ADDENDUM MP-C:

WELL COMPLETION (SOP)

November 2007
Revised September 2009

Approved By: Ken Blom (Vice President Exploration) Date: 9/11/09

WELL COMPLETION PROCEDURE

PURPOSE: This procedure defines the operating standards for detailed well completion. The types of wells included are injection, recovery, and monitor wells.

SCOPE: All injection, recovery and monitor wells shall be completed, and documented by the provisions of this procedure.

SAFETY:

- All personnel, including company employees, contractors, and visitors, shall use personnel protective Equipment (PPE) when working in proximity to the drill rig.
- Minimum PPE shall consist of head, eye, and foot protection. Personnel engaged in handling well completion materials shall use the manufacturer recommended PPE which may include hand and respiratory protection.
- All personnel engaged in handling well completion materials or preparation equipment shall be trained in the tasks involved including the provisions of this procedure.
- Remove all paper bags and trash from the drill site, and dispose of same in an appropriate manner.

RESPONSIBILITY:
Exploration or Production Departments

A. PROCEDURE FOR INSTALLATION OF WELLS WITH UNDERREAMED INTERVALS:

1. Determine well location and pilot hole depth. Stake well location with the hole number and pilot hole depth designated.

2. At the well location, remove top soil and dig mud pit. During excavations of mud pits the topsoil is separated from the subsoil with a backhoe. The topsoil is first removed and then placed at a separate location. The subsoil is then removed and deposited next to the mud pit. When the use of the mud pit is complete (usually within 30 days of initial excavation), the subsoil is then redeposited in the mud pit followed by replacing of the topsoil. The entire well field will be fenced. For the protection of humans, wildlife, and livestock, the mud pit will be fenced when the well location is not directly attended to by the drill crew and is outside the well field fenced area.

3. Transport drill rig to drill location. The drilling rig will typically be a rotary drilling rig with 1000 to 1500 feet capacity. The make will be Gardner Denver, or equivalent.

4. Move water truck to the drill location, with water.

5. Fill mud pit with water and mix drilling fluids to a Marsh funnel viscosity of approximately 32-40 seconds.

6. Typical drilling mud compositions and additives can include bentonite gels like Cetco Super Gel-X, Drispac Plus, or Black Hills Leonardite. Typical loss of circulation materials can include MAGMA FIBER, or COTTONSEED HULLS. These are specific trade names, however similar products may be used as needed to complete the task.

7. Drill the pilot hole to the desired depth. The outside diameter of the hole should be approximately 5 ¼ inches. Uranerz will not drill more than 2 feet into the underlying aquitard when completion zones occur at the bottom of the production sand.

8. Geophysically log the pilot hole. The logging unit may set up through the rig's rotary table. The logger will ground the instruments with a probe set in the mud pit and zero the down hole tool to the collar elevation. The collar elevation is the mean surface level at the bore opening. The tool will be lowered into the hole on a wireline to the bottom of the hole and then log the hole on the way back to the surface. Normal uranium suite electric logs will be run and include, but not exclusive to natural gamma ray, spontaneous potential (SP), resistivity, and drift survey. Other types of logs that may be run include short normal resistance, induced polarization (IP) and delayed neutron (DFN). The down hole electric log will be checked against the driller's depth log and the gamma detection instruments will be calibrated at Casper, Wyoming USBM test pits approximately every 60 days. Records will be kept on these activities.

9. Determine the bottom of the mineralized zone or decide if the hole should be abandoned because of little or no mineralization. Uranerz wellfield engineer will make this determination. If a hole is abandoned it will be considered a Drilled Not Complete (DNC) hole and will follow EXP-SOP-01, Exploration Hole and Well Pilot Hole DNC Procedure.

10. The wellfield engineer provides the drilling contractor with the desired casing depth. The wellfield engineer calculates the number of centralizers (one every 40 feet), reaming depth, amount of cement required, amount of mix water, and the amount of displacement water needed to complete the well. The cement calculations are shown on EXP-SOP-03, "Calculations for Cement and Displacement Requirements". The PVC centralizers can be purchased from Casper Well Products, and are proprietary to Casper Well Products. A picture of a typical centralizer is shown below.

