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Standard Guide for Selection and Documentation of Existing Wells for Use in Environmental Site Characterization and Monitoring[1]

This standard is issued under the fixed designation D5980; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope*

1.1 This guide covers the use of existing wells for environmental site characterization and monitoring. It covers the following major topics: criteria for determining the suitability of existing wells for hydrogeologic characterization and groundwater quality monitoring, types of data needed to document the suitability of an existing well, and the relative advantages and disadvantages of existing large- and small-capacity wells.

1.2 This guide should be used in conjunction with Guide D5730, that provides a general approach for environmental site investigations.

1.3 This guide does not specifically address design and construction of new monitoring or supply wells. Refer to Practices D5092 and D5787.

1.4 This guide does not specifically address groundwater sampling procedures. Refer to Guide D5903.

1.5 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.6 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

1.7 *This guide offers an organized collection of information or a series of options and does not recommend a specific course of action. This guide cannot replace education or experience and should be used in conjunction with professional judgment. Not all aspects of this guide may be applicable in all circumstances. This guide is not intended to represent or replace the standard of care by which the adequacy of a given professional service must be judged, nor should this guide be applied without consideration of a project's many unique aspects. The word "Standard" in the title of this document means only that the document has been approved through the ASTM consensus process.*

2. Referenced Documents

2.1 Pertinent guides addressing specific information necessary to utilize existing wells for hydrologic and water-quality data for environmental site characterization. A comprehensive list of guides, standards, methods, practices, and terminology is contained in Guide D5730. Other guidance documents covering procedures for environmental site investigations with specific objectives or in particular geographic settings may be available from federal, state, and other agencies or organizations. The appropriate agency or organization should be contacted to determine the availability and most current edition of such documents.

2.2 *ASTM Standards:*[2]

D653 Terminology Relating to Soil, Rock, and Contained Fluids
D5092 Practice for Design and Installation of Groundwater Monitoring Wells
D5254 Practice for Minimum Set of Data Elements to Identify a Ground-Water Site
D5408 Guide for Set of Data Elements to Describe a Groundwater Site; Part One—Additional Identification Descriptors
D5409 Guide for Set of Data Elements to Describe a Ground-Water Site; Part Two—Physical Descriptors
D5410 Guide for Set of Data Elements to Describe a Groundwater Site;Part Three—Usage Descriptors (Withdrawn 2016)[3]
D5521 Guide for Development of Groundwater Monitoring Wells in Granular Aquifers
D5730 Guide for Site Characterization for Environmental Purposes With Emphasis on Soil, Rock, the Vadose Zone and Groundwater (Withdrawn 2013)[3]

[1] This guide is under the jurisdiction of ASTM Committee D18 on Soil and Rockand is the direct responsibility of Subcommittee D18.21 on Groundwater and Vadose Zone Investigations.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] The last approved version of this historical standard is referenced on www.astm.org.

***A Summary of Changes section appears at the end of this standard**

D5753 Guide for Planning and Conducting Borehole Geophysical Logging
D5787 Practice for Monitoring Well Protection
D5903 Guide for Planning and Preparing for a Groundwater Sampling Event
D5979 Guide for Conceptualization and Characterization of Groundwater Systems

3. Terminology

3.1 *Definitions*—For common definitions of technical terms used in this standard, refer to Terminology D653.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *supply (production) well, n*—well primarily installed for public supply, irrigation, and industrial use. Supply wells may be used as an observation well.

4. Significance and Use

4.1 This guide describes a general approach for the use of existing wells in environmental investigations with a primary focus on the subsurface and major factors affecting the surface and subsurface environment.

4.2 Existing wells represent a valuable source of information for subsurface environmental investigations. Specific uses of existing wells include:

4.2.1 Well driller logs provide information on subsurface lithology and major water-bearing units in an area. Existing wells can also offer access for downhole geophysical logging for stratigraphic and aquifer interpretations. Examples include natural gamma logs in cased wells and an entire suite of methods in uncased bedrock wells (see Guide D5753). This information can assist in developing the preliminary conceptual model of the site.

