

# Rio Algom Mining LLC

CERTIFIED MAIL – RETURN RECEIPT REQUESTED – 7010 1870 0000 3700 2606

July 5, 2011

Jerry Schoeppner  
New Mexico Environment Department  
Harold Runnels Building  
1190 St. Francis Drive  
PO Box 5469  
Santa Fe, NM 87502-5469

Subject: Rio Algom Mining LLC – Ambrosia Lake  
Monitoring Well Replacement Work Plan

Dear Jerry,

Rio Algom Mining LLC is please to submit the Monitor Well Replacement Work Plan that proposes a solution the well integrity issues identified at the Ambrosia Lake site for New Mexico Environment Department comment, review and approval. Two copies are enclosed, additional copies (hard copy or electronic) can be made available at your request.

Please review the Work Plan and let me know if you have any questions or if you need additional information. Feel free to contact me at (505) 287-8851 ext 19 or by e-mail at [billy.wm.ray@bnpbilliton](mailto:billy.wm.ray@bnpbilliton).

Respectfully submitted,



Billy Ray  
Ambrosia Lake Site Manager

Enclosures – As Noted

# **MONITORING WELL REPLACEMENT WORK PLAN**

**RIO ALGOM MINING, LLC**

***Submitted to:***

Mr. Billy Ray  
Site Manager  
Rio Algom Mining, LLC

***Submitted by:***



6000 Uptown Boulevard NE, Suite 220  
Albuquerque, New Mexico 87110

**June 30, 2011**



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## TABLE OF CONTENTS

<b>LIST OF FIGURES</b> .....	<b>ii</b>
<b>LIST OF TABLES</b> .....	<b>ii</b>
<b>LIST OF APPENDICES</b> .....	<b>ii</b>
<b>1.0 INTRODUCTION</b> .....	<b>1</b>
1.1. Project Background .....	1
<b>2.0 SCOPE OF WORK</b> .....	<b>2</b>
2.1. Task 1: Project Planning and Scheduling .....	2
2.1.1. Personnel.....	2
2.2. Task 2: Monitoring Well Installation, Development, and Abandonment .....	3
2.2.1. Alluvial Monitoring Wells.....	4
2.2.2. Confined Aquifer Monitoring Wells.....	5
2.2.3. Well Development .....	7
2.2.4. Well Abandonment .....	7
2.2.5. Activities Supporting Well Installation and Abandonment .....	7
2.3. Task 3: Project Report Preparation .....	8
<b>3.0 SCHEDULE</b> .....	<b>9</b>



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## LIST OF FIGURES

Figure 1	Site Plan, Well Replacement
Figure 2	Proposed Alluvial Monitoring Well Construction Detail
Figure 3	Monitoring Well Construction Schematic, Dakota Formation Confined Aquifer

## LIST OF TABLES

Table 1	Existing Well Construction Detail and Proposed Replacement Depth
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## LIST OF APPENDICES

Appendix A	New Mexico Environment Department Ground Water Quality Bureau Monitoring Well Construction and Abandonment Guidelines
Appendix B	Rules and Regulations Governing Well Driller Licensing; Construction, Repair and Plugging of Wells
Appendix C	NMED Monitoring Well Construction Requirements
Appendix D	Well Permit Application Form, Example of Completed Well Permit Application Form, Well Plugging Plan of Operations Form, and Plugging Record Form



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## INTRODUCTION

This work plan describes the methods that will be used to abandon 14 existing monitoring wells and install 12 new monitoring wells on property that belongs to Rio Algom Mining, LLC (RAML) (Site). A Site plan showing the well locations is provided in Figure 1. This work plan was prepared in response to a request from Mr. Billy Ray, Site Manager for RAML, to Dr. Dan Erskine of INTERA Incorporated (INTERA) in December 2010.

The purpose of the project is to:

1. Abandon 12 monitoring wells and replace them with 12 new monitoring wells.
2. Abandon 2 monitoring wells (but not replace them with new wells).

As illustrated on Figure 1, the wells to be abandoned and replaced are MW 30-04, MW 30-48 KD, MW 31-05, MW 32-01, MW 32-02, MW 30-68, MW 31-70, MW 5-03, MW 5-08, MW 5-73, MW 32-45 KD, and MW 31-01 TRA. The wells to be abandoned only are MW 30-03 and MW 32-50. Table 1 provides the existing construction design details for all of these wells based on information provided by RAML. The column titled "Replacement Target Depth" in Table 1 provides the proposed depth of the replacement wells, based on the RAML-documented depth of the alluvial/bedrock interface, tabulated data, and well construction diagrams.

The rest of this section provides project background information, Section 2.0 details the scope of work and includes a description of the well installation and abandonment procedures, and Section 3.0 discusses the project schedule.

### 1.1. Project Background

At the request of the New Mexico Environment Department (NMED), RAML performed a review of DP-169 monitoring wells. The review included inspection of original well-completion records for total depth of each well and a comparison to the current measured depth of each well. Wells that were significantly shallower than indicated by well-completion records were selected for replacement. The review also included a physical inspection of each well, and wells that had visible integrity issues, such as a broken casing or screen, were also selected for replacement.

The 14 monitoring wells to be abandoned have been used to monitor groundwater elevation and groundwater chemistry as part of the Site groundwater monitoring program (Figure 1). The wells range in depth from approximately 35 feet (ft) to more than 350 ft below ground surface and are sampled periodically by the RAML field sampling team. These monitoring wells were



constructed in the 1960s and 1970s. The proposed new monitoring wells will be constructed according to current industry standards as described in Sections 2.2.1 and 2.2.2.

The differences in the well depths reflect the different monitoring objectives. Nine of the wells are designed to monitor groundwater in the alluvium, while wells MW 30-48 KD and MW 32-45 KD monitor groundwater in the Dakota Formation. Well MW 5-08 monitors groundwater in both the alluvium and the Tres Hermanos “B” member of the Mancos Shale, although the Tres Hermanos “B” is generally considered to be dry. The alluvial wells are considered to be water table wells (i.e., monitoring the first water encountered in the subsurface), while the aquifers monitored by the other wells may be confined (i.e., separated from the water table by a geologic barrier and under pressure). The drilling and installation of the alluvial wells is relatively simple. However, the wells in the confined aquifers will be drilled and constructed according to NMED and New Mexico Office of the State Engineer (OSE) requirements, as well as best professional practice, with the objective of maintaining separation between the alluvial groundwater and the groundwater in the confined zones.

## **2.0 SCOPE OF WORK**

INTERA has divided the project scope of work into the following three tasks:

- Task 1 – Project Planning and Scheduling
- Task 2 – Monitoring Well Installation, Development, and Abandonment
- Task 3 – Project Report Preparation

This work plan is part of Task 1.

### **2.1. Task 1: Project Planning and Scheduling**

This task includes project planning and scheduling activities for monitoring well installation and development and abandonment of the old wells. Prior to any drilling, INTERA will coordinate with New Mexico One Call and/or RAML to identify and mark any underground or overhead utilities.

#### **2.1.1. Personnel**

The key personnel who will be responsible for completion of the project are listed below along with their areas of responsibility.



Ms. Cindy Ardito, Principal

Ms. Ardito will provide client interface and will review deliverables. She will be responsible for INTERA resource allocation.

Dr. Daniel Erskine, Project Manager

Dr. Erskine will provide senior technical oversight as needed.

Mr. Robert Sengebush, PG, Principal Geologist

Mr. Sengebush will serve as field manager. Mr. Sengebush has extensive experience designing and installing monitoring wells in water table and confined aquifers.

Mr. Lee Dalton, Staff Geologist

Mr. Dalton will oversee field activities and development of wells at the Site.

## **2.2. Task 2: Monitoring Well Installation, Development, and Abandonment**

Twelve well borings will be drilled to the approximate depths shown in Table 1. The alluvial wells will be drilled to whatever depth is necessary to (1) ensure that at least 20 ft of alluvial groundwater is present (if possible) in the wells when they are installed, and (2) account for potential future lowering of the groundwater elevation in the alluvium. However, the new alluvium well depths will not be deeper than the base of the alluvium. The base of the alluvium will be “picked” based on information provided by RAML in previous well logs and/or based on the geologic logging of cuttings as the well bore is drilled. INTERA expects that the alluvial/bedrock interface will be apparent in the cuttings as a change from unconsolidated sand or gravel to a consolidated bedrock shale (Mancos) or cemented sandstone (Tres Hermanos). If the replacement alluvium wells are dry at the interface of the alluvium and the underlying bedrock, this will be considered an acceptable outcome, as it will demonstrate that groundwater is not present in the alluvium at that location.

The Dakota and Tres Hermanos “A” wells may be drilled to approximately the same depths as the existing wells. The wells will be drilled using air-rotary, hollow-stem auger, or sonic drilling equipment. The actual drilling method will be selected based on information and bids obtained from drilling contractors. The confined aquifer wells will be constructed with a conductor casing cemented across the alluvium to maintain separation between the groundwater in the alluvial aquifer and groundwater in the confined Dakota Formation and Tres Hermanos “A” aquifers. Drilling details are provided in Sections 2.2.1 and 2.2.2 below.

An INTERA representative will be on-site to oversee drilling activities, log the borehole lithology, and oversee monitoring well installation and development. Soil cuttings generated during drilling will be thin-spread on the Site or containerized and placed in the proper disposal



cell on the RAML facility, such as Pond 2. A select portion of the cuttings will be bagged, labeled, and stored for future inspection by NMED. All downhole equipment will be decontaminated prior to and between each well boring event using environmental industry standard procedures. Decontamination consists of pressure wash and/or steam cleaning of drill bits, drive casing, and drill rods or other down-hole drilling tools using potable water.

INTERA will prepare the drilling specifications and bid request and obtain the drilling contract (through INTERA) as requested by RAML. INTERA will obtain three drilling bids and select the drilling subcontractor that represents the combination of capability and cost that is most advantageous to RAML.

### **2.2.1. Alluvial Monitoring Wells**

The objective of the alluvial monitoring wells is to monitor the groundwater in the alluvial interval within the 20 ft directly above the alluvium-bedrock interface. The alluvial monitoring well depths vary because the thickness of the alluvium varies across the Site. MW 32-50, which monitors the boundary between the alluvium and the Tres Hermanos "B" zone, is grouped with the alluvial monitoring wells because in that well the alluvium has scoured into the Tres Hermanos "B" such that water in that zone (if any) is in communication with the water table aquifer.

The monitoring wells will be designed and constructed according to New Mexico requirements (<http://www.nmenv.state.nm.us/gwb/documents/MonitoringWellGuidelinesFINAL-March2011.pdf>, *New Mexico Environment Department Ground Water Quality Bureau Monitoring Well Construction and Abandonment Guidelines*, provided in Appendix A of this work plan). A schematic diagram of an alluvial monitoring well is provided in Figure 2. Monitoring well permits (called "Application for Permit to Drill an Exploratory Well") are obtained from the OSE and are described in more detail in Section 2.2.5 of this work plan.

The alluvial aquifer monitoring well boreholes will be drilled to a nominal 8-inch diameter using a dry drilling system, such as air-rotary or other functionally equivalent drilling method. Soil samples will be collected every 10 ft and described (logged) by the field geologist. Each borehole will be converted to a 4-inch polyvinyl chloride (PVC), flush-threaded, schedule 80 well with 20 ft of 0.010-inch slot screen with an end cap and blank casing to the surface. The well casing will extend 3 ft above the ground surface. Each well will be backfilled with 10/20 sand (filter pack) to 2 ft above the top of the well screen, followed by 5 ft of transitional 20/40 (finer-grained) sand. Five (5) ft of hydrated bentonite chips or pellets will then be placed above the sand pack followed by cement/bentonite (97%/3% by volume) grout to 3 ft below grade. Concrete will then be used to backfill the remaining 3 ft and construct a 2-foot by 2-foot by 4-



inch thick surface pad. A steel protective casing with a locking, hinged lid will be installed over the PVC well casing. This casing will be surrounded by four protective traffic posts emplaced in the concrete approximately 3 ft above ground. The location and elevation at top of casing of the monitoring wells PVC casing measuring point will be surveyed. The measuring point will be marked on the north side of the PVC casing.

Each new monitoring well will be developed using surging and bailing techniques. The turbidity of the produced groundwater will be qualitatively monitored and recorded during development, and the water quality parameters (pH, specific conductance, and temperature) will be measured. Development water will be discharged to an on-site surface and allowed to evaporate.

INTERA anticipates that the well-installation activities for the alluvial wells can be completed in a period of no more than 20, 10-hour working days, weather and field conditions permitting.

### **2.2.2. Confined Aquifer Monitoring Wells**

The Dakota Formation wells, MW 30-48 KD and 32-42KD, and the Tres Hermanos "A" well, MW 31-01, will be constructed to maintain the separation between the alluvial and confined Dakota (or Tres Hermanos) aquifers, as required by New Mexico well construction regulations (<http://www.ose.state.nm.us/doing-business/WellDrillerRegs/WellDrillerRulesRegs-2005-08-31.pdf>, 19.27.4.31), provided in Appendix B of this work plan and in a schematic diagram of the confined aquifer monitoring well (Figure 3). These OSE regulations specifically address "artesian" wells (those that may "flow uncontrolled to the land surface or move appreciably between geologic units") and apply to the wells constructed in the Dakota and Tres Hermanos Formations.

The Dakota and Tres Hermanos "A" aquifers are known to be confined aquifers, and the potentiometric surfaces of these aquifers may rise somewhat above the top of the formations, although the flow is not expected to reach the ground surface. Also, it is clear that aquifer conditions can change over time and may be different depending on the location of the well. A completion of the new MW 32-45 KD well with depth dimensions similar to those of the existing well (total depth approximately 270 ft) should provide sufficient water for sampling (currently the water column in this well is 24 ft, according to data provided by RAML). MW 30-48 KD, on the other hand, has a total depth of 351 ft and is dry, suggesting that there is a significant difference in the Dakota aquifer conditions between the two wells (located approximately 4,800 ft apart) or that well damage is preventing water entry. According to the lithologic log of this well provided by RAML, the Dakota is approximately 80 ft thick, the base is at 345 ft, and the well is screened from 331 to 351 ft, but the well is currently dry. It is anticipated that the



drilling depths and screen intervals in the three confined aquifer replacement wells will be essentially equivalent to those of the existing wells.

The Dakota (two wells) and Tres Hermanos "A" (one well) wells will be drilled using air rotary drilling equipment or a functionally equivalent dry drilling method. Drilling these wells dry (i.e., without drilling mud or other wet drilling fluid) will ensure that the target aquifer formations are not damaged by drilling fluids and will reduce the amount of effort required to develop the wells. Geologic logging will be done by observation and description of the cuttings brought to the surface during drilling. The geologic logging of these cuttings, along with the design dimensions of the existing wells, will be the basis for the selection of the replacement well total depths and screened intervals.

The process will begin by drilling a boring for installation of a steel casing (conductor casing) cemented into place approximately 5 ft into the top of the formation (Dakota or Tres Hermanos), effectively sealing off the alluvial aquifer from the confined aquifer. The cased hole will be extended with a smaller diameter boring to the base of the target formation. The monitoring well will be built inside the conductor casing and completed according to the standard well construction methods, as shown in Figure 3.

