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Effective Date: ~~02~~ 2 **09/07** 12/13/2006		

Environment & Remediation Support Services

Standard Operating Procedure

for **WELL CONSTRUCTION**

APPROVAL SIGNATURES:

Subject Matter Expert:	**Organization**	**Signature**	**Date**
Mark Everett	ERSS	Mark Everett	12-5-06
Quality Assurance Specialist:	**Organization**	**Signature**	**Date**
Dave Hawkinson	ERSS	Ebebbs for DH	12/13/06
Responsible Line Manager:	**Organization**	**Signature**	**Date**
Dwain Farley	ERSS	Dwain Farley	12/5/06

1.0 PURPOSE AND SCOPE

The purpose of this procedure is to describe the process of well construction at the Los Alamos National Laboratory (LANL or Laboratory) Environment & Remediation Support Services.

2.0 BACKGROUND AND PRECAUTIONS

2.1 Background

This procedure is to be used in conjunction with an approved Site-Specific Health and Safety Plan (SSHASP). Consult the SSHASP for information on and use of all Personal Protective Equipment (PPE).

Wells are generally installed as components of monitoring systems in accordance with Hazardous and Solid Waste Amendments (HSWA) and Environmental Protection Agency (EPA) guidance. Well construction, development of the wells, collection and measurement of samples, and the documentation of data must be performed as described

A properly constructed well allows access to formation fluids or gases for the collection of samples and for determining in situ characteristics. Ideally, the well should not alter the medium that is being sampled.

2.2 Precautions

The following is a partial list of critical issues involved in well planning, design, and construction:

- preventing the spread of possible contamination;
- selecting soil-boring or rock-coring technique and hole sizes;
- selecting casing and screen materials, including composition and dimensions;
- determining screen-slot size, screen type, and screen interval;
- determining filter pack composition, gradation, and dimensions; and
- choosing a grouting plan.

3.0 EQUIPMENT AND TOOLS

• Silica Sand (i.e., 30/70, 20/40, and 8/12 grain size) • Cement – Portland Type I, Type II or Type I/II only • Approved Water Supply, preferably untreated • Well Casing, Screen Cap, and Bottom Plug for each well, as required • Mechanical Casing Centralizers, if required • Bentonite Pellets, Crushed Bentonite, or Bentonite Grout • A 5-foot Length of Protective Steel Casing – black iron or galvanized – 6”, 8”, or 10” diameter	• Guard Posts • Locking Cap • Padlocks • Drill Rig and Accompanying Equipment (augers, drill rods, casing, samplers) • Tremie Pipe • Grout-Mixing and Pressure-Pumping Unit • Support Equipment (for maintaining 24-hour/day operation)

4.0 STEP-BY-STEP PROCESS DESCRIPTION

4.1 General Well Installation Record Keeping

Field Team Leader	1.	Record all field measurements and comments on the Borehole/Well Completion Information Form (see Attachment 1), or the Borehole/Well Construction Field Data Log Form (see Attachment 3).
	2.	Complete the forms as described in the completion instructions included with each form (see Attachments 2 and 4)
	3.	Complete a Fact Summary Sheet providing construction, stratigraphic and hydrologic information, if necessary.
	4.	Consult with the Subject Matter Expert and/or Project Leader before modifying an existing well design.
	5.	Record any modifications in the Borehole/Well Construction Field Data Log form, the Fact Summary Sheet, and the Daily Activity Log form. [NOTE: This information may also be recorded in a field notebook.]
	6.	Record the following information of the Borehole/Well Completion Information form and the Fact Summary Sheet: • boring/well identification number; • location of boring (coordinates, if available); • nominal hole diameter and depth at which diameter changes; • screen location; • backfill; • seals; • grout; • cave-in; • centralizers; and • the height of the riser above the ground surface.
	7.	Record the actual composition of the grout, seals, and backfill on each on each Borehole/Well Construction Field Data form.
	8.	Include the screen slot size (in inches), slot configuration, and screen manufacturer on the Borehole/Well Construction Field Data form.
	9.	Include the protective casing detail on all well sketches.
	10.	After well development is complete, indicate the static water level on the well-construction diagram.

