragments, dark yellowish brown (10YR 4/2)	
27 - 33	Interbedded sandstone as described above; increase in siltstone/shale material, dark yellowish brown dark yellowish brown (10YR 4/2) to dusky yellow green	
33 - 37	Sandy shale; moderately sorted; contains fine to medium sand; moderate brown (5YR 3/4)	
37 - 50	Interbedded sandstone; poorly sorted; abundant dark yellowish brown (10 YR 4/2) shale; sand is medium- to coarse-grained; subangular to subrounded	
50 - 55	Shale; pale olive (10Y 6/2) grading to dark reddish brown (10R 3/4) at 55 ft bgs	

AMEC Geomatrix

WELL LITHOLOGIC AND COMPLETION LOG

JOB NO: 013655.006.0

PROJECT: Pinedale Anticline Project Area: Hydro Data Gaps

WELL NO: T-3-RW

INTERVAL(FT) below ground surface	LITHOLOGIC DESCRIPTION USCS NAME (USCS symbol): color, moist, % by weight, plasticity, consistency, structure, cementation, geology	REMARKS
55 - 67	Interbedded sandstone; 60 - 70% poorly sorted, subrounded to subangular QTZ and FSP; contains pale olive (10Y 6/2) shale/ siltstone at 58 ft bgs	Very slow penetration rate (~5 ft/hr) @ 88'
67 - 74	Shale; moderately sorted; grayish brown (5YR 3/2) w/ minor olive gray (5Y 4/1); contains silt	
74 - 88	Sandstone; moderately sorted; subrounded to subangular; QTZ and FSP; contains a yellowish gray (5G 8/1) shale	
88 - 105	Shale w/ moderately sorted siltstone; grayish brown (5YR 3/2); contains grayish green (5G 5/2) siltstone	
105 - 128	Interbedded siltstone; moderately to poorly sorted; mostly grayish green (5G 5/2) w/ minor grayish brown (5YR 3/2) shale; contains fine to medium sand; increasing grain size at 113 ft bgs; olive gray (5Y 4/1) shale at 123 ft bgs	Quicker drilling (~20 ft/hr) at 120'
128 - 132	Shale; poorly sorted; contains silt and fine sand; olive gray (5Y 4/1)	Increasing penetration rates: ~30 ft/hr
132 - 135	Siltstone; poorly sorted w/ fine to medium sand; mostly grayish brown (5YR 3/2); abundant grayish green (5G 5/2)	
135 - 145	Shale; greenish gray (5G 6/1) to dark greenish gray (5G 4/1); contains fine to medium sand	
145 - 155	Siltstone; very poorly sorted; abundant medium- to coarse-grained sand; grayish green (5G 5/2)	
155 - 167	Interbedded siltstone; very poorly sorted; medium to coarse grained sand; grayish green (5G 5/2); trace brittle, grayish white (N7-N8) material (cement), sodium silicate?	
167 - 218	Shale; mostly grayish green (5G 5/2); contains greenish black shale (5GY 2/1); blocky texture; contains fine to medium sand at 170 ft bgs	
218 - 225	Siltstone; poorly sorted; contains very fine dark grains (biotite); dark greenish gray (5G 4/1)	
225 - 245	Shale; grayish green (5G 5/2); blocky texture with trace fissile texture; contains grayish brown (5YR 3/2) blocky shale cuttings	
245 - 255	Interbedded siltstone; poorly sorted; grayish green (5G 5/2); contains blocky shale; trace pyritization	
255 - 296	Interbedded shale; grayish green (5G 5/2); blocky texture; from 258 - 265 shale is grayish red (10R 4/2) with trace fissile texture and pyritiazation	
296 - 347	Sandstone/siltstone; fine-grained; poorly sorted; greenish gray (5GY 6/1)	Fine sand and silt decrease in grain size w/ depth (296' - 347')
347 - 362	Shale; dark greenish gray (5G 4/1); blocky texture	
362 - 366	Siltstone; poorly sorted; contains fine biotite grains; olive gray (5Y 4/1)	Driller report easier drilling
366 - 377	Shale; olive black (5Y 2/1); abundant olive gray (5Y 4/1) shale; trace medium-grained sand; from 371 shale is dark greenish gray (5G 4/1) and contains silt and fine sand	
377 - 390	Sandstone; poorly sorted; mostly coarse-grained; subrounded to subandgular; ~80% QTZ; ~10% lithics; ~10% FSP; pyritization common	

AMEC Geomatrix

WELL LITHOLOGIC AND COMPLETION LOG

JOB NO: 013655.006.0

PROJECT: Pinedale Anticline Project Area: Hydro Data Gaps

WELL NO: T-3-RW

INTERVAL(FT)	LITHOLOGIC DESCRIPTION USCS NAME (USCS symbol): color, moist, % by weight, plasticity, consistency, structure, cementation, geology	REMARKS	
below ground surface			
390 - 400	Shale; moderately sorted; blocky with some fissile texture; dark greenish gray (5G 4/1); contains fine- to medium-grained sand	} Faster drilling	
400 - 405	Sandstone; poorly sorted; mostly coarse-grained; some medium-grained sand; ~80% QTZ, 20% FSP; contains pyrite		
405 - 418	Interbedded shale/ sandstone; poorly sorted; contains silt and fine sand; dark greenish gray (5G 4/1)		
418 - 425	Sandstone; poorly sorted; mostly coarse-grained, subrounded to subangular QTZ w/ FSP; contains pyrite		
425 - 472	Sandstone; poorly sorted; mostly coarse-grained/medium-grained sand; dark greenish gray (5G 4/1)		
472 - 485	Shale; ~50% dark greenish gray (5G 4/1); ~50% dark yellowish brown (10YR 4/2)		
485 - 505	Sandstone; poorly sorted; fine- to medium-grained; contains coarse-grained sand; minor siltstone cuttings; greenish gray (5GY 6/1)		} 500 - 540: logged from chip trays collected by driller
505 - 515	Shale; dark greenish gray (5G 4/1); blocky; contains medium- and coarse-grained sand; grayish red shale (10R 4/2) at 510 ft bgs	} At 540 driller began using bentonitic mud; abundant upper borehole cutting present	
515 - 520	Sandstone; poorly sorted; mostly coarse-grained; subangular to subrounded QTZ and FSP		
520 - 530	Interbedded(?) siltstone; moderately sorted; dark greenish gray (5G 4/1); abundant silt; contains coarse sand		
530 - 542	Shale; dark greenish gray (5G 4/1); abundant grayish red shale (10R 4/2) at 535 ft bgs		
542 - 557	Sandstone; poorly sorted; medium- to coarse-grained; contains fines; subangular to subrounded; arkosic		
557 - 575	Silty shale; moderately sorted; abundant silt/fine sand with trace medium-grained sand; dark greenish gray (5G4/1)		
575 - 580	Shale; dark greenish gray (5G 4/1); blocky texture; contains siltstone cuttings; contains grayish brown shale at 578 ft bgs		
580 - 605	Siltstone; dark greenish gray (5G 4/1); poorly sorted; abundant clay and fine sand; greenish gray (5G 6/1) from 600 to 605 ft bgs	} Slow drilling: ~10 ft/hr	
605 - 635	Interbedded sandstone; very poorly sorted; fine- to medium-grained sand w/ abundant silt; 20% coarse arkosic grains; subrounded to subangular; grains supported in grayish white (N7-N8) cement; greenish gray (5G 6/1) overall		
635 - 640	Shale; moderately sorted; contains medium to coarse sand; dark greenish gray (5G 4/1)		
640 - 653	Interbedded sandstone; poorly sorted; fine to coarse arkosic sand; subangular to subrounded, siltstone is dark greenish gray (5G 4/1) to greenish gray (5G 6/1)		
653 - 668	Shale; dark greenish gray (5G 4/1) to dark yellowish brown (10YR 4/2)		
668 - 680	Sandstone; poorly sorted; medium- to coarse-grained; arkosic; subangular to subrounded		} Drilling rate increases
680 - 700	Shale, dark greenish gray (5G 4/1); contains silt and medium sand grains		

AMEC Geomatrix

WELL LITHOLOGIC AND COMPLETION LOG

JOB NO: 013655.006.0 T4 WELL NO: T-4-SW

PROJECT: Pinedale Anticline Project Area: Hydro Data Gaps STATE: WY COUNTY: Sublette LOGGED BY: T. McManus

LEGAL LOCATION: T 29N R 107W S 10 TRACT NW,SW DESCRIPTIVE LOCATION: Antelope 11-10D pad (Shell); Luman Road; well between T-4-RW-a and T-4-RW-b at southern end of drill pad

DATE STARTED: 5/16/2020 DATE COMPLETED: 5/18/2020 DRILLING CO/DRILLER: Thomas Drilling

DRILLING METHOD: Air rotary/casing hammer BOREHOLE DIAM (IN): 8" (40'-200') DRILL FLUIDS USED: None

TOTAL DEPTH DRILLED: 200' TOTAL DEPTH CASSED: 190' INTERVAL PERFORATED FROM OR SCREENED (FT.): 175' 190' DIAMETER: 4" CASING TYPE: PVC

METHOD OF PERFORATION:	DURING WELL CONSTRUCTION WAS/WERE:	YES	NO
<u>Open Hole</u>	<u>Well Developed</u>	<u>X</u>	
<u>Open Bottom</u>	<u>Well Pumped</u>		<u>X</u>
<u>Saw Slotted</u>	<u>Water Samples Collected</u>	<u>X</u>	
<u>X Factory 0.020 (size)</u>	<u>Material Samples Collected</u>		<u>X</u>
<u>Other: Roller Perf tool 1/2" x 1"; 4 rows</u>			

ANNULAR COMPLETION CHARACTERISTICS

WELL PROTECTOR: LENGTH: 40' SURFACE SEAL TYPE: Cement FROM: 3' TO: 0
 DIAM: 10" BACKFILL MATERIAL: Cement grout FROM: 170' TO: 3'
 LOCK NO: Geomatrix Master Lock #2190 HOLE PLUG: Coated bentonite pellets FROM: 165' TO: 170'
 FILTER PACK TYPE: 8/12 silica sand FROM: 170' TO: 200'
Hole Plug and filter pack material poured in and installed w/ tremie pipe

STATIC WATER LEVEL: 50.9 DATE: 9/21/2010 MEASURING POINT DESCRIPTION/ELEVATION: Top well casing, north side MEASURING POINT RELATIVE TO GROUND

SURVEYED LOCATION (m): Northing: 15438344.72 Easting: 2019918.03 WELL CASING ELEV. (ft): 7178.21' GROUND SURFACE ELEV.(ft): 7176.29'
 SURVEYED DATUM: HORIZONTAL: UTM Zone 12 North, NAD83 VERTICAL: NAVD88 SURFACE (+/-) 1.92

REMARKS: Well casing-16" to 20"; 14" to 40'; 10" to 40' (cemented); water samples collected were oily sheen observed on water during drilling.

INTERVAL(FT)	LITHOLOGIC DESCRIPTION USCS NAME (USCS symbol): color, moist, % by weight, plasticity, consistency, structure, cementation, geology	REMARKS
below ground surface		
0 - 7	Sand (SP): fine to coarse; trace silt and gravels; damp; 10YR 5/3 brown; gravels rounded to subangular, up to 15 mm in diameter; [Fill]	
7 - 40	Sand (SP-SM): medium to coarse; gravelly; trace fine sand and silt; damp; 10YR 5/3 brown; gravels sub-rounded, up to 12 mm in diameter; appears nonconsolidated; well graded; trace of brown silt at 23 ft. (weathered shale)	
40 - 92	Silt (SM-ML): sand, clayey; 10YR 5/4 yellowish brown to 5YR 4/3 reddish brown; soft and moderately plastic in parts; trace to some compentent shale fragments, Gley 2 3/1 dark bluish gray; sand primarily fine to medium grained; [weathered shale]	
At 52	Color grades to 5YR 4/2 dark reddish gray; laminated (unit is weathered shale?)	
At 85	As above; primary color is dark bluish gray; trace clay; trace fine sands; easily broken; [shale]	
At 89	As above; more coarse grained sands, bluish gray to reddish brown.	Water at ~90' bgs at ~20 gpm
92 - 112	Sand (SP): fine to coarse; brown to brownish gray (10YR 5/3 to 10YR 6/2); saturated; loose; trace gravels up to 12 mm in diameter; angular to subrounded; appears cemented; well graded; [sandstone]	
At 105	As above; cemented in parts	
112 - 119	Silt (SM): some coarse sands; Gley 2 3/1 dark bluish gray; trace fine sands; friable; laminated in parts; [weathered shale]	

AMEC Geomatrix

WELL LITHOLOGIC AND COMPLETION LOG

JOB NO: 013655.006.0 T4 WELL NO: T-4-RW-a

PROJECT: Pinedale Anticline Project Area: Hydro Data Gaps STATE: WY COUNTY: Sublette LOGGED BY: T. McManus

LEGAL LOCATION: T 29N R 107W S 10 TRACT NW,SW DESCRIPTIVE LOCATION: Antelope 11-10D pad (Shell); Luman Road; eastern-most well at southern end of drill pad

DATE STARTED: 5/18/2010 DATE COMPLETED: 5/28/2010 DRILLING CO/DRILLER: Thomas Drilling

DRILLING METHOD: Air rotary/casing hammer BOREHOLE DIAM (IN): 10" (251-475') DRILL FLUIDS USED: Water, Foam

CONDUCTOR/SURFACE CASING INSTALLED: 14" 0-40'; 10" 0-251' INTERVAL PERFORATED FROM: 430 WELL DIAMETER: 5" OR SCREENED (FT): 460 CASING TYPE: Steel

TOTAL DEPTH DRILLED: <u>475'</u>	TOTAL DEPTH CASED: <u>460'</u>	DURING WELL CONSTRUCTION WAS/WERE:	YES	NO
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METHOD OF PERFORATION:	<input type="checkbox"/> Open Hole <input type="checkbox"/> Open Bottom <input type="checkbox"/> Saw Slotted <input checked="" type="checkbox"/> Factory <u>0.020</u> (size) <input type="checkbox"/> Other: Roller Perf tool 1/2" x 1"; 4 rows	<input type="checkbox"/> Well Developed <input type="checkbox"/> Well Pumped <input type="checkbox"/> Water Samples Collected <input checked="" type="checkbox"/> Material Samples Collected		
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SURFACE SEAL TYPE: <u>Type II cement pad</u>	FROM: <u>0</u>	TO: <u>210'</u>
BACKFILL MATERIAL: <u>Bentonite grout</u>	FROM: <u>210'</u>	TO: <u>417'</u>
HOLE PLUG: <u>Coated pellets</u>	FROM: <u>417'</u>	TO: <u>424'</u>
FILTER PACK TYPE: <u>10/12 silica sand</u>	FROM: <u>424'</u>	TO: <u>475'</u>

Installed backfill material, hole plug, and filter pack w/ tremmie pipe

ANNULAR COMPLETION CHARACTERISTICS
 WELL PROTECTOR: _____ LENGTH/DIAM 251'/10"

LOCK NO: Geomatrix Master Lock #2190

SURVEYED LOCATION (m): Northing: 15438340.111 Easting: 2019950.181 WELL CASING ELEV. (ft): 7177.993' GROUND SURFACE ELEV.(ft): 7176.296'
 SURVEYED DATUM: HORIZONTAL: UTM Zone 12 North, NAD83 VERTICAL: NAVD88

STATIC WATER LEVEL: <u>217.20'</u>	DATE: <u>9/21/2010</u>	MEASURING POINT DESCRIPTION/ELEVATION: <u>North side Top of Casing</u>	MEASURING POINT RELATIVE TO GROUND SURFACE (+/-) <u>1.70</u>
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REMARKS: Well completed in Gas zone.