The inner well will be constructed of schedule 80 PVC casing, with 20 ft of 0.010-inch slotted PVC screen and a 10/20 sand filter pack. The well will be sealed with a bentonite seal and grouted to near the ground surface using cement/bentonite (97%/3% by volume) grout. The well will be finished with an above-ground surface completion, a cement pad, a locking protective casing, and protective traffic posts. The top of the inner casing will be surveyed for location and elevation so that the groundwater elevation may be measured.

Boring and casing dimensions and other specifications will be determined in consultation with the RAML technical staff and the drilling contractor. The conductor casing will need to be of sufficient diameter to accommodate the inner casing, and the equipment required to emplace the sand pack, seal and grout, inner casing, and screen will need to have a large enough diameter to accommodate the pumping equipment used by the RAML field staff to purge and sample the well. The existing wells were completed with a 6-inch inner-diameter conductor casing and a 4-inch diameter well casing and screen. This basic design may be used for the replacement wells.

The confined aquifer wells are expected to take up to a week each to complete, due to the greater depth (compared with the alluvial wells) and the requirement for installation and cementing of the conductor casing.



Additional information regarding drilling and completion of the confined aquifer monitoring well may be found on the NMED website ([http://www.nmenv.state.nm.us/hwb/documents/Att\\_19.pdf](http://www.nmenv.state.nm.us/hwb/documents/Att_19.pdf)) and in Appendix C of this work plan.

### **2.2.3. Well Development**

The monitoring wells will be developed using standard development methods, including bailing, surging, jetting, airlifting, and pumping, until the water is free of sand or silt, according to the judgment of the field geologist. Development water will be disposed of on the ground surface unless other water disposal methods are required.

The well development may require up to several hours per well plus mobilization of development equipment from well to well. The development will be accomplished using a separate “development rig” after all of the monitoring wells are completed.

### **2.2.4. Well Abandonment**

The 14 existing monitoring wells will be plugged and abandoned according to NMED and OSE requirements as described in the *New Mexico Environment Department Ground Water Quality Bureau Monitoring Well Construction and Abandonment Guidelines* (March 2011), included in Appendix A. The NMED abandonment guidelines state, “12. Approval for abandonment of monitoring wells used for ground water monitoring in accordance with Discharge Permit and Abatement Plan requirements must be obtained from NMED prior to abandonment.”

The abandonment task will be conducted by a subcontractor under the supervision of an INTERA field geologist. Prior to the abandonment, the “Well Plugging Plan of Operations” form ([http://www.ose.state.nm.us/water\\_info\\_rights\\_drillers\\_forms.html](http://www.ose.state.nm.us/water_info_rights_drillers_forms.html)) must be completed and submitted to the OSE. A copy of this form is provided in Appendix D.

The procedure will consist of pulling out as much of the old casing as possible, or overdrilling the old well casing and seal to clean out the old borehole. The cleaned borehole will then be filled with cement grout to the surface, according to the NMED *Monitoring Well Construction Requirements* (November 2009), presented in Appendix C of this work plan. Notice of the abandonment, which consists of completing the OSE “Plugging Record” form ([http://www.ose.state.nm.us/water\\_info\\_rights\\_drillers\\_forms.html](http://www.ose.state.nm.us/water_info_rights_drillers_forms.html)), must be provided to OSE and NMED. A copy of this form is provided in Appendix D.

### **2.2.5. Activities Supporting Well Installation and Abandonment**

Activities that will be performed as part of the well installation and abandonment task include:



1. Submit applications for monitoring well permits to the OSE. A copy of a well permit application form is included in Appendix D of this work plan and may be found on the following website: <http://www.ose.state.nm.us/doing-business/forms-inst/wr-forms-inst.html>. Although the form is titled “Application for Permit to Drill an Exploratory Well,” it is the correct form to use for monitoring wells. A fee of \$5.00 per well is required. An example of a completed and approved form is included in Appendix D. INTERA will complete the forms and begin the permitting process at the time of submission of this work plan to RAML. The OSE review and approval period may take several weeks.
2. Complete and submit the “Well Plugging Plan of Operations” form to OSE. A copy of the form is provided in Appendix D.
3. Complete and submit the “Plugging Record” form to OSE and NMED as a record of the abandonment. A copy of the form is provided in Appendix D.
4. Contact New Mexico One Call prior to drilling to arrange for identification and marking of underground utilities.
5. Coordinate with RAML management to identify any potential underground or overhead utilities.
6. Review and update, if necessary, the Site-specific health and safety plan.

Well abandonment will be accomplished using a crew and equipment that is separate from the drilling operations. Abandonment may require up to a day per location, depending on well depth, type and condition of the existing casing, etc.

### **2.3. Task 3: Project Report Preparation**

Upon completion of Task 2, INTERA will prepare a report documenting the methods and outcome of the well abandonment and installation program. The report will include at a minimum:

- A written description of field activities.
- A Site map showing the well locations.
- Geologic logs and well-construction diagrams.
- Well-abandonment documentation consisting of the “Well Plugging Plan of Operations” form, the “Plugging Record” form, notification to NMED, etc.
- Photographic documentation of field activities.



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### 3.0 SCHEDULE

INTERA will begin scheduling and project-coordination activities as soon as possible upon receipt of authorization to proceed from RAML. The work is estimated to be completed in four months, including permitting, field work, and report preparation.

## **APPENDIX A**

**New Mexico Environment Department  
Ground Water Quality Bureau  
Monitoring Well Construction and Abandonment Guidelines**

**NEW MEXICO ENVIRONMENT DEPARTMENT  
GROUND WATER QUALITY BUREAU  
MONITORING WELL CONSTRUCTION AND ABANDONMENT GUIDELINES**

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**Purpose:** These guidelines identify minimum construction and abandonment details for installation of water table monitoring wells under ground water Discharge Permits issued by the NMED's Ground Water Quality Bureau (GWQB) and Abatement Plans approved by the GWQB. Proposed locations of monitoring wells required under Discharge Permits and Abatement Plans and requests to use alternate installation and/or construction methods for water table monitoring wells or other types of monitoring wells (e.g., deep monitoring wells for delineation of vertical extent of contaminants) must be submitted to the GWQB for approval prior to drilling and construction.

**General Drilling Specifications:**

1. All well drilling activities must be performed by an individual with a current and valid well driller license issued by the State of New Mexico in accordance with 19.27.4 NMAC. Use of drillers with environmental well drilling experience and expertise is highly recommended.
2. Drilling methods that allow for accurate determinations of water table locations must be employed. All drill bits, drill rods, and down-hole tools must be thoroughly cleaned immediately prior to the start of drilling. The borehole diameter must be drilled a minimum of 4 inches larger than the casing diameter to allow for the emplacement of sand and sealant.
3. After completion, the well should be allowed to stabilize for a minimum of 12 hours before development is initiated.
4. The well must be developed so that formation water flows freely through the screen and is not turbid, and all sediment and drilling disturbances are removed from the well.

**Well Specifications (see attached monitoring well schematic):**

5. Schedule 40 (or heavier) polyvinyl chloride (PVC) pipe, stainless steel pipe, carbon steel pipe, or pipe of an alternate appropriate material that has been approved for use by NMED must be used as casing. The casing must have an inside diameter not less than 2 inches. The casing material selected for use must be compatible with the anticipated chemistry of the ground water and appropriate for the contaminants of interest at the facility. The casing material and thickness selected for use must have sufficient collapse strength to withstand the pressure exerted by grouts used as annular seals and thermal properties sufficient to withstand the heat generated by the hydration of cement-based grouts. Casing sections may be joined using welded, threaded, or mechanically locking joints; the method selected must provide sufficient joint strength for the specific well installation. The casing must extend from the top of the screen to at least one foot above ground surface. The top of the casing must be fitted with a removable cap, and the exposed casing must be protected by a locking steel well shroud. The shroud must be large enough in diameter to allow easy access for removal of the cap. Alternatively, monitoring wells may be completed below grade. In this case, the casing must extend from the top of the screen to 6 to 12 inches below the ground surface; the monitoring wells must be sealed with locking, expandable well plugs; a flush-mount, watertight well vault that is rated to withstand traffic loads must be emplaced around the wellhead; and the cover must be secured with at least one bolt. The vault cover must indicate that the wellhead of a monitoring well is contained within the vault.
6. A 20-foot section (maximum) of continuous-slot, machine slotted, or other manufactured PVC or stainless steel well screen or well screen of an alternate appropriate material that has been approved for use by NMED must be installed across the water table. Screens created by cutting slots into solid casing with saws or other tools must not be used. The screen material selected for use must be compatible with the anticipated chemistry of the ground water and appropriate for the contaminants of interest at the facility. Screen sections may be joined using welded, threaded, or mechanically

locking joints; the method selected must provide sufficient joint strength for the specific well installation and must not introduce constituents that may reasonably be considered contaminants of interest at the facility. A cap must be attached to the bottom of the well screen; sumps (i.e., casing attached to the bottom of a well screen) should not be installed. The bottom of the screen must be installed no more than 15 feet below the water table; the top of the well screen must be positioned not less than 5 feet above the water table. The well screen slots must be appropriately sized for the formation materials and should be selected to retain 90 percent of the filter pack. A slot size of 0.010 inches is generally adequate for most installations.

7. Casing and well screen must be centered in the borehole by placing centralizers near the top and bottom of the well screen.
8. A filter pack must be installed around the screen by filling the annular space from the bottom of the screen to 2 feet above the top of the screen with clean silica sand. The filter pack must be properly sized to prevent fine particles in the formation from entering the well; clean medium to coarse silica sand is generally adequate as filter pack material for 0.010-inch slotted well screen. For wells deeper than 30 feet, the sand must be emplaced by a tremmie pipe. The well should be surged or bailed to settle the filter pack and additional sand added, if necessary, before the bentonite seal is emplaced.
9. A bentonite seal must be constructed immediately above the filter pack by emplacing bentonite chips or pellets (3/8-inch in size or smaller) in a manner that prevents bridging of the chips/pellets in the annular space. The bentonite seal must be 3 feet in thickness and hydrated with clean water. Adequate time should be allowed for expansion of the bentonite seal before installation of the annular space seal.
10. The annular space above the bentonite seal must be sealed with cement grout or a bentonite-based sealing material acceptable to the State Engineer pursuant to 19.27.4 NMAC. A tremmie pipe must be used when placing sealing materials at depths greater than 20 feet below the ground surface. Annular space seals must extend from the top of the bentonite seal to the ground surface (for wells completed above grade) or to a level 3 to 6 inches below the top of casing (for wells completed below grade).
11. For monitoring wells finished above grade, a concrete pad (2-foot minimum radius, 4-inch minimum thickness) must be poured around the shroud and wellhead. The concrete and surrounding soil must be sloped to direct rainfall and runoff away from the wellhead. The installation of steel posts around the well shroud and wellhead is recommended for monitoring wells finished above grade to protect the wellhead from damage by vehicles or equipment. For monitoring wells finished below grade, a concrete pad (2-foot minimum radius, 4-inch minimum thickness) must be poured around the well vault and wellhead. The concrete and surrounding soil must be sloped to direct rainfall and runoff away from the well vault.

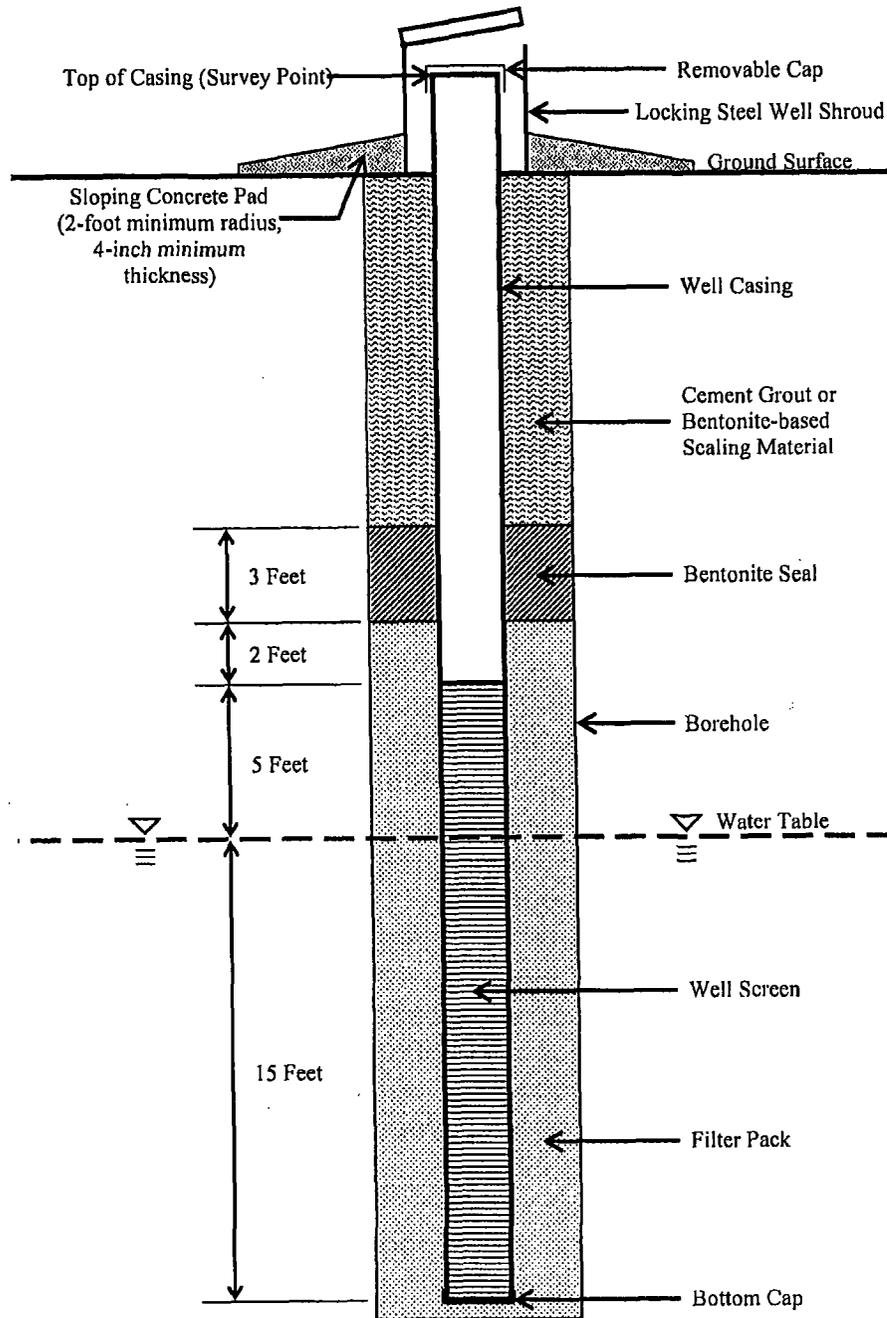
**Abandonment:**

12. Approval for abandonment of monitoring wells used for ground water monitoring in accordance with Discharge Permit and Abatement Plan requirements must be obtained from NMED prior to abandonment.
13. Well abandonment must be accomplished by removing the well casing and placing neat cement grout, bentonite-based plugging material, or other sealing material approved by the State Engineer for wells that encounter water pursuant to 19.27.4 NMAC from the bottom of the borehole to the ground surface using a tremmie pipe. If the casing cannot be removed, neat cement grout, bentonite-based plugging material, or other sealing material approved by the State Engineer must be placed in the well using a tremmie pipe from the bottom of the well to the ground surface.
14. After abandonment, written notification describing the well abandonment must be submitted to the NMED. Written notification of well abandonment must consist of a copy of the well plugging record submitted to the State Engineer in accordance with 19.27.4 NMAC, or alternate documentation containing the information to be provided in a well plugging record required by the State Engineer as specified in 19.27.4 NMAC.