4.2 Sand Pack

Field Team Leader	1.	Ensure continuous flow capability from the natural formation to the well bore through the use of a sand pack, if required.
	2.	Ensure the minimum annular distance between well screen and the borehole wall is 2 inches for EP Directorate project wells.
	3.	Approve the specifications of the proposed sand-pack material before use.
	4.	Use well-sorted (poorly graded) and rounded sand that is clean, inert, and siliceous and compatible with the screen slot size in-use.
	5.	Use sand that has a gradation that will allow less than 10% of filter-pack material to pass through the screen slots.
	6.	Record the filter-pack size, the company from which it was purchased, and the lot number (if available) for each installation.
	7.	Be prepared to take an airtight pint size sample of filter pack material and furnish to the Subject Matter Expert upon request for each well to serve as a quality control.
	8.	Fill the annulus between the well screen and borehole wall with silica sand to a height 5 feet above the screened interval and 5 feet below the screen if above a bentonite seal or as specified in applicable Title I or II drawings, if required.
	9.	Use a tremie pipe to place the materials for wells greater than 30 feet in depth.
	10.	Ascertain the depth of the top of the sand with a measuring device with accuracy within 0.5 feet, and verify the thickness of the sand pack.
	11.	Repeat measurements, and, if necessary, add more sand to bring the top of the sand pack to the proper elevation.
	12.	Under no circumstances extend the sand pack into any aquifer other than the one to be monitored.
	13.	In most cases, modify the well design to allow for a sufficient sand pack without the threat of cross-flow between producing zones.
	14.	If specified in the project documents, partially develop the sand pack to help settle it before installation of bentonite seal and grout.
	15.	In the event a predominantly fine-grained, water-bearing unit is encountered, it may be desirable to construct a monitor well that uses a factory-manufactured screen and filter pre-pack assembly. [NOTE: Various sand-pack gradations are available.]

Field Team Leader (Continued)	16.	Attach the pre-packed screen subassembly to the solid well casing (riser) in the same manner as a conventional screen.
	17.	Allow the fine-grained formation materials to collapse against the pre-packed well screen. [NOTE: Pre-packed well screens have larger OD's which must be considered when calculation backfill.]
	18.	Place centralizers above and below each screen or as specified in Title I design documents, generally no less than one every 50 feet for the uniform and complete annular filling by granular backfill, seal, and grout materials. [NOTE: Centralizers may be required at 10-foot intervals or less when installing angle holes. In some cases, such as very shallow wells and where tremie-pipe placement of materials is done through pipes or augers, the spacing of centralizers can be expanded or eliminated entirely.]
	19.	Fasten centralizers to the well casing and radially space them at 120^{o} or 90^{o} intervals.

4.3 Intermediate Bentonite Seal

Field Team Leader	1.	Before placing the bentonite seal, be sure the filter pack has settled by measuring the depth of the top of the sand with the tremie pipe or a measuring device with an accuracy within 0.5'.
	2.	Ensure the sand pack rises to a depth of 5 feet above the top of the screen.
	3.	In a media that will not maintain an open hole, leave the casing or the hollow-stem auger in the hole during filter-pack placement and bentonite-seal placement to the extent practical.
	4.	Maintain the bentonite in the casing/auger a small distance (1 to 2 feet) above the bottom of the casing/auger for even placement, as the casing/augers are removed.
	5.	Give special attention to the amount of fill material if this procedure is followed due to the risk of bridging in saturated conditions.
	6.	Visually check the condition of the bentonite backfill material before pumping it into the hole by pumping a sample into a bucket.
	7.	Retract the tremie pipe 3 feet from the top of the sand pack and begin pumping.