Typical Centralizer

11. The wellfield engineer completes the two logsheets, Well Completion Log Sheet, EXP-LOG-002 and Well Specifications Log Sheet, EXP-LOG-003. The logsheets for each well are retained.

12. Ream pilot hole to a diameter of 8 5/8 inches.

13. Ream pilot hole to desired depth but not more than 2 feet into the underlying aquitard when completion zones occur at the bottom of the production sand.

14. Pull drill stem, re-enter the hole and wash to the bottom of the reamed hole. Approximately one hole volume (1800 gallons for a 600 foot hole) will be displaced to clear the hole. This is the clean out run.

15. Pull drill stem from reamed hole.

16. Install calculated amount of casing with properly installed centralizers every 40 feet. Casing is usually installed 5 to 10 feet below the mineralized zone. If the mineralized completion zone is at the bottom of the production sand, Uranerz will not drill and set casing more than 2 feet into the underlaying auqitard.

17. On the bottom of the first joint of casing, a cement shoe will be placed. A cement shoe is a cap with a large hole over which the cement wiper plug rests when cement is displaced from inside the casing into the annulus For 5 inch diameter casing, the cement shoe hole would be 2 1/2 to 3 inches in diameter. See diagram of cement shoe.

Typical Cement Shoe

18. Well casing shall be PVC or fiberglass material. Manufactures can include CertainTeed with products such as CERTA-LOK, and SureFIT. Typically 5 inch inside diameter (SDR 17) PVC casing is used, however the following table lists a well casing specification range.

Nominal Size	Class	I.D.	O.D.	Wall Thick	Collapse Pressure	Collapse Safety Factor	Internal Pressure Rating	URZ Max Depth
inches		inches	inches	Inches	PSI	Ratio	PSI	Feet
4.0"	SCH 40	3.968	4.5	0.237	158	2:1	115	450
4.5"	SDR 26	4.502	4.95	0.190	59	2:1	115	450
-	SCH 40	4.379	4.95	0.248	135	2:1	130	500
	SDR 17	4.288	4.95	0.291	224	2:1	160	700
5"	SDR 21	4.941	5.563	0.265	115	2:1	130	500
	SDR 17	4.81	5.563	0.327	224	2:1	180	800
-	SCH 80	4.708	5.563	0.375	347	2:1	215	1100
6"*	SDR 21	5.885	6.625	0.316	115	2:1	150	650
	SDR 17	5.728	6.625	0.39	224	2:1	200	1000

* If 6 inch casing is used a 9 ¾ reamed hole is required

If fiberglass casing is used, a typical manufacture may be Centron International, Inc.

Nominal Size	Class	I.D.	O.D.	Wall Thick	Collapse Pressure	Collapse Safety Factor	Internal Pressure Rating	URZ Max Depth
inches		inches	inches	Inches	PSI	Ratio	PSI	Feet
5"	DHC 175	4.33	4.68	0.175	160	2.5:1	1000	+1100
	DHC 200	4.33	4.73	0.2	240	2.5:1	1200	+1100
	DHC 250	4.33	4.83	0.25	440	2.5:1	1400	+1100

19. To condition the hole prior to cementing the casing, circulate the drilling fluid until the cake wall is sufficient to hold back surrounding material (i.e. no loss of fluid from the mud pit). Conditioning the mud may require refortifying the viscosity or thinning the viscosity of the drilling mud.

20. For commercial production, the drilling rig will then pull off the well.

21. Set and attach the casing weight around the well. As soon as possible but not more than 4 hours, begin the annulus cementing operations. Place a cement head with proper valves to hold water pressure and access for the required cement wiper to the top of the well casing. Test for circulation in the annulus, and then pump the calculated amount of cement plus 10% down the inside of the casing and up the annulus. Refer to EXP-SOP-03 for cement calculations.

22. A portable commercial grouting unit will be used to place cement slurry into the casing and then displace it into the annulus, see figure below.

Typical Commercial Grouting Unit

The grouting machine consists of a small diesel or gasoline engine for power and a piston type pump and piping to pump slurry and chase water into the casing. For commercial operations, the dry cement will be measured/weighed and then mixed in a rotating drum type cement mixer.