**Deviation from Monitoring Well Construction and Abandonment Requirements:** Requests to construct water table monitoring wells or other types of monitoring wells for ground water monitoring under ground water Discharge Permits or Abatement Plans in a manner that deviates from the specified requirements must be submitted in writing to the GWQB. Each request must state the rationale for the proposed deviation from these requirements and provide detailed evidence supporting the request. The GWQB will approve or deny requests to deviate from these requirements in writing.

**MONITORING WELL SCHEMATIC**

(Not to Scale)

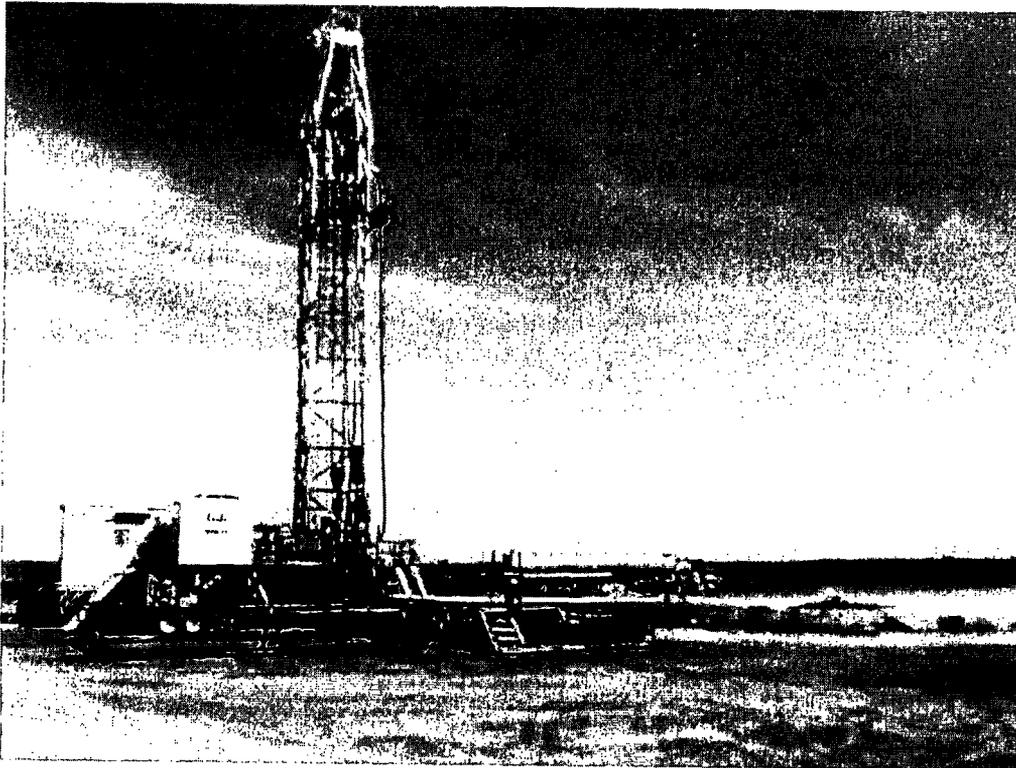


## **APPENDIX B**

### **Rules and Regulations Governing Well Driller Licensing; Construction, Repair and Plugging of Wells**



**RULES AND REGULATIONS  
GOVERNING WELL DRILLER LICENSING;  
CONSTRUCTION, REPAIR AND PLUGGING OF  
WELLS**



**Adopted August 31, 2005**

**John R. D'Antonio, Jr., PE**

**State Engineer**

# INDEX

## WELL DRILLER LICENSING; CONSTRUCTION, REPAIR AND PLUGGING OF WELLS 19.27.4 NMAC

19.27.4.1	Issuing Agency
19.27.4.2	Scope
19.27.4.3	Statutory Authority
19.27.4.4	Duration
19.27.4.5	Effective Date
19.27.4.6	Objective
19.27.4.7	Definitions
19.27.4.8	License Required
19.27.4.9	Existing Well Driller License Recognized
19.27.4.10	Reserved
19.27.4.11	Reserved
19.27.4.12	Application for a New License
19.27.4.13	National Ground Water Association Exams
19.27.4.14	New Mexico General Drilling Exam
19.27.4.15	Application Review and Licensing Requirements
19.27.4.16	Changes to License
19.27.4.17	Request to be Licensed in Additional Drilling Methodology
19.27.4.18	Reserved
19.27.4.19	License Expiration
19.27.4.20	License Renewal
19.27.4.21	Reprimands, Suspension or Revocation of Well Driller License
19.27.4.22	Reserved
19.27.4.23	Reserved
19.27.4.24	Reserved
19.27.4.25	Application for Registration as a Drill Rig Supervisor
19.27.4.26	Application Review and Registration Requirements for Drill Rig Supervisor
19.27.4.27	Renewal of Drill Rig Supervisor Registration
19.27.4.28	Reserved
19.27.4.29	Well Drilling - General Requirements
19.27.4.30	Well Drilling - Non-Artesian Well Requirements
19.27.4.31	Well Drilling - Artesian Well Requirements
19.27.4.32	Reserved
19.27.4.33	Reserved
19.27.4.34	Reserved
19.27.4.35	Reserved
19.27.4.36	Requirements for Mine Drill Holes that Encounter Water
19.27.4.37	Request for Variance
19.27.4.38	Liberal Construction
19.27.4.39	Severability

History of 19.27.4 NMAC

**TITLE 19      NATURAL RESOURCES AND WILDLIFE**  
**CHAPTER 27   UNDERGROUND WATER**  
**PART 4        WELL DRILLER LICENSING; CONSTRUCTION, REPAIR AND PLUGGING OF**  
**WELLS**

**19.27.4.1      ISSUING AGENCY:** Office of the State Engineer.  
[19.27.4.1 NMAC - N, 8-31-2005]

**19.27.4.2      SCOPE:** The rules for well driller licensing, drill rig supervisor registration, and well drilling within the state of New Mexico. These rules also apply to mine drill holes that encounter water. These rules do not apply to oil wells, gas wells, or cathodic protection wells.  
[19.27.4.2 NMAC - N, 8-31-2005]

**19.27.4.3      STATUTORY AUTHORITY:** Section 72-12-1 NMSA provides that the water of underground streams, channels, artesian basins, reservoirs, or lakes having reasonably ascertainable boundaries are declared to be public waters which belong to the public and are subject to appropriation for beneficial use. Section 72-2-8 NMSA gives the state engineer authority to adopt regulations and codes to implement and enforce any provision of any law administered by him. Section 72-12-12 NMSA states that it shall be unlawful for any person, firm, or corporation to drill or to begin the drilling of a well for water from an underground source without a valid, existing license for the drilling of such wells issued by the state engineer of New Mexico. Section 72-12-13 NMSA states any person desiring to engage in the drilling of one or more wells for underground water within the boundaries of any underground source shall file an application with the state engineer for a driller license. Sections 72-12-14 through 72-12-17 NMSA further detail requirements for well drillers in New Mexico. Sections 72-13-1 through 72-13-12 NMSA detail the requirements for the drilling of artesian wells.  
[19.27.4.3 NMAC - N, 8-31-2005]

**19.27.4.4      DURATION:** Permanent.  
[19.27.4.4 NMAC - N, 8-31-2005]

**19.27.4.5      EFFECTIVE DATE:** August 31, 2005, unless a later date is cited at the end of a section.  
[19.27.4.5 NMAC - N, 8-31-2005]

**19.27.4.6      OBJECTIVE:** To update written rules for well driller licensing, drill rig supervisor registration, and well drilling within the state of New Mexico.  
[19.27.4.6 NMAC - N, 8-31-2005]

**19.27.4.7      DEFINITIONS:** Unless defined below or in a specific section of these rules, all other words used herein shall be given their customary and accepted meaning. The use of a masculine pronoun to refer to individuals is for grammatical convenience and is intended to be gender neutral.

**A.      Artesian well:** A well that penetrates a saturated hydrogeologic unit and allows underground water to rise or move appreciably into another geologic unit, or allows underground water to rise to freely flow at the land surface. For regulatory purposes, the determination of whether a well or bore hole is artesian shall be made by the state engineer, taking into consideration the potential for loss of water at the land surface or into another geologic unit.

**B.      Drill rig supervisor:** A person registered by the office of the state engineer who may provide onsite supervision of well drilling activities. A drill rig supervisor shall only provide onsite supervision when he is operating under the direction of a licensed well driller.

**C.      Drilling:** see definition for well drilling.

**D.      Mine drill hole:** A deep narrow hole drilled to explore for or delineate deposits or accumulations of ore, mineral, or rock resources.

**E.      Well:** A bore hole, cased or screened bore hole, or other hydraulic structure that is drilled, driven, or dug with the intent of penetrating a saturated geologic unit. The intended use may be for developing a source of water supply, for monitoring water levels, for monitoring water quality, for exploratory purposes, for water remediation, for injection of water, for geothermal purposes, or for other purposes.

**F. Well drilling, well drilling activities:** The activities associated with the drilling of a well, including, but not limited to, the construction, drilling, completion, repair, deepening, cleaning, plugging, and abandonment of a well.

[19.27.4.7 NMAC - N, 8-31-2005]

**19.27.4.8 LICENSE REQUIRED:** Any person who engages in the business of well drilling within the state of New Mexico shall obtain a well driller license issued by the state engineer (except, under New Mexico state law, a well driller license is not required for driven wells that do not require the use of a drill rig and which have an outside casing diameter of two and three-eighths ( $2\frac{3}{8}$ ) inches or less). A person found engaged in the business of well drilling within the state of New Mexico without a license can be prosecuted in accordance with New Mexico Statutes. A well driller license is not required for work on pumping equipment.

[19.27.4.8 NMAC - Rp, SE 66-1, Article 4-1, 8-31-2005]

**19.27.4.9 EXISTING WELL DRILLER LICENSE RECOGNIZED:** A person holding a valid and current well driller license in the state of New Mexico on August 31, 2005 shall have his license recognized. Any amendment or change to a license shall be made pursuant to the requirements of 19.27.4.16 NMAC and 19.27.4.17 NMAC. A licensed well driller may request that his license be renewed by filing an application with the state engineer prior to the expiration of the current license (see 19.27.4.20 NMAC). A well driller that allows his license to expire and does not reinstate the license within the grace period provided for under 19.27.5.19 NMAC shall apply for a new license in accordance with the requirements of 19.27.4.12 NMAC.

[19.27.4.9 NMAC - N, 8-31-2005]

**19.27.4.10 - 19.27.4.11 RESERVED**

**19.27.4.12 APPLICATION FOR A NEW LICENSE:** An applicant for a well driller license shall meet the following requirements to be considered for licensure.

**A. Qualified applicant:** A qualified applicant for a well driller license shall:

(1) have passed the national ground water association general exam; and  
(2) have passed the appropriate national ground water association methodology exam(s) for each type of drilling method for which the applicant has requested to be licensed (the state engineer shall make the final determination of the test(s) necessary should a question arise regarding applicability of available test(s) to applied method(s) of well construction); and

(3) have at least two (2) years of relevant, on-site experience working under the supervision of a licensed well driller; and

(4) effective July 1, 2006, have passed the New Mexico general drilling exam.

**B. Application - form and content:** An application for a well driller license shall be completed on a form prescribed by the state engineer. The application shall include the name, address, and the phone number of the applicant, the state of residency of the applicant, three letters of reference (one of which shall be from a well driller licensed in New Mexico, or a state's licensing authority, attesting to the applicant's well drilling ability), documentation of prior well drilling experience, proof of required bonds, proof of required insurances, documentation that applicant has passed the required exams listed in Paragraphs (1), (2) and (4) of Subsection A of 19.27.4.12 NMAC, the name of each registered drill rig supervisor that the applicant plans to supervise, if known, the type of well drilling methods the applicant is applying to be licensed for, and other information deemed necessary by the state engineer. The application must also contain a description of each active drill rig owned or controlled by the applicant. The description of the drill rig shall be on a form prescribed by the state engineer and shall include a side-view photograph of the rig.

**C. Filing fee:** A fee of fifty dollars (\$50) is required to accompany an application for a new license.

**D. Bond requirements:** Each applicant for a well driller license shall file a bond in the penal sum of five thousand dollars (\$5,000) on a form acceptable to the state engineer. The surety backing the bond shall be acceptable to the state engineer. A well driller license shall be valid only so long as the bond remains in effect. The bond shall:

(1) be conditioned upon proper compliance with state law and the rules and regulations of the state engineer; and

(2) be effective for the period of time for which the license is issued; and

(3) stipulate the obligee as the "office of the state engineer"; and

(4) not be represented to the public as a performance bond.

**E. Insurance requirements:** Each applicant for a well driller license shall file with the state engineer proof of general liability insurance in the minimum amount of three hundred thousand dollars (\$300,000) and proof of appropriate insurance under the Workers' Compensation Act. [19.27.4.12 NMAC – Rp SE 66-1, Article 4-2, 8-31-2005]

**19.27.4.13 NATIONAL GROUND WATER ASSOCIATION EXAMS:** The national ground water association exams shall consist of the general drilling exam and the appropriate drilling methodology exam(s) developed and administered by the national ground water association. If an applicant has passed the national ground water association general exam and appropriate methodology exams in another state, the applicant shall provide written proof to the state engineer. The fee to take the national ground water association exams will be established by the national ground water association. [19.27.4.13 NMAC - N, 8-31-2005]

**19.27.4.14 NEW MEXICO GENERAL DRILLING EXAM:** This section has an effective date of July 1, 2006. The New Mexico general drilling exam will be offered at least four (4) times a year by the state engineer or his authorized representative.

**A. Exam fee:** The fee to take the New Mexico general drilling exam will be based on the approximate cost of administering the test.

**B. Test - content:** The New Mexico general drilling exam may include questions on the following subjects:

- (1) New Mexico water law as it pertains to well driller licensing, well drilling and construction, and the administration of underground water;
- (2) the state engineer's rules and regulations pertaining well driller licensing, well drilling and construction, and the administration of underground water;
- (3) New Mexico environment department's rules, regulations, and guidelines pertaining to set back requirements, well disinfection, sampling of underground water, and water analysis;
- (4) the proper methods and techniques for well drilling;
- (5) geologic formations and proper terminology used in describing underground material types;
- (6) basic groundwater geology and the occurrence and movement of underground water;
- (7) legal description of well location, latitude and longitude, and the New Mexico coordinate system;
- (8) global positioning system terminology and receiver operation;
- (9) other topics and subjects related to well driller licensing, well construction, and well drilling within the state of New Mexico.