INTERVAL(FT)	LITHOLOGIC DESCRIPTION USCS NAME (USCS symbol): color, moist, % by weight, plasticity, consistency, structure, cementation, geology	REMARKS
below ground surface		
0 - 8	Sand (SP): fine to coarse; contains gravels; trace silt; damp; 10YR 5/3 brown; gravels subrounded to subangular; up to 18 mm in diameter; trace wood fragments; [Fill]	
8 - 40	Sand (SP-SM): fine to coarse; gravelly; silty; damp to moist; 10YR 5/3 brown; gravels subrounded to subangular; up to 10 mm in diameter; well graded; loose; [Sandstone]	
40 - 92	Silt (SM-ML): contains sand and clay; 10YR 5/4 yellowish brown to 5YR 4/3 reddish brown; shale fragments Gley 2 3/1 dark bluish gray; grades to some 5YR 4/2 dark reddish gray at 52 ft.	
92 - 112	Sand (SP): fine to coarse; 10YR 5/3 brown to 10YR 6/2 brownish gray; trace gravels up to 15mm in diameter; subrounded; cemented in parts; [sandstone]	Water at ~95 ft.
112 - 118	Shale; Gley 2 3/1; dark bluish gray; trace fine sandstone at 118 ft.; friable; trace laminated intervals; [interval determined based on T-4-SW lithologic log]	Copper/rust colored oily sheen at ~118 ft bgs
118 - 125	Sandstone; fine to coarse; 10YR 5/3 brown to 10YR 6/2 brownish gray	
125 - 150	Shale; Gley 2 3/1; dark bluish gray; friable; trace laminated intervals	
150 - 166	Sandstone; fine to coarse; 10YR 5/3 brown to 10YR 6/2 brownish gray	
166 - 172	Shale; Gley 2 3/1; dark bluish gray; friable; trace laminated intervals	
172 - 190	Sandstone; fine to coarse; 10YR 5/3 brown to 10YR 6/2 brownish gray	

AMEC Geomatrix

WELL LITHOLOGIC AND COMPLETION LOG

013655.006.0 T4

Pinedale Anticline Project Area: Hydro Data Gaps

WELL NO: T-4-RW-a

INTERVAL(FT) below ground surface	LITHOLOGIC DESCRIPTION USCS NAME (USCS symbol): color, moist, % by weight, plasticity, consistency, structure, cementation, geology	REMARKS	
190 - 202	Shale; Gley 2 3/1; dark bluish gray; friable; trace laminated intervals	Drill to 251 ft.; trip out and install 10" casing	
202 - 236	Sandstone; coarse grained; trace fine to medium grains; trace bluish gray shale fragments		
236 - 260	Shale; fairly competent; brittle; laminated; dark bluish gray; some fine to coarse sands		
At 255	Shale; broken; moist; trace coarse sands; 7.5YR 4/1 to 7.5YR 4/3 dark gray to brown		
260 - 285	Siltstone; 7.5YR 6/1 to 7.5YR 4/1 gray to dark gray; trace fine grained sands; some very fine grained sand- stones		
285 - 300	Shale and siltstone; brown (7.5YR 4/3); trace very fine grained sandstone; 7.5YR 4/3 gray)		
300 - 430	Siltstone and shale; 7.5YR 4/1 dark gray; some fine to very fine grained gray (7.5 YR 6/1) sandstone; trace to some brown (7.5YR 4/3) shales; laminated; damp		
At 320	As above; increasing gray sandstone		
At 340	Matrix color changing to Gley 2 3/1 dark bluish gray; lithology as above		
At 350	As above; dark gray (7.5YR 4/1); (trace methane odor?)		
At 370	As above; increasing gray sandstone		
At 400	As above; drak gray (7.5YR 4/1); siltstone and shale		At 370 ft. formation making small amount of water
430 - 450	Shale and siltstone; brown (7.5YR 4/3) to 10YR 2/1; laminated in parts; trace very fine grained sandstone; 7.5YR 6/1 gray; trace black (7.5YR 2.5/1 shale (coal?) carbon fragments		} Derived plant material?
At 440	Increase in black carbon shale; very friable; blocky and sheets; laminated; found on fracture surfaces (carboniferous shale); matrix color still brown		
450 - 465	Shale and sandstone; Gley 2 4/1 greenish gray to brown 7.5YR 4/3; sandstone is fine grained; uniform and dense; trace pyritization	Gas kick at 455 ft.	
465 - 470	Sandstone; 10YR 5/1 gray; trace shale and siltstone (brownish); medium to fine sands; competent; dense; wet; grain size increasing with depth beginning at 467 ft.	Formation making water at 465 ft	
470 - 475	Sandstone; 10YR 5/1 gray; coarse grained; trace fine to medium grains; loose; trace to some pyritization; grains subangular to subrounded; wet		
475	End of boring (5/27/10)		

AMEC Geomatrix

WELL LITHOLOGIC AND COMPLETION LOG

JOB NO: 013655.006.0 T4 WELL NO: T-4-RWb

PROJECT: Pinedale Anticline Project Area: Hydro Data Gaps STATE: WY COUNTY: Sublette LOGGED BY: T. McManus/
L. McKay

LEGAL LOCATION: T 29N R 107W S 10 TRACT NW ¼ SW ¼ DESCRIPTIVE LOCATION: Well is located at SW corner of Antelope 11-10D pad (Shell)

DATE STARTED: 7/22/2010 DATE COMPLETED: 7/27/2010 DRILLING CO/DRILLER: Thomas Drilling/Tyson Thomas

DRILLING METHOD: Mud Rotary; Tri-Cone Bit BOREHOLE DIAM (IN): 10 DRILL FLUIDS USED: Bentonitic mud, water

TOTAL DEPTH DRILLED: 675' TOTAL DEPTH CASSED: 657' INTERVAL PERFORATED FROM OR SCREENED (FT.): 635' 655' DIAMETER: 5" CASING TYPE: Steel

METHOD OF PERFORATION:	DURING WELL CONSTRUCTION WAS/WERE:			
<input type="checkbox"/> Open Hole	<input type="checkbox"/> Well Developed	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/> Open Bottom	<input type="checkbox"/> Well Pumped		<input type="checkbox"/>	
<input type="checkbox"/> Saw Slotted	<input type="checkbox"/> Water Samples Collected		<input type="checkbox"/>	
<input checked="" type="checkbox"/> Factory <u>0.020</u> (size)	<input type="checkbox"/> Material Samples Collected	<input checked="" type="checkbox"/>		
<input type="checkbox"/> Other: Roller Perf tool 1/2" x 1"; 4 rows				

ANNULAR COMPLETION CHARACTERISTICS

WELL PROTECTOR: LENGTH: 4' SURFACE SEAL TYPE: Type II Portland cement FROM: 120' TO: 0
 DIAM: 10" BACKFILL MATERIAL: Bentonite grout FROM: 611' TO: 120'
 LOCK NO: Amec Geomatrix Master Lock #2190 HOLE PLUG: 3/8" bentonite pellets FROM: 616' TO: 611'
 FILTER PACK TYPE: 8/12 Colorado Silica Sand FROM: 665' TO: 616'
Installed backfill material, hole plug, and filter pack w/ tremmie pipe

SURVEYED LOCATION (m): Northing: 15438374.01 Easting: 2019897.25 WELL CASING ELEV. (ft): 7178.01' GROUND SURFACE ELEV.(ft): 7176.40'
 SURVEYED DATUM: HORIZONTAL: UTM Zone 12 North, NAD83 VERTICAL: NAVD88

STATIC WATER LEVEL: 220.38' btc DATE: 9/21/2010 MEASURING POINT DESCRIPTION/ ELEVATION: Top of casing, north side MEASURING POINT RELATIVE TO GROUND SURFACE (+/-) 1.61'

REMARKS: See associated borings T-4-Rwa and T-4-SW for further information regarding lithology at this location. Shale samples collected from 434' - 455' gas-bearing zone.

INTERVAL(FT)	LITHOLOGIC DESCRIPTION USCS NAME (USCS symbol): color, moist, % by weight, plasticity, consistency, structure, cementation, geology	REMARKS
below ground surface		
0 - 8	Sand (SP); fine to coarse; silty; trace to some gravels; damp 10YR 5/3 brown; trace organic material	Copper rust colored sheen noted in mud tank at ~120 ft bgs
8 - 42	Sand (SM); fine to coarse; silty; some gravels; damp; brown (10YR 5/3); gravels up to 13 mm; well-graded; loose	
42 - 90	Silt (SM-ML) with sand and clay; yellowish brown (10YR 5/4) to reddish brown (5YR 4/3); some shale (Gley 2/31) dark bluish gray	
90 - 126	Sandstone; fine to coarse; brown (10 YR 5/3) to brownish gray (10 YR 6/2); trace to some gravels up to 21 mm; subrounded to subangular; well graded; moist	
126 - 200	Shale and sandstone; sand fine to coarse; brown (10 YR); shales Gley 2 3/1 dark bluish gray; laminated in parts; moist	
200 - 240	Sandstone; medium to coarse grained; trace fines; trace bluish gray shale fragments	
240 - 260	Shale; competent; brittle; laminated dark bluish gray (Gley 2 3/1)	
260 - 285	Siltstone; gray (7.5YR 6/1); trace fine-grained sands; trace to some clay	
285 - 300	Shale and siltstone; brown (7.5YR 4/3); trace gray very fine grained sands	
300 - 308	Shale; greenish gray (5GY 5/1); contains silt and very fine-grained sand (biotite)	

AMEC Geomatrix

WELL LITHOLOGIC AND COMPLETION LOG

JOB NO: 013655.006.0

PROJECT: Pinedale Anticline Project Area: Hydro Data Gaps

WELL NO: T-4-RWb

INTERVAL(FT)	LITHOLOGIC DESCRIPTION USCS NAME (USCS symbol): color, moist, % by weight, plasticity, consistency, structure, cementation, geology	REMARKS
below ground surface		
308 - 310	Siltstone; light gray to white (N7 - N8); very fine-grained; poorly sorted; contains greenish gray (5GY 5/1) clay	Slight increase in drilling rate
310 - 327	Shale; greenish gray (10Y 5/1) with siltstone fragments; contains dusky red (10R 3/3) shale at 318 ft bgs	
327 - 333	Siltstone; grayish green (5GY 6/1); poorly sorted; contains biotite grains and shale fragments	
333 - 334	Shale; greenish gray (10Y 5/1); contains poorly sorted siltstone fragments	
334 - 345	Siltstone; greenish gray (10Y 5/1); moderately sorted; contains very fine-grained sand	
345 - 355	Shale; greenish gray (10Y 5/1); trace poorly sorted siltstone fragments	
355 - 363	Siltstone/shale; moderately sorted; greenish gray (10Y 5/1); abundant shale fragments	
363 - 414	Shale; greenish gray (10Y5/1); contains siltstone fragments; rare coarse sand; competent blocky shale	
	cuttings at 385; thin (1 - 2 ft thick) moderately sorted siltstone unit at 396 ft bgs	
414 - 424	Siltstone/very fine sandstone; light gray (5Y 6/1); poorly to moderately sorted; contains dark greenish gray (10Y 4/1) siltstone/very fine sandstone	
424 - 428	Siltstone; light gray (5Y 6/1); moderately sorted; trace pyritization	At 400 ft bgs - Driller increases weight on bit; clean batch of mud added
428 - 434	Interbedded siltstone/sandstone/shale; abundant dark reddish gray (5YR 4/2) silty shale; light gray (5Y 6/1) siltstone/sandstone w/laminated bedding surfaces; trace pyritization	Abundant organics [Coal]
434 - 440	Shale; grayish brown (10YR 5/2); abundant very dark gray (5Y 3/1) shale w/ organics and laminations; Pyritization and organics predominately on lamination surfaces.	
440 - 450	Shale; greenish gray (10Y 5/1); blocky texture	
450 - 455	Siltstone; poorly sorted; light gray (5Y 6/1); grading to very fine sandstone	
455 - 466	Shale; gray to olive gray (5Y 5/1); contains silt; blocky texture; abundant dark greenish gray (10GY 4/1) shale; trace pyritization	
466 - 469	Siltstone; greenish gray (5GY 5/1); moderately sorted; contains very fine-grained sand; trace light gray to white (N7 - N8) siltstone; very soft; trace pyritization	
469 - 478	Sandstone/siltstone; abundant light gray to white siltstone as above; abundant very coarse to coarse-grained sand; mostly QTZ; contains greenish gray (10Y 5/1) shale w/rare pyritization; increasing sand with depth	
478 - 491	Sandstone; moderately sorted; subrounded to subangular grains; arkosic; trace pyrite	
491 - 499	Sandy shale; dark greenish gray (5GY 4/1); poorly sorted; contains coarse to medium sand; grades into siltstone/very fine sandstone at 496 ft bgs; very poorly sorted	
499 - 504	Sandstone; moderately sorted; subangular to subrounded; arkosic; contains gray to white siltstone	
504 - 506	Siltstone/shale; gray to white (N7-N8) siltstone abundant; contains dark greenish gray (5GY 4/1) shale; trace	
		Slower drilling through sandstone; low cuttings return
		Rig chatter

AMEC Geomatrix

WELL LITHOLOGIC AND COMPLETION LOG

JOB NO: 013655.006.0

PROJECT: Pinedale Anticline Project Area: Hydro Data Gaps

WELL NO: T-4-RWb

INTERVAL(FT)	LITHOLOGIC DESCRIPTION USCS NAME (USCS symbol): color, moist, % by weight, plasticity, consistency, structure, cementation, geology	REMARKS	
below ground surface			
	coarse-grained sand		
506 - 513	Sandy shale; dark greenish gray (5GY 4/1); poorly sorted; contains medium sand; contains dark reddish brown (5YR 3/2) shale at 508 ft bgs	Rig chatter at 513 ft; slow drilling	
513 - 515	Sandstone; moderately sorted; angular to subrounded; arkosic; trace pyritization		
515 - 529	Sandy shale; dark greenish gray (5GY 4/1); poorly sorted; contains medium-grained sand		
529 - 537	Brown shale (dark gray) 10YR 4/1; ~60% dark greenish gray (5GY 4/1) shale		
537 - 543	Shale; dark grayish brown (10YR 4/2)		
543 - 546	Shale/siltstone; poorly sorted; contains silt and medium sand; greenish gray (10Y 5/1); contains brown shale		
	as above		
546 - 548	Sandstone; moderate to poorly sorted; subrounded to subangular; arkosic; contains gray to white (N7 - N8)		} Very slow drilling through brown shale
	silty clay material at 546 ft bgs		
548 - 549	Sandy shale; greenish gray (10YR 5/1); poorly sorted; contains medium coarse sand		} Rig chatter from 575 - 576; slower drilling
549 - 556	Shale; mostly dark grayish brown (10YR 4/2) with abundant greenish gray (10Y 5/1)		
556 - 576	Sandy shale; greenish gray (10Y 5/1); poorly sorted; contains medium to fine sand; increase in sand at 566'		
576 - 579	Sandstone; moderately sorted; coarse grained; subrounded to subangular; arkosic; trace pyritization	} Rig chatter Slow drilling at 597 ft bgs	
579 - 587	Sandy shale; greenish gray (10Y 5/1); contains fine to medium sand; trace white clay material (N7-N8)		
587 - 597	Sandstone; moderate sorting; subrounded to subangular; arkosic; trace pyritization		
597 - 610	Shale; greenish gray (10Y 5/1); contains silt and fine sand; grades to dark grayish brown (10YR 4/2) from 604' to 610'		
610 - 615	Greenish gray shale		
615 - 616	Sandy shale; greenish gray shale with abundant coarse grained sand (thin sand unit)		
616 - 630	Shale; greenish gray w/abundant dark grayish brown (10YR 4/2); fine sand with no brown shale at 620 ft bgs		
630 - 637	Sandy shale; greenish gray (10Y 5/1); medium sand		
637 - 650	Sandstone; moderately sorted; subangular; arkosic; contains pyrite		
650 - 653	Greenish gray (10Y 5/1) shale		
653 - 656	Sandstone; same as (637' - 650')		
656 - 675	Siltstone; greenish gray (10Y 5/1); dark greenish brown shale at 658 ft bgs		
675	End of boring		

AMEC Geomatrix

WELL LITHOLOGIC AND COMPLETION LOG

JOB NO: 013655.006.0 T4 WELL NO: T-5-RW

PROJECT: Pinedale Anticline Project Area: Hydro Data Gaps STATE: WY COUNTY: Sublette LOGGED BY: TM

LEGAL LOCATION: T 31N R 108W S 17 TRACT SE¼ SE¼ DESCRIPTIVE LOCATION: Well located on two-track road about one mile southeast of Boulder South Road. Well is roughly 20 feet north of fence.

