Monitoring Background Groundwater Quality

Internal Management Directive for Regulating Permitted Operations under OAR 340-040-0030

Summary

Purpose

This document provides direction to Department of Environmental Quality (DEQ) staff reviewing background groundwater quality monitoring information submitted by a permitted source or permit applicant as required by OAR 340-040-0030.

Scope

The information provided in this document is meant to guide DEQ in applying existing statutes and rules related to groundwater quality protection at permitted operations. The Internal Management Directive does not create rights or obligations on the part of the public or regulated entities.

Applicability

This Internal Management Directive will be used by DEQ staff conducting groundwater reviews in cases where monitoring background groundwater quality is required under OAR 340-040-0030. This may include review for:

- New or renewal NPDES permits;
- New or renewal WPCF permits;
- New or renewal On-Site Sewage Disposal permits;
- New or renewal Solid Waste Disposal permits;
- New or renewal Hazardous Waste Disposal permits; and
- Any other point source permitted operation or activity that requires monitoring of background ground water quality conditions under OAR 340-040.

This document may be used by permittees and permit applicants in order to collect and prepare information for submittal to DEQ.

Contact for questions

For questions concerning this guidance, contact Karla Urbanowicz (503-229-6099) Groundwater Program Coordinator in the Land Application and Licensing Section, Water Quality Division.

Introduction

What is background water quality?

Background water quality is defined in the Groundwater Quality Protection rules as "… the quality of water immediately upgradient from a current or potential source of pollution that is unaffected by the source". (OAR 340-40-0010(1))

Background groundwater quality is the baseline quality of groundwater in the absence of pollutants added by source facility operations. A representative measure of this baseline can usually be obtained at the upgradient boundary of a facility. In hydrogeologic terms, an upgradient location is related to the direction of groundwater movement and is outside the area of potential adverse impacts from facility operations. Groundwater generally moves in the subsurface from outside the facility boundaries ("upgradient"), flows beneath the area of operations, and eventually flows away from the site ("downgradient"). Groundwater outside and upgradient of the facility is generally presumed to be unaffected by the source. Groundwater beneath and downgradient from the area of facility operations is most likely to be affected by pollutant discharges. Once pollutants affect groundwater, the contaminants usually move in the direction of groundwater flow downgradient and away from area of immediate impact.

What are the requirements for background groundwater monitoring at permitted facilities?

For permitted sources where there is a likely adverse groundwater quality impact, the permittee is required by rule to develop a groundwater quality protection program. (OAR 340-040-0030(2)) This includes a plan for groundwater monitoring for the uppermost aquifer and any other aquifer potentially affected by operations at the facility.

The plan must provide a way to determine the rate and direction of groundwater flow and monitor groundwater quality immediately upgradient and downgradient from the waste management area, and also locate background monitoring points, detection monitoring points, and groundwater quality compliance points.

The permittee must monitor "… the background water quality of the uppermost aquifer. The background monitoring point(s) shall be located where water quality is unaffected by the facility operations." (OAR 340-40-0030(2)(c))

As discussed in the following sections, monitoring must characterize the groundwater upgradient and unaffected by the facility. A monitoring point physically located upgradient of the facility is preferred, but in some circumstances other methods can be used to obtain information that accurately represents groundwater quality upgradient and unaffected by the facility.

What groundwater protection requirements apply?

The Environmental Quality Commission (EQC) adopted in rule a policy to prevent groundwater pollution and control waste discharges to groundwater so the highest possible water quality is maintained. (OAR 340-040-0020(2)) The EQC also adopted a general policy to protect all groundwater from pollution that could impair the existing or potential beneficial uses for which the natural water quality of the groundwater is adequate and to maintain existing high quality groundwater. (OAR 340-040-0020(3)) Rules adopted by EQC (OAR 340-040-0030) direct the Department to implement these policies for permitted sources through groundwater quality protection requirements specified in facility permits.

How does DEQ implement these requirements?

DEQ staff review information submitted by permitted sources on the natural background quality of groundwater in the vicinity of a permitted facility. Information must be sufficient to determine the groundwater quality in the absence of any impacts from activities that have occurred or could in the future occur at a permitted facility. DEQ will use this information to establish permit requirements such as concentration limits at compliance points.

A number of methods can be used by permittees to select points to monitor groundwater quality and collect and analyze data that will be reviewed by DEQ. Examples of various methods and their application are given below.

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Methods to monitor background groundwater quality

Some methods to monitor, collect, and evaluate information on background groundwater quality include:

- Locating monitoring points **upgradient** to the facility
- Locating monitoring points **crossgradient** and adjacent to a facility,
- Locating monitoring points **downgradient** from a site prior to any facility waste discharges,
- Locating other monitoring points, based on specific site hydrogeology,
- Conducting an **interwell** data analysis to compare data collected at upgradient or crossgradient monitoring points to downgradient monitoring points,
- Conducting an **intrawell** data analysis to evaluate data collected at a single downgradient monitoring point before and after facility or waste discharge operations have begun.

DEQ staff and permittees should consult available and current technical reference and guidance documents for specific details on appropriate monitoring protocols, data evaluation methods, and statistical analyses that can be used with the above approaches.

This monitoring information provides a baseline measure of groundwater quality unaffected by facility operations. The baseline can be established for a point physically located upgradient to the facility, or at a location that is representative of groundwater quality upgradient to the facility. The baseline may be established at a point in time prior to facility operations begin, or may be an ongoing measure of background groundwater quality during the operation of a facility.

What method is acceptable?

