NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

MONITORING WELL

(No.)

CODE 353

DEFINITION

A well designed and installed to obtain representative groundwater quality samples and hydrogeologic information.

PURPOSE

To provide controlled access for sampling groundwater near an agricultural waste storage or treatment facility to detect seepage and monitor groundwater quality.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies to the design, installation, and development of monitoring wells where

- Contamination of groundwater from an agricultural waste storage or treatment facility is a concern
- The facility is a component of an agricultural waste management system

This practice does **not** apply to:

- Methods for the collection and analysis of groundwater samples or groundwater information from the well
- Monitoring of subsurface waters in the vadose zone
- The installation of wells for any other purpose
- Temporary exploratory drill holes or borings
- The decommissioning of monitoring wells

CRITERIA

Laws and Regulations. Monitoring wells shall be planned, designed, constructed, operated and maintained in a manner that meets all applicable local, State, Tribal, and Federal laws and regulations.

In California, counties (and some cities) administer and enforce laws or ordinances pertaining to the construction, alteration, maintenance, and destruction of monitoring wells, using standards that equal or exceed those developed by the Department of Water Resources (DWR; http://wwwdpla.water.ca.gov/sd/groundwater/california_well_standards.html). Key provisions in the State Standard that are either not addressed or are more stringent than what is included in the NRCS standard, are included in italicized format. In all cases, more stringent requirements set forth by the local enforcing agency shall supercede those set forth in this standard.

Hydrogeologic Investigation. Prior to the design of a monitoring well, a surface and subsurface investigation shall be conducted to develop a conceptual hydrogeologic model of the site, to identify potential groundwater flow paths, and to determine the location of the target monitoring zone(s).

The hydrogeologic investigation shall

- Include the mapping, identification and description of soil and rock masses that affect the movement and transport of subsurface water occurring within a minimum of 100 feet from the footprint of the facility of interest.
- Identify and describe all characteristics and properties of geologic units that can influence subsurface water flow paths or produce preferred flow paths such as karst development, joint sets, fracture systems, faults, lineaments, and other similar discontinuities. These shall be located on a geologic evaluation map of the site.

- Identify and describe any tile lines, subsurface drains, surface drains, irrigation ditches, irrigation wells, water supply wells, septic drain fields, infiltration strips, quarries, mines, or other water control/management related features that have the potential to alter the native subsurface water flow paths. Such features shall be located on a geologic evaluation map of the site.
- Be of sufficient detail to map the potentiometric surface to a one-foot contour interval. The map of the potentiometric surface shall be used to determine the hydraulic gradient and direction of flow within the target monitoring zone(s).
- Identify and describe any seasonal changes in the potentiometric surface and direction of subsurface water flow paths.
- Identify and describe other features that influence subsurface water flow such as hard pans, sand boils, animal burrows, seasonal desiccation, high shrink/swell soils, dense till, depth of frost line, and permafrost.

The requirement for a hydrogeologic investigation can be satisfied using documentation or certification by the enforcing agency that the monitoring well has been installed according to their requirements.

Layout. Monitoring wells shall be located both up-gradient and down-gradient of the waste storage facility, at a distance and depth based on the results of the hydrogeologic investigation of the site, *and according to requirements set forth by the designated Tribal, State, Regional, or Local enforcing agency.*

To the degree possible, monitoring wells should be located in areas protected from flooding.

The layout of the monitoring wells shall be based on the conceptual hydrogeologic model to intercept representative subsurface water flow path(s) of the target monitoring zone(s).

Unless otherwise directed by the designated regulatory agency, the placement of monitoring wells in fractured-rock and karst aquifers shall be based on the location of zones of high-permeability, even if they are located offsite.

Design. The design of all components of the monitoring well shall conform to ASTM D5092 "Standard Practice for Design and Installation of Groundwater Monitoring Wells in Aquifers", *and to California State/local monitoring well standards and enforcing agency requirements.*

The annular space shall be effectively sealed: a) to prevent it from being a preferential pathway for the movement of poor quality water, pollutants, and contaminants; and b) to isolate the well intake section or screen to one water-bearing unit. A properly installed annular seal may also help protect the structural integrity of the well casing; and protect the casing from chemical attack and corrosion.

Materials. *Materials used for the construction of monitoring wells shall conform to California State/local monitoring well standards and enforcing agency requirements.*

Materials used for the construction of monitoring wells shall be non-reactive with subsurface water and shall not leach substances into the subsurface water.

Materials shall be free of contaminants prior to installation.

Plastic (thermoplastic and fluorocarbon resins) casing materials are commonly used for monitoring wells. Plastic casing shall conform to standards and specifications set forth or cited in the California Water Well Standards, or local standards as appropriate.

Well screens shall be made by machine.

All joints shall be threaded. Glued or solvent-welded joints shall not be used.

Materials shall have adequate strength to withstand the forces of installation and well development.

Monitoring well filter pack material shall consist of nonreactive, smooth, rounded, spherical, granular material of highly uniform size and known composition. Filter pack material shall not degrade or consolidate after placement. The grain-size of the filter pack shall be matched to the slot size of the well screen so that any movement of filter pack material into the well will be limited to prevent significant voids in the filter pack that could ultimately destabilize the annular seal.

Water used for sealing mixtures should generally be of drinking water quality, shall be

compatible with the type of sealing material used, shall be free of petroleum and petroleum products, and shall be free of suspended matter. In no case shall the concentration of chloride in water used in cement-based sealing material exceed 2,000 milligrams per liter. Sulfate shall not exceed 1,500 mg/l.