**C. Passing the exam:** The applicant shall obtain a minimum score of seventy percent (70%) to pass the New Mexico general drilling exam.

**D. Re-examination:** An applicant who fails to obtain the minimum passing score on the exam may retake the exam.

(1) The fee to retake the New Mexico general drilling exam will be based on the approximate cost of administering the test.

(2) Any applicant found cheating on the exam, as determined by the tester or testing agency, will not be permitted to reapply to take the exam for a period of one (1) year from the date of the transgression. [19.27.4.14 NMAC - N, 7-1-2006]

**19.27.4.15 APPLICATION REVIEW AND LICENSING REQUIREMENTS:** If the state engineer finds that an applicant has fulfilled the requirements for licensure as set forth in 19.27.4.12 NMAC, the state engineer shall issue a well driller license to the applicant. The license shall set forth the conditions under which the well driller shall operate his well drilling activities within the state of New Mexico. The license shall also state which drilling methods the well driller may engage in.

**A. License duration:** A license issued by the state engineer will be valid for a period of two (2) years.

**B. Driller identification card:** The state engineer will issue a well driller identification card to each licensed well driller. When drilling within the state of New Mexico, a well driller shall have his identification card available for inspection upon request.

**C. Drill rig marking:** The name and license number of the well driller shall be clearly displayed on each drill rig under his control.

**D. Oversight of registered drill rig supervisor:** A licensed well driller may allow a registered drill rig supervisor to provide onsite supervision of well drilling activities. The licensed well driller is responsible for the actions of each drill rig supervisor that he directs to provide such onsite supervision of well drilling activities. [19.27.4.15 NMAC - Rp, SE 66-1, Articles 4-4 and 4-5, 8-31-2005]

**19.27.4.16 CHANGES TO LICENSE:** A licensed well driller shall notify the state engineer in writing within 10 days of any change to his current license, including:

- A.** change in address or any other contact information; or
  - B.** change in drill rig supervisor; or
  - C.** severing ownership or control of an active drill rig; or
  - D.** acquiring ownership or control of an active drill rig (the description of the drill rig shall be on a form prescribed by the state engineer and shall include a side-view photograph of the rig).
- [19.27.4.16 NMAC - Rp, SE 66-1, Article 4-9, 8-31-2005]

**19.27.4.17 REQUEST TO BE LICENSED IN ADDITIONAL DRILLING METHODOLOGY:** A licensed well driller shall apply in accordance with the requirements of 19.27.4.12 NMAC to be licensed in an additional drilling methodology. [19.27.4.17 NMAC - N, 8-31-2005]

**19.27.4.18 RESERVED**

**19.27.4.19 LICENSE EXPIRATION:** A well driller license shall expire on the date set out on the license. An application to renew a license shall be filed in accordance with 19.27.4.20 NMAC at least ten (10) days prior to the expiration date. If an application to renew a license is not filed with the state engineer prior to the expiration of the current license, the license shall automatically expire. The state engineer will allow a forty-five (45) day grace period after the expiration of a well driller license during which time a well driller may file an application to renew his well driller license and request to have the expired license reinstated. If an application to renew a well driller license is not filed within this time period, the license shall be considered expired without option for reinstatement. A well driller that allows his license to expire and does not reinstate the license within the forty-five (45) day grace period must apply for a new license in accordance with the requirements of 19.27.4.12 NMAC. [19.27.4.19 NMAC - N, 8-31-2005]

**19.27.4.20 LICENSE RENEWAL:** A licensed driller may request that his license be renewed by filing an application with the state engineer prior to the expiration of his current license. The application for renewal of a well driller license shall be completed on a form prescribed by the state engineer.

**A. Form – content:** The application for renewal of a well driller license shall include the name, address, phone number, and license number of the well driller, the state of residency of the well driller, proof of required bonds, proof of required insurances, a list of registered drill rig supervisors that the well driller supervises, evidence of meeting the continuing education requirements, and other information deemed necessary by the state engineer.

**B. Filing fee:** A fee of fifty dollars (\$50) shall accompany the application.

**C. Continuing education requirements:** During each two (2) year licensing period, a licensed well driller shall complete a minimum of eight (8) continuing education hours approved by the state engineer. The continuing education hours shall relate to well drilling. At least two (2) hours of the continuing education shall be specific to regulatory requirements regarding well drilling in the state of New Mexico.

[19.27.4.20 NMAC - Rp, SE 66-1, Article 4-6, 8-31-2005]

**19.27.4.21 REPRIMANDS, SUSPENSION OR REVOCATION OF WELL DRILLER LICENSE:** The state engineer may issue a written reprimand, a compliance order issued pursuant to Section 72-2-18 NMSA, or, after notice and hearing held pursuant to 19.25.2 NMAC and 19.25.4 NMAC, suspend or revoke a well driller license if it is found that a well driller:

- A.** made a material misstatement of facts in his application for license; or
- B.** failed to submit or submitted an incomplete well record or well log; or
- C.** made a material misstatement of facts in a well record or well log; or
- D.** drilled a well in any declared underground water basin without a state engineer permit; or
- E.** violated the conditions of the state engineer permit under which the well was being drilled; or

- F. violated the conditions of his well driller license; or
- G. the licensed well driller or his registered drill rig supervisor was not present at the drilling site during well drilling activities; or
- H. violated the rules and regulations of the state engineer; or
- I. failed to assure the protection of the public safety, health, welfare, and property in the well construction process.

[19.27.4.21 NMAC - Rp, SE 66-1, Article 4-10, 8-31-2005]

**19.27.4.22 - 19.27.4.24 RESERVED**

**19.27.4.25 APPLICATION FOR REGISTRATION AS A DRILL RIG SUPERVISOR:** A person registered by the office of the state engineer as a drill rig supervisor may provide onsite supervision of well drilling activities. A drill rig supervisor shall work under the direction of a licensed well driller. The licensed well driller is responsible for the actions of each drill rig supervisor that he directs to provide onsite supervision of well drilling activities. An applicant for registration as a drill rig supervisor shall meet the following requirements.

**A. Qualified applicant:** A qualified applicant for a registration as a drill rig supervisor shall:

(1) have at least two (2) years of relevant, on-site experience working under the supervision of a licensed well driller; and

(2) be at least eighteen (18) years of age; and

(3) effective July 1, 2006, have passed the New Mexico general drilling exam.

**B. Application - form and content:** An application for registration as a drill rig supervisor shall be completed on a form prescribed by the state engineer. The application shall include the name, address, and phone number of the applicant, a letter of reference from a well driller licensed in New Mexico, or a state's licensing authority, attesting to applicant's well drilling ability, the license number and contact information of the well driller the applicant plans to work for, if known, documentation of prior well drilling experience, documentation that the applicant has passed the New Mexico general drilling exam, and other information deemed necessary by the state engineer.

**C. Filing fee:** There is no filing fee for the application.

[19.27.4.25 NMAC - N, 8-31-2005]

**19.27.4.26 APPLICATION REVIEW AND REGISTRATION REQUIREMENTS FOR DRILL RIG SUPERVISOR:** If the state engineer finds that the applicant has fulfilled the requirements for registration as set forth in 19.27.4.25 NMAC, the state engineer shall register the applicant as a drill rig supervisor. The registration shall set forth the conditions under which the drill rig supervisor may provide onsite supervision of well drilling activities within the state of New Mexico.

**A. Registration duration:** A registration issued by the state engineer will be valid for a period of two (2) years.

**B. Identification card:** The state engineer will issue a drill rig supervisor identification card with the registration. Each drill rig supervisor, when providing onsite supervision of well drilling activities within the state of New Mexico shall have his identification card available for inspection upon request.

[19.27.4.26 NMAC - N, 8-31-2005]

**19.27.4.27 RENEWAL OF DRILL RIG SUPERVISOR REGISTRATION:** A registered drill rig supervisor may request that his registration be renewed by filing an application with the state engineer prior to the expiration of his current registration.

**A. Form - content:** The application shall be on a form prescribed by the state engineer and shall include the name, address, phone number, and registration number of the drill rig supervisor, the license number and contact information of the well driller the drill rig supervisor is currently working under, evidence of meeting the continuing education requirements, and other information deemed necessary by the state engineer.

**B. Filing fee:** There is no filing fee for the application.

**C. Continuing education requirements:** During each two (2) year registration period, a registered drill rig supervisor shall complete a minimum of eight (8) continuing education hours approved by the state engineer. The continuing education hours shall relate to well drilling. At least two (2) hours of the continuing education shall be specific to regulatory requirements regarding well drilling in the state of New Mexico.

**D. New Mexico general drilling exam:** Persons registered as drill rig supervisor in the state of New Mexico on or before July 1, 2006 shall be required to pass the New Mexico general drilling exam on or before August 31, 2010.  
[19.27.4.27 NMAC - N, 8-31-2005]

**19.27.4.28 RESERVED**

**19.27.4.29 WELL DRILLING – GENERAL REQUIREMENTS:** All wells shall be constructed to prevent contamination, to prevent inter-aquifer exchange of water, to prevent flood waters from contaminating the aquifer, and to prevent infiltration of surface water. A licensed well driller shall ensure that an appropriate well permit or emergency authorization has been granted by the state engineer prior to the well drilling. A licensed well driller shall ensure that the well drilling activities are made in accordance with 19.27.4.30 NMAC, 19.27.4.31 NMAC, and the following requirements:

**A. On-site supervision of well drilling:** A licensed well driller or registered drill rig supervisor shall be present at the drilling site during well drilling.

**B. Materials:** Materials used in well drilling shall conform to industry standards acceptable to the state engineer. Acceptable standards include, but are not limited to, standards developed by the American water works association (AWWA), the American standard for testing materials (ASTM), the American petroleum institute (API), and the national sanitation foundation (NSF). The state engineer shall make the final determination of applicability of standards if any of the acceptable standards are different from one another. Materials used in well construction shall be in new or good condition. No materials shall be used that may cause water contamination. Only potable water shall be placed in a well during well drilling.

**C. Cleaning of drilling equipment:** All down-hole equipment shall be maintained in a clean and sanitary condition to prevent contamination and to protect the public health. To reduce the potential of contaminating a well, equipment shall be disinfected prior to well drilling with a chlorine solution of household chlorine bleach diluted at one part bleach to nine parts water. Adequate contact time shall be allowed for the disinfectant to sanitize the equipment before rinsing (laboratory testing will not be required).

**D. Well setbacks:** All wells shall be set back a minimum of fifty (50) feet from an existing well of other ownership, unless a variance has been granted by the state engineer. All wells shall be set back from potential sources of contamination in accordance with New Mexico environment department regulations and other applicable ordinances or regulations.

**E. Casing height:** The top of all well casings shall extend a minimum of eighteen (18) inches above land surface. All vents installed in the well casing shall be protected against the entrance of foreign material by installation of down-turned and screened "U" bends. All other openings in casings shall be sealed to prevent entrance of foreign material and flood waters.

**F. Subsurface vault:** The completion of a well within a subsurface vault is not recommended due to difficulty in performing well repairs and cleaning. If a well is completed within a subsurface vault, the casing shall extend a minimum of eighteen (18) inches above the floor of the vault.

**G. Surface pad:** A concrete pad is recommended on all wells. It is recommended that:

- (1) the surface area of the concrete pad be a minimum of four (4) square feet; and
- (2) the concrete pad be centered around the well; and
- (3) the pad be at least four (4) inches in thickness and slope away from the well; and
- (4) when surface casing is used, the surface pad should seal the top of the annular space between the production casing and the surface casing.

**H. Access for water level monitoring:** Every well shall be constructed with a wellhead opening of at least one half (½) inch diameter to allow the water level to be measured. A water-tight removable cap or plug shall be securely placed in the opening. An artesian well that flows at land surface upon completion of the well shall be equipped with a valve to which a pressure gauge may be attached.

**I. Requirement to cover or cap wells:** During well drilling, a well shall be securely covered or capped unless a licensed well driller or registered drill rig supervisor is on-site attending to the well. A permanent well cap or cover shall be securely affixed to the well casing upon completion. All permanent caps shall have a well access opening in accordance with Subsection H of 19.27.4.29 NMAC.

**J. Well identification tag:** The state engineer may require that a well be tagged with a well identification tag. If a well tag is required, the well driller shall affix the tag in plain view. The state engineer will provide a well tag when a permit is issued. Replacement well tags will be issued upon request. The permit holder is

responsible for maintaining the well identification tag. A missing, damaged, or illegible well identification tag shall be replaced with a duplicate tag.

**K. Well record:** The well driller shall keep a record of each well drilling activity as the work progresses.

(1) **Time for filing:** The well driller shall file a complete well record with the state engineer and the permit holder no later than twenty (20) days after completion of the well drilling.

(2) **Form – content:** The well record shall be on a form prescribed by the state engineer and shall include the name and address of the permittee, the well driller's name and license number, the state engineer file number, the name of each registered drill rig supervisor that supervised well drilling activities, the location of the well (reported in latitude and longitude using a global positioning system (gps) receiver capable of five (5) meters accuracy), the date when drilling or other work began, the date when drilling or other work concluded, the depth of the well, the depth to water first encountered, the depth to water upon completion of the well (measured by a method approved by the state engineer), the estimated well yield, the method used to estimate well yield, the size and type of casing, the location of perforations, the location of the sanitary seal, and other information deemed necessary by the state engineer. The well record shall include a completed well log. The well log shall include detailed information on the depth and thickness of all strata penetrated, including whether each stratum was water bearing.

**L. Geologic formation samples:** When requested by the state engineer, the well driller shall furnish lithologic samples ("drill cuttings") of the geologic units penetrated during drilling operations. The method of sampling, interval of sampling, and the quantities required will be specified by the state engineer. Lithologic samples shall be placed in sample bags supplied by the state engineer.

[19.27.4.29 NMAC - Rp, SE 66-1, Articles 4-11, 4-12, and 4-13, 8-31-2005]

**19.27.4.30 WELL DRILLING - NON-ARTESIAN WELL REQUIREMENTS:** A licensed well driller shall ensure that the well drilling activities associated with the drilling of non-artesian wells are made in accordance with 19.27.4.29 NMAC and the following requirements:

**A. Annular seal:** All wells shall be constructed to prevent contaminants from entering the hole from the land surface by sealing the annular space around the outermost casing. When necessary; annular seals will be required to prevent inter-aquifer exchange of water, to prevent the loss of hydraulic head between geologic zones, and to prevent the flow of contaminated or low quality water. Sealing operations shall be made with cement grout or bentonite-based sealing material acceptable to the state engineer. Casings shall be centered in the bore hole so grout or sealing materials may be placed evenly around the casing.

(1) **Annular space:** The diameter of the hole in which the annular seal is to be placed shall be at least four (4) inches greater than the outside diameter of the outermost casing. The diameter of the hole in which the annular seal is to be placed may be reduced to three (3) inches greater than the outside diameter of the outermost casing if pressure grouting from the bottom up is used for grout placement and the well casing is centralized in the bore hole. If surface casing is used, the inside diameter of the surface casing shall be at least three (3) inches greater than the outside diameter of the production casing.

