STANDARD OPERATING PROCEDURE FOR:

GROUNDWATER MONITORING WELL ABANDONMENT

TVA-KIF-SOP-46

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for
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Environment and Technology
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1.0 PURPOSE

This standard operating procedure (SOP) describes the procedures for proper plugging and abandonment of groundwater monitoring wells. Specifically, this SOP presents the procedures to be used for effective permanent abandonment of single screened wells utilizing cement/bentonite grout. This SOP applies to monitoring wells that have been approved for proper abandonment by TVA site management.

2.0 GENERAL CONSIDERATIONS

Potential hazards associated with the planned tasks are thoroughly evaluated prior to conducting field activities. The *Site-Wide Safety and Health Plan* (SWSHP) provides a description of potential hazards and associated safety and control measures.

Per Tennessee Department of Environment and Conservation (TDEC) rule 1200-4-9-.16, well plugging and abandonment is accomplished by a licensed driller. Well plugging and abandonment reports include a diagram showing the location and distance in feet of the abandoned well from one specific landmark and septic system or sewer systems (if applicable) on the property.

Prior to overdrill abandonment activities deeper than 6 inches, the appropriate utility notifications (that is, National 811 One Call) must be made by the Field Team Leader or designee and the dates of intrusive activities must be within the lawful dates provided by the One Call Center. The Field Team Leader verifies that utilities have responded to the One Call request and have marked their respective utilities. If there is uncertainty associated with potentially unmarked utilities, the Field Team Leader suspends work until the issues can be resolved.

Well abandonment equipment is decontaminated in accordance with the *Decontamination of Equipment* SOP (TVA-KIF-SOP-08) prior to use. Although well abandonment is typically conducted from least to most impacted, field logistics may necessitate other sample collection orders. The following devices are generally used for groundwater monitoring well abandonments:

- Hollow-stem auger drill rig
- Type 1 Portland cement (specification C150) mixed with 3-5% bentonite and potable water

3.0 PROCEDURES

The following sections describe the procedures for groundwater monitoring well abandonment. Any variation in these procedures must be approved by the Project Manager and Quality Assurance/Quality Control (QA/QC) Lead and must be fully documented. Field work cannot progress until deviations are approved or resolved.

3.1 Pre-Job Preparation

The Project Manager is responsible for overall implementation of this SOP and ensuring that the SOP complies with current regulations and standards as these are subject to change. The Project Manager is also responsible for the following activities.

a. Obtain equipment necessary for completing the abandonment activities (see Table 1 for an example checklist of monitoring well abandonment equipment and materials).

b. If abandonment is being conducted on personal property, provide the Field Team Leader with the schedule for sampling and verify that site/sampling area access and legal right-of-entry have been obtained, where required.

c. Review the site-specific work control documents such as the *Quality Assurance Project Plan* (TVA-KIF-QAPP), *Kingston Ash Recovery Project Non-Time-Critical Removal Action for the River System Sampling and Analysis Plan* (SAP), SWSHP, and appropriate SOPs to determine appropriate field protocols.

d. Review geophysical logs, well construction logs, or driller's logs for a description of stratigraphy, structural geography, construction materials and detail, and hydraulic gradients.

e. Obtain appropriate site maps that clearly show the location of wells to be abandoned.

3.2 Field Preparation

The Field Team Leader introduces the field team to the property owner, if present, upon arrival at the site. After introductions, the following steps are performed.

a. Predetermine monitoring well locations and reference in project-specific documentation. Record the monitoring well locations with a GPS device. Verify utility clearance prior to overdrill abandonment activities deeper than 6 inches (usually conducted by Field Team Leader or a designee). Verify that the appropriate utility clearance service has marked utilities at off-site monitoring well locations.

b. Confirm with the Project Manager that clearance and right-of-access permission have been obtained from the landowner(s) for off-site monitoring well location access.

c. Document clearance activities and utility markings in the field logbook and request sign-offs from the Project Manager.

