

**WAC 173-350-500 Groundwater monitoring. (1) Groundwater monitoring - General provisions.**

(a) Applicability. This section applies to limited purpose landfills subject to WAC 173-350-400 and surface impoundments that do not have a leak detection layer subject to WAC 173-350-330. Subsections (1), (3), (4) and (5) of this section apply to all such facilities, and subsection (2) of this section applies to WAC 173-350-400 Limited purpose landfills, only.

(b) Jurisdictional health departments are responsible for regulation of groundwater monitoring at landfills and other solid waste handling facilities they permit, except in instances where responsibility is shared with the department.

(c) All reports, plans, procedures, and design specifications required by this section must be prepared by a licensed professional in accordance with the requirements of chapter 18.220 RCW, Geologists.

**(2) Groundwater monitoring - Site characterization for landfill sites.** A site proposed for limited purpose landfill activities subject to WAC 173-350-400 must be characterized for its geologic and hydrogeologic properties and suitability for constructing, operating, and monitoring the facility in accordance with all applicable requirements of this chapter. The site characterization report must be submitted with the permit application and must include at a minimum the following:

(a) A summary of local and regional geology and hydrology, including:

- (i) Faults;
- (ii) Joints and fractures;
- (iii) Unstable slopes and subsidence areas on-site;
- (iv) Areas of groundwater recharge and discharge;
- (v) Stratigraphy; and
- (vi) Erosional and depositional environments.

(b) A site-specific borehole program that includes a description of lithology, soil/bedrock types and properties, preferential groundwater flow paths or zones of higher hydraulic conductivity, the presence of confining unit(s) and geologic features such as fault zones, cross-cutting structures, the target hydrostratigraphic unit(s) to be monitored, and other relevant information. All procedures conducted must follow current applicable ASTM procedures. A list of procedures that were followed must be identified in subsequent report(s). Requirements of the borehole program include:

(i) Each boring will be of sufficient depth below the proposed grade of the bottom liner to identify soil, bedrock, and hydrostratigraphic unit(s);

(ii) Boring samples must be collected from five-foot intervals at a minimum and at changes in lithology. Representative samples must be described using the unified soil classification system; and tested for the following, if appropriate:

- (A) Particle size distribution by sieve and hydrometer analyses;
- (B) Atterburg limits;
- (C) Moisture content sufficient to characterize the unit;
- (D) Shear strength and consolidation testing on soft or potentially weak layers, for use in stability and settlement analyses; and
- (E) Hydraulic conductivity by an in situ field method or laboratory method.

(iii) All boring logs must be submitted with the following information:

- (A) Soil and rock descriptions and classifications;

- (B) Method of sampling;
- (C) Sample depth, interval and recovery;
- (D) Date of boring;
- (E) Water level measurements;
- (F) Standard penetration number;
- (G) Boring location; and
- (H) Soil test data (in report text or on log).

(iv) All borings not converted to monitoring wells or piezometers shall be carefully backfilled, plugged, and recorded in accordance with WAC 173-160-420;

(v) During the borehole drilling program, any on-site drilling and lithologic unit identification must be performed under the direction of a licensed professional in accordance with the requirements of chapter 18.220 RCW, Geologists, who is trained to sample and identify soils and bedrock lithology;

(vi) An on-site horizontal and vertical reference datum must be established during the site characterization. The standards for land boundary surveys and geodetic control surveys and guidelines for the preparation of land descriptions must be used to establish borehole and monitoring well coordinates and casing elevations from the reference datum; and

(vii) Other methods, including geophysical techniques, may be used to supplement the borehole program to ensure that a sufficient hydrogeologic site characterization is accomplished.

(c) A site-specific flow path analysis that includes:

(i) The depths to groundwater and hydrostratigraphic unit(s) including transmissive and confining units; and

(ii) Potentiometric surface elevations and contour maps, direction and rate of horizontal and vertical groundwater flow.