(2) **Annular seal completed to land surface:** Annular seals shall extend from land surface to at least twenty (20) feet below land surface. If a well is completed less than twenty (20) feet below land surface, the seal shall be placed from land surface to the bottom of the blank casing used. The annular seal shall extend to land surface unless a pitless adapter is installed. For wells completed with a pitless adapter, the top of the seal shall extend to one (1) foot below the pitless adapter connection. All sealing materials placed deeper than twenty (20) feet below land surface shall be placed by tremie pipe or by pressure-grouting through the well casing and up the annulus.

(3) **Annular seals to prevent inter-aquifer exchange of water or loss of hydraulic head between geologic zones:** Sufficient annular seal shall be placed to prevent inter-aquifer exchange of water and to prevent loss of hydraulic head between geologic zones. Sufficient annular seal shall be placed to prevent loss of hydraulic head through the well annulus, through perforated or screened casing, or through an open bore interval.

(4) **Annular seals to prevent the contamination of potable water:** Wells which encounter non-potable, contaminated, or polluted water at any depth shall have the well annulus sealed and the well properly screened to prevent the commingling of the undesirable water with any potable or uncontaminated water. The use of salt-tolerant sealing materials may be required by the state engineer in wells that encounter highly mineralized water.

(5) **Annular seal requirements for community water supply wells:** Community water supply wells shall also be completed with annular seals in accordance with New Mexico environment department regulations and other applicable ordinances or regulations.

**B. Well casing:** The well casing shall have sufficient wall thickness to withstand formation and hydrostatic pressures placed on the casing during installation, well development, and use.

**C. Well plugging:** A non-artesian well that is abandoned or not properly constructed shall be immediately plugged. A plan for plugging the well shall be filed with - and approved by - the state engineer prior to plugging. The state engineer may require that the plugging process be witnessed by an authorized representative.

**(1) Methods and materials:** To plug a well, the entire well shall be filled from the bottom upwards to land surface using a tremie pipe. The well shall be plugged with neat cement slurry, bentonite based plugging material, or other sealing material approved by the state engineer for use in the plugging of non-artesian wells. Wells that do not encounter a water bearing stratum shall be immediately plugged by filling the well with drill cuttings or clean native fill to within ten (10) feet of land surface and by plugging the remaining ten (10) feet of the well to land surface with a plug of neat cement slurry, bentonite based plugging material, or other sealing material approved by the state engineer.

**(2) Contamination indicated:** Wells encountering contaminated water or soil may require coordination between the office of the state engineer and the New Mexico environment department (or other authorized agency or department) prior to the plugging of the well. Specialty plugging materials and plugging methods may be required.

**(3) Plugging record:** A licensed well driller shall keep a record of each well plugged as the work progresses. The well driller shall file a complete plugging record with the state engineer and the permit holder no later than twenty (20) days after completion of the plugging. The plugging record shall be on a form prescribed by the state engineer and shall include the name and address of the well owner, the well driller's name and license number, the name of each drill rig supervisor that supervised the well plugging, the state engineer file number for the well, the location of the well (reported in latitude and longitude using a global positioning system (gps) receiver capable of five (5) meters accuracy), the date when plugging began, the date when plugging concluded, the plugging material(s) used, the depth of the well, the size and type of casing, the location of perforations, the location of the sanitary seal, and other information deemed necessary by the state engineer. The plugging record shall include a completed well log. The well log shall include detailed information on the depth and thickness of all strata plugged, including whether each stratum was water bearing.

**D. Repair requirements:** A well driller license is not required to install or repair pumping equipment.

[19.27.4.30 NMAC - Rp, SE 66-1, Article 4-14, 8-31-2005]

**19.27.4.31 WELL DRILLING - ARTESIAN WELL REQUIREMENTS:** No artesian well shall be constructed that allows ground water to flow uncontrolled to the land surface or move appreciably between geologic units. For regulatory purposes, the determination of whether a well is artesian shall be made by the state engineer. A licensed well driller shall ensure that well drilling activities associated with the drilling of artesian wells are made in accordance with 19.27.4.29 NMAC and the following requirements:

**A. Plan of operations:** The permittee or owner of the land upon which the well drilling is planned shall provide a description of the proposed work on a form prescribed by the state engineer. The plan of operations shall list the materials to be used and include the cementing and testing procedures. The plan of operations shall be completed by a licensed well driller. A plan of operations must be approved by the state engineer before the drilling of any artesian well. Drilling of an artesian well shall be made in accordance with a plan of operations approved by the state engineer.

**B. Construction inspection:** The casing, cementing, plugging, and testing of an artesian well shall be witnessed by an authorized representative of the state engineer.

**C. Artesian wells - no prior knowledge of artesian stratum:** In the course of drilling a well, if a previously unidentified artesian stratum is encountered, such that underground water is flowing uncontrolled to the land surface or between geologic units, the flow shall be controlled immediately. The state engineer shall be immediately notified that an artesian stratum was encountered, and a plan of operations shall be submitted in accordance with Subsection A of 19.27.4.31 NMAC.

**D. Casing and coupling material requirements:** Couplings and threaded steel casing used in the construction of an artesian well shall meet minimum American petroleum institute (API) specifications (the API casing specifications are listed in the table below). If the well casing or joint connection proposed in the plan of operations is not listed in the table below, the specifications for the casing and connections shall be approved by the state engineer prior to well drilling. If casing length exceeds one thousand (1,000) feet and the diameter of the casing is thirteen and three-eighths (13 $\frac{3}{8}$ ) inch diameter or larger, H-grade or better shall be used. The casing for artesian wells shall be inspected by an authorized representative of the state engineer prior to well construction.

Outside Diameter (inches)	Weight with Couplings (lbs/ft)	Wall Thickness (inches)	Coupling O.D. (inches)	Coupling Length (inches)	Threads per Inch	Minimum Grade of Casing
4½	9.50	.205	5.000	5	8	F-25
5½	13.00	.225	6.050	6¾	8	F-25
6	15.00	.233	6.625	7	8	F-25
6¾	17.00	.245	7.390	7¼	8	F-25
7	17.00	.231	7.656	7¼	8	F-25
7¾	20.00	.250	8.500	7½	8	F-25
8¾	24.00	.264	9.625	7¾	8	F-25
9¾	29.30	.281	10.625	7¾	8	F-25
10¾	32.75	.279	11.750	8	8	F-25
11¾	38.00	.300	12.750	8	8	F-25
13¾	48.00	.330	14.375	8	8	F-25
16	55.00	.312	17.000	9	8	F-25
20	94.00	.438	21.000	9	8	F-25

**E. Casing installation requirements:** The casing shall be centered within the bore hole so grout may be evenly placed around the casing. A commercially made float shoe shall be installed on the lowermost joint of casing to be landed unless an alternate method for cementing has been approved by the state engineer. The casing shall be un-perforated and the well shall be designed in a manner to prevent the commingling of water from the artesian stratum with water in an overlying or underlying geologic unit.

**F. Annular space:** The diameter of the hole in which the cement seal shall be placed shall be at least four (4) inches greater than the outside diameter of the casing set through the confining formation overlying the artesian aquifer. The diameter of the hole in which the cement seal shall be placed may be reduced to three (3) inches greater than the outside diameter of the casing set through the confining formation overlying the artesian aquifer if pressure grouting from the bottom up is used for grout placement and the well casing is centralized in the bore hole. If surface casing is used, the inside diameter of the surface casing shall be at least three (3) inches greater than the outside diameter of the production casing.

**G. Annular space cementing requirements:** The annular seal shall consist of a neat cement slurry acceptable to the state engineer. The cement seal shall originate within the artesian stratum and shall be continuously placed to land surface. The cementing process shall be witnessed by an authorized representative of the state engineer. When necessary, sufficient annular seal shall be placed to prevent inter-aquifer exchange of water and to prevent loss of hydraulic head between geologic zones.

**H. Annular space – cement placement:** The cement slurry shall be placed in the annular space by one of the following methods:

(1) **Tremie method:** The neat cement slurry shall be pumped using a tremie pipe to fill the annular space of the well from the origin of the seal within the artesian stratum to land surface. Flow of undiluted cement out of the top of the annular space shall be established with the tremie pipe suspended in the annulus. The lower end of the tremie shall remain immersed in the cement slurry for the duration of pumping. The tremie pipe may be gradually removed as cement level in the annulus rises.

(2) **Pressure grout method:** The neat cement slurry shall be pumped down the inside of the casing, through the float shoe, and up the annular space until undiluted cement slurry circulates out of the annulus at land surface. Excess cement may be displaced out of the casing from behind with drilling fluid, but the drilling fluid shall not be pumped entirely to the level of the float shoe except to lodge a drillable plug at the bottom of the casing. Should undiluted cement slurry not be displaced out the top of the annulus in a continuous pressure grouting operation, the cementing job may be completed by the use of the tremie method. If the tremie method is employed, a tremie pipe shall be suspended in the annulus to the approximate level of the competent cement grout. The neat cement slurry shall be pumped to fill the annular space of the well from the top of the competent cement grout to land surface.

**I. Sealing off formations:** The compressive strength of neat cement shall be five hundred (500) psi or more before well drilling is resumed. Cement must be allowed to set a minimum of forty-eight (48) hours before well drilling is resumed. Shorter set times may be requested if approved accelerants are used. Sealing off of the formations shall be checked by a method acceptable to the state engineer. In the case of remediation of

unanticipated artesian bore holes, the compressive strength of neat cement shall be one thousand (1,000) psi or more before artesian head is shut-in at the wellhead.

**J. Repair requirements:** When an artesian well is in need of repair, the permittee or owner of the land upon which the well is located shall provide a plan of operations to the state engineer. The plan of operations shall be prepared in accordance with Subsection A of 19.27.4.31 NMAC. Before repairs are made to an artesian well, the well shall first be inspected by an authorized representative of the state engineer to determine if the condition of the well is such that it may be repaired. When a leak in the casing is found and the casing and well are otherwise in good condition, the state engineer may allow the well to be repaired. A packer or bridge plug may be required to complete necessary well repairs. The use of a lead packer is prohibited. An inspection shall be made at the completion of the work to determine if the repair is satisfactory. During an inspection, the well shall be open to allow for the entrance of equipment for testing and inspection.

**K. Plugging requirements:** An artesian well that is abandoned or not properly constructed shall be immediately plugged. Plugging of an artesian well shall require submittal of a plan of operations in accordance with Subsection A of 19.27.4.31 NMAC. The well shall be plugged from the bottom upwards with a neat cement slurry. The well plugging shall be witnessed by an authorized representative of the state engineer.

**(1) Well plugging, contamination indicated:** Wells encountering contaminated water or soil may require coordination between the office of the state engineer and the New Mexico environment department (or other authorized agency or department) prior to the plugging of the well. Specialty plugging materials and plugging methods may be required.

**(2) Plugging record:** A licensed well driller shall keep a record of each well plugged as the work progresses. A plugging record shall be filed in accordance with Paragraph 3 of Subsection C of 19.27.4.30 NMAC. [19.27.4.31 NMAC - Rp, SE 66-1, Articles 4-15, 4-16, 4-17, 4-18, and 4-19, 8-31-2005]

#### **19.27.4.32 - 19.27.4.35 RESERVED**

**19.27.4.36 REQUIREMENTS FOR MINE DRILL HOLES THAT ENCOUNTER WATER:** Any person drilling a mine drill hole that encounters a water bearing stratum shall plug that hole in accordance with Subsection C of 19.27.4.30 NMAC or Subsection K of 19.27.4.31 NMAC within 30 days of encountering the water bearing stratum.

**A. Well record required:** Within thirty (30) days after the date of the discovery of water, a well record shall be filed in accordance with Subsection K of 19.27.4.29 NMAC.

**B. Artesian water encountered:** If artesian water is encountered in the process of drilling a mine drill hole, the drill hole shall be constructed or plugged in accordance with 19.27.4.31 NMAC. [19.27.4.36 NMAC - Rp, SE 66-1, Article 4-21, 8-31-2005]

**19.27.4.37 REQUEST FOR VARIANCE:** The rules in 19.27.4.29 NMAC, 19.27.4.30 NMAC, and 19.27.4.31 NMAC are not intended to cover every situation encountered during well drilling. Geologic conditions vary across the state, and may warrant the need to deviate from the rules contained in 19.27.4.29 NMAC, 19.27.4.30 NMAC, or 19.27.4.31 NMAC. A request for a variance to a rule in 19.27.4 NMAC shall be submitted in writing by a qualified applicant, permit holder, or licensed well driller. It is recommended that a request for variance be prepared by a licensed well driller. The request shall include a detailed justification for the variance and shall demonstrate that such a variance is necessary to preclude unreasonable hardship or that application of a rule in 19.27.4 NMAC would not be practicable. The state engineer may grant the variance if he finds the request to be reasonable and just. The state engineer shall respond in writing to the request for variance and, if the variance is granted, the state engineer may impose terms and conditions. [19.27.4.37 NMAC - Rp, SE 66-1, Article 4-22, 8/31/2005]

**19.27.4.38 LIBERAL CONSTRUCTION:** This part shall be liberally construed to carry out its purpose. [19.27.4.38 NMAC - N, 8/31/2005]

**19.27.4.39 SEVERABILITY:** If any portion of this part is found to be invalid, the remaining portion of this part shall remain in force and not be affected. [19.27.4.39 NMAC - N, 8-31-2005]

#### **HISTORY OF 19.27.4 NMAC:**

**Pre NMAC History:** The material in this part was derived from that previously filed with the State Records Center and Archives.

SE-66-1, Rules and Regulations Governing Drilling of Wells and Appropriation and Use of Ground Water in New Mexico, Article 4, Well Drillers Licensing, Construction, Repair and Plugging Of Wells, originally filed with the Supreme Court Law Library 11/1/66. Filed with the State Records Center 6/27/91.

**History of Repealed Material:**

SE-66-1, Rules and Regulations Governing Drilling of Wells and Appropriation and Use of Ground Water in New Mexico, Article 4, Well Drillers Licensing, Construction, Repair and Plugging of Wells - Repealed 8/31/2005.

**APPENDIX C**  
**NMED Monitoring Well Construction Requirements**  
**(Attachment 19)**

## **ATTACHMENT 19 MONITORING WELL CONSTRUCTION REQUIREMENTS**

### **19.1 TYPES OF MONITORING WELLS**

Two types of groundwater monitoring wells are required at the Facility: single completion (containing one screened interval) and multiple screened wells. General drilling procedures are presented in Section 19.2 and monitoring well construction requirements are presented in Section 19.3 of this Permit Attachment.