DATE STARTED: 8/27/2010 DATE COMPLETED: 9/2/2010 DRILLING CO/DRILLER: Thomas Drilling/Tyson Thomas

DRILLING METHOD: Air rotary BOREHOLE DIAM (IN): 10" DRILL FLUIDS USED: Water, foam

TOTAL DEPTH DRILLED: 615' TOTAL DEPTH CASSED: 590' INTERVAL PERFORATED FROM OR SCREENED (FT.): 550 / 590 DIAMETER: 5" CASING TYPE: Steel

METHOD OF PERFORATION:	DURING WELL CONSTRUCTION WAS/WERE:	YES	NO
<input type="checkbox"/> Open Hole	<input type="checkbox"/> Well Developed		X
<input type="checkbox"/> Open Bottom	<input type="checkbox"/> Well Pumped		X
<input type="checkbox"/> Saw Slotted	<input type="checkbox"/> Water Samples Collected		X
<input checked="" type="checkbox"/> Factory <u>0.020</u> (size)	<input type="checkbox"/> Material Samples Collected		X
<input type="checkbox"/> Other: Roller Perf tool 1/2" x 1"; 4 rows			

ANNULAR COMPLETION CHARACTERISTICS

WELL PROTECTOR: LENGTH: 5.7' DIAM: 8" SURFACE SEAL TYPE: Cement FROM: 4' TO: 0' Bentonite chips FROM: 4' TO: 20'

LOCK NO: Geomatrix Master Lock #2190 BACKFILL MATERIAL: Hi Solids grout/chips FROM: 20' TO: 533'

HOLE PLUG: 3/8" bentonite pellets FROM: 533' TO: 540'

FILTER PACK TYPE: 8/12 silica sand FROM: 540' TO: 615'

Hole Plug and filter pack material poured in and installed w/ tremie pipe

SURVEYED LOCATION (m): Northing: 15494031.46 Easting: 1980611.59 WELL CASING ELEV. (ft): 7018.72' GROUND SURFACE ELEV. (ft): 7017.23'

SURVEYED DATUM: HORIZONTAL: UTM Zone 12 North, NAD83 VERTICAL: NAVD88

STATIC WATER LEVEL: 72.23 DATE: 9/1/2010 MEASURING POINT DESCRIPTION/ELEVATION: Top of casing MEASURING POINT RELATIVE TO GROUND SURFACE (+/-) 1.49

REMARKS:

INTERVAL(FT)	LITHOLOGIC DESCRIPTION USCS NAME (USCS symbol): color, moist, % by weight, plasticity, consistency, structure, cementation, geology	REMARKS
below ground surface		
0 - 12	Silt (SM) and siltstone; easily broken; pale brown (10YR 7/3); dry	
12 - 25	Sandstone; yellowish pale brown (10YR 7/3); trace silt (laminated); trace competent sandstone fragments; 10YR 8/1; overall matrix is dry; loose; well graded	
25 - 42	Silt/sandstone; sandstone is pale brown (10YR 7/3); fine grained; loose; interbedded shales with some laminations; Gley 4/4-1 to Gley 8/7-1 dark bluish gray to light bluish gray; trace to some black carboniferous shale and carbon on bedding surfaces (no gas detected); trace pyritization with coarse grained sandstone	
42 - 65	Coarse grained sandstone/siltstone; 10YR 8/2 to 10YR 8/1 light pale brown to white; siltstone is soft; friable; Gley 4 4/1 dark greenish/bluish gray; trace to some pyrite; increasing siltstone with depth	
65 - 80	Sandstone; coarse grained; some medium grains, trace of fines; 10YR 8/1 white; trace pyrite; trace bluish gray siltstone; some Gley 4/4-1 siltstone at 70 ft.	At 75 ft. first notice Formation water (~75 gpm)
At 70	Some Gley 4/4-1 siltstone	
80 - 148	Siltstone; soft; friable; Gley 4 4/1 dark bluish gray to 10YR 6/3 pale brown; some coarse grained sandstone (white); trace pyrite	
At 110	Sandstone layer; medium to coarse grained; trace fine 10YR 8/1 white to 10YR 8/2 light pale brown	
At 130	Sandstone layer as above (110' interval)	

AMEC Geomatrix

WELL LITHOLOGIC AND COMPLETION LOG

JOB NO: 013655.006.0 T4 WELL NO: T-6-SW

PROJECT: Pinedale Anticline Project Area: Hydro Data Gaps STATE: WY COUNTY: Sublette LOGGED BY: JW Dawson

LEGAL LOCATION: T 31N R 109W S 30 TRACT SW ¼ SW¼ DESCRIPTIVE LOCATION: 1.4 mile north on Mesa Rd. from intersection with Paradise Rd., then 0.75 mile north on 2-track; well on south side

DATE STARTED: 11/1/2009 DATE COMPLETED: 11/3/2009 DRILLING CO/DRILLER: White Mountain Operating LLC; Roberto

DRILLING METHOD: Air Rotary; Tri-Cone Bit BOREHOLE DIAM (IN): 11 DRILL FLUIDS USED: Water; F-450 drill foam added at ≈ 160'

TOTAL DEPTH DRILLED: 260' TOTAL DEPTH CASSED: 257' INTERVAL PERFORATED FROM OR SCREENED (FT.): 217 257 DIAMETER: 4" CASING TYPE: Sch. 80 PVC

METHOD OF PERFORATION:	DURING WELL CONSTRUCTION WAS/WERE:	YES	NO
<u> </u> Open Hole	<u> </u> Well Developed		
<u> </u> Open Bottom	<u> </u> Well Pumped		X
<u> </u> Saw Slotted	<u> </u> Water Samples Collected		X
<u> X </u> Factory <u>0.020</u> (size)	<u> </u> Material Samples Collected	X	
<u> </u> Other: Roller Perf tool 1/2" x 1"; 4 rows			

ANNULAR COMPLETION CHARACTERISTICS

WELL PROTECTOR: <u> </u>	LENGTH: <u>5'</u>	SURFACE SEAL TYPE: <u>Concrete</u>	FROM: <u>6'</u> TO: <u>0</u>
LOCK NO: <u>Geomatrix Master Lock #2190</u>	DIAM: <u>6"</u>	BACKFILL MATERIAL: <u>Grout</u>	FROM: <u>196'</u> TO: <u>6'</u>
		HOLE PLUG: <u>Bentonite</u>	FROM: <u>206'</u> TO: <u>196'</u>
		FILTER PACK TYPE: <u>No 10 Colorado Silica Sand</u>	FROM: <u>260'</u> TO: <u>206'</u>

Installed backfill material, hole plug, and filter pack w/ tremmie pipe

SURVEYED LOCATION (m): Northing: 15486054.15 Easting: 1941583.71 WELL CASING ELEV. (ft): 7000.13' GROUND SURFACE ELEV. (ft): 6998.43'
 SURVEYED DATUM: HORIZONTAL: UTM Zone 12 North, NAD83 VERTICAL: NAVD88

STATIC WATER LEVEL: <u>144.61</u>	DATE: <u>11/10/2009</u>	MEASURING POINT DESCRIPTION/ELEVATION: <u>North Side, Steel Casing</u>	MEASURING POINT RELATIVE TO GROUND SURFACE (+/-) <u>+1.7'</u>
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REMARKS:

INTERVAL(FT)	LITHOLOGIC DESCRIPTION USCS NAME (USCS symbol): color, moist, % by weight, plasticity, consistency, structure, cementation, geology	REMARKS
below ground surface		
0 - 1	Medium-brown, sandy clay topsoil, with fluvial deposits (sand, gravel, pebbles, and cobbles of quartzite, granite, basalt, siltstone); dry, friable, slightly plastic	
1 - 5	Fluvial deposits with evaporites	
5 - 15	Light grayish-green shale with gray siltstone; dry; difficult drilling due to collapse of fluvial deposits into hole	
15 - 17	Medium greenish-gray shale, with gray fine grained sandstone and siltstone; easier drilling	Inject water at 17'
17 - 20	Greenish-gray fine grained sandstone; harder drilling; water added; sandstone is well indurated	
20 - 30	Greenish-brown, very fine grained sandstone and siltstone; weak	
30 - 40	Greenish-brown, fine- to medium-grained sandstone, with some dark greenish-gray siltstone and brown siltstone with a trace of mica; weak	
40 - 50	Grayish-green shale, with grayish green siltstone and trace of mica	
50 - 65	Greenish-gray shale and medium to dark gray siltstone and very fine grained, greenish-gray weakly indurated sandstone	
65 - 78	Medium gray, fine- to medium-grained sandstone; hard; difficult drilling	
78 - 92	Medium greenish-gray shale and siltstone, with some fine-grained sandstone	
92 - 94	Light- to medium-gray, fine-grained sandstone; hard	

AMEC Geomatrix

WELL LITHOLOGIC AND COMPLETION LOG

JOB NO: 013655.006.0 T4 WELL NO: T-6-RW

PROJECT: Pinedale Anticline Project Area: Hydro Data Gaps STATE: WY COUNTY: Sublette LOGGED BY: L. McKay

LEGAL LOCATION: T 31N R 109W S 30 TRACT SW, SE DESCRIPTIVE LOCATION: 1.4 mile north on Mesa Rd. from intersection with Paradise Rd., then 0.75 mile north on 2-track; well on south side 15 ft north of T-6-SW

DATE STARTED: 8/9/2010 DATE COMPLETED: 8/13/2010 DRILLING CO/DRILLER: Thomas Drilling/ Tyson Thomas

DRILLING METHOD: Air Rotary; Tri-Cone Bit BOREHOLE DIAM (IN): 10 DRILL FLUIDS USED: Water, foam

TOTAL DEPTH DRILLED: 512' TOTAL DEPTH CASSED: 497' INTERVAL PERFORATED FROM OR SCREENED (FT.): 475 / 495 DIAMETER: 5" CASING TYPE: Steel

METHOD OF PERFORATION:	DURING WELL CONSTRUCTION WAS/WERE:	YES	NO
<input type="checkbox"/> Open Hole	Well Developed		X
<input type="checkbox"/> Open Bottom	Well Pumped		X
<input type="checkbox"/> Saw Slotted	Water Samples Collected		X
<input checked="" type="checkbox"/> Factory 0.02"(size)	Material Samples Collected		X
<input type="checkbox"/> Other: Roller Perf tool 1/2" x 1"; 4 rows			

ANNULAR COMPLETION CHARACTERISTICS

WELL PROTECTOR: LENGTH: 20' SURFACE SEAL TYPE: Grout/Concrete FROM: 125' TO: 0
 DIAM: 10" BACKFILL MATERIAL: Bentonite grout FROM: 446' TO: 125'
 LOCK NO: Geomatrix Master Lock #2190 HOLE PLUG: Bentonite FROM: 454' TO: 446'
 FILTER PACK TYPE: 8/12 silica sand FROM: 505' TO: 454'
** Backfill material, hole plug and filter pack installed with tremmie pipe*

SURVEYED LOCATION (m): Northing: 15486064.92 Easting: 1941571.71 WELL CASING ELEV. (ft): 7001.14' GROUND SURFACE ELEV. (ft): 6999.07'
 SURVEYED DATUM: HORIZONTAL: UTM Zone 12 North, NAD83 VERTICAL: NAVD88

STATIC WATER LEVEL: 126.7 ft btc DATE: 9/21/2010 MEASURING POINT DESCRIPTION/ ELEVATION: North Side, top steel Casing MEASURING POINT RELATIVE TO GROUND SURFACE (+/-) +2.07'

REMARKS: Sloughed cuttings from 512' to 505'.

