Risk evaluation and site management decision at petroleum release sites

Petroleum Remediation Program

This document describes the procedures for completing receptor surveys, evaluating risk, and making a site management decision at petroleum release sites. **You are strongly encouraged to complete the surveys prior to starting subsurface investigation activities to optimize site work.**

I. Water supply well receptor survey and risk evaluation

The water supply well receptor survey identifies water wells that may be at risk from the petroleum release and also provides information regarding the geology and groundwater use near the release site. For the water supply well receptor survey, complete the following:

A. Walking survey

Conduct a walking survey of all properties within 500 feet of the source. This survey consists of the following steps:

1. Prepare a base map showing property boundaries and relevant features, such as buildings, roads, and surface water within 500 feet of the source.
2. Identify property ownership. Base maps with property ownership can usually be obtained from the city or county.
3. Contact residents, property owners, and business owners within 500 feet of the source and obtain the following information for each property:
    - Presence of a water supply well(s) or connection to a public water supply. Include a description of how this information was obtained, such as visual observation, personal contact, telephone conversation, returned postcard, or assumed.
    - Type of well usage, such as private, domestic, or irrigation, and the well construction, if applicable
    - Presence of a basement or sump
    - Possible petroleum sources
    - Property-specific comments

    The first attempt at contacting residents, property owners, and business owners must be in person. This is usually done during the walking survey. If personal contact is not made, follow up by phone, or leave a stamped, self-addressed postcard or letter at each address to request the information listed above. The request should communicate at a minimum:

    - The purpose of the request is to assess potential risk to nearby water supply wells and basements from the nearby property that contains petroleum contamination.
    - A statement that if no reply is received by a specified date, an assumption will be made that there is no wells or basements on site.

4. Complete a visual inspection of properties located within the 500-foot radius during the walking survey. This consists of inspecting each property from all accessible property lines or vantage points. Physical limitations to this inspection must be noted in the Investigation report. During the inspection, document and map the following:
    - Water supply wells
    - Subsurface structures, such as basements, utility markers, and manholes
    - Obvious surface water features such as, but not limited to, lakes, creeks, rivers, ponds, and wetlands within the survey area
    - Possible petroleum sources such as underground storage tanks, above ground storage tanks, hydraulic lifts, etc.

B. Public water supply confirmation

Submit a list of the addresses of all properties within 500 feet of the source to the city utility billing department to confirm the status of water supply to those addresses. In addition, request information regarding plans for groundwater development in the impacted aquifer within ½ mile of the site or one mile of the site if the aquifer is fractured bedrock. Document the water supply confirmation and groundwater development information in the Investigation report.

C. Well records search and review

Review the Minnesota Well Index for wells within ½ mile of the source to gather information on groundwater usage, well construction, aquifers, and geology. Provide this information in the Investigation report. Include copies of the well logs, or well logs for the nearest 25 wells if there are over 25 within ½ mile, and an accurate map depicting the location of the wells. If there are no wells within ½ mile of the source, expand the search to 1 mile.

D. Sensitive groundwater conditions

Sensitive groundwater conditions are determined based on geology and groundwater usage. Sensitive conditions include wellhead protection areas, shallow bedrock, sole source aquifers, and shallow sand and gravel aquifers. When a sensitive groundwater condition exists, additional investigation may be necessary to determine actual risk due to the sensitive condition. See Assessment of sensitive groundwater conditions for definitions, reporting requirements, and investigation requirements and options.

E. Risk evaluation

Information from the water supply well receptor survey guides the soil and groundwater investigation. For example, the geology data from well logs facilitates planning the depth of subsurface investigations in order to assess the potential for contaminant migration to an aquifer or well. Collect and analyze water samples from water supply wells that may be at risk.