4.2.2 Well tests using existing wells may provide information on the hydrologic characteristics of an aquifer.

4.2.3 Monitoring of water levels in existing wells, provided that they are cased in the aquifer of interest, allow development of potentiometric maps and interpretations of groundwater flow directions and gradients.

4.2.4 Existing wells are the primary means by which regional drinking water quality is evaluated and monitored.

4.2.5 Existing wells may assist in the mapping of contaminant plumes, and in ongoing monitoring of groundwater quality changes at the site-specific level.

4.3 Data from existing wells should only be used when characteristics of the well have been sufficiently documented to determine that they satisfy criteria for the purpose for which the data are to be used.

5. General Considerations in Selection and Use of Existing Wells

5.1 Selection and use of existing wells should take place in the context of a conceptual framework consisting of a description of the system, including, as necessary, physical and cultural characteristics, such as climate, hydrology, ecology, physiography, population, water use and land use, and hypotheses about processes of interest that occur within that system. A step-wise approach for conceptualization and characterization is a direct approach to develop the framework for Hydrologic Systems as described in Kolm (**1**)[4], (see Guide D5979). Conceptualization of hydrologic and regional groundwater quality systems can be formulated using the methods outlined in Alley (**2**). The framework is reviewed and refined by an iterative process of data collection and analysis, testing hypotheses with data collected, and identifying data needs to further revise the framework. Refinement must be made within the limits established by the accuracy, precision, and completeness of the data. Methods for data collection are selected that will provide data appropriate for testing hypotheses which evaluate the conceptual framework.

5.2 Well design and installation can greatly affect the quality of groundwater monitoring. Such effects apply both to existing wells and to wells specifically installed for a purpose. The effects of well design and installation, therefore, need to be considered regardless of whether existing wells are selected or if wells are specifically installed for a specific purpose. The most common feature of an existing well that may render it unsuitable for water level measurement or water-quality monitoring is that the well is completed in multiple hydrogeologic units causing water levels and water-quality parameters to reflect a mixing of multiple hydrogeologic units. Such data cannot be reliably compared with data from wells completed in the individual hydrogeologic units.

5.3 Major steps in the selection of existing wells for environmental investigations include: developing specific criteria for evaluating the suitability of existing wells in relation to the objectives of the investigations (see Section 6), conducting an inventory of existing wells in the area of interest (see 8.1), documenting the characteristics of the wells identified in the inventory that are relevant to the selection criteria (see 8.2), and identification of wells that satisfy the selection criteria (see Section 9).

6. Well-Selection Criteria

6.1 Assessing the suitability of existing wells for hydrological and groundwater quality studies requires development of specific well-selection criteria. The criteria are based on considerations of project objectives by defining the problem to be solved, the conceptual framework, and data-collection requirements.

6.2 *Specific Well-Selection Criteria*—Specific criteria will depend on the objectives of the investigation. The following general criteria will apply to most situations:

6.2.1 The well is suitably located for use in relation to the conceptual framework.

6.2.2 The well must be completed in the targeted hydrogeologic unit or units.

6.2.3 Well design and construction must not bias water level measurements or water-quality sampling results (see Note 1). Section 7 provides information on the general characteristics of major types of existing wells.

NOTE 1—Gillham et al. (**3**), provides information on the suitability of

[4] The boldface numbers in parentheses refer to the list of references at the end of this standard.

materials coming in contact with water samples and that table provides information on the compatibility of well casing materials with different organic contaminants.

6.2.4 The well is accessible for measurements and sampling.

6.2.5 The well's maintenance condition may not compromise it as a sampling point; however, there are examples that may compromise it as a sampling point, that is, a cracked casing allowing non-screened water into the well.

6.3 *Examples of Well Selection Criteria*—The following are illustrative examples of criteria for specific investigation objectives (see Note 2).

NOTE 2—These are illustrative examples and should not be construed as recommended criteria.

6.3.1 A project to determine the quality of potable groundwater might require the following selection criteria: wells selected must be used for public water supply, must be geographically distributed over the entire aquifer of interest, and must be able to be sampled prior to any water treatment.