### **19.2 DRILLING METHODS**

Groundwater monitoring wells and piezometers must be designed and constructed in a manner that will yield high quality samples, ensure that the well will last the duration of the project, and ensure that the well will not serve as a conduit for contaminants to migrate between different stratigraphic units or aquifers. The design and construction of groundwater monitoring wells shall comply with the guidelines established in various EPA RCRA guidance, including, but not limited to:

- U.S. EPA, *RCRA Groundwater Monitoring: Draft Technical Guidance*, EPA/530-R-93-001, November, 1992;
- U.S. EPA, *RCRA Groundwater Monitoring Technical Enforcement Guidance Document*, OSWER-9950.1, September, 1986; and
- Aller, L., Bennett, T.W., Hackett, G., Petty, R.J., Lehr, J.H., Sedoris, H., Nielsen, D.M., and Denne, J.E., *Handbook of Suggested Practices for the Design and Installation of Groundwater Monitoring Wells*, EPA 600/4-89/034, 1989.

A variety of methods are available for drilling monitoring wells. While the selection of the drilling procedure is usually based on the site-specific geologic conditions, the following issues shall also be considered:

- Drilling shall be performed in a manner that minimizes impacts to the natural properties of the subsurface materials.
- Contamination and cross-contamination of groundwater and aquifer materials during drilling shall be avoided.
- The drilling method shall allow for the collection of representative samples of rock, unconsolidated materials, and soil.
- The drilling method shall allow the Permittee to determine when the appropriate location for the screened interval(s) has been encountered.
- The drilling method shall allow for the proper placement of the filter pack and annular sealants. The borehole diameter shall be at least four inches larger in diameter than the nominal diameter of the well casing and screen to allow adequate space for placement of the filter pack and annular sealants.

The drilling method shall allow for the collection of representative groundwater samples. Drilling fluids (which includes air) shall be used only when minimal impact to the surrounding formation and groundwater can be ensured.

A brief description of the different drilling methods that may be appropriate for the construction of monitoring wells at the Facility follows. Many of these methods may be used alone, or in combination, to install monitoring wells at the Facility. While the selection of the specific drilling procedure will usually depend on the site-specific geologic conditions, justification for the method selected must be provided to NMED.

### **19.2.1 Hollow-Stem Auger**

The hollow-stem continuous flight auger consists of a hollow, steel shaft with a continuous, spiraled steel flight welded onto the exterior side of the stem. The stem is connected to an auger bit and, when rotated, transports cuttings to the surface. The hollow stem of the auger allows drill rods, split-spoon core barrels, Shelby tubes, and other samplers to be inserted through the center of the auger so that samples may be retrieved during the drilling operations. The hollow stem also acts to temporarily case the borehole, so that the well screen and casing (riser) may be inserted down through the center of the augers once the desired depth is reached, minimizing the risk of possible collapse of the borehole. A bottom plug or pilot bit can be fastened onto the bottom of the augers to keep out most of the soils and/or water that have a tendency to clog the bottom of the augers during drilling. Drilling without a center plug is acceptable provided that the soil plug, formed in the bottom of the auger, is removed before sampling or installing well casings. The soil plug can be removed by washing out the plug using a side discharge rotary bit, or augering out the plug with a solid-stem auger bit sized to fit inside the hollow-stem auger. In situations where heaving sands are a problem, potable water may be poured into the augers to equalize the pressure so that the inflow of formation materials and water shall be held to a minimum when the bottom plug is removed. The hollow-stem auger method is best suited for drilling shallow overburden wells.

### **19.2.2 Air Rotary/Air Down-The-Hole Hammer/ODEX**

The air rotary method consists of a drill pipe or drill stem coupled to a drill bit that rotates and cuts through soils and rock. The cuttings produced from the rotation of the drilling bit are transported to the surface by compressed air, which is forced down the borehole through the drill pipe and returns to the surface through the annular space (between the drill pipe and the borehole wall). The circulation of the compressed air not only removes the cuttings from the borehole but also helps to cool the drill bit. The use of air rotary drilling is best suited for hard-rock formations. In soft unconsolidated formations, casing is driven to keep the formation from caving. When using air rotary, the air compressor shall have an in-line filter system to filter the air coming from the compressor. The filter system shall be inspected regularly to insure that the system is functioning properly. In addition, a cyclone velocity dissipator or similar air containment/dust-suppression system shall be used to funnel the cuttings to one location instead of allowing the cuttings to discharge uncontrolled from the borehole. Air rotary that employs the dual-tube (reverse circulation) drilling system is acceptable because the cuttings are contained within the drill stem and are discharged through a cyclone velocity dissipator to the ground surface.

The injection of air into the borehole during air rotary drilling has the potential to alter the natural properties of the subsurface. This can occur through air-stripping of the VOCs in both soil and groundwater in the vicinity of the borehole, altering the groundwater geochemical parameters (e.g., pH and redox potential), and potentially increasing biodegradation of organic compounds in the aquifer near the borehole. These factors may prevent the well from yielding groundwater samples that are representative of in-situ conditions.

In hard, abrasive, consolidated rock, a down-the-hole hammer may be more appropriate than the air rotary method. In this method, compressed air is used to actuate and operate a pneumatic hammer as well as lift the cuttings to the surface and cool the hammer bit. One drawback of the down-the-hole hammer is that oil is required in the air stream to lubricate the hammer-actuating device, and this oil could potentially contaminate the soil in the vicinity of the borehole and the aquifer.

The ODEX method is a variation of the air rotary method in which a casing-driving technique is used in combination with air rotary drilling. With the ODEX system, the drill bit extends outward and reams a pilot hole large enough for a casing assembly to slide down behind the drill bit assembly. As a result, casing is advanced simultaneously while drilling the hole.

### **19.2.3 Water Rotary and Mud Rotary**

The water and mud rotary drilling methods consist of rotary drilling techniques where water or drilling mud is used as the circulating fluid. In both methods, the circulating fluid is pumped down through the drill pipe and is returned back up the borehole through the annular space. The circulating fluid stabilizes the borehole, cools the drill bit, and carries the drill cuttings up to the surface. While the water and mud rotary drilling techniques are rapid and effective drilling methods, the recognition of water-bearing zones is hampered by the addition of water into the system.

Mud rotary drilling is similar to water rotary drilling with the exception that mud additives are added to the water to change the properties (e.g., density, viscosity, yield point, gel strength, fluid-loss-control effectiveness, lubricity) of the circulating fluid. Drilling muds provide greater borehole stabilization than water alone. There are several types of mud presently available, including bentonite, barium sulfate, organic polymers, cellulose polymers, and polyacrylamides. While drilling muds enhance the stability of the borehole and allow for drilling in formations not appropriate to other methods, they can adversely affect the hydrologic properties and geochemistry of the aquifer. For example, drilling fluid invasion and the buildup of borehole filter cake may reduce the effective porosity of the aquifer in the vicinity of the borehole. In addition, bentonite drilling muds may affect the pH of groundwater and organic polymer drilling muds have been observed to facilitate bacterial growth, which reduces the reliability of sampling results. If polymer emulsions are to be used in the drilling program at the Facility, polymer dispersion agents shall be used at the completion of the drilling program to remove the polymers from the boreholes. For example, if EZ Mud® is used as a drilling additive, a dispersant (e.g., BARAFOS® or five percent sodium hypochlorite) shall be used to disperse and chemically breakdown the polymer prior to developing and sampling the well.

### **19.2.4 Dual-Wall Reverse Circulation**

The dual-wall reverse circulation drilling method utilizes a double-wall drill pipe and has the reverse circulation of other conventional rotary drilling methods. The circulating fluid (water or air) is pumped down the borehole between the outer and inner drill pipe, and returns up the inner drill pipe. Cuttings are lifted to the surface through the inner drill pipe. The inner drill pipe rotates the bit, and the outer drill pipe acts as a casing and stabilizes the borehole. Typically, a tri-cone bit is used when drilling through unconsolidated formations and a down-the-hole hammer is used in hard rock.

The dual-wall reverse circulation rotary method is one of the better methods available for obtaining representative and continuous formation samples while drilling. If a roller cone bit is used, the formation that is being drilled is located only a few inches ahead of the double-wall pipe. As a

result, the cuttings observed at the surface represent no more than one foot of the formation at any point in time.

When drilling with air, an in-line filter shall be used to remove oil or other impurities from the airstream. However, if a down-the-hole hammer is used, it must be used with caution since it requires oil in the airstream to lubricate the hammer. This could possibly introduce contaminants to the borehole and aquifer.

### **19.2.5 Resonant Sonic**

Resonant sonic drilling is a method that uses a sonic drill head to produce high-frequency, high-force vibrations in a steel drill pipe. The vibrations in the pipe create a cutting action at the bit face, which allows a continuous core of the formation to move into a core barrel. The method requires no drilling fluid, drills very fast (up to one ft/sec in certain formations), drills at any angle through all formations (rock, clay, sand, boulders, permafrost, glacial till), and yields virtually no cuttings in the drilling process. While there are numerous advantages to this process, the primary disadvantage is the cost of the method. This drilling method has been proven and used at various facilities.

### **19.2.6 Cryogenic**

Cryogenic drilling is a technique that uses standard air rotary drilling methods, but employs cold nitrogen gas as the circulating fluid instead of compressed air. The use of nitrogen gas as the circulation fluid freezes the borehole wall while drilling, which stabilizes unconsolidated sediments and prevents potential cross-contamination of different water-bearing zones. In addition, the method produces fewer cuttings than liquid based drilling methods, requires minimal equipment modifications to existing drill rigs, and does not add contaminants to the borehole during the drilling process due to the benign nature of nitrogen gas. The method is especially applicable for drilling through alternating hard (competent) and soft (unconsolidated) formations. This drilling method has been tested by the Department of Energy (DOE) and proposed for future use at various DOE facilities.

## **19.3 WELL CONSTRUCTION/COMPLETION METHODS**

### **19.3.1 Well Construction Materials**

Well construction materials shall be selected based on the goals and objectives of the proposed monitoring program and the geologic conditions at the site. When selecting well construction materials, the primary concern shall be selecting materials that will not contribute foreign constituents or remove contaminants from the groundwater. Other factors to be considered include the tensile strength, compressive strength, and collapse strength of the materials; length of time the monitoring well will be in service; and the material's resistance to chemical and microbiological corrosion. Generally, if the monitoring program requires the analysis of organic constituents, stainless steel or fluoropolymer materials should be used. However, if the monitoring program requires only inorganic constituent analyses, polyvinyl chloride (PVC) materials may be used. PVC should not be used for monitoring wells where organic constituents will be analyzed due to its potential for sorption and leaching of contaminants.

Well screen and casing materials acceptable for the construction of RCRA monitoring wells include stainless steel (304 or 316), rigid PVC (meeting American National Standards Institute/National Sanitation Foundation Standard 14), and fluoropolymer materials (polytetrafluoroethylene,

fluorinated ethylene propylene, and polyvinylidene). In addition, there are other materials available for the construction of monitoring wells including acrylonitrile butadiene styrene (ABS), fiberglass-reinforced plastic (FRP), black iron, carbon steel, and galvanized steel, but these materials are not recommended for use in long term monitoring wells due to their low resistance to chemical attack and potential contribution of contamination to the groundwater. However, these materials may be used in the construction of monitoring wells where they will not be in contact with the groundwater that will be sampled (e.g., carbon steel pipe used as surface casing).

### **19.3.2 Well Construction Techniques**

#### **19.3.2.a Single-cased Wells**

The borehole shall be bored, drilled, or augered as close to vertical as possible, and checked with a plumb bob, level, or appropriate downhole logging tool. Slanted boreholes shall not be acceptable unless specified in the design. The borehole shall be of sufficient diameter so that well construction can proceed without major difficulties. To assure an adequate size, a minimum two-inch annular space is required between the casing and the borehole wall (or the hollow-stem auger wall). The two-inch annular space around the casing will allow the filter pack, bentonite seal, and annular grout to be placed at an acceptable thickness. Also, the two-inch annular space will allow up to a 1.5-inch outer diameter tremie pipe to be used for placing the filter pack, bentonite seal, and grout at the specified intervals.

It may be necessary to overdrill the borehole so that any soils that have not been removed (or that have fallen into the borehole during augering or drill stem retrieval) will fall to the bottom of the borehole below the depth where the filter pack and well screen are to be placed. Normally, three to five ft is sufficient for overdrilling shallow wells. Deep wells may require deeper overdrilling. The borehole can also be overdrilled to allow for an extra space for a well sump to be installed. If the borehole is overdrilled deeper than desired, it can be backfilled to the designated depth with bentonite pellets or the filter pack.

The well casings (riser assembly) should be secured to the well screen by flush-jointed threads or other appropriate connections and placed into the borehole and plumbed by the use of centralizers, a plumb bob, or a level. No petroleum-based lubricating oils or grease shall be used on casing threads. Teflon tape can be used to wrap the threads to insure a tight fit and minimize leakage. No glue of any type shall be used to secure casing joints. Teflon or fluoropolymer elastomer "O" rings can also be used to ensure a tight fit and minimize leakage. "O" rings made of materials other than Teflon or fluoropolymer elastomers are not acceptable if the well will be sampled for organic compound analyses. Before the well screen and casings are placed at the bottom of the borehole, at least six inches of filter material shall be placed at the bottom to serve as a firm footing. The string of well screen and casing should then be placed into the borehole and plumbed. If centralizers are used, they shall be placed below the well screens and above the bentonite annular seals so that the placement of the filter pack, overlying bentonite seal, and annular grout will not be hindered. Centralizers placed in the wrong locations can cause bridging during material placement. If installing the well screen and casings through hollow-stem augers, the augers shall be slowly extracted as the filter pack, bentonite seal, and grout are tremied or poured into place. The gradual extraction of the augers will allow the materials being placed in the augers to flow out of the bottom of the augers into the borehole. If the augers are not gradually extracted, the materials will accumulate at the bottom of the augers causing potential bridging problems. After the string of well screen and casing is plumb, the

filter material shall be placed around the well screen (preferably by the tremie pipe method) up to the designated depth. After the filter pack has been installed, the bentonite seal shall be placed directly on top of the filter pack up to the designated depth or a minimum of two ft above the filter pack, whichever is greater. After the bentonite seal has hydrated for the specified time, the annular grout shall be pumped by the tremie method into the annular space around the casings (riser assembly) up to within two ft of the ground surface or below the frost line, whichever is greater. The grout shall be allowed to cure for a minimum of 24 hours before the surface pad and protective casing are installed. After the surface pad and protective casing are installed, bumper guards (guideposts) shall be installed (if necessary).

#### **19.3.2.b Double-cased Wells**

Double-cased wells should be constructed when there is reason to believe that interconnection of two aquifers by well construction may cause cross contamination, or when flowing sands make it impossible to install a monitoring well using conventional methods. A pilot borehole should be advanced through the overburden and the contaminated zone into a clay, confining layer, or bedrock. An outer casing (surface or pilot casing) shall be placed into the borehole and sealed with grout. The borehole and outer casing should extend into tight clay a minimum of two ft or into competent bedrock a minimum of one foot. The total depth into the clay or bedrock will vary depending upon the plasticity of the clay and the extent of weathering and fracturing of the bedrock. The size of the outer casing shall be of sufficient inside diameter to contain the inner casing and the two-inch annular space. In addition, the borehole shall be of sufficient size to contain the outer casing and the two-inch minimum outer annular space, if applicable.

