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 local, State, Tribal and Federal laws and regulations. Refer to the Oklahoma Water Resources Board (OWRB) Rules and Regulations, Chapter 35, Subchapter 7-2 “Minimum standards for construction of monitoring wells and geotechnical borings”. The (OWRB) rules are minimum standards and other laws and regulations which are more stringent may be applicable.

Criteria, where not in conflict with, or less stringent than that required in, the OWRB rules, shall conform to the ASTM guidance below.

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.

Layout. Monitoring wells shall be located both up-gradient and down-gradient of the waste storage facility and at a distance and depth based on the results of the hydrogeologic investigation of the site.

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).

At a minimum, one well shall be placed up gradient and three down gradient.

Where seasonal changes have a potential to impact subsurface flow directions, monitoring wells shall be place to account for such flow changes.

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 one of the following;

ASTM D5092 “Standard Practice for Design and Installation of Groundwater Monitoring Wells in Aquifers” for granular aquifers.

ASTM D5717 “Standard Guide for Design of Ground-Water Monitoring Systems in Karst and Fractured-Rock Aquifers” for karst or fractured-rock aquifers.

Well development shall ensure that only the targeted hydrogeologic unit contributes to the monitoring well and that the annular space is sealed to prevent cross contamination from other groundwater sources.

Materials. 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.

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.

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

Installation methods shall be in conformance with ASTM D5092 for granular aquifers, and ASTM D5717 for karst and fractured rock aquifers.

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

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.

Positive surface drainage away from the well head shall be established.

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 for granular aquifers shall be selected from alternatives provided in ASTM D5521 "Standard Guide for Development of Groundwater Monitoring Wells in Granular Aquifers." For fractured-rock and karst aquifers, the well development method shall conform to ASTM D5717. The selection of the method shall be based on the physical characteristics of the target hydrogeologic unit and the drilling method used.

Record Keeping. 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"

Installation of monitoring wells shall be reported as required by local, State, Tribal, and Federal laws and regulations.

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.

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."

REFERENCES

Title 785. Oklahoma Water Resources Board, Chapter 35. Well Drill and Pump Installer Licensing

American Society for Testing and Materials (ASTM), D5092 "Standard Practice for Design and Installation of Groundwater Monitoring Wells in Aquifers"

ASTM D5717 "Standard Guide for Design of Ground-Water Monitoring Systems in Karst and Fractured-Rock Aquifers"

ASTM D5787 "Standard Practice for Monitoring Well Protection."