INTERVAL(FT)	LITHOLOGIC DESCRIPTION USCS NAME (USCS symbol): color, moist, % by weight, plasticity, consistency, structure, cementation, geology	REMARKS
below ground surface		Begin drilling w/16 inch tri-cone bit
1 - 5	Sandy silt w/gravel (CL): Pale yellowish brown (10 YR 6/2); dry; ~70% silt, ~20% sand, ~10% gravels and clay; contains large (> 6 in diameter) gravels and cobbles; rounded to well rounded; [Alluvium]	Driller reports softer drilling
6 - 12	Sandy silt/clay (ML): Yellowish gray (5Y 7/2); ~70% silt/clay, ~30% sand; dry; sand is mostly coarse-grained; angular quartzite; contains subangular mafic grains; poorly indurated; [Shale]	Hard drilling; rig chatter
12 - 18	Sandy silt clay (CL): Pale olive to light olive gray (10Y 6/2 - 5Y 5/2); ~80% silt/clay, ~20% sand and gravel; dry; poorly indurated; sand/gravel is angular to subangular quartzite; [Shale]	
18 - 20	Shale/siltstone; light olive gray (5Y 5/2); blocky; weakly indurated; shale contains rounded medium sand grains; siltstone is poorly sorted w/ fine-grained mica and quartz	
20 - 29	Siltstone/very fine sandstone; light olive gray to yellowish gray (5Y 5/2 - 5Y 4/1); well to moderately sorted; slightly damp; weakly indurated	Water added at 30 ft.
29 - 40	Sandstone; olive gray (5Y 4/1) w/ minor moderate olive brown (5Y 4/4); angular to subangular grains; moderate to well sorted; fine-grained; mostly quartz w/trace feldspar and mafic grains; well indurated; trace FeO ₂ staining (contains quartzite cuttings from above)	
40 - 44	Shale; dusky yellow green (5GY 5/2); blocky; soft; some green shale cuttings contain fissile texture	
44 - 53	Siltstone/shale; dark greenish gray to greenish gray (5GY 4/1 - 5GY 6/1); poorly sorted; contains silt; contains	

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WELL LITHOLOGIC AND COMPLETION LOG

JOB NO: 013655.006.0 T4

PROJECT: Pinedale Anticline Project Area: Hydro Data Gaps

WELL NO: T-6-RW

INTERVAL(FT) below ground surface	LITHOLOGIC DESCRIPTION USCS NAME (USCS symbol): color, moist, % by weight, plasticity, consistency, structure, cementation, geology	REMARKS
	sandstone/siltstone cuttings from 20' - 40'	Foam added at 60'; driller reports a thin shale unit at 64' due to a change in water color and med viscosity
53 - 70	Sandstone; medium gray to light olive gray (N5 - 5Y 4/1); moderately sorted; fine to vey fine grained; contains biotite; predominantly medium gray at 63'; moderate induration; decrease in very fine sand at 68'	
70 - 85	Siltstone/shale; olive gray to dark greenish gray (5Y 4/1 - 5G 4/1); moderately to well sorted; some fissile texture; contains fine biotite grains; ~80% shale; 20% siltstone	
85 - 108	Siltstone/shale; shale is dark greenish gray (5Y 4/1); siltstone is medium light gray (N6); moderately sorted; ~60% shale, ~40% silstone; contains fine to very fine sandstone; weakly indurated; fine grained sandstone increases to ~80% at 95' bgs	Shale unit soaking up foam/water
108 - 115	Shale; dark greenish gray (5G 4/1); highly to moderately indurated; contains silt; contains siltstone/very fine-grained sandstone	
115 - 150	Sandstone; light olive gray (5Y 6/1); moderately sorted; fine to medium-grained sand; contains siltstone; Sand stone is well sorted at 145'	
150 - 155	Sandstone/shale; sandstone as in 115' - 150' unit; shale is light olive gray to dark greenish gray (5Y 6/1 - 5GY 4/1); some fissile texture	At 150, driller reports loosing circulation
155 - 160	Sandstone/siltstone; light olive gray (5Y 6/1); well sorted; fine-grained; subangular to subrounded arkosic grains w/biotite; weakly indurated; siltstone is poorly sorted; slight evidence of graded bedding	At 160, better circulation; Q = 5 gpm
160 - 166	Same as 150' - 155' interval	
166 - 178	Sandstone/siltstone; light olive gray (5Y 4/1); poorly sorted; fine sand to silt	
178 - 190	Shale; olive gray to med. dark gray (5Y 4/1 - N4); fissile texture; hard; trace organics on bedding surfaces; contains siltstone and trace pyritization at 185 ft bgs	
190 - 218	Siltstone; olive gray (5Y 4/1); mostly poorly sorted; contains biotite; bedding surfaces evident; abundant organics and pyritization; trace dark shale; mostly weakly indurated; trace very fine to fine sandstone	Q = 15 gpm At 215, Q = 25 gpm
At 185	Decrease in organics	
218 - 228	Shale; dark greenish gray (5GY 4/1); blocky; contains siltstone chips as in 190' to 218'; organics present on planar bedding surfaces	
228 - 247	As above; decrease in shale; increase in siltstone/very fine-grained sandstone	
247 - 258	Shale; dark greenish gray (5G 4/1); blocky; soft; trace siltstone; ~30% very dusky red shale (10R 2/2) at 254 ft bgs	
258 - 268	Cherty shale; light olive gray (5Y 6/1); hard (scratches glass); conchoidal texture; 40% pale yellowish brown (10YR 6/2); abundant green shale as above	
268 - 277	Shale; ~90% dark greenish gray siltstone (5G 4/1); soft; contains silt; ~10% yellowish brown chert as above; fine sandstone; increase in dark greenish gray siltstone (5G 4/1) at 275 ft bgs; grades to siltstone/poorly	Foam added at 275'

AMEC Geomatrix

WELL LITHOLOGIC AND COMPLETION LOG

JOB NO: 013655.006.0 T4

PROJECT: Pinedale Anticline Project Area: Hydro Data Gaps

WELL NO: T-6-RW

INTERVAL(FT) below ground surface	LITHOLOGIC DESCRIPTION USCS NAME (USCS symbol): color, moist, % by weight, plasticity, consistency, structure, cementation, geology	REMARKS	
	sorted fine sandstone; contains shale as above		
277 - 286	Shale; 40% grayish brown (5YR 3/2); 60% grayish green; soft; blocky; brown shale contains moderate yellow green (5GY 7/4) mottling or patches	} Logged from cuttings	
286 - 290	Shale/siltstone; ~20% grayish brown (5YR 3/2) shale; ~80% moderately sorted greenish gray to dark greenish gray (5GY 6/1 - 4/1) siltstone/fine sandstone; contains fine biotite grains; increasing grain size at 288'; poorly/moderately sorted fine sandstone; weakly indurated		
290 - 295	Shale; ~40% dark greenish gray (5G 4/1); ~40% grayish brown (5YR 3/2); some fragments mottled with both colors; blocky; contains some silt; cuttings contain ~10% sandstone siltstone as above		
295 - 300	As above; ~ 60% v. fine grained sandstone/siltstone; moderately sorted; contains biotite; silt to fine sand; shale is green and brown as above; trace light olive gray shale (5Y 5/2)		
300 - 315	Shale as 290'- 295'; increasing light olive gray (5Y 5/2) color to 50% at 310; bgs		
315 - 325	Siltstone/sandstone; olive gray to medium gray (5Y 4/1 - N5); moderate to well sorted; fine sand; subrounded to subangular; arkosic (90% qtz); weakly indurated		
325 - 335	Shale; greenish gray to olive gray (5GY 6/1 - 5Y 4/1); contains silt; moderately sorted		
335 - 348	Shale/siltstone; dark greenish gray (5G 4/1); poorly sorted; contains silt; soft; harder at 340 ft with increasing silt/siltstone; siltstone at 345' bgs		
348 - 363	Siltstone/shale; ~70% dark greenish gray silty shale; hard; slightly fissile; contains silt; ~20% fine grained sandstone/siltstone; moderately sorted; contains biotite; weakly indurated; ~10% light olive gray (5GY 5/2) shale; blocky; soft		} Very slow drilling at 345'
At 353	As above; ~40% light olive gray shale; ~20% dark greenish gray silty shale; ~10% dusky yellow green (5GY 5/2) shale; soft;		} At 350', much quicker drilling 350' - 365': very low return; rig chatter at 366'; foam added
At 360	As above; slight laminations on olive gray shale; rare brownish gray (5YR 4/1) shale; contains fine-grained sandstone		
363 - 375	Sandstone/siltstone; dark greenish gray (5G 4/1) ; weakly indurated; well to moderately sorted; sandstone is olive gray; moderately sorted with fine sand; contains biotite		
375 - 380	Shale; dark greenish gray (5G 4/1); soft		
380 - 390	Shale/siltstone/sandstone; ~30% shale as above; 60-70% siltstone/sandstone as in 363' - 375'		
390 - 393	Shale; same as 375' - 380'; contains brownish gray (5YR 4/1) shale		
393 - 404	Sandstone/shale; shale as above (~20%); sandstone is well sorted, fine grained; arkosic (mostly quartz); subangular to subrounded; medium gray (N5)		
404 - 410	Shale; dark greenish gray (5G 4/1); contains grayish black shale (N2); trace coarse quartz grains; angular to subangular; trace pyritization	} Slower drilling from 410' - 430'	
410 - 415	Sandstone(?)/shale; ~40% coarse sand as above		

AMEC Geomatrix

WELL LITHOLOGIC AND COMPLETION LOG

JOB NO: 013655.006.0 T4 WELL NO: T-7-SW

PROJECT: Pinedale Anticline Project Area: Hydro Data Gaps STATE: WY COUNTY: Sublette LOGGED BY: JW Dawson

LEGAL LOCATION: T 33N R 110W S 2 TRACT SW¼ NW¼ DESCRIPTIVE LOCATION: 1.0 mile south on Green River Rd. from intersection with Highway 191; 600 ft SE on 2-track; well on south side

DATE STARTED: 10/15/2009 DATE COMPLETED: 10/18/2009 DRILLING CO/DRILLER: White Mountain Operating LLC; Roberto

DRILLING METHOD: Air Rotary; tri-cone bit BOREHOLE DIAM (IN): 8" DRILL FLUIDS USED: Water

TOTAL DEPTH DRILLED: 220' TOTAL DEPTH CASSED: 217.5' INTERVAL PERFORATED FROM OR SCREENED (FT.): 167 / 207 DIAMETER: 4" CASING TYPE: Sch. 80 PVC

METHOD OF PERFORATION:	DURING WELL CONSTRUCTION WAS/WERE:	YES	NO
<input type="checkbox"/> Open Hole	<input type="checkbox"/> Well Developed	X	
<input type="checkbox"/> Open Bottom	<input type="checkbox"/> Well Pumped		X
<input type="checkbox"/> Saw Slotted	<input type="checkbox"/> Water Samples Collected		X
<input checked="" type="checkbox"/> Factory <u>.020</u> (size)	<input type="checkbox"/> Material Samples Collected	X	
<input type="checkbox"/> Other: Roller Perf tool 1/2" x 1"; 4 rows			

ANNULAR COMPLETION CHARACTERISTICS

WELL PROTECTOR:	LENGTH: <u>5'</u>	SURFACE SEAL TYPE: <u>Grout/Concrete</u>	FROM: <u>2'</u> TO: <u>0</u>
	DIAM: <u>6"</u>	BACKFILL MATERIAL: <u>Concrete/Grout</u>	FROM: <u>141'</u> TO: <u>2'</u>
LOCK NO: <u>Geomatrix Master Lock #2190</u>		HOLE PLUG: <u>Bentonite</u>	FROM: <u>153'</u> TO: <u>141'</u>
		FILTER PACK TYPE: <u>Pea Gravel</u>	FROM: <u>220'</u> TO: <u>153'</u>

Hole Plug and filter pack material poured in and installed w/ tremmie pipe

SURVEYED LOCATION (m): Northing: 15568976.15 Easting: 1920131.14 WELL CASING ELEV. (ft): 7330.63' GROUND SURFACE ELEV. (ft): 7329.56'
 SURVEYED DATUM: HORIZONTAL: UTM Zone 12 North, NAD83 VERTICAL: NAVD88

STATIC WATER LEVEL: <u>127.26</u>	DATE: <u>11/10/2009</u>	MEASURING POINT DESCRIPTION/ELEVATION: <u>North Side, Steel Casing</u>	MEASURING POINT RELATIVE TO GROUND SURFACE (+/-) <u>+1.07'</u>
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REMARKS:

INTERVAL(FT)	LITHOLOGIC DESCRIPTION USCS NAME (USCS symbol): color, moist, % by weight, plasticity, consistency, structure, cementation, geology	REMARKS
below ground surface		
0 - 2	Fluvial deposits (sand, gravel, pebbles and cobbles) of subrounded quartzite, granite, mafic minerals, that develops a reddish-brown silty clay soil; dry; plastic to semi-plastic	
2 - 60	Gray/grayish-green shale with fine-grained sandstone composed of quartz biotite (?) and mica; easy drilling; becomes more competent below 12 feet	Water injected at 12'
60 - 116	Interbedded gray shale, siltstone, and fine-grained sandstone (quartz, biotite and iron minerals); weakly indurated	
116 - 130	Gray, very fine-grained sandstone that is weakly indurated; hard layer from 116 to 117 feet	
130 - 160	Gray shale and siltstone with some fine to very fine-grained sandstone units occasionally	
160 - 192	Gray siltstone and fine-grained sandstone, with some gray shale and occasionally reddish brown shale	
192 - 200	Light gray, fine-grained sandstone comprised of rounded quartz grains, biotite (?) and red minerals; very hard drilling from 192 - 194' and 196 - 198'; water approximately 2.5 gpm	Water: Q ≈ 2.5 gpm
200 - 210	Light gray, very fine-grained sandstone and siltstone with micro-flecks of mafic minerals	
210 - 220	Light to medium gray siltstone	
220	Borehole terminated	

AMEC Geomatrix

WELL LITHOLOGIC AND COMPLETION LOG

JOB NO: 013655.006.0 T4 WELL NO: T-7-RW

PROJECT: Pinedale Anticline Project Area: Hydro Data Gaps STATE: WY COUNTY: Sublette LOGGED BY: JW Dawson

LEGAL LOCATION: T 33N R 110W S 2 TRACT SW ¼ NW¼ DESCRIPTIVE LOCATION: 1.8 miles south on East Green River Rd from intersection with Highway 191; 600 ft SE on 2-track; well on south side

DATE STARTED: 10/25/2009 DATE COMPLETED: 10/31/2009 DRILLING CO/DRILLER: White Mountain Operating LLC; Roberto Zamora
White Mountain Operating LLC; Kenny Wells

DRILLING METHOD: Air Rotary; Tri-Cone Bit BOREHOLE DIAM (IN): 11 DRILL FLUIDS USED: Water

TOTAL DEPTH DRILLED: 535' TOTAL DEPTH CASSED: 518' INTERVAL PERFORATED FROM OR SCREENED (FT.): 470.0 515.5 DIAMETER: 6" CASING TYPE: Steel

METHOD OF PERFORATION:	DURING WELL CONSTRUCTION WAS/WERE:	YES	NO
<input type="checkbox"/> Open Hole	<input type="checkbox"/> Well Developed	X	
<input type="checkbox"/> Open Bottom	<input type="checkbox"/> Well Pumped		X
<input type="checkbox"/> Saw Slotted	<input type="checkbox"/> Water Samples Collected		X
<input type="checkbox"/> Factory _____ (size)	<input type="checkbox"/> Material Samples Collected	X	
<input checked="" type="checkbox"/> Other: Roller Perf tool 1/2" x 1"; 4 rows			

ANNULAR COMPLETION CHARACTERISTICS

WELL PROTECTOR: LENGTH: Well Casing SURFACE SEAL TYPE: Grout/Concrete FROM: 8' TO: 0
 DIAM: 6" BACKFILL MATERIAL: Grout FROM: 463' TO: 8'
 LOCK NO: Geomatrix Master Lock #2190 HOLE PLUG: Bentonite FROM: 469' TO: 463'
 FILTER PACK TYPE: Pea Gravel FROM: 518' TO: 469'

** Backfill material, hole plug and filter pack installed with tremmie pipe*

SURVEYED LOCATION (m): Northing: 15568984.75 Easting: 1920128.03 WELL CASING ELEV. (ft): 7332.15' GROUND SURFACE ELEV. (ft): 7330.04'
 SURVEYED DATUM: HORIZONTAL: UTM Zone 12 North, NAD83 VERTICAL: NAVD88