6.3.2 All wells or a subset of wells down-gradient from a hazardous-waste site would be unsuitable to include in a network designed for a study to determine non-point source groundwater quality.

6.3.3 Choosing a well located down-gradient of a complex mix of land uses would be inappropriate in a study designed to assess the effects of specific land uses on groundwater quality.

6.3.4 A supply well screened over a long interval would not be appropriate for investigating small-scale vertical variations in water quality down-gradient of a landfill, or for potentiometric mapping.

6.3.5 A well constructed of PVC (polyvinylchloride) with glued joints would not be suitable for sampling if the volatile-organic compounds of interest in the groundwater also are found in the glue used to join the sections of well casing. Similarly, a well constructed of steel may not be suitable for the sampling of metals.

6.3.6 Selecting an observation well in an area undergoing rapid development would be avoided in constructing a network of wells for evaluating long-term trends in groundwater quality because of the possibility of the well being destroyed by later development.

7. General Characteristics of Major Types of Existing Wells

7.1 There are two general categories of existing wells available for hydrologic and groundwater quality studies: large- and small-capacity supply or production wells installed for drinking, irrigation, and industrial use (see 7.2 and 7.3); and wells specially designed and installed to monitor hydrologic or water-quality studies, or both (see 7.4). Each type of well has its own general advantages and disadvantages.

7.2 *Large-Capacity Supply Wells*—Large-capacity supply wells are usually developed for drinking water systems that supply multiple households, and for irrigation and industrial purposes.

7.2.1 *Advantages:*

7.2.1.1 Documentation of well construction commonly is good.

7.2.1.2 Large-capacity wells generally are well developed and fully purged.

7.2.1.3 Long-term access may be possible, particularly for municipal wells.

7.2.1.4 Large-capacity wells generally provide a larger vertical mix of water in an aquifer or aquifer system than small-capacity wells, and thus can provide a more integrated measure of regional groundwater quality than small-capacity wells.

7.2.1.5 Much of the water produced for irrigation and municipal water is from large-capacity wells equipped with taps which allow a direct sample of the pumped water.

7.2.1.6 Long-term water-quality and quantity data may be available.

7.2.2 *Disadvantages:*

7.2.2.1 Large-capacity wells may not have flow-rate controls and a sampling point near the well head.

7.2.2.2 High pumping rates may entrain artifacts, such as colloids or suspended material, into the sample stream.

7.2.2.3 Pumping schedules could be irregular: for example, irrigation wells generally are pumped seasonally, and could lead to seasonal variations in water quality that actually are an artifact of the pumping regime.

7.2.2.4 Large capacity wells may have a long vertical gravel pack, screened or open intervals might span more than one aquifer or aquifer system, making them unsuitable for potentiometric mapping or water quality monitoring. For example, dilution of contaminant concentrations wells with long screen intervals may result in large errors if concentrations are used for detailed delineation of the geometry and concentrations of contaminant plumes or for detection of contaminants in low concentrations (Pohlmann and Alduino (**4**)).

7.2.2.5 Wells with high pumping rates may draw water from water-bearing units other than those screened even if the well is screened solely within one unit; thus, the vertical integration of water from water-bearing units might be unknown.

7.2.2.6 Local hydraulics may be atypical of regional groundwater movement as a result of compaction or enhanced downward flow.

7.2.2.7 Municipal wells that produce water not meeting water-quality standards are usually abandoned, implying that the remaining population of municipal wells is biased toward acceptable water quality.

7.2.2.8 Down-hole chlorination or other chemical treatment might affect water chemistry, so that samples do not reflect ambient groundwater composition.

7.2.2.9 Depth-dependent differences in water quality could be lost, as water sampled could reflect a mixture of water obtained at different depths.

7.3 *Small-Capacity Supply Wells*—Small-capacity supply wells are usually developed for domestic water use involving a single household.

7.3.1 *Advantages:*

7.3.1.1 Domestic wells are a major source of drinking-water supply for rural population, so wells reflect this resource use.