Installation. *Construction of monitoring wells shall be performed by licensed C-57 water well drilling contractors, except where exempted by law.*

Installation methods shall be selected based on site-specific conditions identified during the hydrogeologic investigation.

Installation methods shall conform to ASTM D5092 "Standard Practice for Design and Installation of Groundwater Monitoring Wells in Aquifers" *and to California State/local monitoring well standards and enforcing agency requirements.*

The equipment used shall be capable of creating a stable, open, vertical borehole for installation of the monitoring well.

Filter pack material shall be placed in the well boring by use of a tremie pipe or equivalent. The depth of the top of the filter pack shall be carefully checked and the volume of emplaced filter pack material verified to determine that filter pack materials have not bridged during installation.

All loose cuttings and other obstructions shall be removed from the annular space before sealing materials are placed. Sealing may be accomplished by using pressure grouting techniques, a tremie pipe, or equivalent. Sealing materials shall not be installed by "free-fall" from the surface unless the interval to be sealed is dry and less than 30 feet deep.

Drill cuttings and wastewater from monitoring wells in areas of known or suspected contamination or pollution shall be disposed of in accordance with all applicable Federal, State, and Local requirements.

Well Protection. Installation of measures to protect the monitoring well from damage from hazards such as frost action, surface drainage, animal or equipment traffic, and lack of visibility shall conform to ASTM D5092.

The top of the well casing shall terminate above the ground surface and known levels of flooding, except where site conditions, such as vehicular traffic or freezing, will not allow. Well casing that terminates below the ground surface must be approved by the enforcing agency, and shall not terminate below 4 feet depth. For subsurface terminations, a structurally-sound watertight vault (or equivalent) shall be installed to house the top of a monitoring well, in conformance with State/local monitoring well standards and enforcing agency requirements.

For monitoring wells where the casing terminates at or above the ground surface, a concrete base or pad shall be constructed around the top of a monitoring well casing at ground surface, in conformance with State/local monitoring well standards and enforcing agency requirements. The base shall be at least 4 inches thick, extend at least 2 feet laterally in all directions from the outside of the well boring, and drain away from the well casing.

The base shall be free of cracks, voids, and other significant defects likely to prevent water tightness. Contacts between the base and the annular seal, and the base and the well casing must be water tight and must not cause the failure of the well casing or annular seal. Where cement-based annular sealing material is used, the concrete base shall be poured before the annular seal has set.

Protection from natural or human caused damage shall be provided in conformance with ASTM D5787 "Standard Practice for Monitoring Well Protection."

A buffer zone with a minimum radius of 30 feet shall be established around each well head. The buffer zone shall be fenced or otherwise protected from access by motor vehicles and livestock.

Within the buffer zone there shall be no storage, handling, mixing, or application of fertilizers, pesticides or other agricultural chemicals or cleaning of equipment used in the handling or application of such items.

Development. The monitoring well shall be developed to improve the hydraulic connection between the target hydrogeologic unit and the well screen, to minimize the interference of sediment with water quality samples, and to restore the groundwater properties disturbed by the drilling process. The well is developed

after the well is installed, including fill and sealing materials and well-head protection.

The well development method shall be selected from alternatives provided in ASTM D5521 “Standard Guide for Development of Groundwater Monitoring Wells in Granular Aquifers.” The selection of the method shall be based on the physical characteristics of the target hydrogeologic unit and the drilling method used.

Record Keeping. *Monitoring well construction, alteration, and destruction reports shall be completed on forms provided (or otherwise approved) by the California Department of Water Resources, and submitted as required by relevant provisions of the California Water Code . Information regarding State Well Completion Reports is online at http://www.water.ca.gov/groundwater/well_info_and_other/well_completion_reports.cfm.*

Record keeping shall conform to:

- ASTM D5254 “Standard Practice for Minimum Set of Data Elements to Identify a Ground-Water Site”
- ASTM D5408 “Standard Guide for Set of Data Elements to Describe a Ground-Water Site: Part One – Additional Identification Descriptors”
- ASTM D5409 “Standard Guide for Set of Data Elements to Describe a Ground-Water Site: Part Two – Physical Descriptors”

CONSIDERATIONS

Consider using geophysical tools in conjunction with penetrative exploratory techniques to improve and refine the mapping of the location, shape, orientation and extent of subsurface hydrogeologic units.

Consider effects of geomorphic processes, geologic structures, regional stratigraphy, and soil and rock properties on subsurface flow patterns when developing a conceptual hydrogeologic model.

Consider the physical properties and methods of movement in the environment of the solutes and pollutants of interest when designing monitoring wells.

In locating a monitoring well, consider the need to access the well for future maintenance, modification, repair, and destruction.

Consider installing additional monitoring wells at other points as dictated by the results of the hydrogeologic investigation to adequately monitor the location and direction of movement of any potential contaminant plume.

Consider evaluating alternative drilling methods for installing monitoring wells provided in ASTM D6286 “Standard Guide for Selection of Drilling Methods for Environmental Site Characterization.”

Where frost heave is a concern, consider design alternatives that reduce the potential for frost heave to damage the monitoring well.

PLANS AND SPECIFICATIONS

Plans and specifications for constructing, installing, completing, and developing monitoring wells shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose.

OPERATION AND MAINTENANCE

Provisions shall be made for operation and maintenance requirements in keeping with the purpose of this standard. When no longer needed, close the well according to NRCS National Conservation Practice Standard 351 “Water Well Decommissioning.”