STATIC WATER LEVEL: 232.96 DATE: 11/10/2009 MEASURING POINT DESCRIPTION/ELEVATION: North Side, Steel Casing MEASURING POINT RELATIVE TO GROUND SURFACE (+/-) +2.11'

REMARKS: Lithologic description from 0-200 feet based on well T-7-SW

INTERVAL(FT)	LITHOLOGIC DESCRIPTION USCS NAME (USCS symbol): color, moist, % by weight, plasticity, consistency, structure, cementation, geology	REMARKS
below ground surface		
0 - 2	Fluvial deposits (sand, gravel, pebbles and cobbles) of subrounded quartzite, granite, mafic rocks (basalt, diorite?) that develops a reddish-brown silty clay soil; dry; semi-plastic to plastic	
2 - 60	Gray to greenish gray shale with fine-grained sandstone composed of quartz, biotite(?) and mica; easy drilling; becomes more competent below 12 feet	
60 - 116	Interbedded gray shale, siltstone, and fine-grained sandstone (quartz, biotite) and red (iron) grains; weakly indurated	
116 - 130	Gray, very fine-grained, weakly indurated sandstone; hard layer at 116-117'	
130 - 160	Gray shale and siltstone, with occasional fine- to very fine-grained sandstone	
160 - 192	Gray siltstone and fine-grained sandstone, with some gray shale and occasional reddish-brown shale	Minor water at 160', start injecting water > 160'
192 - 200	Light gray, fine-grained sandstone comprised of rounded quartz grains, biotite (?) and red (iron?) minerals; very hard drilling at 192-194' and 196-198' water - Q ≈ 1.5 gpm	
200 - 230	Greenish-gray, medium grained sandstone (quartz and mafic minerals), interbedded with dark gray, fine-grained, weakly indurated sandstone and siltstone; some dark gray shale at 220-230'	
230 - 255	Mostly dark gray shale, with some dark gray siltstone, and minor fine-grained sandstone; transitions to maroon and green shale at 255'	

AMEC Geomatrix

WELL LITHOLOGIC AND COMPLETION LOG

JOB NO: 013655.006.0

PROJECT: Pinedale Anticline Project Area: Hydro Data Gaps

WELL NO: T-7-RW

INTERVAL(FT) below ground surface	LITHOLOGIC DESCRIPTION USCS NAME (USCS symbol): color, moist, % by weight, plasticity, consistency, structure, cementation, geology	REMARKS
255 - 285	Maroon and green shale	Water: Q ≈ 5 gpm (285-300')
285 - 300	Gray, fine-grained sandstone; water - Q ≈ 5 gpm	
300 - 348	Gray, fine-grained sandstone and green shale; weakly indurated; some maroon shale and gray siltstone from 330-348	
348 - 362	Greenish-gray shale and siltstone, interbedded with maroon shale; easy drilling	Cave-In occurs from 300' - 320'
362 - 364	Gray, medium-grained sandstone; hard drilling	
364 - 370	Maroon shale and fine-grained sandstone	
370 - 400	Gray, medium- to coarse-grained sandstone, with trace maroon and green shale from 370-380' and 390-400'; hard drilling; sandstone comprised of subround fragments of quartz, feldspar, basalt (?), and red (iron) minerals; water - Q≈ 25 gpm; borehole collapse in this interval encountered during trip out/in activities	Water: Q ≈ 25 gpm (370 - 380')
400 - 440	Greenish-gray to dark gray and maroon shale, with minor amounts of gray fine- to medium-grained sandstone and siltstone	
440 - 475	Green, dark gray, and maroon shale, with some dark gray siltstone at 460-475'	
475 - 476	Green, fine-grained sandstone	Reddish-brown water; odor; (475 - 515') Q ≈ 0.5 - 1 gpm
476 - 535	Greenish-gray, dark gray and maroon shale, with grayish-green, fine-grained sandstone and light gray siltstone; medium-gray, fine-grained sandstone @ 512-513'; occasional light to medium gray, fine-grained sandstone and medium-gray siltstone present from 515-535'.	
535	Bottom of borehole	
		Blew hole for 10 min. Q ≈ 1.0 gpm, probably from upper zone

AMEC Geomatrix

WELL LITHOLOGIC AND COMPLETION LOG

JOB NO: 013655.006.0 T4 WELL NO: T-8-A

PROJECT: Pinedale Anticline Project Area: Hydro Data Gaps STATE: WY COUNTY: Sublette LOGGED BY: L. McKay

LEGAL LOCATION: T 32N R 108W S 34 TRACT SW¼ DESCRIPTIVE LOCATION: East side of HWY 191 near mile post 84, just south of E. Fk. River; well closest to river

DATE STARTED: 8/17/2010 DATE COMPLETED: 8/17/2010 DRILLING CO/DRILLER: Thomas Drilling/ Tyson Thomas

DRILLING METHOD: Air Rotary; tri-cone bit BOREHOLE DIAM (IN): 10" DRILL FLUIDS USED: Water

TOTAL DEPTH DRILLED: 15' TOTAL DEPTH CASSED: 15' INTERVAL PERFORATED FROM OR SCREENED (FT.): 5' DIAMETER: 4" CASING TYPE: Sch. 80 PVC

METHOD OF PERFORATION:	DURING WELL CONSTRUCTION WAS/WERE:	YES	NO
<u> </u> Open Hole	<u> </u> Well Developed		X
<u> </u> Open Bottom	<u> </u> Well Pumped		X
<u> </u> Saw Slotted	<u> </u> Water Samples Collected		X
<u> X </u> Factory <u>.020</u> (size)	<u> </u> Material Samples Collected		X
<u> </u> Other: Roller Perf tool 1/2" x 1"; 4 rows			

ANNULAR COMPLETION CHARACTERISTICS

WELL PROTECTOR:	LENGTH: <u>5.6'</u>	SURFACE SEAL TYPE: <u>Type II portland cement</u>	FROM: <u>0.6'</u> TO: <u>0</u>
	DIAM: <u>8"</u>	BACKFILL MATERIAL: <u>N/A</u>	FROM: <u> </u> TO: <u> </u>
LOCK NO: <u>Geomatrix Master Lock #2190</u>		HOLE PLUG: <u>Bentonite chips (med/crse)</u>	FROM: <u>4'</u> TO: <u>0.6'</u>
		FILTER PACK TYPE: <u>8/12 silica sand</u>	FROM: <u>15'</u> TO: <u>4'</u>

Hole Plug and filter pack material poured in and installed w/ tremie pipe

SURVEYED LOCATION (m): Northing: 15511120.61 Easting: 1985874.13 WELL CASING ELEV. (ft): 6929.81' GROUND SURFACE ELEV. (ft): 6928.64'
 SURVEYED DATUM: HORIZONTAL: UTM Zone 12 North, NAD83 VERTICAL: NAVD88

STATIC WATER LEVEL: <u>10.43' btc</u>	DATE: <u>8/19/2010</u>	MEASURING POINT DESCRIPTION/ ELEVATION: <u>North Side of top PVC Casing</u>	MEASURING POINT RELATIVE TO GROUND SURFACE (+/-) <u>+1.17'</u>
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REMARKS: _____

INTERVAL(FT)	LITHOLOGIC DESCRIPTION USCS NAME (USCS symbol): color, moist, % by weight, plasticity, consistency, structure, cementation, geology	REMARKS
below ground surface		
0 - 3	Silty sand (SM); moderate yellowish brown (10YR 5/4); dry; poorly sorted; 60% fine sand; 5% medium sand; 35% silt; unconsolidated; contains organics; [Topsoil]	
3 - 7	Clean sand (SP); pale yellowish brown (10 YR 6/2); dry; moderately sorted; ~40% fine sand; ~35% medium sand; ~10% coarse sand; ~5% gravel; unconsolidated; qtz and fsp; subangular to subrounded grains gravels are rounded [Alluvium]	
7 - 10	Clean sand (SP); pale yellowish brown (10 YR 6/2); dry; well sorted; ~97% coarse sand; ~3% silt/clay; qtz and fsp; rounded; unconsolidated; [Alluvium]	
10 - 14	Sandy gravel (GM); moderate yellowish brown (10 YR 4/2); wet; ~65% gravel; ~15% coarse sand; ~10% medium sand; 10% fine sand; unconsolidated; gravels are angular fragments of rounded granitic cobbles; trace petrified wood; sand is arkosic; [Alluvium]	Water at 10 ft; driller estimates Q = 4 gpm
14 - 15	Shale; greenish gray (5G 6/1); moderately indurated (fingernail will lightly scratch); dry to damp in places; slight fissile texture; mostly blocky; at 14 ft contains silt; slightly harder; more blocky; [Wasatch Fm]	
15	End of boring	

AMEC Geomatrix

WELL LITHOLOGIC AND COMPLETION LOG

JOB NO: 013655.006.0 T4 WELL NO: T-8-SW

PROJECT: Pinedale Anticline Project Area: Hydro Data Gaps STATE: WY COUNTY: Sublette LOGGED BY: L. McKay

LEGAL LOCATION: T 32N R 108W S 34 TRACT SW¼ DESCRIPTIVE LOCATION: East side of HWY 191 near mile post 84, just south of E. Fk. River; well furthest from river (most southern)

DATE STARTED: 8/17/2010 DATE COMPLETED: 8/19/2010 DRILLING CO/DRILLER: Thomas Drilling/ Tyson Thomas

DRILLING METHOD: Air Rotary; tri-cone bit BOREHOLE DIAM (IN): 10" DRILL FLUIDS USED: Water

TOTAL DEPTH DRILLED: 230' TOTAL DEPTH CASSED: 228' INTERVAL PERFORATED FROM OR SCREENED (FT.): 208' 228' DIAMETER: 4" CASING TYPE: Sch. 80 PVC

METHOD OF PERFORATION:	DURING WELL CONSTRUCTION WAS/WERE:	YES	NO
<u> </u> Open Hole	<u> </u> Well Developed	<u> </u>	<u> </u> X
<u> </u> Open Bottom	<u> </u> Well Pumped	<u> </u>	<u> </u> X
<u> </u> Saw Slotted	<u> </u> Water Samples Collected	<u> </u>	<u> </u> X
<u> </u> X Factory <u>0.020</u> (size)	<u> </u> Material Samples Collected	<u> </u>	<u> </u> X
<u> </u> Other: Roller Perf tool 1/2" x 1"; 4 rows			

ANNULAR COMPLETION CHARACTERISTICS

WELL PROTECTOR: LENGTH: 6.0' SURFACE SEAL TYPE: Type II portland cement FROM: 0.6' TO: 0
 DIAM: 8" BACKFILL MATERIAL: N/A FROM: TO:
 LOCK NO: Geomatrix Master Lock #2190 HOLE PLUG: Bentonite chips (med/crse) FROM: 4' TO: 0.6'
 FILTER PACK TYPE: 8/12 silica sand FROM: 15' TO: 4'
Hole Plug and filter pack material poured in and installed w/ tremie pipe

SURVEYED LOCATION (m): Northing: 15511115.26 Easting: 1985873.49 WELL CASING ELEV. (ft): 6930.49' GROUND SURFACE ELEV. (ft): 6928.83'
 SURVEYED DATUM: HORIZONTAL: UTM Zone 12 North, NAD83 VERTICAL: NAVD88

STATIC WATER LEVEL: DATE: 8/18/2010 MEASURING POINT DESCRIPTION/ ELEVATION: North Side of top PVC Casing MEASURING POINT RELATIVE TO GROUND SURFACE (+/-) +1.66'

REMARKS: Artesian flow (Q = <0.5 gpm) contained with 4 in. J-plug

INTERVAL(FT)	LITHOLOGIC DESCRIPTION USCS NAME (USCS symbol): color, moist, % by weight, plasticity, consistency, structure, cementation, geology	REMARKS
below ground surface		
0 - 3	Silty sand (SM); moderate yellowish brown (10YR 5/4); dry; poorly sorted; 60% fine sand; 5% medium sand; 35% silt; unconsolidated; contains organics; [Topsoil]	
3 - 7	Clean sand (SP); pale yellowish brown (10 YR 6/2); dry; moderately sorted; ~40% fine sand; ~35% medium sand; ~10% coarse sand; ~5% gravel; unconsolidated; qtz and fsp; subangular to subrounded grains; gravels are rounded [Alluvium]	
7 - 10	Clean sand (SP); pale yellowish brown (10 YR 6/2); dry; well sorted; ~97% coarse sand; ~3% silt/clay; qtz and fsp; rounded; unconsolidated; [Alluvium]	
10 - 14	Sandy gravel (GM); moderate yellowish brown (10 YR 4/2); wet; ~65% gravel; ~15% coarse sand; ~10% medium sand; 10% fine sand; unconsolidated; gravels are angular fragments of rounded granitic cobbles; trace petrified wood; sand is arkosic; [Alluvium]	Water at 10 ft; driller estimates Q = 4 gpm
14 - 21	Shale; greenish gray (5G 6/1); moderately indurated (fingernail will lightly scratch); dry to damp in places; slight fissile texture; mostly blocky; at 14 ft contains silt; slightly harder; more blocky; less silt at 20 ft; dry; [Wasatch Fm]	
21 - 22	Sandstone; very pale orange (10 YR 8/2) overall; wet; moderately sorted; ~80% coarse; ~15% medium; ~5%	Q = 5 gpm

AMEC Geomatrix

WELL LITHOLOGIC AND COMPLETION LOG

JOB NO: 013655.006.0

PROJECT: Pinedale Anticline Project Area: Hydro Data Gaps

WELL NO: T-8-SW

INTERVAL(FT) below ground surface	LITHOLOGIC DESCRIPTION USCS NAME (USCS symbol): color, moist, % by weight, plasticity, consistency, structure, cementation, geology	REMARKS
	gravel; sand is arkosic; subangular to subrounded; contains shale cuttings as above	
22 - 37	Shale; dark greenish gray (5GY 4/1); moderately indurated; blocky to fissile texture; soft; trace well indurated	
	shale; @ 25 ft grades to dark greenish gray (5G 4/1); very soft	
37 - 49	Siltstone/fine sandstone; dark greenish gray (5G 4/1); well sorted w/silt and fine sand; contains biotite; well indurated; ~10% light gray fine sandstone (N7); unconsolidated well sorted fine sand lense at 40 ft.	At 39 ft, Q = 15 gpm
At 35	Contains shale	
49 - 51	Shale; greenish black (5G 2/1); soft; blocky texture; contains silt	
51 - 52	Sandstone; well sorted; subangular coarse grains; arkosic; ~10% soft greenish gray siltstone; trace pyritization	Increasing water; Q = 75 gpm
52 - 95	Silty shale; dark greenish gray (5G 4/1); weakly indurated	
At 58	Shale; greenish black to brownish black (5GY 2/1 - 5YR 2/1); moderately indurated; blocky; soft; trace medium and coarse sand	
At 82 - 85	Contains coarse sand in cuttings [thin coarse-grained sand lense]; arkosic; subrounded to subangular	
At 89 - 90	Sandstone lense as above	
95 - 113	Sandstone as above [interbedded with shale as above]	Q = 150 gpm
At 98	Shale as above	
113 - 115	Shale; dark green as above	
115 - 121	Sandstone; as above (51'-52')	
121 - 126	Silt shale as 52'-95'	
126 - 136	Sandstone; same as 51'-52'; at 130' sandstone is moderately to well sorted; ~90% coarse sand, 10% very coarse sand; mostly qtz with trace pyrite; contains lithics	Increase in water: Q > 200 gpm
136 - 138	Shale; greenish gray (5G 6/1); very soft	
138 - 139	Shale (silty shale); dark greenish gray (5GY 2/1) with minor greenish black (5GY 2/1)	
139 - 140	Shale; brownish black to greenish black (5YR 2/1 - 5GY 2/1); ~50% each; blocky; moderately indurated (slightly hard)	
140 - 155	Shale; same as 52'-95'	
At 150	~50% brownish black and greenish black shale; same as 139'-140'	
155 - 163	Siltstone/silty shale; greenish gray (5G 6/1); soft; weakly indurated; less siltstone from 160 - 163 (~10%)	At 158 ft, slower drilling
163 -192	Sandstone; same as 51'-52'; contains shale as above; @ 165', no shale	
192 - 198	Shale; same as 52'-95'	
198 - 200	Shale; brownish black (5YR 2/1); contains greenish black (5GY 2/1)	
200 - 208	Shale; same as 52'-95'	
At 204	Shale is mottled brownish black and greenish black (5YR 3/1) and (5GY 2/1)	
208 - 226	Sandstone; same as 52'-95'; contains shale	Fast drilling at ~208 ft