The cement slurry will be mixed at a rate of one sack (94 lbs) of Portland Class A cement (Dacotah Cement, Oil Well Cement, or equivalent), to two percent by weight bentonite, and 6.4 gallons of water. According to commercial cementing tables, this will yield a slurry weight of 14.8 pounds per gallon and a yield of 1.35 cubic feet per sack. The following table shows the compressive strength (PSI) for cement slurry using two percent bentonite mix for 12, 24, and 72 hour thickening times. Acceptable maximum mix water parameters are also provided.

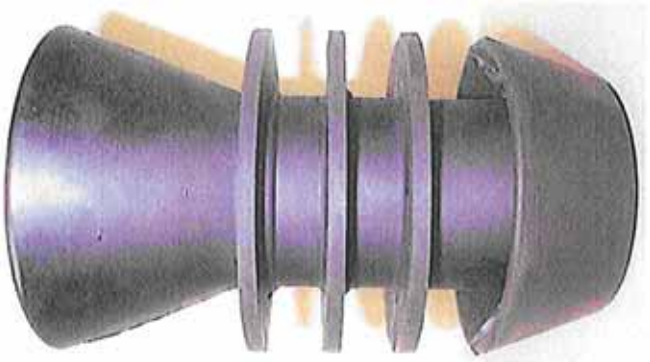
Compressive Strength (PSI) at 60 degrees F

% Bentonite	12 hours	24 hours	72 hours
2	55	395	1185

Acceptable Maximum Mix Water Parameters

Chloride	Sulfate	Alkaline	TDS
PPM	PPM	PPM	PPM
1000	3000	600	50,000

23. Launch the cement wiper plug and pump the calculated amount of displacement water down the casing. When the wiper plug contacts the cement shoe at the bottom of the well, only a slight increase in pumping pressure will be allowed and pumping stopped. As a check on this part of the cementing process, the amount of calculated chase water will be monitored as pumping progresses so that the pressure increase can be anticipated.



Typical Cement Wiper Plug

24. Observe and document cement slurry surface return from the annulus.

25. Shut the well in by closing the appropriate valves on the cement head and let cement in the well set up and cure for a minimum of 3 days (72 hours).

26. Cement slurry will be used to fill the annulus if hardened cement has fallen below the collar elevation. If surface settling of the cement is greater than forty feet in the annulus then a tremie pipe must be used to top off the well to ensure there was no bridging in the annulus.

27. Drill out any residual cement to a point five feet past the bottom of the lowest estimated projected under reamed interval (1 foot if completion interval is at the bottom of the production sand).

28. Under ream mineralized intervals through casing and cement using up to 12 inch blades.

29. If a screen is to be installed across the under reamed interval, lightly flush the well with water to remove all cuttings. Install the pre-determined length of 3 inch screen assembly with a packer by

telescoping it to the bottom. Clean the well up with clear water and air lifting until an acceptable pH and turbidity are achieved usually 2 casing volumes at a minimum.

30. The screen can be either PVC or stainless steel. Johnson Well Equipment, Inc is one of many possible manufactures. A typical screen for five (5) inch casing may be a three (3) inch Plastic Wire Wrapped on Pipe screen with an I.D. of 2.864 inches, an O.D. of 3.50 inches, a perforated area per foot of .02 to .04 square inches, and a total slot area per foot of screen of 18.23 to 32.26 square inches per foot.

31. The type of packer will be a "K" packer (Tri-Seals), manufactured by Western Rubber and Manufacturing, or equivalent. This provides a sand tight seal between the screen and casing. The packer is constructed of neoprene rubber being vulcanized and bonded under heat and pressure to coupling or pipe. A detailed drawing of a typical threaded K packer is shown below.

Typical
K Packer

32. Wash out all casing and cement cuttings in the under reamed intervals and airlift from bottom for up to one hour (2 casing volumes at a minimum). Flush well by using drilling rig until water is clear or an acceptable turbidity is achieved.