When monitoring wells are installed for remedial investigations, use the monitoring data to evaluate groundwater flow direction, assess plume stability, and calculate the hydraulic gradient within the impacted aquifer. Estimate groundwater travel times in aquifers using grain size-based hydraulic conductivity and hydraulic gradient. Estimated travel times and contaminant distribution can be used to quickly assess risk to nearby water supply wells and other receptors.

Groundwater travel time
Estimated groundwater travel times are used for the initial risk evaluation and as a basis for recommendations. Measured groundwater travel times, as referred to in Section VI, are more robust calculations used to make a site management decision.

II. Water line permeation receptor survey and risk evaluation

Water line permeation is the mass transfer of a chemical into and through the walls of a water line via diffusion. This process has the potential to adversely affect the quality of the water standing in or transmitted by the water line. Data have shown that certain piping, such as polyethylene, polybutylene, polyvinyl chloride, and asbestos cement, and gasket materials such as non-metallic, are subject to permeation by petroleum contaminants. Petroleum contaminants can infiltrate directly through some materials or degrade and weaken the material, allowing permeation to occur. The highest risk scenarios involve:

- Small diameter, permeable pipe, and/or gaskets used for private service lines that have a low flow volume. This allows the contents of the line to remain stagnant for a period of time and, subsequently, contaminant concentrations to increase.
- Instances where high concentrations of petroleum compounds exist in the subsurface adjacent to water distribution lines. However, any permeable piping or gaskets exposed to petroleum contamination may be at risk.

The following receptor survey and risk evaluation must be completed to assess the risk of water distribution line permeation.

A. Water line permeation receptor survey

The construction details of all public and private water line distribution components within the contaminated area must be well documented by collecting the following information. If water line construction details are unknown, it may be necessary to expose the water line(s) by completing a small excavation.

- Piping and gasket materials used
- Pipe diameter(s)
- Approximate daily water usage of a facility; this information may be determined by using past water meter readings
- Flow directions
- Depth
- Backfill materials
- Age (date installed)
- Distance to nearest point of use for each section of pipe
- Length of the pipe within the impacted zone
- Name of person who owns each section of pipe within the survey area

B. Risk evaluation

If permeable piping or gaskets are present within a contaminated area, advance soil borings to determine the magnitude of soil and groundwater contamination in contact with these components and the length of pipe that may be impacted. If light non-aqueous phase liquid (LNAPL) or highly contaminated groundwater is in contact with a pipe, assume permeation is a risk and collect and analyze water samples from the line at the nearest point(s) of use (i.e., water faucet, spigot, etc.). Refer to Groundwater sample collection and analysis procedures for water line sampling procedures.

III. Surface water receptor survey and risk evaluation

Sites involving spills that flow to surface water generally pose the greatest potential impact to surface water quality and, therefore, should be addressed immediately. The following procedures apply to potential surface water impacts due to discharge of contaminated groundwater.

A. Surface water receptor survey

Identify and prepare a map showing the locations of all surface water features within ¼ mile of the site. Include any features identified during the 500-foot walking survey discussed in Section I.A. Obtain surface water information from a variety of sources, including United States Geological Survey (USGS) topographical maps and in-field surveys. Identify any potential pathways such as ditches, drain tiles, and storm sewers that may lead to an identified surface water feature.

B. Risk evaluation

Use the survey to plan sampling locations for the subsurface investigation. Evaluate the groundwater quality between the site and a surface water feature by drilling a soil boring or installing a monitoring well between the site and the feature. If the boring or well is contaminated, assume contaminated groundwater discharges to surface water. If a discharge is occurring or is assumed to be occurring, determine the discharge rate based on the plume width, plume thickness, hydraulic conductivity, and horizontal gradient. Calculate discharge using the equation provided in the Investigation report.

If contamination may be discharging to surface water via a pathway such as a leaky storm sewer or other conduit, collect samples within the conduit at the nearest downgradient location. Based on initial sample results, it may be necessary to sample additional locations to adequately evaluate risk to the receptor.