There are situations when it is technically advisable to use one method versus another to monitor background groundwater quality.

The appropriate methodology should be chosen based on the site geology and groundwater flow conditions, potential facility impacts on groundwater, and the ability to adequately monitor the uppermost aquifer or any aquifer that could be affected.

It is generally preferable to use a monitoring point that is physically located upgradient to a facility and collect information during the facility operations.

However, geology and groundwater flow systems are not always simple and straightforward. At some sites, groundwater monitoring upgradient and downgradient of a facility will provide adequate information to assess and monitor current and potential impacts from pollutant discharges. In some complex geologic and groundwater settings, this information may not be adequate or technically appropriate to determine the effects of the facility on groundwater quality. Other information may be required to adequately characterize baseline groundwater quality and assess the impacts of the facility on the uppermost aquifer or another aquifer that may be potentially impacted. The following examples illustrate the application of several methods.

Examples

Using upgradient monitoring points

At some sites, background groundwater quality can be monitored at points physically located upgradient of current or potential facility operation areas. The purpose of upgradient monitoring is to provide information on the quality of groundwater before it moves beneath a waste management area. Information from an upgradient monitoring point can be used to set permit-specific concentration limits. Upgradient monitoring can also indicate changes in off-site groundwater quality, or help evaluate changes in groundwater quality at facility compliance points.

The following factors should be considered by DEQ hydrogeologists reviewing information from upgradient monitoring points to determine the appropriate use

of the monitoring data:

- Hydrostratigraphic zone screened by the upgradient monitoring point;
- Hydrostratigraphic zone screened by detection monitoring points and compliance points;
- Groundwater flow systems, particular hydrogeologic divides or aquifer boundaries;
- Spatial distribution of upgradient monitoring points in relation to facility operations, and detection and compliance monitoring points
- Potential for pollutants to migrate upgradient of waste management areas (i.e., landfill gas or vapor phase migration, upgradient groundwater dispersion, seasonal groundwater flow changes).

Data collected from upgradient monitoring points may be evaluated using standard statistical analyses such as calculating upper tolerance limits to determine permit-specific concentration limits, or comparison between upgradient and downgradient points for statistically significant differences.

Using crossgradient monitoring points

Crossgradient monitoring points are located at points adjacent to facility operations and monitor groundwater moving alongside rather than under a site. In some cases, a crossgradient monitoring point may be used to monitor background groundwater quality if the permittee can demonstrate that such a location will not be affected by facility operations and is representative of the potentially impacted aquifers upgradient and under the facility. This demonstration should be based on a thorough understanding of area geology and the groundwater flow system.

For instance, a facility may be located at the edge of a valley. Information about the site geology and hydrogeology may show that the uppermost aquifer under the facility is not present outside the site boundary in the upgradient direction. In this case, a background monitoring point installed in the upgradient direction would not monitor the same groundwater zone present under the facility. Monitoring in the upgradient direction would not be appropriate to determine the baseline background groundwater quality and serve as a point of comparison to monitor potential impacts from the facility. In this instance, a monitoring point located cross gradient to the facility in the same groundwater zone present under the area of operations would provide better information on the quality of groundwater unaffected by facility operations.

Using downgradient monitoring points

Monitoring at points located downgradient from a future waste management operation can provide information on groundwater quality prior to facility operations. This information can be used to represent upgradient background groundwater quality and in some cases can be used to set permit-specific concentration limits. A statistically sufficient amount of groundwater quality information must be collected prior to facility operations. The permittee must

demonstrate that the information represents groundwater quality that is unaffected by facility operations.

Intrawell data evaluation

The evaluation of groundwater quality data from a single monitoring point can be done using *intrawell analytical techniques.* To use this type of analysis, the permittee must demonstrate that the groundwater quality data has not been impacted by facility operations. Statistical methods such as the analysis of variance (ANOVA) may be an appropriate data evaluation technique. If groundwater has been affected by facility operations at any point in time, this approach cannot be used to monitor background groundwater quality.

Using an intrawell data evaluation may provide a sensitive method to determine if a contaminant release has occurred. This data evaluation method may eliminate uncertainty created by spatial variability between upgradient and downgradient monitoring points. By using data collected from one monitoring point and comparing it to data collected over time at that same monitoring point, spatial variability can be eliminated. Seasonal variations in groundwater quality may still be a factor to be evaluated.

Conclusion to Internal Management Directive

Implementing rule requirements

DEQ staff review information submitted by permitted sources on the background quality of groundwater in the vicinity of a permitted facility. This information should be sufficient to determine the groundwater quality in the absence of any impacts from activities that have occurred or could in the future occur at a permitted facility. Information collected upgradient of a facility or equivalently representing the groundwater quality upgradient of a facility will be used by DEQ staff for setting and implementing permit requirements.

A number of methods can be used by permittees to select points to monitor groundwater quality and collect and analyze data that will be reviewed by DEQ. The appropriate methodology should be chosen based on the site geology and groundwater flow conditions, potential facility impacts on groundwater, and the ability to adequately monitor the uppermost aquifer or any aquifer that could be affected. It is generally preferable to use a monitoring point that is physically located upgradient to a facility and collect information during the facility operations. In situations when it is technically advisable to use another method, the appropriate method should be chosen based on site geology and groundwater flow conditions, potential facility impacts on groundwater, and the ability to adequately monitor the uppermost aquifer or any aquifer that could be affected.

Issued:

Michael T. Llewelyn
Administrator
Water Quality Division

Dick Pedersen
Administrator
Land Quality Division

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7/29/03 (KG)