Assessment of sensitive groundwater conditions

Petroleum Remediation Program

This document describes the procedures for identifying sensitive groundwater conditions and the investigation and reporting requirements when a sensitive condition exists. This document supplements the site investigation and risk evaluation procedures described in Soil and groundwater assessments performed during site investigations, Risk evaluation and site management decision at petroleum release sites, and Investigation requirements for fuel releases containing lead scavengers. In addition, investigation options are provided when further risk evaluation is necessary. This assessment is not required when there is definitive evidence through laboratory analysis that groundwater has not been impacted.

I. Sensitive groundwater conditions

A. Description

Sensitive groundwater conditions are based on geology and groundwater usage. They represent conditions where risk to water supply wells is inherently greater due to the geological setting and the proximity of water supply wells to a release. These conditions, therefore, require additional assessment of the exposure pathway. Sensitive groundwater conditions are defined below.

1. **Wellhead protection areas**

   Sites with contamination located within a wellhead protection area that has 1) an aquifer sensitivity rating of high for Source Water Assessment Areas and Inner Wellhead Management Zones or 2) a vulnerability rating of high or very high for Drinking Water Supply Management Areas (DWSMA).

2. **Shallow bedrock**

   Sites located over bedrock with a soil overburden thickness of 50 feet or less.

3. **Sole-source aquifer**

   Sites located over an aquifer that provides the only available or practicable source of drinking water to a drinking water user.

4. **Shallow sand and gravel aquifers**

   Sites located in areas where water supply wells are generally less than 75 feet deep, and soils consist predominantly of sand or gravel.

B. Identification

1. **Wellhead protection areas**

   A flowchart of the identification process is provided in Appendix 1. The first step is to determine if contamination from the release is within a designated wellhead protection area. If contamination is within a designated area, the next step is to determine the aquifer's susceptibility to contamination.

Determine if contamination is within a wellhead protection area.

Petroleum Remediation Program Maps Online is used to determine if a site is within a designated area. The three designated wellhead protection areas depicted in Petroleum Remediation Program PRP Maps Online are 1) DWSMA), 2) Source Water Assessment Area (SWAA), and 3) Inner Wellhead Management Zone (IWMZ).

If contamination from the release is located in one of these three areas, proceed with determining the aquifer's susceptibility to contamination. If contamination from the release is not located in one of these areas, this sensitive condition does not exist.

Determine if the wellhead protection area is susceptible to contamination.

If contamination is within a DWSMA, use PRP Maps Online to review the DSWMA Vulnerability Map Layer. If the DWSMA vulnerability rating is high or very high in the area of the contamination, a sensitive groundwater condition exists.

If contamination is within a SWAA or IWMZ, use PRP Maps Online to locate the aquifer sensitivity rating in the designated area's identification pop-up window. If the aquifer sensitivity rating is high, a sensitive groundwater condition exists.

Minnesota Department of Health Assistance
The Minnesota Department of Health (MDH) Source Water Protection Unit staff may be able to provide more information about a public water system than what is contained in a Source Water Assessment. Staff may be able to sample wells for tritium or volatile organic compounds if a well is at risk and current data are unavailable. They can assist in obtaining historical well sampling results, reviewing aquifer test designs, and sharing equipment.

2. **Shallow bedrock**

Bedrock depth, or overburden thickness, may be obtained from several sources: site investigation data, nearby well records, and published geospatial data. Soil borings are the preferred and best source of site-specific information, but the data must be conclusive, not drilling refusal due to rocks or dense soil. Similarly, nearby well records must have fairly consistent bedrock depths to be considered a reliable measure of overburden thickness at the site. A statewide depth to bedrock map is available from the Minnesota Geological Survey and can be viewed in a web-based mapping application.

If the overburden thickness is 50 feet or less, a sensitive groundwater condition exists. If more than 50 feet of overburden exists, this sensitive condition does not exist.

For sites located in karst areas with an overburden thickness of 50 feet or less, supplemental investigation and reporting requirements are described in Groundwater investigations in karst areas.

3. **Sole-source aquifer**

Identifying a sole-source aquifer condition involves considering all potential drinking water sources to determine if there is only one available or practicable source for the site. Factors to consider when evaluating a potential source include the ability of the source to meet the water usage needs of the site and the inherent water quality of the source. Minnesota Well Index records, USGS Hydrologic Atlases, Minnesota County Atlases, and local well drillers may be useful sources for inventorying potential sources.

To assist in making this determination, practicable and impracticable drinking water sources include but are not limited to the examples below. The following lists are not exhaustive. If a review of nearby well records indicates only one aquifer is in use, conduct a more careful evaluation of other potential drinking water sources to determine if there is a practicable alternative source.