Field Team Leader (Continued)	8.	Place a bentonite chip or pellet above the sand pack and below the annular well seal to prevent infiltration of cement into the filter pack and the well. [NOTE: Use bentonite chips, bentonite pellets, or crushed, granular bentonite. The pellets should have a minimum purity of 90% montmorilonite clay and a minimum dry bulk density of 75 lb./ft.^{3}.]
	9.	Do not place bentonite into the well bore.
	10.	Place a cap over the top of the well casing before pouring the bentonite pellets.
	11.	Hydrate the bentonite seal and wait a minimum of 4 hours before adding a slurry grout.
	12.	In special circumstances, drill an open borehole to a depth below where the screen is set.
	13.	If grout is used to seal off a lower aquifer or as backfill up to the proper level, place a bentonite seal above the grout and hydrate for 4 hours before the casing, screen, and sand pack are introduced.
	14.	Allow the grout to set up for a minimum of 24 hours before placing the bentonite seal.
	15.	Place 5 feet of sand pack between this grout and the well screen.
	16.	Place the bentonite seal in the borehole. [NOTE: The minimum width for the annular well seal (between casing and borehole) is 2 inches for EP Directorate wells.]
	17.	For wells that are 30 feet or less in depth, do the following: • Pour the bentonite directly down the annulus; • Pour the pellets from different points around the casing to ensure an even application; • Use a tremie pipe to redistribute and level the top of the seal (if necessary); • Fill the annulus between the well casing and borehole above the filter pack with a bentonite seal at least 2 feet thick (vertically); and • Hydrate and wait 12 hours.
	18.	For wells deeper than 30 feet, do the following: • Pump or pour the bentonite backfill material through a tremie pipe; • Determine the method after evaluating the condition of the borehole walls; and • If there are no centralizers in the upper portions of the casing, manipulate the casing to prevent pellets from hanging up in the narrow annulus and to allow them to settle to the bottom as rapidly as possible.
	19.	Measure the distance to the top of the seal with an acceptable measuring device to verify that the proper thickness of seal has been placed in the annulus.
	20.	Until the proper thickness of bentonite has been placed in the well annulus, repeat the application and verification.

4.4 Annular Well Seal

Field Team Leader	1.	If a cement-grout annular seal is to be installed, use only Portland Type I, Type II, or Type I/II cement.
	2.	Mix the grout thoroughly with 2% to 5% bentonite powder to produce a nonshrinking seal. [NOTE: The cement must be mechanically mixed thoroughly before it is pumped into the borehole.]
	3.	If a slurry of bentonite is used as an annular seal, prepare the slurry by mixing powdered or granular bentonite with pre-approved potable water according to manufacturer specifications. [NOTE: The slurry should be of sufficiently high specific gravity and viscosity to prevent movement of the overlying grout into the saturated zone. Pellets may be added to solidify the surface of the bentonite slurry in order to prevent cement intrusion.]
	4.	Use a dry mixture of fine sand, silica flour, and bentonite powder or a mixture of cuttings, sandy clay, or tight soil where the fill material needs to have less permeability than the formation. [NOTE: In general, the cuttings cannot be easily emplaced because of screening and/or compacting problems. Cuttings mixed with dry bentonite can be used for abandonment purposes.]

4.5 Surface Well Seal Minimum Depth and Width

[NOTE: The minimum depth of an annular well seal above the fill is 10 feet. The minimum width of the annular seal is 2 inches.]

Field Team Member	1.	Allow a minimum of 12 hours (HSWA requirement) after a bentonite-slurry seal has been placed, then place cement grout from the top of the bentonite seal to the surface.
	2.	Use grouts as specified in project documents.
	3.	Fill the annulus with grout between the well casing and borehole wall with cement grout.
	4.	On all wells 30 feet deep or deeper, pump the cement grout through the tremie pipe to the bottom of the open annulus until undiluted grout flows from the annulus at the ground surface. [NOTE: the cement grout should consist of a mix of cement (Portland Type I, Type II, or Type I/II) and 2% to 5% bentonite mix.]
	5.	Use only grout mixed with pre-approved water.

Field Team Member (Continued)	6.	When drilling in materials that will not maintain an open hole, leave the hollow-stem auger or temporary casing in the hole during grouting to the extent practical.
	7.	Remove them as the level of the grout rises above the bottom of the auger.
	8.	If necessary, add more grout to compensate for the removed casing or auger and tremie pipe and to ensure that the top of the grout is at or above the ground surface.
	9.	Place the protective casing over the well casing.
	10.	After the grout has set (about 24 hours), fill any depression in the grout caused by settlement with a grout mix similar to that previously described.