(d) Identification of the quantity, location, and construction (where available) of private and public wells within a two thousand-foot radius, measured from the edge of the solid waste handling unit;

(e) Tabulation of all water rights for groundwater and surface water within a two thousand-foot radius, measured from site boundaries;

(f) Identification and description of all surface waters within a one-mile radius, measured from the edge of the solid waste handling unit;

(g) A summary of all previously collected site groundwater and surface water analytical data, and for expanded facilities, identification of impacts of the existing facility upon ground and surface waters from landfill leachate discharges to date;

(h) Calculation of a site water balance;

(i) Conceptual design of groundwater and surface water monitoring systems, and where applicable surface water and vadose zone monitoring systems, including proposed construction and installation methods for these systems;

(j) Description of land use in the area, including nearby residences;

(k) A topographic map of the site and drainage patterns, including an outline of the solid waste handling unit, property boundary, the proposed location of groundwater monitoring wells, and township and range designations; and

(l) Geologic cross sections.

(3) **Groundwater monitoring - System design.**

(a) The groundwater monitoring system design and report must be submitted with the permit application and must meet the following criteria:

(i) A sufficient number of monitoring wells must be installed at appropriate locations and depths to yield representative groundwater samples from those hydrostratigraphic units which have been identified during site characterization as the earliest potential contaminant flowpaths;

(ii) Represent the quality of groundwater at the point of compliance, and include at a minimum:

(A) A groundwater flow path analysis which supports why the chosen hydrostratigraphic unit is capable of providing an early warning detection of any groundwater contamination;

(B) Documentation and calculations of all of the following information:

(I) Hydrostratigraphic unit thickness including confining units and transmissive units;

(II) Vertical and horizontal groundwater flow directions including seasonal, man-made, or other short-term fluctuations in groundwater flow;

(III) Stratigraphy and lithology;

(IV) Hydraulic conductivity; and

(V) Porosity and effective porosity.

(b) Upgradient monitoring wells (background wells) must meet the following performance criteria:

(i) Must be installed in groundwater that has not been affected by leakage from a solid waste handling unit; or

(ii) If hydrogeologic conditions do not allow for the determination of an upgradient monitoring well, then sampling at other monitoring wells which provide representative background groundwater quality may be allowed.

(c) Downgradient monitoring wells (compliance wells) must meet the following performance criteria:

(i) Represent the quality of groundwater at the point of compliance;

(ii) Be installed as close as practical to the point of compliance; and

(iii) When physical obstacles preclude installation of groundwater monitoring wells at the point of compliance, the downgradient monitoring system may be installed at the closest practical distance hydraulically downgradient from the point of compliance that ensures detection of groundwater contamination in the chosen hydrostratigraphic unit.

(d) All monitoring wells must be constructed in accordance with chapter 173-160 WAC, Minimum standards for construction and maintenance of wells, and chapter 173-162 WAC, Regulation and licensing of well contractors and operators.

(e) The owner or operator must notify the jurisdictional health department and the department of any proposed changes to the design, installation, development, and decommission of any monitoring wells, piezometers, and other measurement, sampling, and analytical devices. Proposed changes must not be implemented prior to the jurisdictional health department's written approval. Upon completing changes, all documentation, including date of change, new monitoring well location maps, boring logs, and monitoring well diagrams, must be submitted to the jurisdictional health department and must be placed in the operating record.

(f) All monitoring wells, piezometers, and other measurement, sampling, and analytical devices must be operated and maintained so that they perform to design specifications throughout the life of the monitoring program.

**(4) Groundwater monitoring - Sampling and analysis plan.**

(a) The groundwater monitoring program must include consistent sampling and analysis procedures that are designed to provide monitoring results that are representative of groundwater quality within site monitoring wells. In addition to monitoring wells, facilities with hydraulic gradient control and/or leak detection systems will provide representative groundwater samples from those systems. The owner or operator must submit a compliance sampling and analysis plan as part of the permit application. The plan must include procedures and techniques for:

- (i) Sample collection and handling;
- (ii) Sample preservation and shipment;
- (iii) Analytical constituents and procedures;
- (iv) Chain-of-custody control;
- (v) Quality assurance and quality control;
- (vi) Decontamination of drilling and sampling equipment;
- (vii) Procedures to ensure employee health and safety during well installation and monitoring;
- (viii) Well operation and maintenance procedures; and
- (ix) Statistical analysis methods.