AMEC Geomatrix

WELL LITHOLOGIC AND COMPLETION LOG

JOB NO: 013655.006.0 T4 WELL NO: T-9-RW

PROJECT: Pinedale Anticline Project Area: Hydro Data Gaps STATE: WY COUNTY: Sublette LOGGED BY: TM

LEGAL LOCATION: T 30N R 107W S 13 TRACT: NW, SW DESCRIPTIVE LOCATION: BLM

DATE STARTED: 6/3/2010 DATE COMPLETED: 6/16/2010 DRILLING CO/DRILLER: Thomas Drilling/ Tyson Thomas

DRILLING METHOD: Air Rotary; casing hammer BOREHOLE DIAM (IN): 16" to 20' / 10' to TD DRILL FLUIDS USED: Water and foam

TOTAL DEPTH DRILLED: 795' TOTAL DEPTH CASSED: 780' INTERVAL PERFORATED FROM OR SCREENED (FT.): 740 / 780 DIAMETER: 5" CASING TYPE: Steel

METHOD OF PERFORATION:	DURING WELL CONSTRUCTION WAS/WERE:	YES	NO
<input type="checkbox"/> Open Hole	<input type="checkbox"/> Well Developed		X
<input type="checkbox"/> Open Bottom	<input type="checkbox"/> Well Pumped		X
<input type="checkbox"/> Saw Slotted	<input type="checkbox"/> Water Samples Collected		X
<input checked="" type="checkbox"/> Factory <u>0.020</u> (size)	<input type="checkbox"/> Material Samples Collected		X
<input type="checkbox"/> Other: Roller Perf tool 1/2" x 1"; 4 rows			

ANNULAR COMPLETION CHARACTERISTICS

WELL PROTECTOR: LENGTH: 5' SURFACE SEAL TYPE: Type II portland cement FROM: 0 TO: 3'
 DIAM: 8" BACKFILL MATERIAL: Bentonite grout FROM: 3' TO: 727'
 LOCK NO: Geomatrix Master Lock #2190 HOLE PLUG: Coated bentonite pellets FROM: 727' TO: 733'
 FILTER PACK TYPE: 8/12 silica sand FROM: 733' TO: 795'
Hole Plug and filter pack material poured in and installed w/ tremie pipe

SURVEYED LOCATION (m): Northing: 15465281.22 Easting: 2029496.05 WELL CASING ELEV. (ft): 7297.95' GROUND SURFACE ELEV.(ft): 7295.95'
 SURVEYED DATUM: HORIZONTAL: UTM Zone 12 North, NAD83 VERTICAL: NAVD88

STATIC WATER LEVEL: 328.61 DATE: 9/21/2010 MEASURING POINT DESCRIPTION/ ELEVATION: Top of casing MEASURING POINT RELATIVE TO GROUND SURFACE (+/-) +2.00

REMARKS:

INTERVAL(FT)	LITHOLOGIC DESCRIPTION USCS NAME (USCS symbol): color, moist, % by weight, plasticity, consistency, structure, cementation, geology	REMARKS
below ground surface		
5 - 55	Sandstone; fine to coarse; 10YR 5/3 brown; subangular; moist; loose (trace cementation); some to moderate amounts of siltstone (weathered shale?); trace laminated 10YR 4/2 to 10YR 2/2 dark grayish brown to dark brown; trace gravels; subrounded up to 12 mm in diameter	
At 15	Medium to coarse grained; trace fines	
At 45	Coarse grained sandstone with trace gravel up to 12 mm in diameter	
At 55-80	Weathered shale and siltstone; laminated in parts; friable; Gley 2 3/1 dark bluish gray to 7.5YR 3/3 brown; trace sandy/clayey, very fine grained 7.5YR 5/1 gray	
80 - 95	Sandstone; fine to coarse; brown (10YR 5/3); trace gravels up to 12 mm in diameter	At 80 - 85 some water from formation
95 - 125	Siltstone (primary); dark brown to dark bluish gray; trace sandstone; medium to coarse grained; trace interbedded light gray clays; trace shale	
125 - 130	Sandstone; fine to medium grained; gray (Gley 2/1); trace siltstone	
130 - 165	Siltstone; Gley 2 3/1 to 7.5YR 3/3 dark bluish gray to brown; some medium to coarse grained sandstone fragments; some clay on siltstone fracture surfaces; light gray color; siltstone is more brownish at 155 ft	
165 - 170	Sandstone and siltstone; light gray to light brown; trace siltstone; fine to coarse grained sand	Making water at 170 ft. [Shallow Wasatch]
170 - 205	Siltstone; Gley 2 3/1; some sandstone medium to coarse; trace interbedded light gray clays; some coarse	

AMEC Geomatrix

WELL LITHOLOGIC AND COMPLETION LOG

JOB NO: 013655.006.0 T4 WELL NO: X-1-SW

PROJECT: Pinedale Anticline Project Area: Hydro Data Gaps STATE: WY COUNTY: Sublette LOGGED BY: TM

LEGAL LOCATION: T 34N R 109W S 32 TRACT SE, SW DESCRIPTIVE LOCATION: West of Pinedale, WY on HWY 191

DATE STARTED: 5/12/2010 DATE COMPLETED: 5/12/2010 DRILLING CO/DRILLER: Thomas Drilling

DRILLING METHOD: Air rotary/casing hammer BOREHOLE DIAM (IN): 10" DRILL FLUIDS USED: None

TOTAL DEPTH DRILLED: 154.5' TOTAL DEPTH CASED: 155' INTERVAL PERFORATED FROM OR SCREENED (FT.): 120.9 150.9 DIAMETER: 8" CASING TYPE: steel

METHOD OF PERFORATION:	DURING WELL CONSTRUCTION WAS/WERE:	YES	NO
<input type="checkbox"/> Open Hole	<input type="checkbox"/> Well Developed	X	
<input type="checkbox"/> Open Bottom	<input type="checkbox"/> Well Pumped	X	
<input type="checkbox"/> Saw Slotted	<input type="checkbox"/> Water Samples Collected		X
<input checked="" type="checkbox"/> Factory <u>0.020</u> (size)	<input type="checkbox"/> Material Samples Collected		X
<input type="checkbox"/> Other: <u>Roller Perf tool 1/2" x 1"; 4 rows</u>			

ANNULAR COMPLETION CHARACTERISTICS

WELL PROTECTOR:	LENGTH: <u>5'</u>	DIAM: <u>8"</u>	SURFACE SEAL TYPE: <u>Cement</u>	FROM: <u>3'</u>	TO: <u>0</u>
LOCK NO: <u>Geomatrix Master Lock #2190</u>			BACKFILL MATERIAL: <u>Cement grout</u>	FROM: <u>3'</u>	TO: <u>110'</u>
			HOLE PLUG: <u>3/8" bentonite pellets</u>	FROM: <u>110'</u>	TO: <u>115.9'</u>
			FILTER PACK TYPE: <u>8/12 silica sand</u>	FROM: <u>115.9'</u>	TO: <u>154.5'</u>

Hole Plug and filter pack material poured in and installed w/ tremie pipe

SURVEYED LOCATION (m): Northing: 15573011.90 Easting: 1936440.14 WELL CASING ELEV. (ft): 7182.05' GROUND SURFACE ELEV.(ft): 7180.46'
 SURVEYED DATUM: HORIZONTAL: UTM Zone 12 North, NAD83 VERTICAL: NAVD88

STATIC WATER LEVEL: <u>6.86 ft. btc</u>	DATE: <u>9/26/2010</u>	MEASURING POINT DESCRIPTION/ELEVATION: <u>Top well casing, north side</u>	MEASURING POINT RELATIVE TO GROUND SURFACE (+/-) <u>+1.59</u>
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REMARKS:

INTERVAL(FT)	LITHOLOGIC DESCRIPTION USCS NAME (USCS symbol): color, moist, % by weight, plasticity, consistency, structure, cementation, geology	REMARKS
below ground surface		
0 - 5	Sand and gravel (SP-GW): fine to coarse sands; gravels up to 35 mm in diameter; angular to subrounded; loose; well graded; 10YR 5/3; moist; trace silts on surfaces	
5 - 10	Sand (SC): fine to medium grained; contains clay; trace silts; moist; medium plasticity; 10YR 6/4	
10 - 15	Sand (SP-SM): fine to medium grained; trace silt; poorly graded; 10YR 5/6; moist	
15 - 35	Sand as above; color grading to 10YR 4/4; increasingly wet; trace weathered friable sandstone fragments	Formation making water
35 - 40	Sandstone; 10YR 5/3 to 10YR 5/4 brown to yellowish brown; friable; weak cementation; weathered; trace to some black carbon fragments; possible wood fragments	
40 - 55	Sandstone; Gley 2 5/1 bluish gray; massive; poorly to moderately cemented; fine grained; trace pyritization; bluish gray (Gley 2 5), soft mudstone at 55 - 60 ft.	
55 - 60	Mudstone; Gley 2 5/1 bluish grey, soft	Driller reports small increase in water
60 - 115	Sandstone; Gley 2 5/1 to Gley 2 4/1 bluish gray to dark bluish gray; fine to medium grained; trace coarse grains; friable; poor to moderate cementation; trace siltstone fragments	
At 85	Fine grained sandstone; trace siltstone	
At 90	Increasing coarse grained sandstone; trace pyrite	
At 105	Fine grained sandstone; trace bluish gray	

AMEC Geomatrix

WELL LITHOLOGIC AND COMPLETION LOG

JOB NO: 013655.006.0 T4 WELL NO: X-2-A

PROJECT: Pinedale Anticline Project Area: Hydro Data Gaps STATE: WY COUNTY: Sublette LOGGED BY: T. McManus

LEGAL LOCATION: T 33N R 109W S 15 TRACT NW, NW DESCRIPTIVE LOCATION: Maytag Ranch (Questar)

DATE STARTED: 5/14/2010 DATE COMPLETED: 5/14/2010 DRILLING CO/ DRILLER: Thomas Drilling

DRILLING METHOD: Air Rotary; casing hammer BOREHOLE DIAM (IN): 9" DRILL FLUIDS USED: None

TOTAL DEPTH DRILLED: 40' TOTAL DEPTH CASSED: 40' INTERVAL PERFORATED FROM OR SCREENED (FT.): 15 / 30 DIAMETER: 4" CASING TYPE: PVC

METHOD OF PERFORATION:	DURING WELL CONSTRUCTION WAS/WERE:	YES	NO
<input type="checkbox"/> Open Hole	<input checked="" type="checkbox"/> Well Developed	X	
<input type="checkbox"/> Open Bottom	<input type="checkbox"/> Well Pumped	X	
<input type="checkbox"/> Saw Slotted	<input type="checkbox"/> Water Samples Collected		X
<input checked="" type="checkbox"/> Factory 0.02"(size)	<input type="checkbox"/> Material Samples Collected		X
<input type="checkbox"/> Other: Roller Perf tool 1/2" x 1"; 4 rows			

ANNULAR COMPLETION CHARACTERISTICS

WELL PROTECTOR: LENGTH: 5' SURFACE SEAL TYPE: Cement FROM: 3' TO: 0
 DIAM: 8" BACKFILL MATERIAL: FROM: TO:
 LOCK NO: Geomatrix Master Lock #2190 HOLE PLUG: Bentonite pellets FROM: 10' TO: 3'
 FILTER PACK TYPE: 8/12 silica sand FROM: 40' TO: 10'

** Backfill material, hole plug and filter pack installed with tremmie pipe*

SURVEYED LOCATION (m): Northing: 15561226.156 Easting: 1948199.026 WELL CASING ELEV. (ft): 7115.2' GROUND SURFACE ELEV.(ft): 7113.41'
 SURVEYED DATUM: HORIZONTAL: UTM Zone 12 North, NAD83 VERTICAL: NAVD88

STATIC WATER LEVEL: 6.80 ft. DATE: 5/15/2010 MEASURING POINT DESCRIPTION/ ELEVATION: Top of casing, north side MEASURING POINT RELATIVE TO GROUND SURFACE (+/-) -1.97'

REMARKS:

INTERVAL(FT)	LITHOLOGIC DESCRIPTION USCS NAME (USCS symbol); color, moist, % by weight, plasticity, consistency, structure, cementation, geology	REMARKS
below ground surface		
0 - 14	Gravels (GW) and sand; trace silts; 10YR 5/3 brown; angular to rounded up to 55 mm in diameter; sands fine to medium; trace coarse; damp to moist; becoming wet ~6.5' bgs. [Alluvium]	Water at ~6.5 ft.
14 - 28	Sand (SP): medium grained; trace fine; some coarse; trace gravels; loose; well graded; 10YR 5/3 brown; wet [Alluvium]	
28 - 40	Weathered sandstone; 5YR 4/2 reddish gray to Gley 2 4/1 dark greenish gray; oxidized in parts; fine grained; trace silts and clays; trace coarse sands; damp	
40	End of boring	

AMEC Geomatrix

WELL LITHOLOGIC AND COMPLETION LOG

JOB NO: 013655.006.0 T4 WELL NO: X-2-SW

PROJECT: Pinedale Anticline Project Area: Hydro Data Gaps STATE: WY COUNTY: Sublette LOGGED BY: T. McManus

LEGAL LOCATION: T 33N R 109W S 15 TRACT NW, NW DESCRIPTIVE LOCATION: Maytag Ranch (Questar)

DATE STARTED: 5/14/2010 DATE COMPLETED: 5/15/2010 DRILLING CO/ DRILLER: Thomas Drilling/ Bob Thomas

DRILLING METHOD: Air rotary/casing hammer BOREHOLE DIAM (IN): 9" DRILL FLUIDS USED: None