4.6 Placement of Dry Product Annular Backfill Materials (Intermediate and Deep Wells)

Driller	1.	Place all annular fill materials (dry products only) through a tremie pipe maintaining a 10-foot minimum buffer between the targeted backfill depth and the bottom of the tremie pipe.
	2.	Together with the Site Geologist, record tallies of tremie pipe and drill casing in a logbook to ensure the exact depths are known at all times.
	3.	Together with the Site Geologist, on a scheduled basis, compare tremie pipe and drill casing tallies to ensure they are in agreement.
	4.	In the event they are not in agreement, suspend backfill activities until an acceptable resolution is attained and the depths can be verified to the satisfaction of both parties.
	5.	Use potable water (municipal supply) as a transport fluid to carry dry materials such as bentonite pellets and silica sand down the tremie to the desired depth.
	6.	Add a polymer such as EZ-MUD approved by the technical representative to the transport fluid to delay hydration of bentonite chips or pellets in deeper applications. [NOTE: This will reduce the potential for swelling within the tremie pipe which commonly results in plugging.]
	7.	If a polymer solution is used, flush the tremie with one volume of the tremie rodwith clear water prior to filter pack sand emplacement.
	8.	Record in a field notebook the quantities of water and additives used during the placement of annular backfill material.
	9.	Use silica sand that meets the specifications in the Title II design drawing (typically fine-grained 30/70 and 20/40 grade) for filter packs and transition zones between filter packs and bentonite seals.

Driller (Continued)	10.	Allow fine-grained sands (30/70, 20/40 grade) to settle for 15 to 30 minutes after the pour is completed before sounding the depth.
	11.	If the sand level is low, allow an additional 15 to 30 minutes for the sand to settle and then re-sound the sand level. [NOTE: Sands with grades greater than 20/40 can be expected to settle more rapidly and typically can be measured immediately after emplacement.]

4.7 Drill Casing Retraction During Backfill Operations (Intermediate and Deep Wells)

Driller	1.	Retract the drill casing in stages as backfill materials are emplaced to avoid borehole collapse in potentially unstable formations.
	2.	Maintain a 10-foot minimum buffer between the targeted backfill depth and the bottom of the drill casing to prevent backfill from getting between well casing and drill casing. [NOTE: This may result in sand locking the casings or smearing bentonite across well screens.]
	3.	Determine the length of drill casing to be retracted between pours based on borehole stability, the size of the batch to be poured, and casing stickup in the rig table.
Site Geologist	4.	Provide borehole stability information to the driller based on site stratigraphic, geophysical logging data, and video logs, if available.
Driller	5.	For large intervals of backfill in stable formations, pull 100 or more feet of casing followed by one large or several small batches of backfill.
	6.	In unstable formations, retract casing at shorter intervals of 20 to 40 feet, followed by small batches of backfill, to minimize borehole caving into the annular space. [NOTE: Cave-ins may result in damage to the well casing and screens, displacement of annular fill materials, and may compromise the integrity of annular seals.]

4.8 Volume Calculations

Driller and Site Geologist	1.	Make volume calculations of all materials introduced into the borehole prior to emplacement. [NOTE: Backfilling should not proceed until the calculated volumes are in agreement.]
	2.	Ensure the calculated volume for the interval to be filled is not exceeded regardless of the character of the formation.

Driller	3.	Take extreme care when backfilling with bentonite below a screened section of the well casing to prevent impact to the screen.
	4.	Ensure the target depth for standard batches of bentonite are at a minimum 20 feet below the bottom of the screen.
	5.	Ensure the remainder of the bentonite interval below the screen is poured in small batches calculated to raise the level in the annulus by 2 to 3 feet per batch.
	6.	Sound (measure) the bentonite after each batch until the desired depth is reached.
	7.	Allow the bentonite to hydrate for a minimum of 30 minutes before installing silica sand. [NOTE: The volume of the annular space can be determined by subtracting the volume displaced by the well casing (outside diameter) from the total borehole volume. The borehole volume and casing displacement is determined using drilling reference tables or the formula for the volume of a cylinder ($V=\pi r^2 h$). Annular space volume (V_a) is determined using $V_a = V_t - V_c$; where a=annulus, t=total, and c=casing.]
Driller or Site Geologist	8.	Perform calculations for each batch, and record them in the field logbook.

4.9 Sounding Backfill Depths (Intermediate and Deep Wells)

Driller	1.	Sound the depth to the top of the fill material using a mechanical (weighted tap/wire line) or electronic sounding device.
Site Geologist	2.	Oversee and concur with each measurement before recording the depth in the logbook and Title II drawing.
Driller	3.	Run the sounding line through a sheave suspended over the borehole and lowered through the tremie pipe
	4.	Take care to avoid entanglement of the sounding line in the well casing centralizers.
	5.	Maintain cognizance of centralizer locations relative to the tremie pipe at all times.
	6.	If a mechanical sounding line is used (weighted tape or wire line), carefully monitor the tension on the wire or tape as the weight nears the depth where the fill is calculated to be.
	7.	When an electronic sounder is used, carefully monitor the cable-counter and slow the sounder winch as it approaches the calculated depth of the fill.
	8.	Once the sounding device tags bottom, verify the measurement by repeating the measurement process two times with the same result, or within five tenths of a foot (+/- 0.5 feet).