33. Attach to top of well a threaded adapter – typically 5 inch adapter. Screw a threaded cap to top of adapter.

34. On the outside of the casing, write the well number.

35. The well may be callipered if the incorrect under reamed interval is suspected.

36. Prior to putting the well into service, integrity test the well. Refer to EXP-SOP-04 Mechanical Integrity Testing.

37. Reclaim the drilling location and mud pit.

38. A drawing of a typical well completion is shown in Figure 3.2 – Typical Monitor Well Construction Diagram.

B. PROCEDURE FOR OPEN HOLE INTERVALS:

1. Follow items 1-26 listed above, with the following exceptions.

2. The depth to be reamed is to the top of the designated interval to be completed.

3. The casing depth is also to the top of the designated interval to be completed. Below the designated casing end point, there is screened or slotted pipe or an open hole completion.

4. Casing is cemented using the standard casing displacement method.

5. After 3 days of cement set up and cure time, the drill rig drills out any residual cement in the casing and cleans or drills out the completion interval.

6. A 3 inch screen assembly and packer are then telescoped to the bottom of the completion interval.

7. The well is then flushed with clean water followed by air lifting until a sufficient clarity and pH is obtained (2 casing volumes at a minimum).

8. Prior to putting the well into service, integrity test the well. Refer to EXP-SOP-04 Mechanical Integrity Testing.

9. Cap the wellhead.

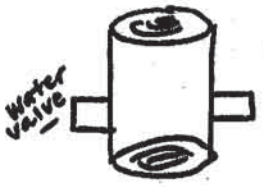
C. PROCEDURE FOR SAND PACKING

1. If conditions warrant, a sand pack will be installed in the open hole or under reamed interval.

2. If sand packing is necessary, 10 to 20 mesh sand will be used. To calculate the volume of sand pack – identify the casing diameter, determine the corresponding cross-sectional area from an industry standard Sand Pack Volume Calculation Table. For 5 inch diameter casing the cross-sectional area would be 0.1364 ft^3/ft of completion thickness. Then subtract the area of the casing from the area of hole to determine annular space. Multiply annular space by length of sand pack interval to determine the volume of annual space (in cubic feet) to be filled with sand pack. One cubic foot of sand = approximately 100 pounds. See Oglebay Norton Industrial Sands, Inc – technical data sheets.

3. The screen assembly will consist of a J – collar on the top, K style rubber packers, the screen assembly, and swing check valves on the bottom for gravel emplacement. See Figure 3.1 – Injection and Recovery Well Construction Diagram. A detailed diagram of a typical J – collar is shown below. Jerry's Welding and Machine Shop in Douglas, Wyoming is a possible vendor for the J-collars. The typical specifications include – collar 2.5 inch line pipe, nubs 7/8 inch cold rolled, protruding 1 inch, collar drilled through, center cold rolled, and welded on inside of coupling.

Typical
J Collar



4. The screen assembly will be lowered on a drill stem and positioned in the under reamed interval adjacent the mineralized zone. Knowing the diameter and length of the under reamed interval, a volume of 10 to 20 mesh sand is calculated which will be needed to completely fill the annulus between the screen and the under reamed hole wall. This volume of sand is added to the water and is pumped down through the drill steam in a stinger pipe which extends out through the lower end of the screen and through the check valves. The water deposits the sand around the screen and then flows through the screen slots to return to the surface through the annulus formed between the drill stem and the casing. When the annulus between the screen and the under reamed hole is completely filled with sand, there will be an increase in pump pressure and a decrease in water flow. The stinger pipe is then raised out of the check valves so its lower end will lie within the screen and water is circulated through to clean the inside of the screen. The drill stem and stinger pipe is then removed leaving the screen and surrounding sand pack in place.

5. Sand will be slowly placed in the void area of the under reamed interval through the drill pipe and check valves.

6. The drill pipe will be unlatched from the J – collar and pulled up above the screen assembly.

7. The well will be air lifted and flushed until a sufficient clarity and pH is obtained.

8. Prior to putting the well into service, integrity test the well. Refer to EXP-SOP-04 Mechanical Integrity Testing.

9. Cap the well.

QUALITY ASSURANCE/QUALITY CONTROL:

1. The Well Completion Logsheet EXP-LOG-002 and Well Specifications Logsheet EXP-LOG-003, shall be documentation for proof of conformance with WDEQ regulations regarding well completion.