TOTAL DEPTH DRILLED: 150' TOTAL DEPTH CASSED: 150' INTERVAL PERFORATED FROM OR SCREENED (FT.): 110' 150' DIAMETER: 4" CASING TYPE: PVC

METHOD OF PERFORATION:	DURING WELL CONSTRUCTION WAS/WERE:	YES	NO
<u> </u> Open Hole	<u> </u> Well Developed	X	
<u> </u> Open Bottom	<u> </u> Well Pumped	X	
<u> </u> Saw Slotted	<u> </u> Water Samples Collected		X
<u> X </u> Factory <u>.020</u> (size)	<u> </u> Material Samples Collected		X
<u> </u> Other: Roller Perf tool 1/2" x 1"; 4 rows			

ANNULAR COMPLETION CHARACTERISTICS

WELL PROTECTOR:	LENGTH: <u>5'</u>	SURFACE SEAL TYPE: <u>Cement</u>	FROM: <u>3'</u> TO: <u>0</u>
	DIAM: <u>8"</u>	BACKFILL MATERIAL: <u>Cement grout</u>	FROM: <u>100'</u> TO: <u>3'</u>
LOCK NO: <u>Geomatrix Master Lock #2190</u>		HOLE PLUG: <u>Bentonite pellets</u>	FROM: <u>105'</u> TO: <u>100'</u>
		FILTER PACK TYPE: <u>8/12 sand</u>	FROM: <u>151'</u> TO: <u>105'</u>

Hole Plug and filter pack material poured in and installed w/ tremie pipe

SURVEYED LOCATION (m): Northing: 15561223.346 Easting: 1948218.74 WELL CASING ELEV. (ft): 7115.189' GROUND SURFACE ELEV.(ft): 7113.29'
 SURVEYED DATUM: HORIZONTAL: UTM Zone 12 North, NAD83 VERTICAL: NAVD88

STATIC WATER LEVEL:	DATE: <u>5/15/2010</u>	MEASURING POINT DESCRIPTION/ ELEVATION: <u>Top well casing, north side</u>	MEASURING POINT RELATIVE TO GROUND SURFACE (+/-) <u>1.9'</u>
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REMARKS:

INTERVAL(FT)	LITHOLOGIC DESCRIPTION USCS NAME (USCS symbol): color, moist, % by weight, plasticity, consistency, structure, cementation, geology	REMARKS
below ground surface		
0 - 15	Gravel (GW) and sand (fine to coarse); trace to silty; 10YR 5/3 brown; angular to rounded up to 62 mm in diameter; moist to wet; well graded [Alluvium]	Static water level at ~6.5' bgs
15 - 30	Sand (SP) medium grained; trace fine to coarse; some gravels; well graded; loose; 10YR 5/3 brown; wet [Alluvium]	
30 - 50	Sandstone (weathered); Gley 2 4/1 dark greenish gray; trace 5YR 4/2 reddish gray; oxidized in parts; primarily fine grained; some silt and clay (coating bedding surfaces?); damp to moist; coarse grained at 45 ft.	
50 - 80	Siltstone and sandstone; 5YR 3/1 dark gray to 10YR 4/1 gray; soft; friable; trace sand, fine grained; trace coarse g coarse grained; trace clay; weathered?	
At 65	Same as above; more competent rock, harder in parts	
80 - 110	Sandstone; fine grained; Gley 2 6/1 to Gley 2 5/1 light gray to gray; friable; moist	Picking up water at ~83 ft. bgs
At 83	Sandstone; coarse grained; trace silt; trace fine sand; poorly cemented; 10YR 5/3 brown; wet	
At 100	Increasing coarse grained sandstone	
110 - 150	Sandstone; coarse grained; 10YR 6/1 gray to Gley 2 4/1 dark bluish gray; wet to saturated; trace fine grained sands; trace silt in parts	
150	End of boring	

AMEC Geomatrix

WELL LITHOLOGIC AND COMPLETION LOG

JOB NO: 013655.006.0 T4 WELL NO: X-3-A

PROJECT: Pinedale Anticline Project Area: Hydro Data Gaps STATE: WY COUNTY: Sublette LOGGED BY: L. McKay

LEGAL LOCATION: T 32N R 108W S 17 TRACT NW¼ DESCRIPTIVE LOCATION: North side of Paradise Rd; 1 mile west of HWY 191; well located at North end of parking area closest to pond

DATE STARTED: 8/14/2010 DATE COMPLETED: 8/15/2010 DRILLING CO/DRILLER: Thomas Drilling/ Tyson Thomas

DRILLING METHOD: Casing hammer BOREHOLE DIAM (IN): 10" DRILL FLUIDS USED: Water and Foam

TOTAL DEPTH DRILLED: 37.5' TOTAL DEPTH CASSED: 37.5 INTERVAL PERFORATED FROM OR SCREENED (FT.): 17.5 37.5 DIAMETER: 4" CASING TYPE: Sch. 80 PVC

METHOD OF PERFORATION:	DURING WELL CONSTRUCTION WAS/WERE:	YES	NO
<u> </u> Open Hole	<u> </u> Well Developed		X
<u> </u> Open Bottom	<u> </u> Well Pumped		X
<u> </u> Saw Slotted	<u> </u> Water Samples Collected		X
<u> X</u> Factory <u>0.020</u> (size)	<u> </u> Material Samples Collected		X
<u> </u> Other: Roller Perf tool 1/2" x 1"; 4 rows			

ANNULAR COMPLETION CHARACTERISTICS

WELL PROTECTOR:	LENGTH: <u>6.5'</u>	SURFACE SEAL TYPE: <u>Type II portland cement</u>	FROM: <u>2.5'</u> TO: <u>0</u>
	DIAM: <u>8"</u>	BACKFILL MATERIAL: <u>Bentonite chips</u>	FROM: <u>6.5'</u> TO: <u>2.5'</u>
LOCK NO: <u>Geomatrix Master Lock #2190</u>		HOLE PLUG: <u>3/8" bentonite pellets</u>	FROM: <u>13.8'</u> TO: <u>6.5'</u>
		FILTER PACK TYPE: <u>8/12 silica sand</u>	FROM: <u>37.55</u> TO: <u>13.8'</u>

Hole Plug and filter pack material poured in and installed w/ tremie pipe

SURVEYED LOCATION (m): Northing: 15530378.68 Easting: 1976801.84 WELL CASING ELEV. (ft): 6995.42' GROUND SURFACE ELEV. (ft): 6993.73'
 SURVEYED DATUM: HORIZONTAL: UTM Zone 12 North, NAD83 VERTICAL: NAVD88

STATIC WATER LEVEL: <u>10.08</u>	DATE: <u>8/14/2010</u>	MEASURING POINT DESCRIPTION/ELEVATION: <u>Top well casing; NE</u>	MEASURING POINT RELATIVE TO GROUND SURFACE (+/-) <u>+1.92'</u>
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REMARKS: _____

INTERVAL(FT)	LITHOLOGIC DESCRIPTION USCS NAME (USCS symbol): color, moist, % by weight, plasticity, consistency, structure, cementation, geology	REMARKS
below ground surface		
0 - 5	Sandy gravel (GM): light olive gray (5Y 6/1); dry to slightly damp; ~60% gravel; 20% sand; ~20% silt; gravel is predominately granitic; contains quartzite; sand is qtz and fsp; [Alluvium]	
5 - 10	Silty clay (CL): moderate yellowish brown (10 YR 5/4); moist to damp; highly plastic; 90% clay; ~8% silt; ~2% fine sand; contains granitic gravel as above	
10 - 16	Clayey sand (SC): moderate yellowish brown (10YR 5/4); moist; ~35% clay as above; ~50% coarse to medium sand; ~15% silt; unconsolidated; [Alluvium]	
16 - 31	Gravel to sandy gravel (GP - GW): multicolored gravel; predominately olive gray (5Y 4/1); wet; 95% gravel from 16 to 19 ft.; increasing coarse sand beginning at 19 ft; angular granitic fragments 0.5 to 1.0 inch diameter; sand is qtz and fsp with some angular quartzite fragments; [Alluvium]	
31 - 34	Silty sand (SC): dark yellowish brown (10 YR 4/2); moist; ~75% medium grained sand; moderately to well sorted; ~20% silt; ~5% clay; trace angular gravel fragments; [Alluvium]	Water added at 31 ft
34 - 37.5	Clayey sand (SC): moderate olive brown (5Y 4/4); moist; ~90% clay; ~8% silt; ~2% sand; moderately plastic soft; [Alluvium]	
37.5	Shale; brownish black to greenish black (5YR 2/1 - 5GY 2/1); mottled; soft; weakly to moderately indurated;	

AMEC Geomatrix

WELL LITHOLOGIC AND COMPLETION LOG

	poorly sorted; contains silt and fine sand; blocky; [Wasatch Fm]	
37.5	End of boring	

AMEC Geomatrix

WELL LITHOLOGIC AND COMPLETION LOG

JOB NO: 013655.006.0 T4 WELL NO: X-3-SW

PROJECT: Pinedale Anticline Project Area: Hydro Data Gaps STATE: WY COUNTY: Sublette LOGGED BY: L. McKay

LEGAL LOCATION: T 32N R 108W S 34 TRACT SW¼ DESCRIPTIVE LOCATION: North side of Paradise Rd; 1 mile west of HWY 191; well located at North end of parking area closest to BLM sign

DATE STARTED: 8/15/2010 DATE COMPLETED: 8/17/2010 DRILLING CO/ DRILLER: Thomas Drilling/ Tyson Thomas

DRILLING METHOD: Air Rotary; tri-cone bit BOREHOLE DIAM (IN): 10" DRILL FLUIDS USED: Water and foam

TOTAL DEPTH DRILLED: 260' TOTAL DEPTH CASSED: 246' INTERVAL PERFORATED FROM OR SCREENED (FT.): 226 / 246 DIAMETER: 4" CASING TYPE: Sch. 80 PVC

METHOD OF PERFORATION:	DURING WELL CONSTRUCTION WAS/WERE:	YES	NO
<u> </u> Open Hole	Well Developed		X
<u> </u> Open Bottom	Well Pumped		X
<u> </u> Saw Slotted	Water Samples Collected		X
<u> X </u> Factory <u>.0020</u> (size)	Material Samples Collected	X	
<u> </u> Other: Roller Perf tool 1/2" x 1"; 4 rows			

ANNULAR COMPLETION CHARACTERISTICS

WELL PROTECTOR:	LENGTH: <u>6.5'</u>	SURFACE SEAL TYPE: <u>Type II portland cement</u>	FROM: <u>12'</u> TO: <u>0</u>
	DIAM: <u>8"</u>	BACKFILL MATERIAL: <u>Bentonite grout</u>	FROM: <u>196'</u> TO: <u>12'</u>
LOCK NO: <u>Geomatrix Master Lock #2190</u>		HOLE PLUG: <u>Coated bentonite pellets</u>	FROM: <u>204'</u> TO: <u>196'</u>
		FILTER PACK TYPE: <u>8/12 silica sand</u>	FROM: <u>259'</u> TO: <u>204'</u>

Hole Plug and filter pack material poured in and installed w/ tremie pipe

SURVEYED LOCATION (m): Northing: 15530379.50 Easting: 1976817.70 WELL CASING ELEV. (ft): 6995.32' GROUND SURFACE ELEV. (ft): 6993.51'
 SURVEYED DATUM: HORIZONTAL: UTM Zone 12 North, NAD83 VERTICAL: NAVD88

STATIC WATER LEVEL: <u>16.40' btc</u>	DATE: <u>8/19/2010</u>	MEASURING POINT DESCRIPTION/ ELEVATION: <u>North Side of top PVC Casing</u>	MEASURING POINT RELATIVE TO GROUND SURFACE (+/-) <u>+2.06'</u>
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REMARKS: _____

INTERVAL(FT)	LITHOLOGIC DESCRIPTION USCS NAME (USCS symbol): color, moist, % by weight, plasticity, consistency, structure, cementation, geology	REMARKS	
below ground surface			
0 - 10	Sandy gravel (GM): light gray (N7); damp; ~60% rounded to angular gravel; granitic; ~40% coarse sand; angular to subangular; [Alluvium]	0 - 75 ft logged from cuttings and driller comments	
10 - 30	Gravelly sand (GM - SM): yellowish gray (5Y 7/2); damp; ~70% coarse to moderately sorted sand; ~20% silt; ~10% granitic gravel; increasing gravel (~40%) from 25 to 30 ft.		
30 - 35	Silty clay (ML): dark yellowish brown (10YR 4/2); moist; well sorted; low plasticity; ~40% silt; 45% clay; 15% fine sand; soft; [Alluvium]		
35 - 53	Silty shale; greenish gray (5GY 6/1); moist; soft; very weakly indurated; contains fine to medium sand; grades to brownish black (5YR 2/1) at 45 ft.		
53 - 60	Interbedded sandstone; greenish gray (5G 8/1); sand is well sorted (~90%); subangular to subrounded; mostly qtz; contains fsp and lithics; shale (10%) is grayish green		
60 - 66	Sandstone; as above; grayish yellow		
66 - 75	Shale; brownish black to greenish black (5YR 2/1 - 5GY 2/1); contains silt and fine sand; soft; cuttings contain ~30% sand as above; sand increases to 40% at 70 ft.		
75 - 84	Silty shale/siltstone; dark greenish gray (5G 4/1); silty shale from 75 - 80 ft.; soft; at 80 ft. shale becomes		
			Q = 50 gpm

AMEC Geomatrix

WELL LITHOLOGIC AND COMPLETION LOG

	moderately indurated and hard (siltstone); contains biotite	
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AMEC Geomatrix