The MPCA will evaluate the need for corrective action based on a comparison of contaminant concentrations at the surface water discharge point to applicable standards in Minnesota's surface water rules.

IV. Vapor receptor survey and risk evaluation

This section discusses the assessment of petroleum vapors that may result in explosive conditions in structures and utilities. If the vapor receptor survey and risk evaluation identify structures or utilities intersecting contamination that poses a risk, then perform a vapor survey as described in subsection C below.

A. Vapor receptor survey

To complete a vapor receptor survey, identify the location and type of nearby vapor receptors.

1. Buildings

Vapor receptors include buildings, especially those with basements and sumps. Building location and construction information within 500 feet of the site is obtained as part of the walking survey described in Section 1, therefore no additional work is required for the vapor receptor survey.

Vapor intrusion assessment
Chronic human health risk from low-level indoor vapor impacts is evaluated by a vapor intrusion assessment, which is discussed in Vapor intrusion assessments performed during site investigations.

2. Utilities

Vapor receptors include:

- Manways, fiber optic conduits, sanitary and storm sewers, and other subsurface structures where petroleum vapors could accumulate.
- Water, electric, telephone, gas, and cable television lines, etc. That can act as migration pathways via the backfill or conduits.
- On-site service lines connecting site structures to main lines that can act as conduits or contaminant migration pathways.

Contact public and private utility owners for information about their subsurface structures. Document the available information on their construction, such as material, depth, elevations, and liquid flow direction, and the condition, such as if it's cracked or leaking, and its age.

Identify all utility vapor receptors on site and on adjacent properties, including underneath all roadways. If the risk evaluation identifies contamination that poses a vapor risk beyond these boundaries, or a vapor survey identifies impacts beyond these boundaries, extend the utility receptor survey to include all areas where subsurface structures intersect contamination or impacts have been detected. This may require multiple vapor receptor survey events when additional risk evaluation or vapor survey data are obtained.

Contact the local fire department to ask about petroleum vapor complaints or reports in the vicinity of the site. Ask occupants of potentially impacted buildings whether they have smelled petroleum odors.

Prepare a vapor receptor map(s) showing the location and identity of all vapor receptors and vapor migration pathways. Include the map(s), subsurface structure construction information, and data sources in the Investigation report.

B. Risk evaluation

If there are vapor receptors, use the data to plan the soil and groundwater investigation. Utility backfill investigations are discussed in Soil and groundwater assessments performed during site investigations. Evaluate the data collected from the soil and groundwater investigation relative to the locations and types of subsurface pathways and structures. In making this evaluation, consider the following:

1. The highest vapor risk settings involve:
    - Sites with LNAPL or groundwater with high levels of dissolved volatile petroleum products.
    - Groundwater that intersects contamination and backfilled utility trenches, sewer lines, basements, or other confined spaces.
2. Vapors migrate along pressure gradients, moving from high to low pressure. Enclosed structures can be a low pressure point, particularly when a furnace is operating. Even buildings without basements draw subsurface vapors. Vapors can migrate in backfill of intact sewer lines.
3. The condition and type of storm and sanitary sewer lines can influence vapor risk since clay tile sewers or very old sewers with cracks or gaps can allow inflow of LNAPL and groundwater.
4. Utility trenches or building foundations that are backfilled with more permeable material than the native soil, such as sand or gravel backfill in clay soil.

Discuss the evaluation of vapor risks in the Investigation report. If any of the above conditions exist, then perform a vapor survey as described in subsection C below.

C. Vapor survey

When conducting a building vapor survey for possible emergency conditions:

1. Interview the building owner and/or occupant to determine the frequency and occurrence of petroleum odors.
2. Check buildings and basements which the vapor risk assessment indicates may be impacted, including site basement, using both an explosimeter and photoionization detector (PID) to take vapor readings. Record names, addresses, and telephone numbers of building owners/occupants.
3. Take vapor readings to assess explosive conditions in the basement.
4. Check for vapors near basement sewer drains and near any cracks in the foundation. Carefully check for vapor pockets at covered sumps, building corners, crawl spaces, or in any area of poor air circulation.