2. Logseheets of Well Completion and Wellfield Specifications activities will be maintained by Uranerz management and shall be retained in a Well Installation file.

REFERENCES:

1. Wyoming DEQ/LQD, Noncoal Rules, Chapter 8, Noncoal exploration by Drilling

2. Uranerz EXP-SOP-01 Exploration Hole and Well Pilot Hole DNC Procedure.

3. Uranerz EXP-SOP-03 Calculations for Cement and Displacement Requirements.

4. Uranerz EXP-SOP-04 Mechanically Integrity Testing.

5. Uranerz Energy Corporation, Abandonment Form, EXP-LOG-001.

6. Oglebay Norton Industrial Sands, Inc – technical data sheets.

ATTACHMENTS

1. Uranerz Energy Corporation, Well Completion Log Sheet, EXP-LOG-002

2. Uranerz Energy Corporation, Well Specifications Log Sheet, EXP-LOG-003

3. Uranerz Figure 3-1 Typical Injection and Recovery Well Construction Diagrams

4. Uranerz Figure 3-2 Typical Monitor Well Construction Diagrams.

Well Completion LogSheet
EXP-LOG-002

Well #		Driller:	
Date:		Rig#	
Supervisor:			

Materials:	Type	Quantity
Casing		
Joint & Collars		
Socket * Thread Adapt		
Centralizers		
Cement Basket		
Shale Packer		
Other		

Cement Sacks:	
Bentonite:	
Mix Water:	
Displacement:	
Gals/ Barrel:	
Total Depth:	

Revised:
Revision: New
Date: 4/1/2008

Well Specifications Logsheet
EXP-LOG-003

ate: _____ Well # _____ Project Area: _____

Geologist: _____ Driller: _____ Supervisor: _____

Section: _____ Township: _____ Range: _____ Area: _____

DRILLING AND LOGGING:

Bit	Type	Size	Depth			Drilling Fluid
Pilot				to		
Ream				to		
Washout				to		
Underreamer				to		
Core				to		

Logs Run: Gamma ☐ Res. ☐ S.P. ☐ Total Rig Hours: _____

Caliper ☐ Other ☐ Drift ☐

COMPLETION: ☐ Original ☐ Replacement ☐ DNC

Casing: Type: _____ O.D. _____" I.D. _____" Depth _____ to _____

tralizers: Type: _____ Number: _____ Depths: _____ feet

Cement Basket: Type: _____ Depth: _____

Packer Type: _____ Depth: _____ Riser Pipe: _____

Completed: Open Hole: ☐ Slotted ☐ Screen ☐ Depth _____ to _____

Well Screen: Type: _____ O.D. _____" I.D. _____" Slot Size: _____"

Other: Collars: _____ Soc. X Thrd. _____ Other: _____

Underream: Depth _____ to _____ Diameter: _____"

Development: Method _____ Time: _____

CEMENTING:

Dry Cement: Type: _____ Class _____ # of Sacks _____ Pounds _____

Additives: Type: _____ # of Sacks _____ Pounds _____

Mix Water: Gallons/Sack _____ Total Gallons: _____

FlushWater: Gallons: _____ GPM: _____

Cement Slurry: Gallons: _____ Pounds/Gal _____ GPM: _____ PSI: _____

Return Gallons: _____

Displacement Water: Gallons: _____ GPM: _____

it In: PSI: _____ Drop In Annulus: _____ Top Off: _____ Sacks: _____

Comments:

Rev: New Date: 4/1/08 Revised:

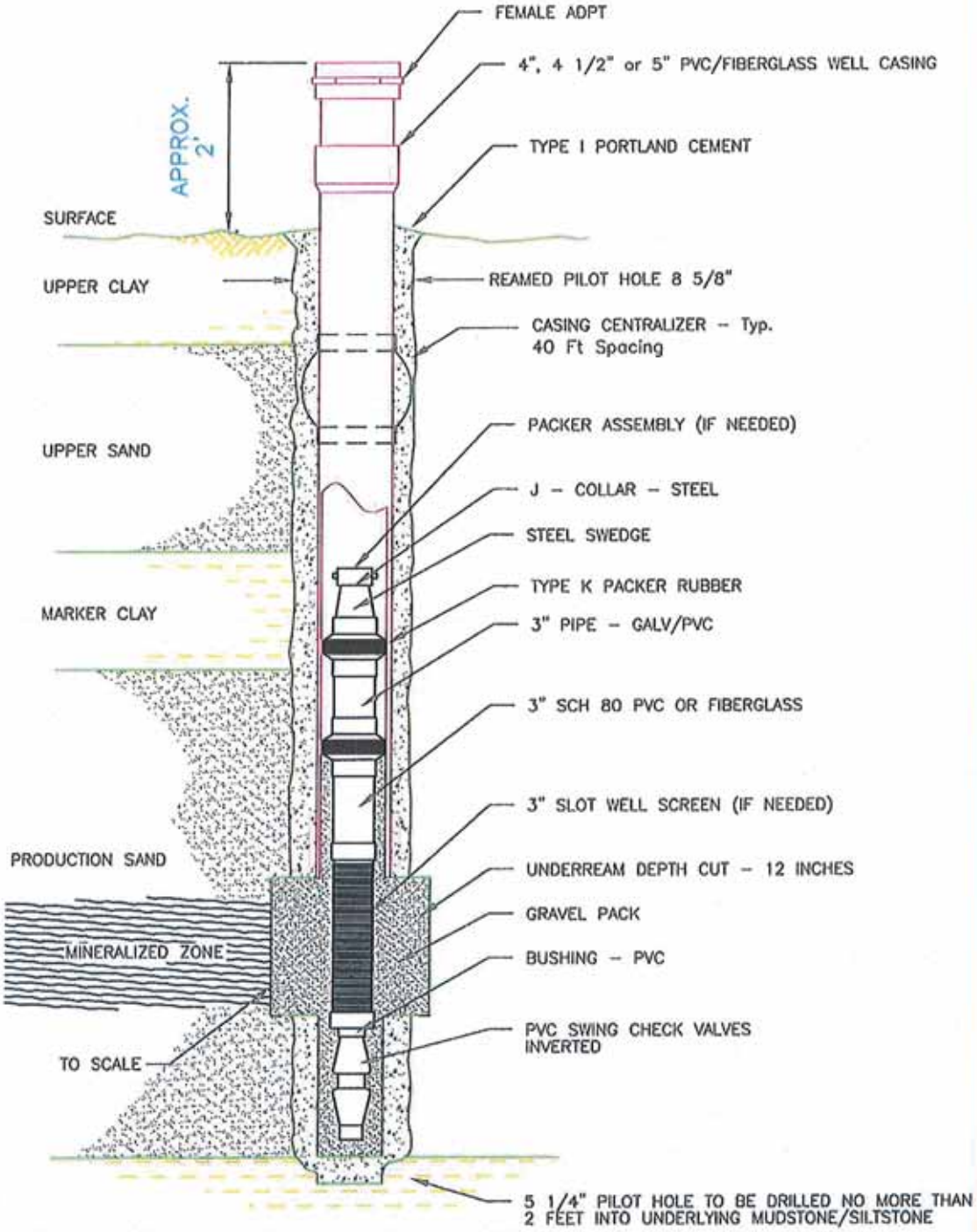


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FIGURE 3-1 NICHOLS RANCH & HANK ISR PROJECTS

CEMENTING UNIT CONSTRUCTION DIAGRAM

JOB NO.	URZ Well Design
DATE:	Sept. 25, 2007
SCALE:	N.T.S.
APPROVED BY:	HA
DRAWN BY:	CB, JDN
DRAWING NO.	Figure 3-1