WELL LITHOLOGIC AND COMPLETION LOG

JOB NO: 013655.006.0

PROJECT: Pinedale Anticline Project Area: Hydro Data Gaps

WELL NO: X-3-SW

INTERVAL(FT) below ground surface	LITHOLOGIC DESCRIPTION USCS NAME (USCS symbol): color, moist, % by weight, plasticity, consistency, structure, cementation, geology	REMARKS
84 - 89	Sandstone; well to moderately sorted; coarse-grained; mostly qtz with fsp and trace lithics; subangular to rounded	
89 - 93	Shale/siltstone; brownish black to greenish black (5YR 2/1 - 5GY 2/1); very poorly sorted; ~10% fine to medium sand in silty/shaley matrix; poorly indurated; soft	
93 - 100	Sandstone; well sorted; coarse-grained; mostly qtz with fsp and trace lithics; subangular to rounded	
100 - 103	Shale/siltstone; olive gray (5Y 3/2); poorly sorted; mostly soft and brittle	
103 - 112	Sandstone; well sorted; coarse-grained; mostly qtz with fsp and trace lithics; subangular to rounded; contains dark greenish gray silty shale at 109 ft.	
112 - 114	Shale/siltstone; at 112 - 113 ft brownish black to greenish black (5YR 2/1 - 5GY 2/1); poorly sorted; moderately indurated; at 113 - 114 ft. greenish gray (5GY 6/1); soft; contains silt and biotite	
114 - 117	Sandstone; well to moderately sorted; coarse-grained; mostly qtz with fsp and trace lithics; subangular to rounded	
117 - 133	Interbedded sandstone/silty shale; ~50% sand as above; ~50% brownish black (5YR 2/1) shale; dark greenish gray silty shale at 125 ft.; weakly indurated	
133 - 152	Silty shale; dusky yellowish brown (10YR 2/2) to mostly brownish black (5YR 2/1); contains greenish gray shale at 140 ft; weakly indurated; increase in dark yellowish brown (10YR 4/2) shale at 142 ft.; grades to weakly indurated siltstone (50%) at 143 ft.	
152 - 173	Interbedded sandstone; sand is well to moderately sorted; coarse-grained; mostly qtz with fsp and trace lithics; subangular to rounded; contains greenish gray (5GY 6/1) siltstone at 165 - 170 ft.	
173 - 180	Siltstone/shale; dark greenish gray (5G 4/1); well sorted; moderately to well indurated; contains siltstone and 80% coarse sand at 179 ft. [sandstone lense]	
180 - 197	Silty shale; brownish gray to brownish black (5YR 4/1 - 5YR 2/1); brownish gray shale contains silt and fine sand; soft; brownish black shale is well indurated (~40%); contains soft greenish gray siltstone at 195	
197 - 208	Sandstone; well to moderately sorted; coarse-grained; mostly qtz with fsp and trace lithics; subangular to rounded; 30% greenish gray siltstone as above	
208 - 226	Shale; brownish gray to brownish black (5YR 4/1 - 5YR 2/1); brownish gray shale contains silt and fine sand; soft; brownish black shale is well indurated (~40%)	
226 - 246	Sandstone; well to moderately sorted; coarse-grained; mostly qtz with fsp and trace lithics; subangular to rounded	
246 -	Shale; brownish gray to brownish black (5YR 4/1 - 5YR 2/1); brownish gray shale contains silt and fine sand; soft; brownish black shale is well indurated	
260	End of boring	

AMEC Geomatrix

WELL LITHOLOGIC AND COMPLETION LOG

JOB NO: 013655.006.0 T4 WELL NO: X-4-SW

PROJECT: Pinedale Anticline Project Area: Hydro Data Gaps STATE: WY COUNTY: Sublette LOGGED BY: D. Holman

LEGAL LOCATION: T 31N R 109W S 11 TRACT SW,NE DESCRIPTIVE LOCATION: Shell Jensen 11-11 pad; well located on southern end of pad near east road entrance. Well is furthest to the east.

DATE STARTED: 7/11/2010 DATE COMPLETED: 7/13/2010 DRILLING CO/DRILLER: Thomas Drilling/Bob Thomas

DRILLING METHOD: Air rotary/casing hammer BOREHOLE DIAM (IN): 10" DRILL FLUIDS USED: Potable water/ foam as needed

TOTAL DEPTH DRILLED: 220' TOTAL DEPTH CASED: 212' INTERVAL PERFORATED FROM OR SCREENED (FT.): 190 / 210 DIAMETER: 5" CASING TYPE: steel

METHOD OF PERFORATION:	DURING WELL CONSTRUCTION WAS/WERE:	YES	NO
<input type="checkbox"/> Open Hole	<input type="checkbox"/> Well Developed	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/> Open Bottom	<input type="checkbox"/> Well Pumped	<input type="checkbox"/>	<input checked="" type="checkbox"/>
<input type="checkbox"/> Saw Slotted	<input type="checkbox"/> Water Samples Collected	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/> Factory <u>0.020</u> (size)	<input type="checkbox"/> Material Samples Collected	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/> Other: Roller Perf tool 1/2" x 1"; 4 rows			

ANNULAR COMPLETION CHARACTERISTICS

WELL PROTECTOR: LENGTH: _____ DIAM: _____ SURFACE SEAL TYPE: Cement FROM: 172.5' TO: 0'

LOCK NO: Geomatrix Master Lock #2190 BACKFILL MATERIAL: NA

HOLE PLUG: 3/8" bentonite pellets FROM: 162.5' TO: 172.5'

FILTER PACK TYPE: 10/20 silica sand FROM: 172.5' TO: 220'

Hole Plug and filter pack material poured in and installed w/ tremie pipe

SURVEYED LOCATION (m): Northing: 15501442.50 Easting: 1962075.08 WELL CASING ELEV. (ft): NM GROUND SURFACE ELEV.(ft): 6888.26'

SURVEYED DATUM: HORIZONTAL: UTM Zone 12 North, NAD83 VERTICAL: NAVD88

STATIC WATER LEVEL: Artesian DATE: _____ MEASURING POINT DESCRIPTION/ ELEVATION: NA MEASURING POINT RELATIVE TO GROUND SURFACE (+/-) NM

REMARKS: Well log not completed during drilled; Lithologic descriptions from adjacent well (X-4-RW)

INTERVAL(FT)	LITHOLOGIC DESCRIPTION USCS NAME (USCS symbol): color, moist, % by weight, plasticity, consistency, structure, cementation, geology	REMARKS
below ground surface		
0 - 3	Sand (SP): medium grained to coarse grained; contains gravel; dry	
3 - 20	Sand; medium grained; poorly sorted; sub rounded to subangular; qtz predominant; trace fine gravels	
20 - 25	Sand (SC); fine to medium sand and clay	
25 - 40	Sandstone; subangular; predominantly qtz sand; muscovite minerals; minor pyrite; greenish gray (2Gley 6/1)	Making some water at 25 - 40 ft
40 - 54	Shale; dark greenish gray (2Gley 4/1)	
54 - 60	Sandstone; medium grained; subangular; qtz; making some water	
60 - 65	Shale; dark greenish gray (2Gley 4/1)	
65 - 75	Sandstone; very fine grained; dark greenish gray	
75 - 90	Shale; dark greenish gray (2Gley 4/1) to dark reddish gray (2.5YR 3/1)	
90 - 100	Sandstone; dark greenish gray; very fine-grained	
100 - 110	Shale; dark reddish black (10R 2.5/1); medium grained sandstone from 105 to 110 ft.	
110 - 115	Siltstone; dark greenish gray; (2Gley 4/1)	
115 - 125	Shale; dark reddish gray and dark greenish gray; some fragments of well cemented fine grained sandstone	
	in returns	
125 - 135	Sandstone; greenish gray (2Gley 6/1); medium grained; subangular; qtz	

AMEC Geomatrix

WELL LITHOLOGIC AND COMPLETION LOG

JOB NO: 013655.006.0 T4 WELL NO: X-4-RW

PROJECT: Pinedale Anticline Project Area: Hydro Data Gaps STATE: WY COUNTY: Sublette LOGGED BY: D. Holman

LEGAL LOCATION: T 31N R 109W S 11 TRACT SW,NE DESCRIPTIVE LOCATION: Shell Jensen 11-11 pad; well located on southern end of pad near east road entrance. Well is furthest to the west.

DATE STARTED: 7/7/2010 DATE COMPLETED: 7/11/2010 DRILLING CO/DRILLER: Thomas Drilling/Bob Thomas

DRILLING METHOD: Air rotary/casing hammer BOREHOLE DIAM (IN): 10" DRILL FLUIDS USED: Potable water/ foam as needed

TOTAL DEPTH DRILLED: 430' TOTAL DEPTH CASED: 412' INTERVAL PERFORATED FROM OR SCREENED (FT.): 390 / 410 DIAMETER: 5" CASING TYPE: steel

METHOD OF PERFORATION:	DURING WELL CONSTRUCTION WAS/WERE:	YES	NO
<input type="checkbox"/> Open Hole	<input type="checkbox"/> Well Developed	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/> Open Bottom	<input type="checkbox"/> Well Pumped	<input type="checkbox"/>	<input checked="" type="checkbox"/>
<input type="checkbox"/> Saw Slotted	<input type="checkbox"/> Water Samples Collected	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/> Factory <u>0.020</u> (size)	<input type="checkbox"/> Material Samples Collected	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/> Other: Roller Perf tool 1/2" x 1"; 4 rows			

ANNULAR COMPLETION CHARACTERISTICS

WELL PROTECTOR:	LENGTH: _____	SURFACE SEAL TYPE:	Cement	FROM: 0	TO: 60'
	DIAM: _____	BACKFILL MATERIAL:	Bentonite grout	FROM: 60'	TO: 360'
LOCK NO: <u>Geomatrix Master Lock #2190</u>		HOLE PLUG:	3/8" bentonite pellets	FROM: 360'	TO: 370'
		FILTER PACK TYPE:	8/12 silica sand	FROM: 370'	TO: 430'

Hole Plug and filter pack material poured in and installed w/ tremie pipe

SURVEYED LOCATION (m): Northing: 15501436.93 Easting: 1962140.17 WELL CASING ELEV. (ft): NM GROUND SURFACE ELEV.(ft): 6888.26'
 SURVEYED DATUM: HORIZONTAL: UTM Zone 12 North, NAD83 VERTICAL: NAVD88

STATIC WATER LEVEL:	DATE: <u>5/18/2010</u>	MEASURING POINT DESCRIPTION/ ELEVATION: <u>NA</u>	MEASURING POINT RELATIVE TO GROUND SURFACE (+/-) _____
<u>Artesian</u>			

REMARKS: Well cased with 12" from 0 to 40', 5" from 0 to 410'; artesian flows ~12 gpm at ~24 psi.

INTERVAL(FT)	LITHOLOGIC DESCRIPTION USCS NAME (USCS symbol): color, moist, % by weight, plasticity, consistency, structure, cementation, geology	REMARKS
below ground surface		
0 - 3	Sand (SP): medium grained to coarse grained; contains gravel; dry	
3 - 20	Sand; medium grained; poorly sorted; sub rounded to subangular; qtz predominant; trace fine gravels	
20 - 25	Sand (SC); fine to medium sand and clay	Making some water at 25 - 40 ft
25 - 40	Sandstone; subangular; predominantly qtz sand; muscovite minerals; minor pyrite; greenish gray (2Gley 6/1)	
40 - 54	Shale; dark greenish gray (2Gley 4/1)	
54 - 60	Sandstone; medium grained; subangular; qtz; making some water	
60 - 65	Shale; dark greenish gray (2Gley 4/1)	
65 - 75	Sandstone; very fine grained; dark greenish gray	
75 - 90	Shale; dark greenish gray (2Gley 4/1) to dark reddish gray (2.5YR 3/1)	
90 - 100	Sandstone; dark greenish gray; very fine-grained	
100 - 110	Shale; dark reddish black (10R 2.5/1); medium grained sandstone from 105 to 110 ft.	
110 - 115	Siltstone; dark greenish gray; (2Gley 4/1)	
115 - 125	Shale; dark reddish gray and dark greenish gray; some fragments of well cemented fine grained sandstone	
	in returns	
125 - 135	Sandstone; greenish gray (2Gley 6/1); medium grained; subangular; qtz	

AMEC Geomatrix

WELL LITHOLOGIC AND COMPLETION LOG

JOB NO: 013655.006.0 T4 WELL NO: X-5-SW

PROJECT: Pinedale Anticline Project Area: Hydro Data Gaps STATE: WY COUNTY: Sublette LOGGED BY: TM

LEGAL LOCATION: T 30N R 110W S 22 TRACT NE, NE DESCRIPTIVE LOCATION: South of HWY 351 on Rd 23-175 by NFR Bridge

DATE STARTED: 8/24/2010 DATE COMPLETED: 8/25/2010 DRILLING CO/ DRILLER: Thomas Drilling/Tyson Thomas

DRILLING METHOD: Air Rotary w/hammer BOREHOLE DIAM (IN): 10" DRILL FLUIDS USED: Water

TOTAL DEPTH DRILLED: 210' TOTAL DEPTH CASSED: 200 INTERVAL PERFORATED FROM OR SCREENED (FT.): 160' 200' DIAMETER: 4" CASING TYPE: Steel

METHOD OF PERFORATION:	DURING WELL CONSTRUCTION WAS/WERE:	YES	NO
<u> </u> Open Hole	<u> </u> Well Developed		X
<u> </u> Open Bottom	<u> </u> Well Pumped		X
<u> </u> Saw Slotted	<u> </u> Water Samples Collected		X
<u> X</u> Factory 0.02"(size)	<u> </u> Material Samples Collected		X
<u> </u> Other: Roller Perf tool 1/2" x 1"; 4 rows			

ANNULAR COMPLETION CHARACTERISTICS

WELL PROTECTOR: LENGTH: DIAM: SURFACE SEAL TYPE: Bentonite chips FROM: 10' TO: 3'
 LOCK NO: Geomatrix Master Lock #2190 BACKFILL MATERIAL: Cement FROM: 10' TO: 140'
 HOLE PLUG: Bentonite coated pellets FROM: 140' TO: 147'
 FILTER PACK TYPE: 8/12 silica sand FROM: 147' TO: 210'

** Backfill material, hole plug and filter pack installed with tremmie pipe*

SURVEYED LOCATION (m): Northing: 15463905.63 Easting: 1928495.48 TOP OF RIM ELEV. (ft): 6812.91 TOP OF FLANGE ELEV.(ft): 6812.16
 SURVEYED DATUM: HORIZONTAL: UTM Zone 12 North, NAD83 VERTICAL: NAVD88

STATIC WATER LEVEL: Artesian DATE: 8/27/2010 MEASURING POINT DESCRIPTION/ ELEVATION: NA MEASURING POINT RELATIVE TO GROUND SURFACE (+/-) -0.75

REMARKS: See associated boring X-5-A for additional information regarding lithology of this location; Flush mount well

INTERVAL(FT)	LITHOLOGIC DESCRIPTION USCS NAME (USCS symbol): color, moist, % by weight, plasticity, consistency, structure, cementation, geology	REMARKS
below ground surface		
0 - 7	Silty gravelly sand (SM-GM); fine grained; well graded; moist; Gravels rounded to subrounded; up to 40 mm in diameter; matrix color is brown (10YR 5/3)	
7 - 13	Silty gravelly sand (SM-GM); fine grained sands; brown (10YR 5/3) to light gray (10YR 7/2); wet; gravels well rounded to subrounded; up to 30 mm in diameter	
13 - 16	Silty sand (SM); trace gravels; fine to medium grained; 10YR 7/2 light gray; moist; loose	
16 - 43	Siltstone/shale; some fine to medium grained sand; Gley 2 5/1 bluish gray; waxy; laminated; trace light gray (10YR 7/1) siltstone; trace clay	
43 - 46	Shale; reddish brown (5YR 4/3); broken; trace fine grained sands; laminated in parts; damp	
46 - 75	Siltstone/sandstone; 5YR 4/1 grading to 5YR 4/1 dark gray; sand grains very fine; friable; more sand in parts; broken; moist; sandy unit from 82 - 85 ft.; fine grained; loose; 5YR 6/1 gray	
92 - 97	Sandstone; fine grained; soft to dense (competent in parts); moist	
97 - 113	Shale; 5YR 4/1 to 5YR 6/1 drak gray to gray; some very fine grained sand; friable; sheety; waxy; moist	
113 - 146	Shale/siltstone; some sandstone; 5YR 6/4 to 5YR 5/2 light reddish brown to reddish gray; competent in parts; friable; sands are fine grained; loose to dense; moist to damp	