3.3 Abandonment of Permanent and Temporary Monitoring Wells

Well abandonment is conducted to prevent the well from becoming a conduit for migration of contaminants from the ground surface to the water table or between aquifers. The preferred method of abandonment is to completely remove the well casing and screen from the borehole; however, certain situations may warrant grouting the well in place (as discussed in Section 3.3.3 of this SOP). This SOP applies to permanent and temporary monitoring wells including Geoprobe® screen point boreholes.

3.3.1 Overdrill and Grout

The preferred method of abandonment for a monitoring well is to completely remove the well casing and screen from the borehole by augering with a hollow-stem auger over the well casing to the bottom of the borehole. The well construction materials are then removed and appropriate grouting material is used to fill the open borehole.

The following procedures are used to plug the monitoring well for abandonment using the overdrill and grout method.

a. Utilize a hollow-stem auger rig with drill bit slightly larger than the well casing to ream out the sand pack and grout materials

   Note: This method shall be used for smaller diameter wells (1-inch to 4-inch diameter). Due to their brittleness, PVC wells may require the use of a drag bit or roller cone bit with the wet rotary method to grind the casing into smaller cuttings that will be flushed out of the borehole.

b. Remove the well casing and screen from the borehole with the drill rig.

c. Fill the open borehole with the appropriate grout material.

3.3.1.1 Grouting Method and Materials

a. Fill the borehole with the positive displacement method (tremie method) starting at the bottom of the borehole and filling to the top.

b. Use Type 1 Portland cement (ASTM C-150 or equivalent) mixed with potable water and 3-5% bentonite for plugging material (recommended).

   Note: Type 1 Portland cement has a high heat of hydration that may be a problem in PVC wells.

   Note: Type 1 Portland cement is not used in the presence of strong acids or in low pH environments.

c. Grout borehole to approximately 1to 2 foot below ground surface.

d. After the grout has hardened, top off with material that matches the surrounding ground surface (such as asphalt, grass, stone, or dirt).

3.3.2 Well Extraction

Hollow-stem auger removal is difficult for wells with diameters larger than 4 inches; therefore, it is recommended to force a drill stem with a tapered wedge assembly or a solid-stem auger into the well casing and extract the casing and screen from the borehole. This technique is especially viable for wells with little or no grouted annular space and/or sound well casing. After removal of the well construction materials, the well is grouted as previously detailed in Section 3.3.1.1 of this SOP.

Note: This method is not recommended for wells with badly corroded casings and/or thickly grouted annular spaces.

3.3.3 Grout in Place

Wells with larger diameters that would be removed by the well extraction technique may need to be grouted in place if they are old with badly corroded casings and/or thickly grouted annular space because they have a tendency to twist and/or break-off in the borehole. If this occurs, the well is grouted with the remaining casing left in the borehole. The remaining well casing and borehole is grouted as previously detailed in Section 3.3.1.1 of this SOP.

Note: The pressurized grout will be forced out through the well screen into the filter material and up the inside of the well casing sealing holes and breaks that are present.

Geoprobe® screen point boreholes are abandoned by pressure grouting through the probe rod during sampler retrieval.

a. Knock out the grout plug from the bottom of the screen using a grout plug push adapter and feed a grout nozzle through the probe rod, extending just below the bottom of the screen.

b. As the probe rod and sampler are pulled, inject grout in the open hole below the screen at a rate that just fills the open hole created by the pull.

c. Alternatively, pull the Geoprobe® and re-probe the hole with a tool string to be used for through-the-rod grouting.

3.4 Field Logbook Documentation

Field logbooks to record daily activities, including sample collection and tracking information, are maintained by the Field Team Leader. Information is entered into the field logbook by the appropriate field team member using waterproof ink. In addition to the minimum requirements discussed in the *Field Documentation* SOP (TVA-KIF-SOP-06), the field logbooks document the well abandonment activities specific to this SOP and as defined in the applicable project work control documents.

The Field Team Leader and/or designee reviews the field logbook entries on a weekly basis at a minimum (daily review is preferred) for completeness and accuracy and indicates this review by initialing the entries. The Field Team Leader is also responsible for the completion of the well abandonment form (provided in Table 2).