REV.	DATE	DESCRIPTION
1	3/10/08	

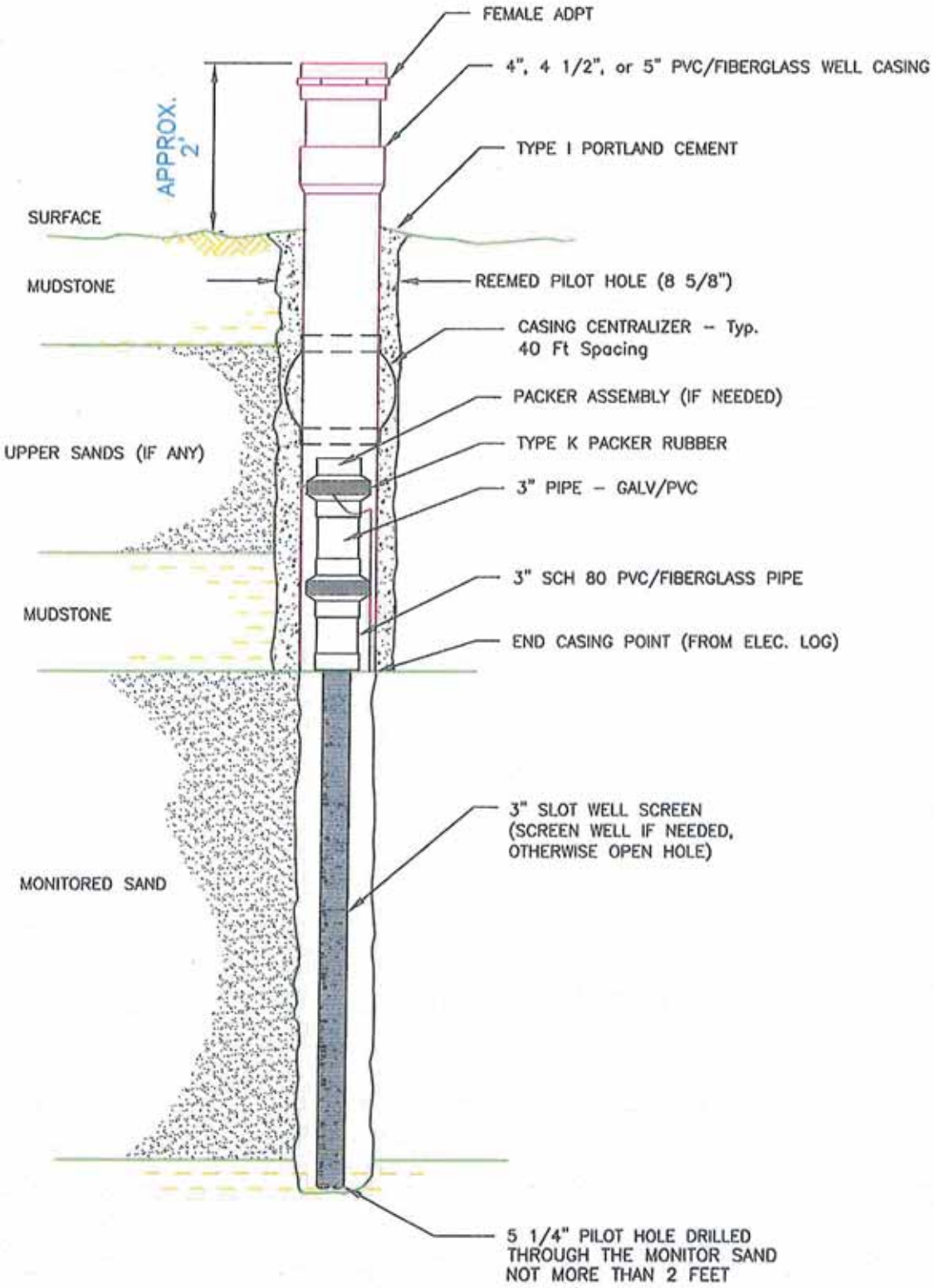

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FIG. 3-2 - NICHOLS RANCH & HANK ISR PROJECTS

TYPICAL MONITOR WELL CONSTRUCTION DIAGRAM

JOB NO. Monitor Well Design	1	3/10/08	
DATE: Sept. 25, 2007	1	8/20/09	
SCALE: N.T.S.			
APPROVED BY: HA			
DRAWN BY: S.M.F.			
DRAWING NO. Figure 3-2	REV.	DATE	DESCRIPTION