Site Geologist	9.	Record the confined measurement in the field logbook to the nearest tenth of a foot (0.1 foot).
	10.	Adjust measurements read from a cable counter or graduated tape to account for the length of the weight on the end of the wire or tape.
	11.	Subtract the height of the tremie pipe stickup (above ground level) from each measurement when referencing depths below ground level.
Driller and Site Geologist	12.	In the event the calculated depth and the measured depth are significantly different, evaluate the difference and resolve any nonconformance(s).
	13.	Review the casing and centralizer configuration in the Title II well design drawing to ensure a well-casing centralizer is not inadvertently being tagged.
	14.	If the fill is lower than expected, review the geophysical logs, the video logs, and the drillers logs to determine if voids or fractures are present in the subject interval.
4.10 Installing Protective Casing Around All Monitoring Wells		
Field Team Leader	1.	Ensure the protective steel casing and locking cap is weatherproof, and the locking cap secured to the casing by padlocks.
Driller	2.	Set the protective casing (5-foot minimum length) so the top of the pipe is about 1.5 to 3.0 feet above the ground surface and grout it in place.
	3.	Use 8-inch diameter pipe for 4-inch wells, 6-inch diameter pipe for 2-inch wells, and 10-inch diameter pipe for 5-inch wells (depending on approved borehole size). [NOTE: A drain hole near ground level that is 0.5-inch in diameter is permitted.]
	4.	Mark the location ID on the inside and outside of the cover with indelible ink, metal pouch lettering kit, or by writing with an arc welding machine/rod.
	5.	Form and pour the concrete protective pad around the protective pad around the protective steel casing. [NOTE: Pad dimensions will not be less than 2’ x 2’ x 0.5’.]
	6.	Slope the concrete pad away from the casing for positive drainage.
	7.	Place the brass monument into the concrete in the northwest corner of the pad, approximately 12 inches from the edges of the concrete.

Field Team Leader	8.	Ensure the location and elevation coordinates and the FIMAD location ID number is clearly imprinted in the monument.
	9.	In addition to the protective casing, ensure installation of guard posts following the steps below in areas where vehicle traffic might pose a hazard: • Guard posts must consist of steel posts at least 3 inches in diameter; • Four guard posts are radically located around each well vault and placed at least 2 feet below the ground's surface; • Each post will have a minimum of four feet above the ground surface and, in cases where the borehole/well is surrounded by high vegetation, will have a flag attached for greater visibility; and • Each post should be cemented inside of a hole that has a minimum diameter of 6 inches.
4.11 Recording Well Construction Details		
Driller and Site Geologist	1.	Keep an accurate record of all well construction materials in the site logbook, including, at a minimum, the following information: • type of material; • manufacturer's name and address; • batch or control number; • calculations showing estimated volume of material placed during each lift; • number of packages of each product used in each interval/lift; • size of individual packages; • volume and composition of transport fluids; • condition of materials and packaging; and • any other potentially valuable information.
Site Geologist	2.	After completing a unit of backfill (i.e., filterpack interval), make and record a comparison between the calculated and actual volumes of material required in the field logbook.
	3.	Describe and record methods of well installation in the field logbook.
4.12 Documenting the Final Well Configuration		
Site Geologist	1.	Record the final measured depth of each complete unit of annular fill on the most recently approved Title II well design drawing and in the field logbook.
	2.	Record all observations made during backfilling and depth sounding in the field logbook, including the following observations: • differences in the design-specified and as-built fill levels of each unit of annular fill; • anomalous depth measurements; • an evaluation of any problems encountered and the final resolutions; and • any other information or observations that may be useful in assessing the quality of the installation.

4.13 Post-Operation Activities		
Field Team Leader	1.	Ensure all equipment is accounted for and decontaminated.
	2.	Return equipment to the equipment manager and report incidents of malfunction or damage.
	3.	Ensure all wells are properly labeled and the location ID is readily visible on the protective casing and the brass monument.
	4.	Ensure well surveying for horizontal control and datum determination are completed and the necessary information is entered on the Borehole/Well Completion Information Form.
4.14 Records		
Field Team Leader	1.	Submit the following records generated by this procedure to the Records Processing Facility: • Daily Activity Log Forms, or a field notebook; • Completed Borehole/Well Completion Information Form; • Completed Borehole/Well Construction Field Data Log Form; • Well Construction Calculations (as applicable); • Completed Logbook; and • Red-lined Title II Design Drawings (as applicable). [NOTE: If other records are generated, they are to be paginated and attached to the records in the record package.]