When conducting a sewer vapor survey:

1. Only a person with proper training, experience, and equipment should conduct the survey due to the potential hazards of working with sewers and confined spaces.

2. Contact the city utility department. They can provide sewer maps to determine sewer construction, depth, and the direction of sewer flow and assist in locating and opening manholes.
3. Contact the local police department or public works department if traffic control is needed. If the vapor survey is near a State Trunk Highway and traffic control is needed, contact Minnesota Department of Transportation district personnel.
4. Always use an explosimeter before a PID. Unsafe conditions may exist if explosimeter readings are above 10% of the LEL. When it is safe to use a PID, start at the manhole closest to the site. Work upstream and downstream to determine where product or vapors are entering and the extent of the impacted area. "Crack" each cover first and take readings of oxygen, explosimeter, and PID. Repeat measurements at mid-depth and at the waste water level.
5. Check the airflow direction from the manhole to determine if dilution is occurring.
6. Check water flow direction and collect a water or sewage sample (but do not enter the sewer for this sample). Look for rainbow sheen and check for odors. If there is odor but no product, use a PID to conduct a bag headspace analysis on the water or sewage sample. Consider collecting samples for laboratory analysis if it is important to demonstrate whether and where petroleum contamination is entering a leaking sewer.
7. Check all the incoming branches in the sewer, if possible. If odors are detected, continue upstream and downstream even if no product is present. Vapors may travel "upstream" from the source (especially in winter) and therefore may be misleading.
8. Check lift stations near the site.

What to do when vapors are detected during a vapor survey:

Situation	Actions to take
>10% LEL	**Do not enter buildings or continue the sewer survey** **Immediately contact the local fire department (911) and the Minnesota Duty Officer (24 hours) 651-649-5451 or 800-422-0798**

B. Risk evaluation

Results from the site investigation are used to evaluate risk. Surface soil contamination is considered a high risk if the soil is petroleum saturated according to the petroleum sheen test or has a gasoline range organics (GRO) or diesel range organics (DRO) concentration of 100 mg/kg or greater.

VI. Site management decision

The decision to complete a corrective action, monitor contaminant trends, or close a site is based on information collected during the site investigation. Site management decisions are based on the rationale described below.

A. Corrective action

When risk is considered high according to the conditions listed below, corrective action will usually be required. When recommending corrective action, contact the MPCA prior to submitting the Investigation report. The process for obtaining corrective action design approval is described in Corrective action design and implementation. When remediation is being considered as the corrective action alternative, the cleanup must focus on targeting the LNAPL body and must be technically feasible.

High-risk conditions:

- Petroleum impacts to a drinking water supply well above a drinking water standard or conditions that indicate impacts above a drinking water standard are imminent.
- Petroleum impacts to a nondrinking water supply well above a beneficial use level.
- Expanding groundwater contaminant plume within a measured five-year groundwater travel time of a water supply well. See Soil and groundwater assessments performed during site investigations for more information on measuring groundwater travel time.
- Petroleum compounds are present above a drinking water standard in the aquifer associated with a sensitive groundwater condition.
- Petroleum impacts to a drinking water supply line above a drinking water standard or conditions that indicate impacts above a drinking water standard are imminent (water line permeation).
- Contaminant concentration above a surface water standard at the compliance point.
- Petroleum sheen on the surface water.
- Actual or potential for explosive vapor accumulation in structures or utilities.
- Petroleum impacts to a habitable structure above a vapor intrusion screening value (ISV) or conditions that indicate impacts above an ISV are imminent.
- Surface soil that is petroleum saturated or has a GRO or DRO concentration of 100 mg/kg or greater within the uppermost two feet of soil at a commercial or industrial property.
- Surface soil that is petroleum saturated or has a GRO or DRO concentration of 100 mg/kg or greater within the uppermost four feet of soil at a residential property.
- When a recent release has occurred (see Recent releases at petroleum tank sites).