The outer casing shall be grouted by the tremie method from the bottom of the borehole to within two ft of the ground surface. The grout shall be pumped into the annular space between the outer casing and the borehole wall. This can be accomplished by either placing the tremie pipe in the annular space and pumping the grout from the bottom of the borehole to the surface, or placing a grout shoe or plug inside the casing at the bottom of the borehole and pumping the grout through the bottom grout plug and up the annular space on the outside of the casing. The grout shall consist of a Type I Portland cement and bentonite or other approved grout to provide a rigid seal. A minimum of 24 hours shall be allowed for the grout plug (seal) to cure before attempting to drill through it. When drilling through the seal, care shall be taken to avoid cracking, shattering, and washing out of the seal. If caving conditions exist so that the outer casing cannot be sufficiently sealed by grouting, the outer casing shall be driven into place and a grout seal placed in the bottom of the casing.

#### **19.3.2.c Bedrock Wells**

The installation of monitoring wells into bedrock can be accomplished in two ways. The first method is to drill or bore a pilot borehole through the soil overburden into the bedrock. An outer casing is installed into the borehole by setting it into the bedrock, and grouting it into place. After the grout has set, the borehole can be advanced through the grout seal into the bedrock. The preferred method of advancing the borehole into the bedrock is rock coring. Rock coring makes a smooth, round hole through the seal and into the bedrock without cracking or shattering the seal. Roller cone bits are used in soft bedrock, but extreme caution should be taken when using a roller cone bit to advance through the grout seal in the bottom of the borehole because excessive water and bit pressure can cause cracking, eroding (washing), and/or shattering of the seal. Low volume air hammers may be used to advance the borehole, but they have a tendency to shatter the seal because

of the hammering action. If the structural integrity of the grout seal is in question, a pressure test can be utilized to check for leaks. If the seal leaks, the seal is not acceptable. When the drilling is complete, the finished well will consist of an open borehole from the ground surface to the bottom of the well. The major limitation of open borehole bedrock wells is that the entire bedrock interval serves as the monitoring zone.

The second method is to install the outer surface casing and drill the borehole into bedrock, and then install an inner casing and well screen with the filter pack, bentonite seal, and annular grout. The well is completed with a surface protective casing and concrete pad. This well installation method gives the flexibility of isolating the monitoring zone(s) and minimizing inter-aquifer flow. In addition, it gives structural integrity to the well, especially in unstable areas (e.g., steeply dipping shales) where the bedrock has a tendency to shift or move when disturbed.

### **19.3.3 Well Screen and Filter Pack Design**

Well screens and filter packs shall be designed to accurately sample the aquifer zone that the well is intended to sample, minimize the passage of formation materials (turbidity) into the well, and ensure sufficient structural integrity to prevent the collapse of the intake structure. The selection of the well screen length depends upon the objective of the well. Piezometers and wells where only a discrete flow path is monitored are generally completed with short screens (two ft or less). While monitoring wells are usually constructed with longer screens (usually five to ten ft), they shall be kept to the minimum length appropriate for intercepting a contaminant plume. The screen slot size shall be selected to retain from 90 to 100 percent of the filter pack material in artificially filter packed wells, and from 50 to 100 percent of the formation material in naturally packed wells. All well screens shall be factory wire-wrapped or machine slotted.

A filter pack shall be used when: 1) the natural formation is poorly sorted; 2) a long screen interval is required or the screen spans highly stratified geologic materials of widely varying grain sizes; 3) the natural formation is uniform fine sand, silt, or clay, 4) the natural formation is thin-bedded; 5) the natural formation is poorly cemented sandstone; 6) the natural formation is highly fractured or characterized by relatively large solution channels; 7) the natural formation is shale or coal that will act as a constant source of turbidity to groundwater samples; or 8) the diameter of the borehole is significantly greater than the diameter of the screen. The use of natural formation material as a filter pack is only recommended when the natural formation materials are relatively coarse-grained, permeable, and uniform in grain size.

Filter pack materials shall consist of clean, rounded to well-rounded, hard, insoluble particles of siliceous composition (industrial grade quartz sand or glass beads). The required grain-size distribution or particle sizes of the filter pack materials shall be selected based upon a sieve analysis of the aquifer materials or the formation to be monitored, or the characteristics of the aquifer materials using information acquired during previous investigations.

Where sieve analyses are used to select the appropriate filter pack particle size, the results of a sieve analysis of the formation materials are plotted on a grain-size distribution graph, and a grain-size distribution curve is generated. The 70 percent retained grain size value should be multiplied by a factor between four and six (four for fine, uniform formations and six for coarse, non-uniform formations). A second grain-size distribution curve is then drawn on the graph for this new value, ensuring that the uniformity coefficient does not exceed 2.5. The filter pack that shall be used will fall within the area defined by these two curves.

Once the filter pack size is determined, the screen slot size shall be selected to retain at least 90 percent of the filter pack material. The Permittee may propose the use of a pre-determined well screen slot size and filter pack for monitoring wells in the site-specific work plans submitted to NMED.

The filter pack shall be installed in a manner that prevents bridging and particle-size segregation. Filter packs placed below the water table shall be installed by the tremie pipe method. Filter pack materials shall not be poured into the annular space unless the well is shallow (e.g., less than 30 ft deep) and the filter pack material can be poured continuously into the well without stopping. At least two inches of filter pack material shall be installed between the well screen and the borehole wall, and two ft of material shall extend above the top of the well screen. A minimum of six-inches of filter pack material shall also be placed under the bottom of the well screen to provide a firm footing and an unrestricted flow under the screened area. In deep wells (e.g., greater than 200 ft deep), the filter pack may not compress when initially installed. As a result, filter packs may need to be installed as high as five ft above the screened interval in these situations. The precise volume of filter pack material required shall be calculated and recorded before placement, and the actual volume used shall be determined and recorded during well construction. Any significant discrepancy between the calculated and actual volume shall be explained. Prior to installing the filter pack annular seal, a one to two-ft layer of chemically inert fine sand shall be placed over the filter pack to prevent the intrusion of annular sealants into the filter pack.

Several pre-fabricated groundwater sampling systems that can be installed in open boreholes are available on the market. These include multi-level borehole completion systems (e.g., Westbay MP System<sup>®</sup>) and pneumatically deployed inverting PVC membranes (e.g., SEAMIST). If these types of borehole completions are to be used in the Facility wells, they shall be installed under the supervision of personnel from the authorized vendor unless otherwise approved by NMED.

#### **19.3.4 Annular Sealant**

The annular space between the well casing and the borehole must be properly sealed to prevent cross-contamination of samples and the groundwater. The materials used for annular sealants shall be chemically inert with respect to the highest anticipated concentration of chemical constituents expected in the groundwater at the Facility. In general, the permeability of the sealing material shall be one to two orders of magnitude lower than the least permeable parts of the formation in contact with the well. The precise volume of annular sealants required shall be calculated and recorded before placement, and the actual volume shall be determined and recorded during well construction. Any significant discrepancy between the calculated volume and the actual volume shall be explained.

During well construction, an annular seal shall be placed on top of the filter pack. This seal shall consist of a high solids (10-30 percent) bentonite material in the form of bentonite pellets, granular bentonite, or bentonite chips. The bentonite seal shall be placed in the annulus through a tremie pipe if the well is deep (greater than 30 ft), or by pouring directly down the annulus in shallow wells (less than 30 ft). If the bentonite materials are poured directly down the annulus (which is an acceptable method only in wells less than 30 feet deep), a tamping device shall be used to ensure that the seal is emplaced at the proper depth and the bentonite has not bridged higher in the well casing. The bentonite seal shall be placed above the filter pack a minimum of two ft vertical thickness. The bentonite seal shall be allowed to completely hydrate in conformance with the manufacturer's specifications prior to installing the overlying annular grout seal. The time required for the bentonite

seal to completely hydrate will differ with the materials used and the specific conditions encountered, but is generally a minimum of four to 24 hours.

A grout seal shall be installed on top of the filter pack annular seal. The grout seal may consist of a high solids (30 percent) bentonite grout, a neat cement grout, or a cement/bentonite grout. The grout shall be pumped under pressure (not gravity fed) into the annular space by the tremie pipe method, from the top of the filter pack annular seal to within a few ft of the ground surface. The tremie pipe shall be equipped with a side discharge port (or bottom discharge for grouting at depths greater than 100 feet) to minimize damage to the filter pack or filter pack annular bentonite seal during grout placement. The grout seal shall be allowed to cure for a minimum of 24 hours before the concrete surface pad is installed. All grouts shall be prepared in accordance with the manufacturer's specifications. High solids (30 percent) bentonite grouts shall have a minimum density of ten pounds per gallon (as measured by a mud balance) to ensure proper setup. Cement grouts shall be mixed using six and one-half to seven gallons of water per 94-pound bag of Type I Portland cement. Bentonite (five to ten percent) may be added to delay the setting time and reduce the shrinkage of the grout.

### **19.3.5 Well Development**

All monitoring wells shall be developed to create an effective filter pack around the well screen, correct damage to the formation caused by drilling, remove fine particles from the formation near the borehole, and assist in restoring the natural water quality of the aquifer in the vicinity of the well. Development stresses the formation around the screen, as well as the filter pack, so that mobile fines, silts, and clays are pulled into the well and removed. Development is also used to remove any foreign materials (e.g., water, drilling mud) that may have been introduced into the borehole during the drilling and well installation activities, and to aid in the equilibration that will occur between the filter pack, well casing, and the formation water. The development of a well is extremely important to ensuring the collection of representative groundwater samples.

Newly installed monitoring wells shall not be developed for at least 48 hours after the outer protective casing is installed. This will allow sufficient time for the well materials to cure before the development procedures are initiated. A new monitoring well shall be developed until the column of water in the well is free of visible sediment, and the pH, temperature, turbidity, and specific conductivity have stabilized. In most cases, the above requirements can be satisfied. However, in some cases, the pH, temperature, and specific conductivity may stabilize but the water remains turbid. In this case, the well may still contain well construction materials, such as drilling mud in the form of a mud cake or formation soils that have not been washed out of the borehole. Thick drilling mud cannot be flushed out of a borehole with one or two well volumes of flushing. Instead, continuous flushing over a period of several days may be necessary to complete the well development. If the well is pumped dry, the water level shall be allowed to sufficiently recover before the next development period is initiated. The common methods used for developing wells include:

- Pumping and overpumping;
- Backwashing;
- Surging (with a surge block);
- Bailing;

- Jetting; and
- Airlift pumping.

These development procedures can be used, either individually or in combination, to achieve the most effective well development. However, the most favorable well development methods include pumping, overpumping, bailing, surging, or a combination of these methods. Well development methods and equipment that alter the chemical composition of the groundwater shall not be used. Development methods that involve adding water or other fluids to the well or borehole, or that use air to accomplish well development should be avoided, if possible. Approval shall be obtained from NMED prior to introducing air, water, or other fluids into the well for the purpose of well development. If water is introduced to a borehole during well drilling and completion, then the same or greater volume of water shall be removed from the well during development. In addition, the volume of water withdrawn from a well during development shall be recorded.

### **19.3.6 Surface Completion**

Monitoring wells may be completed either as flush-mounted wells, or as above-ground completions. A surface seal shall be installed over the grout seal and extended vertically up the well annulus to the land surface. The lower end of the surface seal shall extend a minimum of one foot below the frost line to prevent damage from frost heaving. The composition of the surface seal shall be neat cement or concrete. In above-ground completions, a minimum three-foot wide, four-inch thick concrete surface pad shall be installed around the well at the same time the protective casing is installed. The surface pad shall be sloped so that drainage will flow away from the protective casing and off the pad. In addition, a minimum of one inch of the finished pad shall be below grade or ground elevation to prevent washing and undermining by soil erosion.

A locking protective casing shall be installed around the well casing (riser) to prevent damage or unauthorized entry. The protective casing shall be anchored in the concrete surface pad below the frost line and extend several inches above the well riser stickup. A weep hole shall be drilled into the protective casing just above the top of the concrete surface pad to prevent water from accumulating and freezing inside the protective casing around the well riser. A cap shall be placed on the well riser to prevent tampering or the entry of foreign materials, and a lock shall be installed on the protective casing to provide security. If the wells are located in an area that receives traffic, a minimum of three bumper guards consisting of steel pipes three to four inches in diameter and a minimum of five-foot length should be installed. The bumper guards should be installed to a minimum depth of two feet below the ground surface in a concrete footing and extend a minimum of three feet above ground surface. The pipes should be filled with concrete to provide additional strength. The pipes should be painted a bright color to reduce the possibility of vehicular damage.

If flush-mounted completions are required (e.g., in active roadway areas), a protective structure such as a utility vault or meter box should be installed around the well casing. In addition, measures should be taken to prevent the accumulation of surface water in the protective structure and around the well intake. These measures should include outfitting the protective structure with a steel lid or manhole cover that has a rubber seal or gasket, and ensuring that the bond between the cement surface seal and the protective structure is watertight.

## **19.4 WELL ABANDONMENT**

All well abandonment must be conducted in accordance with 19.27.4 NMAC including submittal of a plan for well abandonment in accordance with 19.27.4.30 C NMAC. Wells are usually abandoned when they are no longer required in the monitoring network or when they are damaged beyond repair. The goal of well abandonment is to seal the borehole in such a manner that the well cannot act as a conduit for migration of contaminants from the ground surface to the aquifer or between aquifers. To properly abandon a well, the preferred method is to completely remove the well casing and screen from the borehole, clean out the borehole, and backfill with a cement or bentonite grout, neat cement, or concrete. The well abandonment procedure must also comply with current EPA well abandonment guidance.

For wells with small diameter casing, abandonment shall be accomplished by overdrilling the well with a large diameter hollow-stem auger. After the well has been overdrilled, the well casing and grout can be lifted out of the ground with a drill rig, and the remaining filter pack can be drilled out. The open borehole can then be pressure grouted (via the tremie pipe method) from the bottom of the borehole to the ground surface. After the grout has cured, the top two ft of the borehole shall be filled with concrete to insure a secure surface seal.

Several other well abandonment procedures are available for wells with larger diameter screens and casings. One method is to force a drill stem with a tapered wedge assembly or a solid-stem auger into the well casing and pull the casing out of the ground. However, if the casing breaks or the well cannot be pulled from the ground, the well will have to be grouted in place. To abandon a well in place, a tremie pipe shall be placed at the lowest point in the well (at the bottom of the screen or in the well sump). The entire well is then pressure grouted from the bottom of the well upward. The pressurized grout will be forced out through the well screen into the filter pack and up the inside of the well casing sealing off all breaks and holes in the casing. Once the well is grouted, the casing is cut off even with the ground surface and covered with concrete.

If a PVC well cannot be abandoned due to internal casing damage (e.g., the tremie pipe cannot be extended to the bottom of the screen), it may be necessary to drill out the casing with a roller cone or drag bit using the wet rotary drilling method, or grind out the casing using a solid-stem auger equipped with a carbide tooth bit. Once the casing is removed, the open borehole can be cleaned out and pressure grouted from the bottom of the borehole upward.