(b) Facilities collecting leachate must include leachate sampling and analysis as part of the plan in (a) of this subsection.

(c) The groundwater monitoring program must include sampling and analytical methods that are appropriate for groundwater samples. The sampling and analytical methods must provide sufficient sensitivity, precision, selectivity and limited bias so that changes in groundwater quality can be detected and quantified. All samples must be sent to an accredited laboratory for analyses in accordance with chapter 173-50 WAC, Accreditation of environmental laboratories.

(d) Groundwater elevations must be measured in each monitoring well immediately prior to sampling purging, each time groundwater is sampled. The owner or operator must determine the rate and direction of groundwater flow each time groundwater is sampled. All groundwater elevations must be determined by a method that ensures measurement to the one hundredth of a foot relative to the top of the well casing.

(e) Groundwater elevations in monitored wells must be measured within a period of time short enough to avoid any groundwater fluctuations which could preclude the accurate determination of groundwater flow rate and direction.

(f) The owner or operator must establish background groundwater quality in all upgradient monitoring wells, and all future downgradient monitoring wells at landfill sites where waste has not yet been deposited. Background groundwater quality must be based upon a minimum of eight independent samples. Samples must be collected for each monitoring well and must be analyzed for parameters required in the permit for the first year of groundwater monitoring. Each independent sampling event must be no later than one month after the previous sampling event.

(g) Groundwater quality must be determined at each monitoring well at least quarterly during the active life of the landfill or impoundment, and the post-closure period of the landfill. More frequent monitoring may be required to protect downgradient water supply wells. Groundwater monitoring must begin after background groundwater quality

has been established. Laboratory analysis methods must have sufficiently low detection limits, when practical, to determine whether constituent concentrations exceed chapter 173-200 WAC, Water quality standards for groundwaters of the state of Washington, criteria. The owner or operator may propose an alternate groundwater monitoring frequency; however, groundwater monitoring frequency must be no less than semiannually. The owner or operator must apply for a permit modification or must apply during the renewal process for changes in groundwater monitoring frequency making a demonstration based on the following information:

(i) A characterization of the hydrostratigraphic unit(s) including the unsaturated zone, transmissive and confining units and include the following:

- (A) Hydraulic conductivity; and
- (B) Groundwater flow rates.

(ii) Minimum distance between upgradient edge of the solid waste landfill and/or the impoundment and downgradient monitoring wells (minimum distance of travel); and

(iii) Contaminant fate and transport characteristics.

(h) All facilities must test for the following parameters:

(i) Field parameters:

- (A) pH;
- (B) Specific conductance;
- (C) Temperature; and
- (D) Static water level.

(ii) Geochemical indicator parameters:

- (A) Alkalinity (as Ca CO<sub>3</sub>);
- (B) Bicarbonate (HCO<sub>3</sub>);
- (C) Dissolved calcium (Ca);
- (D) Chloride (Cl);
- (E) Total and dissolved iron (Fe);
- (F) Total and dissolved magnesium (Mg);
- (G) Total and dissolved manganese (Mn);
- (H) Nitrate (NO<sub>3</sub>);
- (I) Dissolved potassium;
- (J) Dissolved sodium (Na); and
- (K) Sulfate (SO<sub>4</sub>).

(iii) Leachate indicators:

- (A) Ammonia (NH<sub>3</sub>-N);
- (B) Total organic carbon (TOC); and
- (C) Total dissolved solids (TDS).

(i) If other pertinent constituents are identified based upon the site specific waste profile and/or leachate characteristics for lined facilities, if tested, the owner or operator must propose those additional constituents to include in the monitoring program. The jurisdictional health department will specify the additional constituents in the solid waste permit.

(j) Testing must be performed in accordance with "*Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*," U.S. EPA Publication SW-846, or other testing methods approved by the jurisdictional health department.

(k) Maximum contaminant levels (MCL) for groundwater are those specified in chapter 173-200 WAC, Water quality standards for groundwaters of the state of Washington.