Drinking water standards
Applicable standards include state Health Risk Limits (HRLs), Health Based Values (HBVs), Risk Assessment Advice (RAA), and federal Maximum Contaminant Levels (MCLs).

Beneficial use levels
Levels determined on a site-specific basis dependent on the actual usage of the groundwater and the necessary water quality level needed to maintain those uses.

- When recoverable mobile LNAPL is present (see Light non-aqueous phase liquid management strategy).
- When an emergency condition exists (see Petroleum remediation program general policy).

B. Additional investigation or monitoring

The extent and magnitude of soil and groundwater contamination, as well as the extent of mobile LNAPL if present, must be determined prior to submitting the Investigation report. Additional investigation or monitoring, however, is often necessary after the Investigation report is completed to refine the CSM.

In the case of groundwater monitoring, the goal is to demonstrate plume stability, a condition for site closure. If plume stability is not apparent after six quarters of monitoring, MPCA staff will consider the need for a corrective action, continued groundwater monitoring, or other risk reduction or elimination methods.

Recommending additional investigation or monitoring in the Investigation report or a subsequent Monitoring report may be appropriate in, but not limited to, the following circumstances.

Additional investigation:

- When further assessment is required for a sensitive groundwater condition
- When an expanding groundwater plume exists
- When water line construction data are unknown and permeation risk is a concern
- When field-detectable vapor impacts require further investigation
- When further assessment beyond a preliminary soil gas assessment is required to evaluate the vapor intrusion exposure pathway
- When further delineation of surface soil contamination is required prior to corrective action approval
- When site conditions change or new information indicates a need to update the CSM with further investigation

Additional monitoring:

- When groundwater plume stability has not been established
- When water supply wells are at risk or have been impacted
- When surface water risk requires additional monitoring to establish discharge concentrations and trends
- When further assessment of field-detectable vapor impacts to subsurface structures is needed
- When further assessment of contaminant concentrations in permanent soil gas or sub-slab soil gas monitoring points is needed
- When monitoring of site conditions during or following corrective action implementation is needed to determine corrective action effectiveness

C. Site closure

A recommendation for site closure is appropriate when all the following conditions are met:

- Proper treatment of excavated soil is completed and documented
- Mobile LNAPL is recovered to the maximum extent practicable
- The groundwater plume is demonstrably stable (see Soil and groundwater assessments performed during site investigations)
- The corrective action goals are achieved

VII. 2008 Petroleum release notification bill

Effective August 1, 2008, all tank owners will be responsible for providing information to all residents contacted as part of the receptor survey. This information will include notification of the release, results of the receptor survey, and any corrective actions taken on behalf of the release. The complete bill language is provided below:

> *Sec. 11. [116.482] Petroleum Release Notification*
> *(a) When a potential receptor survey is conducted for a petroleum tank release as provided in agency guidance documents, the tank owner must provide information on the results of the survey, reports of all releases, and any corrective actions, as defined in section 115C.02, that are related to the petroleum tank release in an understandable manner to residents contacted in the survey. The information may be provided through personal contact, mail, or e-mail. (b) An owner may delegate the owner's responsibility under paragraph (a) to the owner's consultant or contractor, as those terms are defined in section 115C.02, or to the operator of the tank.*

To assist the tank owner in complying with this law, the MPCA has developed a guidance document that contains a letter template to facilitate communication to all contacted residents. See Petroleum tank release follow-up notification. Following completion of a potential receptor survey as defined in this guidance document, submit a notification letter to all residents contacted as part of the survey. The example template is an illustration of language that should satisfy the law's requirements. Tank owners and their consultants may use the template as is or modify it to suit their site-specific situation.