Practicable sources include:

- An existing public water system that services the area or is near enough to be considered a feasible alternative source.
- An aquifer with existing water supply well usage.
- Designated surface water sources as listed in Minn. R. ch. 7050.

Impracticable sources include:

- Shallow water table aquifers less than 15 feet from the surface.
- Bedrock formations not currently used as a water supply unless proven practicable by test well installation.
- A hydrogeologic unit with a transmissivity less than 50 ft^2/day is not considered an aquifer by the PRP.

If there is only one available or practicable drinking water source, a sensitive condition exists.

4. **Shallow sand and gravel aquifers**

   Use site investigation data (e.g., well records, soil borings, receptor survey results) to determine the predominant soil type and the presence and depth of existing water supply wells.

   If active water supply wells are generally screened within the upper 75 feet, and the predominant soil type is sand or gravel, a sensitive condition exists.

II. Investigation and reporting requirements

A. Investigation requirements

1. For all sensitive conditions, the following work is required prior to submitting the Investigation report:

   Sample all well(s)[1]

   - Within 500 feet of the site
   - Within 1,000 feet of the site if recalcitrant petroleum compounds[2] are present[3]

2. In addition, for a wellhead protection area sensitive condition associated with a Community or Nontransient Noncommunity public water system, the following work is required prior to submitting the Investigation report:

   - Obtain the latest MDH volatile organic compound (VOC) sampling results[4]
   - Obtain a copy of the Wellhead Protection Plan[5] if available

Notes:

[1]If there are more than 10 water supply wells within the applicable radial distance, contact the Minnesota Pollution Control Agency (MPCA) to discuss the need to sample more than 10 wells. Be prepared to discuss well locations, groundwater plume geometry, groundwater flow direction, and geology.

[2]Recalcitrant petroleum compounds include 1,2-dibromoethane (EDB), 1,2-dichloroethane (DCA), and methyl *tertiary*-butyl ether (MTBE).

[3]Present means a contaminant has been detected through laboratory analysis during the site investigation.

[4]MDH VOC sampling results for Community and Nontransient Noncommunity public water systems can be obtained for by contacting MDH staff in the Drinking Water Protection Section.

[5]Wellhead Protection Plans, if available, can be obtained from the public water system's Source Water Assessment.

B. Reporting requirements

The results of the assessment are reported in the Investigation report. Prior to submitting the Investigation report, however, contact the MPCA to discuss your strategies to further evaluate the risk and whether corrective action should be considered. Section III lists several options that can aid in evaluating the risk associated with sensitive groundwater conditions. If you want to consider other options not listed below, be prepared to discuss them when contacting the MPCA.

III. Options for evaluating risk for sensitive groundwater conditions

Written MPCA approval is required before proceeding with any of these options. Approval will occur after submittal of the *Investigation Report*.

A. Measured travel time evaluation

When calculating groundwater travel time using hydraulic conductivity, grain size-based hydraulic conductivity estimates are not applicable for sensitive conditions. More robust methods for determining hydraulic conductivity, such as pump tests, are needed to adequately determine travel times to nearby receptors. Consider contamination depth, preferential flow paths, and aquifer heterogeneity when assessing if the current monitoring well network is suitable for evaluating hydraulic conductivity with these methods.

B. Vertical migration evaluation

Vertical contaminant migration is an important factor at sites with a sensitive groundwater condition. Additional assessment techniques may be required to fully characterize the three-dimensional extent and stability of the contaminant plume. Confining layers may still transmit water to deeper aquifers or contain fractures with contaminant migration rates orders of magnitude higher than predicted. Some of these techniques include but are not limited to:

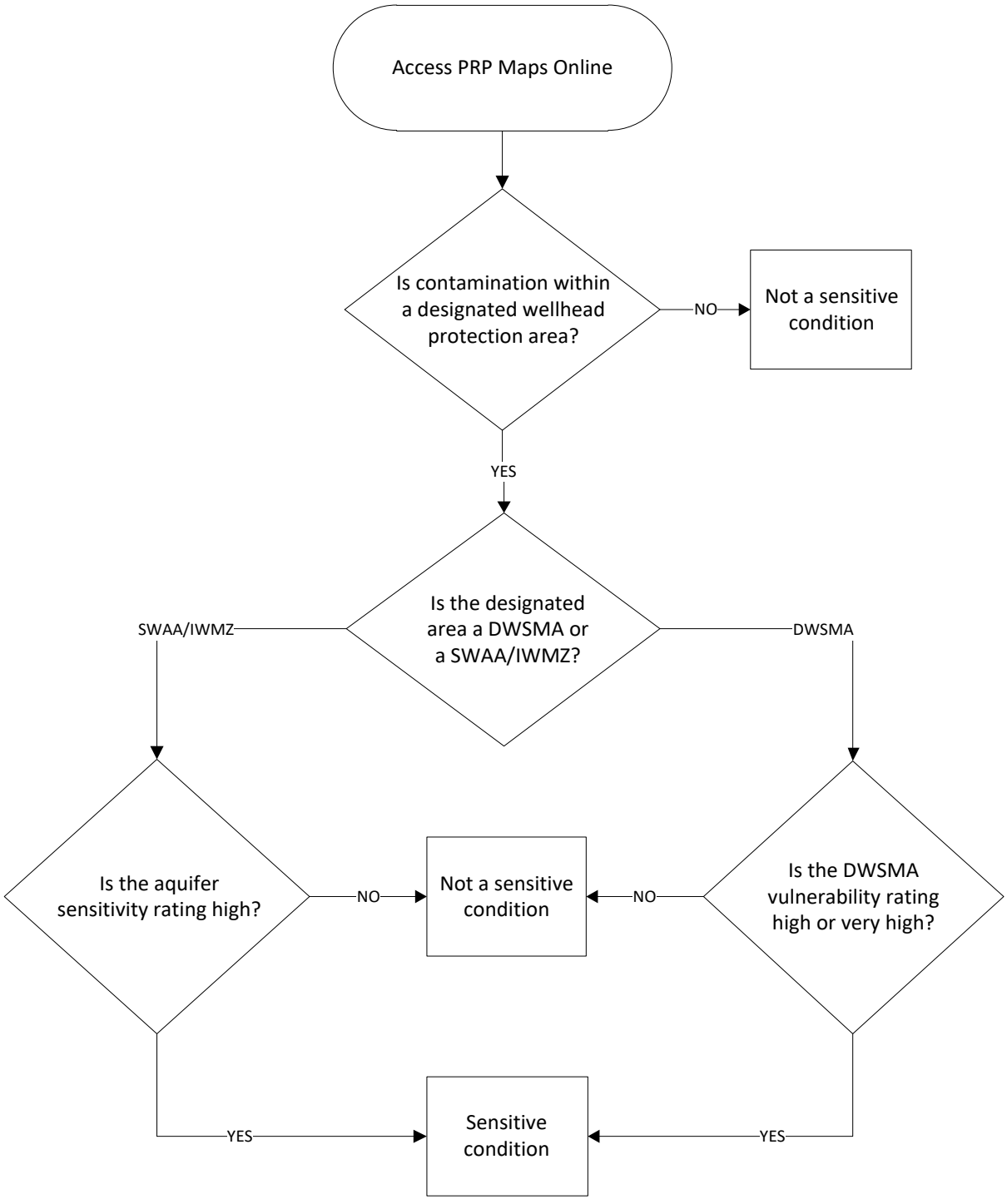
1. **Environmental tracers.** Environmental tracers can be used to determine groundwater age and flow conditions. Some of these tracers include chloride, nitrate, chlorofluorocarbons, sulfur hexafluoride, and tritium. Tracer analysis can be employed to determine if a deeper aquifer has been impacted by anthropogenic activities and, therefore, may be at risk from surface or near-surface contamination.
2. **Deep or multi-level wells.** To account for complex flow paths in stratified or fractured, low permeability soils, deeper wells should be located downgradient of areas where vertical migration is likely to define the plume edge. In addition, do not place these wells in areas of light non-aqueous phase liquid or highly contaminated groundwater. Consideration needs to be given to the design of deep monitoring wells. This includes screen length and placement, such as five-foot screen lengths at the top of a confined aquifer where contamination is migrating through a confining layer. In addition, off-the-shelf multi-level well systems are an option for contaminant monitoring at specific depth intervals.

Additional vertical migration evaluation techniques for leaded fuel release sites are described in Investigation requirements for fuel releases containing lead scavengers.

C. Plume stability assessment

When a sensitive groundwater condition exists, plume stability assessment will generally require monitoring for a minimum of three years. The purposes of extended monitoring are to confidently assess plume stability and to better capture seasonal fluctuations. The monitoring duration may be influenced by the time required to install a suitable monitoring well network.

Appendix 1. Process for identifying sensitive conditions associated with wellhead protection areas



DWSMA – Drinking Water Supply Management Area
SWAA – Source Water Assessment Area
IWMZ – Inner Wellhead Management Zone