3.5 Decontamination and Waste Management

Well abandonment procedures typically result in the generation of solid waste material (such as manhole covers, well pads, PVC scraps, and bollards). The generated waste material is staged onsite for proper disposal. The field team leader contacts plant personnel and ash recovery project management to arrange for proper disposal.

Equipment decontamination is performed in a manner consistent with the *Decontamination of Equipment* SOP (TVA-KIF-SOP-08). Investigation-derived wastes produced during decontamination are managed in accordance with the *Management of Investigation-Derived Waste* SOP (TVA-KIF-SOP-12).

4.0 REFERENCES

- ASTM International. *Standard Guide for Decommissioning of Ground Water Wells, Vadose Zone Monitoring Devises, Boreholes, and Other Devices for Environmental Activities.* D 5299 - 99. 2005.
- Tennessee Valley Authority (TVA). *Decontamination of Equipment* SOP (TVA-KIF-SOP-08), 2010.
- TVA. *Field Documentation* SOP (TVA-KIF-SOP-06). March 2009.
- TVA. *Kingston Ash Recovery Project Non-Time-Critical Removal Action for the River System Sampling and Analysis Plan* (SAP), 15 February 2010.
- TVA. *Management of Investigation-Derived Waste* SOP (TVA-KIF-SOP-12), 2010.
- TVA. *Quality Assurance Project Plan for the Tennessee Valley Authority Kingston Ash Recovery Project* (TVA-KIF-QAPP), December 18, 2009.
- TVA. *Site-Wide Safety and Health Plan for the TVA Kingston Fossil Plant Ash Release Response* (SWSHP), 2010.
- U. S. Environmental Protection Agency (EPA) Region 4. *Design and Installation of Monitoring Wells*. *SESDGUID-101-R0.* February 13, 2008.

Table 1: Suggested Monitoring Well Abandonment Equipment & Materials Checklist	
Item Description	**Check**
Health & Safety	
Nitrile gloves	
Hard hat	
Steel-toed boots	
Hearing protection	
Field first-aid kit	
Eyewash	
Safety glasses	
Barricades, cones, flashing lights, signs	
Respirator and cartridges (if necessary)	
Saranex™/Tyvek® suits and booties (if necessary)	
Paperwork	
Safety and Health Plan	
Scope-of-work/project guidance documents	
Well abandonment location map	
Well construction diagram and boring logs for existing wells	
Field logbook	
Drum labels (if needed)	
Flags or paint for marking wells planned for abandonment	
Well abandonment form	
Monitoring Well Equipment	
Hollow-stem auger rig	
Grout, bentonite, potable water, and Type 1-N Portland cement	
Drums (if needed)	
Portable GPS device	
Digital camera	
Measuring tape/ruler	

Table 2. Monitoring Well Abandonment Form

General Information

Monitoring Well Number: _____

Date: _____ Project Name: _____

Oversight By: _____ Abandoned By: _____

Well Details (Check one per section):

Casing Diameter

_____ 2”
_____ 4”
_____ 6”
_____ Other/NA

Well Type

_____ Permanent
_____ Temporary
_____ Geoprobe® Screen Point (GSP) or Equiv.

Casing Material

_____ PVC
_____ Steel
_____ Other/NA

Abandonment Details (Check one per section):

Abandonment Method (as detailed in TVA-KIF-SOP-46)

_____ Overdrill and Grout
_____ Well Extraction
_____ Grout in Place
_____ Bentonite Sealing- Pellets and Neat Cement (low-risk GSP only)
_____ Bentonite Sealing- Pellets Only (low-risk GSP only)
_____ Probe Hole Grouting (higher risk GSP only)
_____ Re-proved for through-the-rod grouting (GSP only alternative)

Materials and Quantity Used

_____ Type 1 Portland Cement mixed with 3-5% bentonite
_____ Bentonite Pellets
_____ Neat Cement
_____ Other _____

Overdrilled Well Cuttings and Debris

_____ Staged Onsite for Disposal (covered top and bottom with poly-sheeting)
_____ Drummed for Disposal

Reviewed By: _____ _____
Signature Date/Time

_____
Print Name

End of Procedure