## **19.5 DOCUMENTATION**

All information on the design, construction, and development of each monitoring well shall be recorded and presented on a boring log, a well construction log, and well construction diagram. The well construction log and well construction diagram shall include the following information:

- Well name/number;
- Date/time of well construction;
- Borehole diameter and well casing diameter;
- Well depth;
- Casing length;
- Casing materials;

- Casing and screen joint type;
- Screened interval(s);
- Screen materials;
- Screen slot size and design;
- Filter pack material and size;
- Filter pack volume (calculated and actual);
- Filter pack placement method;
- Filter pack interval(s);
- Annular sealant composition;
- Annular sealant placement method;
- Annular sealant volume (calculated and actual);
- Annular sealant interval(s);
- Surface sealant composition;
- Surface seal placement method;
- Surface sealant volume (calculated and actual);
- Surface sealant interval;
- Surface seal and well apron design and construction;
- Well development procedure and turbidity measurements;
- Well development purge volume(s) and stabilization parameter measurements;
- Type and design and construction of protective casing;
- Well cap and lock;
- Ground surface elevation;
- Survey reference point elevation on well casing;
- Top of monitoring well casing elevation; and
- Top of protective steel casing elevation.

## **APPENDIX D**

**Well Permit Application Form  
Example of Completed Well Permit Application Form  
Well Plugging Plan of Operations Form  
Plugging Record Form**

**NEW MEXICO OFFICE OF THE STATE ENGINEER  
APPLICATION FOR PERMIT  
TO DRILL AN EXPLORATORY WELL**

**1. APPLICANT:**

Name: \_\_\_\_\_ Work Phone: \_\_\_\_\_  
Contact: \_\_\_\_\_ Home Phone: \_\_\_\_\_  
Address: \_\_\_\_\_  
City: \_\_\_\_\_ State: \_\_ Zip: \_\_\_\_\_

**2. LOCATION OF WELL (A, B, C, or D required, E or F if known):**

- A. \_\_\_ 1/4 \_\_\_ 1/4 \_\_\_ 1/4 Section: \_\_\_ Township: \_\_\_ Range: \_\_\_ N.M.P.M.  
in \_\_\_\_\_ County.
- B. X = \_\_\_\_\_ feet, Y = \_\_\_\_\_ feet, N.M. Coordinate System  
Zone in the \_\_\_\_\_ Grant.  
U.S.G.S. Quad Map \_\_\_\_\_
- C. Latitude: \_\_\_ d \_\_\_ m \_\_\_ s Longitude: \_\_\_ d \_\_\_ m \_\_\_ s
- D. East \_\_\_\_\_ (m), North \_\_\_\_\_ (m), UTM Zone 13, NAD \_\_\_ (27 or 83)
- E. Tract No. \_\_\_\_\_, Map No. \_\_\_\_\_ of the \_\_\_\_\_ Hydrographic Survey
- F. Lot No. \_\_\_\_\_, Block No. \_\_\_\_\_ of Unit/Tract \_\_\_\_\_ of the  
\_\_\_\_\_ Subdivision recorded in \_\_\_\_\_ County.
- G. Other: \_\_\_\_\_
- H. Give State Engineer File Number of existing well: \_\_\_\_\_
- I. On land owned by (required): \_\_\_\_\_

**3. WELL INFORMATION:**

Approximate depth \_\_\_\_\_ feet; Outside diameter of casing \_\_\_\_\_ inches.  
Name of well driller and driller license number \_\_\_\_\_

**4. ADDITIONAL STATEMENT OR EXPLANATIONS:**

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Do Not Write Below This Line



File Number: RG-92561  
(For OSE Use Only)

NEW MEXICO OFFICE OF THE STATE ENGINEER  
APPLICATION FOR PERMIT  
TO DRILL AN EXPLORATORY WELL

1. APPLICANT:

Name: New Mexico Department of Transportation Work Phone: 505-827-5376  
Contact: Mr. Doug Jones Home Phone: \_\_\_\_\_  
Address: 1120 Carrizosa Road  
Room 126  
City: Santa Fe, NM 87504 State: NM Zip: 87504

2. LOCATION OF WELL (A, B, C, or D required, E or F if known):

A.     1/4     1/4     1/4 Section:     Township:     Range:     N.M.P.M.  
in     County.

B. X =     feet, Y =     feet, N.M. Coordinate System  
Zone in the     Grant.  
U.S.G.S. Quad Map    

C. Latitude: 35 d 40 m 27.4 s Longitude: 105 d 57 m 26.5 s

D. East     (m), North     (m), UTM Zone 13, NAD     (27 or 83)

E. Tract No.    , Map No.     of the     Hydrographic Survey

F. Lot No.    , Block No.     of Unit/Tract     of the     County.  
    Subdivision recorded in    

G. Other:    

H. Give State Engineer File Number of existing well:    

I. On land owned by (required): NM DOT

3. WELL INFORMATION:

Approximate depth 350 feet; Outside diameter of casing 4 inches.  
Name of well driller and driller license number WD-1664

4. ADDITIONAL STATEMENT OR EXPLANATIONS:

Purpose of well is to monitor groundwater quality  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Do Not Write Below This Line

File Number: RG-92561  
Form: wz-07

page 1 of 2

Trn Number: 473450

OFFICE OF THE STATE ENGINEER  
SANTA FE, N.M.

2011 FEB -9 11:11:54

File Number: \_\_\_\_\_  
(For OSE Use Only)

**NEW MEXICO OFFICE OF THE STATE ENGINEER  
APPLICATION FOR PERMIT  
TO DRILL AN EXPLORATORY WELL**

**ACKNOWLEDGEMENT**

(I, We) Dave Jones affirm that the  
(Please Print)  
foregoing statements are true to the best of my knowledge and belief.

[Signature] Applicant Signature      Applicant Signature

**ACTION OF STATE ENGINEER**

This application is approved/~~denied~~/~~partially approved~~ provided it is not exercised to the detriment of any others having existing rights, and is not contrary to the conservation of water in New Mexico nor detrimental to the public welfare, and further subject to the following conditions: \_\_\_\_\_

See attached conditions of Approval

Witness my hand and seal this 10<sup>th</sup> day of February, 20 11

John R. D'Antonio Jr. P.E., State Engineer

By: [Signature]

Do Not Write Below This Line

File Number: \_\_\_\_\_  
Form: wr-07

Trn Number: \_\_\_\_\_  
page 2 of 2



# WELL PLUGGING PLAN OF OPERATIONS



NOTE: A Well Plugging Plan of Operations shall be filed with and accepted by the Office of the State Engineer prior to plugging.

**I. FILING FEE:** There is no filing fee for this form.

**II. GENERAL / WELL OWNERSHIP:**

Existing Office of the State Engineer POD Number (Well Number) for well to be plugged: \_\_\_\_\_

Name of well owner: \_\_\_\_\_

Mailing address: \_\_\_\_\_

City: \_\_\_\_\_ State: \_\_\_\_\_ Zip code: \_\_\_\_\_

Phone number: \_\_\_\_\_ E-mail: \_\_\_\_\_

**III. WELL DRILLER INFORMATION:**

Well Driller contracted to provide plugging services: \_\_\_\_\_

New Mexico Well Driller License No.: \_\_\_\_\_ Expiration Date: \_\_\_\_\_

**IV. WELL INFORMATION:**

Note: A copy of the existing Well Record for the well to be plugged should be attached to this plan.

1) GPS Well Location: Latitude: \_\_\_\_\_ deg, \_\_\_\_\_ min, \_\_\_\_\_ sec  
Longitude: \_\_\_\_\_ deg, \_\_\_\_\_ min, \_\_\_\_\_ sec, NAD 83

2) Reason(s) for plugging well: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

3) Was well used for any type of monitoring program? \_\_\_\_\_ If yes, please use section VII of this form to detail what hydrogeologic parameters were monitored. If the well was used to monitor contaminated or poor quality water, authorization from the New Mexico Environment Department may be required prior to plugging.

4) Does the well tap brackish, saline, or otherwise poor quality water? \_\_\_\_\_ If yes, provide additional detail, including analytical results and/or laboratory report(s): \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

5) Static water level: \_\_\_\_\_ feet below land surface / feet above land surface (circle one)

6) Depth of the well: \_\_\_\_\_ feet

- 7) Inside diameter of innermost casing: \_\_\_\_\_ inches.
- 8) Casing material: \_\_\_\_\_
- 9) The well was constructed with:  
 \_\_\_\_\_ an open-hole production interval, state the open interval: \_\_\_\_\_  
 \_\_\_\_\_ a well screen or perforated pipe, state the screened interval(s): \_\_\_\_\_
- 10) What annular interval surrounding the artesian casing of this well is cement-grouted? \_\_\_\_\_
- 11) Was the well built with surface casing? \_\_\_\_\_ If yes, is the annulus surrounding the surface casing grouted or otherwise sealed? \_\_\_\_\_ If yes, please describe: \_\_\_\_\_  
 \_\_\_\_\_
- 12) Has all pumping equipment and associated piping been removed from the well? \_\_\_\_\_ If not, describe remaining equipment and intentions to remove prior to plugging in Section VII of this form.

**V. DESCRIPTION OF PLANNED WELL PLUGGING:**

Note: If this plan proposes to plug an artesian well in a way other than with cement grout, placed bottom to top with a tremie pipe, a detailed diagram of the well showing proposed final plugged configuration shall be attached, as well as any additional technical information, such as geophysical logs, that are necessary to adequately describe the proposal.

- 1) Describe the method by which cement grout shall be placed in the well, or describe requested plugging methodology proposed for the well: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_
- 2) Will well head be cut-off below land surface after plugging? \_\_\_\_\_

**VI. PLUGGING AND SEALING MATERIALS:**

Note: The plugging of a well that taps poor quality water may require the use of a specialty cement or specialty sealant

- 1) For plugging intervals that employ cement grout, complete and attach Table A.
- 2) For plugging intervals that will employ approved non-cement based sealant(s), complete and attach Table B.
- 3) Theoretical volume of grout required to plug the well to land surface: \_\_\_\_\_
- 4) Type of Cement proposed: \_\_\_\_\_
- 5) Proposed cement grout mix: \_\_\_\_\_ gallons of water per 94 pound sack of Portland cement.
- 6) Will the grout be: \_\_\_\_\_ batch-mixed and delivered to the site  
 \_\_\_\_\_ mixed on site

7) Grout additives requested, and percent by dry weight relative to cement: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

8) Additional notes and calculations: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**VII. ADDITIONAL INFORMATION:** List additional information below, or on separate sheet(s):

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**VIII. SIGNATURE:**

I, \_\_\_\_\_, say that I have carefully read the foregoing Well Plugging Plan of Operations and any attachments, which are a part hereof; that I am familiar with the rules and regulations of the State Engineer pertaining to the plugging of wells and will comply with them, and that each and all of the statements in the Well Plugging Plan of Operations and attachments are true to the best of my knowledge and belief.

\_\_\_\_\_  
Signature of Applicant

\_\_\_\_\_  
Date

**IX. ACTION OF THE STATE ENGINEER:**

This Well Plugging Plan of Operations is:

- \_\_\_\_\_ Approved subject to the attached conditions.  
\_\_\_\_\_ Not approved for the reasons provided on the attached letter.

Witness my hand and official seal this \_\_\_\_\_ day of \_\_\_\_\_, \_\_\_\_\_

John R. D'Antonio, Jr., State Engineer

By: \_\_\_\_\_

**TABLE A - For plugging intervals that employ cement grout. Start with deepest interval.**

	<b>Interval 1 – deepest</b>	<b>Interval 2</b>	<b>Interval 3 – most shallow</b>
			Note: if the well is non-artesian and breaches only one aquifer, use only this column.
Top of proposed interval of grout placement (ft bgl)			
Bottom of proposed interval of grout placement (ft bgl)			
Theoretical volume of grout required per interval (gallons)			
Proposed cement grout mix gallons of water per 94-lb. sack of Portland cement			
Mixed on-site or batch-mixed and delivered?			
Grout additive 1 requested			
Additive 1 percent by dry weight relative to cement			
Grout additive 2 requested			
Additive 2 percent by dry weight relative to cement			

**TABLE B - For plugging intervals that will employ approved non-cement based sealant(s). Start with deepest interval.**

	<b>Interval 1 – deepest</b>	<b>Interval 2</b>	<b>Interval 3 – most shallow</b>
			Note: if the well is non-artesian and breaches only one aquifer, use only this column.
Top of proposed interval of sealant placement (ft bgl)			
Bottom of proposed sealant of grout placement (ft bgl)			
Theoretical volume of sealant required per interval (gallons)			
Proposed abandonment sealant (manufacturer and trade name)			



# PLUGGING RECORD



**NOTE: A Well Plugging Plan of Operations shall be approved by the State Engineer prior to plugging - 19.27.4 NMAC**

## **I. GENERAL / WELL OWNERSHIP:**

State Engineer Well Number: \_\_\_\_\_

Well owner: \_\_\_\_\_ Phone No.: \_\_\_\_\_

Mailing address: \_\_\_\_\_

City: \_\_\_\_\_ State: \_\_\_\_\_ Zip code: \_\_\_\_\_

## **II. WELL PLUGGING INFORMATION:**

1) Name of well drilling company that plugged well: \_\_\_\_\_

2) New Mexico Well Driller License No.: \_\_\_\_\_ Expiration Date: \_\_\_\_\_

3) Well plugging activities were supervised by the following well driller(s)/rig supervisor(s): \_\_\_\_\_

4) Date well plugging began: \_\_\_\_\_ Date well plugging concluded: \_\_\_\_\_

5) GPS Well Location: Latitude: \_\_\_\_\_ deg, \_\_\_\_\_ min, \_\_\_\_\_ sec  
Longitude: \_\_\_\_\_ deg, \_\_\_\_\_ min, \_\_\_\_\_ sec, WGS 84

6) Depth of well confirmed at initiation of plugging as: \_\_\_\_\_ ft below ground level (bgl),  
by the following manner: \_\_\_\_\_

7) Static water level measured at initiation of plugging: \_\_\_\_\_ ft bgl

8) Date well plugging plan of operations was approved by the State Engineer: \_\_\_\_\_

9) Were all plugging activities consistent with an approved plugging plan? \_\_\_\_\_ If not, please describe differences between the approved plugging plan and the well as it was plugged (attach additional pages as needed):

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

- 10) Log of Plugging Activities - Label vertical scale with depths, and indicate separate plugging intervals with horizontal lines as necessary to illustrate material or methodology changes. Attach additional pages if necessary.

For each interval plugged, describe within the following columns:

<u>Depth</u> (ft bgl)	<u>Plugging Material Used</u> (include any additives used)	<u>Volume of Material Placed</u> (gallons)	<u>Theoretical Volume of Borehole/ Casing</u> (gallons)	<u>Placement Method</u> (tremie pipe, other)	<u>Comments</u> ("casing perforated first", "open annular space also plugged", etc.)

MULTIPLY		BY		AND OBTAIN
cubic feet	x	7.4805	=	gallons
cubic yards	x	201.97	=	gallons

**III. SIGNATURE:**

I, \_\_\_\_\_, say that I am familiar with the rules of the Office of the State Engineer pertaining to the plugging of wells and that each and all of the statements in this Plugging Record and attachments are true to the best of my knowledge and belief.

\_\_\_\_\_  
Signature of Well Driller

\_\_\_\_\_  
Date