**(5) Groundwater monitoring - Data analysis, notification and reporting.**

(a) The results of monitoring well sample analyses as required by subsection (4)(h) and (i) of this section must be evaluated using an appropriate statistical procedure(s), as approved by the jurisdictional health department. Statistical procedure(s) used must be proposed in the sampling and analysis plan, and must be capable of determining whether a significant increase over background has occurred. Selection of parameters undergoing statistical analysis, as specified in the solid waste permit, must be based on site-specific leachate analyses, synthetic precipitation leaching procedure (SPLP) results, or toxicity characteristic leaching procedure (TCLP) results, if available, and typically at least include pH, specific conductance, chloride, iron, manganese, nitrate, sulfate, ammonia, and total dissolved solids.

(b) If statistical analyses determine a significant increase over background:

(i) The owner or operator must:

(A) Notify the jurisdictional health department and the department of this finding within thirty days of receipt of the sampling data. The notification must indicate what parameters or constituents have shown statistically significant increases;

(B) Within thirty days, resample parameter(s) showing statistically significant increase(s) in the monitoring well(s) where the statistically significant increase has occurred; and

(C) Establish a groundwater protection standard based on the groundwater quality criteria of chapter 173-200 WAC, Water quality standards for groundwaters of the state of Washington. If the background concentration level established in the facility's monitoring record for a constituent is greater than the numeric criterion for the constituent in chapter 173-200 WAC, Water quality standards for groundwaters of the state of Washington, the owner or operator must use the background concentration as the protection standard.

(ii) The owner or operator may demonstrate that a source other than a landfill unit or surface impoundment caused the contamination, or the statistically significant increase resulted from error in sampling, analyses, statistical evaluation, or natural variation in groundwater quality. If a demonstration cannot be made and the concentrations or levels of the constituents exceed the criteria established by chapter 173-200 WAC, Water quality standards for groundwaters of the state of Washington, the owner or operator must:

(A) Characterize the chemical composition of the release and the contaminant fate and transport characteristics by installing additional monitoring wells;

(B) Assess and, if necessary, implement appropriate intermediate measures to remedy the release. The measures must be approved by the jurisdictional health department and the department; and

(C) Evaluate, select, and implement remedial actions in accordance with chapter 173-340 WAC, Model Toxics Control Act—Cleanup. The roles of the jurisdictional health department and the department in remedial action are further defined by WAC 173-350-900.

(c) The owner or operator must submit an annual report to the jurisdictional health department and the department by April 1st of each year. However, more frequent reporting may be required. Reports may be submitted to the department in either digital format or hard copy. The annual report must summarize and interpret the following information:

(i) All groundwater monitoring data, including laboratory and field data for the sampling periods;

(ii) Statistical results and/or any statistical trends including any findings of any statistical increases for the year and time/concentration series plots;

(iii) A summary of concentrations above the maximum contaminant levels of chapter 173-200 WAC, Water quality standards for groundwaters of the state of Washington;

(iv) Static water level readings for each monitoring well for each sampling event;

(v) Potentiometric surface elevation maps depicting flow direction for each sampling event;

(vi) Groundwater flow velocity calculations for each sampling event, and a discussion of any trends or changes during the year;

(vii) Geochemical evaluation including cation-anion balancing and trilinear and/or stiff diagramming for each sampling event noting any changes or trends in water chemistry for each well during the year; and

(viii) Leachate, hydraulic gradient control and/or leak detection system results, if applicable, for each sampling event.

(d) All groundwater monitoring data must be submitted consistent with procedures specified by the department. Unless otherwise specified by the department, all groundwater monitoring data for the previous year must be submitted by April 1st of each year in an electronic form capable of being transferred into the department's data management system.

[Statutory Authority: Chapter 70.95 RCW, and RCW 70.95.060, 70.95.215, 70.95.218, 70.95.260(6), 70.95.300, 70.95.305, 70.95.310, 70.95.440. WSR 18-17-008 (Order 13-08), § 173-350-500, filed 8/1/18, effective 9/1/18. Statutory Authority: Chapter 70.95 RCW. WSR 03-03-043 (Order 99-24), § 173-350-500, filed 1/10/03, effective 2/10/03.]