5.0 PROCESS FLOW CHART

Flow chart is to be included at a later date.

6.0 ATTACHMENTS

Attachment 1: 5032-1 Borehole/Well Completion Information Form (1 page)

Attachment 2: 5032-2 Instructions for Completion of the Borehole/Well Completion Information Form (2 pages)

Attachment 3: 5032-3 Borehole/Well Construction Field Data Log Form (1 page)

Attachment 4: 5032-4 Instructions for Completion of the Borehole/Well Construction Field Data Log Form (1 page)

7.0 REVISION HISTORY

Author: Paula Schuh

Revision No. *[Enter current revision number, beginning with Rev.0]*	Effective Date *[DCC inserts effective date for revision]*	Description of Changes *[List specific changes made since the previous revision]*	Type of Change *[Technical (T) or Editorial (E)]*
0.0	02/09/07	Reformatted and renumbered, supersedes SOP-05.01	E

Using a CRYPTOCard, click here to record "self-study" training to this procedure.

If you do not possess a CRYPTOCard or encounter problems, contact the EP training specialist.

ATTACHMENT 1: BOREHOLE/WELL COMPLETION INFORMATION FORM

5032-1

Borehole/Well Completion Information Form

Records Use only

Los Alamos NATIONAL LABORATORY EST. 1943

Date/Time:		**Sheet _____ of _____**	
Technical Area:	**Focus Area:**	**Site Work Plan:**	
Field Team Leader:		**Installer:**	
Printed Name/Signature	**Date**	**Printed Name/Signature**	**Date**
Driller/Installer's Company:			

Borehole/Well Construction Information

Borehole ID:		**Surface Seal Material:**	
Drilling Method:		**Annular Seal Material:**	
Drilling Fluids Used:		**Filter Pack Mesh Size:**	
Estimated Amounts:		**Filter Pack Material:**	
Casing Material:		**Screen Material:**	
		Screen Slot Size:	
Well Type		**Source**	
Monitoring:	**Treatment:**	**Regional Aquifer:**	**Alluvial:**
Other (describe):		**Perched:**	**Vadose:**
		Other (describe):	

Completed Borehole/Well Information

Borehole Diameter:		**Surface Seal Length:**	
Total Depth:		**Annular Seal Length:**	
Casing Diameter:		**Filter Pack Length:**	
Casing Length:		**Screen Length:**	
		Blank Length:	

ATTACHMENT 2: INSTRUCTIONS FOR COMPLETION OF THE BOREHOLE/WELL COMPLETION INFORMATION FORM

5032-2 **Instructions for Completion of the Borehole/Well Completion Information Form**	Records Use only Los Alamos NATIONAL LABORATORY EST.1943

Use an indelible dark-ink pen. Make an entry in each blank. For entry blanks for which no data are obtained (except in Comments section), enter "UNK" for unknown, "N/A" for not applicable, or "ND" for not done, as appropriate. To change an entry, draw a single line through it, add the correct information above it, and date and initial the change. For all forms, complete the following information:

	Header Information
1.	**Date/Time -** The date and time when the measurement was made, in the following formats: DD-MMM-YY (e.g., 01-JAN-07) and the 24-hour clock time (e.g., 0837 for 8:37 a.m. and 1912 for 7:12 p.m.)
2.	**Sheet Number -** The unique number that identifies the borehole.
3.	**Technical Area (TA) -** Two-digit number which identifies the TA in which the activity is being performed.
4.	**Focus Area -** Indicate the Focus Area in which the activity is being performed.
5.	**Site Work Plan -** Title of the Site Work Plan.
6.	**Field Team Leader -** Print name, sign, and date.
7.	**Installer -** Print name, sign, and date.
8.	**Driller/Installer's Company -** The name and address of the installer's company.
	Borehole/Well Construction Information
1.	**Borehole ID –** The unique number that identifies the borehole.
2.	**Drilling Method –** The method of drilling used to complete the borehole.
3.	**Drilling Fluids Used –** The type of drilling fluids or mud used during drilling, if any.
4.	**Estimated Amounts –** The amount of drilling fluids or mud expended or lost during drilling.
5.	**Casing Material(s) –** The composition of the borehole casing or casings used.
6.	**Surface Seal Material –** Type or composition of material used for surface sealing.
7.	**Annular Seal Material –** The type or composition of material used to seal the annular spacing between the borehole and casing.
8.	**Filter Pack Mesh Size –** The mesh size or grain size of filter pack.
9.	**Filter Pack Material –** The composition of the filter pack material.
10.	**Screen Material –** The material or composition of the screen.
11.	**Screen Slot Size –** Size of slots used for screen.
	Well Type
The purpose or type of well (e.g., monitoring, treatment, other). If other, describe the type.	

ATTACHMENT 2: INSTRUCTIONS FOR COMPLETION OF THE BOREHOLE/WELL COMPLETION INFORMATION FORM

5032-2 **Instructions for Completion of the Borehole/Well Completion Information Form**	Records Use only Los Alamos NATIONAL LABORATORY EST.1943

Source

Flow Relationship - The type of aquifer or well relationship to aquifer, if any (e.g., regional aquifer, perched or intermediate, alluvial, vadose, or other). If other, describe the flow relationship.

Completed Borehole/Well Information

1.	**Borehole Diameter –** Outside diameter of borehole (in inches).
2.	**Total Depth –** The total depth of borehole (in feet).
3.	**Casing Diameter –** Outside diameter of casing (in inches).
4.	**Casing Length –** Total length of casing (in feet).
5.	**Surface Seal Length –** Length of surface seal (in feet).
6.	**Annular Seal Length –** Length of annular seal (in feet).
7.	**Filter Pack Length –** Length of filter pack area (in feet).
8.	**Screen Length –** Length of slotted screen (in feet).
9.	**Blank Length –** Distance between bottom of screen and bottom of casing (in feet).

ATTACHMENT 3: BOREHOLE/WELL CONSTRUCTION FIELD DATA LOG FORM

5032-3

Borehole/Well Construction Field Log Data Form

Records Use only

Date/Time:		**Borehole ID:**
Technical Area:	**Focus Area:**	**Site Work Plan:**
Field Team Leader:		**Installer:**
Printed Name/Signature **Date**		**Printed Name/Signature** **Date**
Driller/Installer's Company:		
Diagram of Well:		
Comments:		

ATTACHMENT 4: INSTRUCTIONS FOR COMPLETION OF THE BOREHOLE/WELL CONSTRUCTION FIELD DATA LOG FORM

5032-4 **Instructions for Completion of the Borehole/Well Construction Field Log Data Form**	Records Use only Los Alamos NATIONAL LABORATORY EST.1943

Use an indelible dark-ink pen. Make an entry in each blank. For entry blanks for which no data are obtained (except in Comments section), enter "UNK" for unknown, "N/A" for not applicable, or "ND" for not done, as appropriate. To change an entry, draw a single line through it, add the correct information above it, and date and initial the change. For all forms, complete the following information:

	Header Information
1.	**Date/Time –** The date and time when the measurement was made, in the following formats: DD-MMM-YY (e.g., 01-JAN-07) and the 24-hour clock time (e.g., 0837 for 8:37 a.m. and 1912 for 7:12 p.m.)
2.	**Borehole ID –** The unique number that identifies the borehole.
3.	**Technical Area (TA) –** Two-digit number which identifies the TA in which the activity is being performed.
4.	**Focus Area –** Indicate the Focus Area in which the activity is being performed.
5.	**Site Work Plan –** Title of the Site Work Plan.
6.	**Field Team Leader –** Print name, sign, and date.
7.	**Installer –** Print name, sign, and date.
8.	**Driller/Installer's Company –** The name and address of the installer's company.
	Completed Borehole/Well Information
1.	**Borehole Diameter –** Outside diameter of borehole (in inches).
2.	**Total Depth –** The total depth of the borehole (in feet).
3.	**Casing Diameter –** Outside diameter of casing (in inches).
4.	**Casing Length –** Total length of casing (in feet).
5.	**Surface Seal Length –** Length of surface seal (in feet).
6.	**Annular Seal Length –** Length of annual seal (in feet).
7.	**Filter Pack Length –** Length of filter pack area (in feet).
8.	**Screen Length –** Length of slotted screen (in feet).
9.	**Blank Length –** Distance between bottom of screen and bottom of casing (in feet).
10.	**Filter Pack Material –** Composition of filter pack material (in feet).