TIER 1 GUIDANCE

Site Assessment of Leaking Underground Storage Tanks (LUST) Using Risk-Based Corrective Action (RBCA)

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RISK-BASED CORRECTIVE ACTION OVERVIEW

General Information

The Iowa Department of Natural Resources (DNR) Underground Storage Tank (UST) Section utilizes the Risk-Based corrective action (RBCA), which assesses the risk(s) posed by petroleum contamination using site-specific conditions and a tiered approach to protect human health and the environment. Based on the results of the tiered assessment, corrective action can then be used to minimize or remove risk(s). Corrective action options can include: reducing contamination through active or passive methods, using technological or institutional controls, or monitoring.

Tier 1 Site Assessment

A Tier 1 Site Assessment (Tier 1) uses limited site data to determine whether a site poses an unreasonable risk to public health, safety, and the environment. A Tier 1 assessment generally includes: conducting a field investigation to determine the maximum concentrations of chemicals of concern in soil and groundwater associated with the petroleum release, surveying the surrounding area for receptors and comparing maximum contaminant concentrations to the Tier 1 Look-up Table to determine which pathways are complete. The Tier 1 levels are derived from models using conservative assumptions to predict contaminant movement and exposure to receptors.

A Tier 1 Assessment assumes the worst-case scenario, by evaluating whether actual or potential receptors could be exposed to chemicals of concern through soil and groundwater pathways. The location with the maximum concentrations is assumed to be the point of exposure, i.e., the source.

Additional assessment after the Tier 1 assessment is complete depends on maximum concentrations identified. For example, if the maximum concentrations do not exceed the Tier 1 levels for a pathway, further assessment of that pathway may not be required. If a maximum concentration does exceed a Tier 1 level, additional assessment or corrective action may be required, including but not limited to conducting a Tier 2, performing soil excavation, or implementing an institutional or technical control.

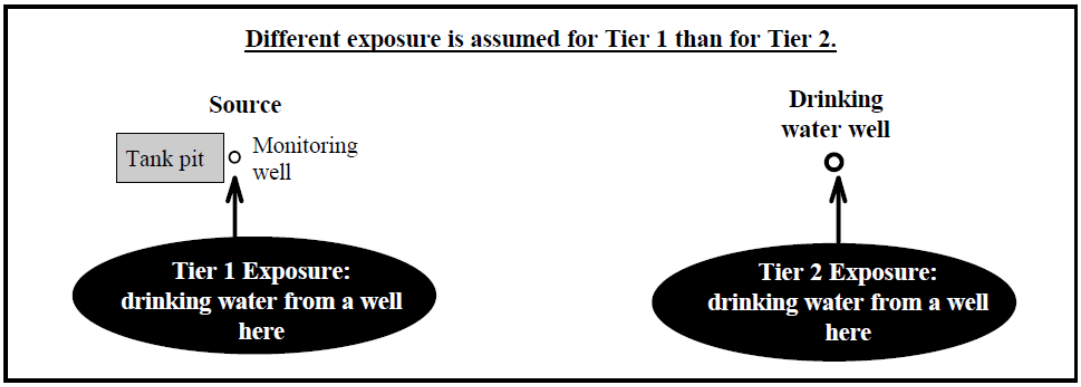
Two Classification Levels for Tier 1 Assessment: Pathway(s) Complete or No Action Required

A pathway(s) is a transport mechanism by which chemicals of concern exceeding a Tier 1 level may reach a receptor or a location of a potential receptor. A single pathway may have multiple classifications based on actual or potential receptor evaluations. Separate classification criteria may apply to actual and potential receptors for any pathway. Based on the DNR's review, a site can complete a pathway or obtain a No Action Required classification.

The DNR has 90 days to review a report for accuracy and completeness. Incomplete reports, including reports not submitted in the format required by the DNR, will be rejected.

Tier 2 Site Cleanup Report

A Tier 2 Site Cleanup Report (Tier 2) is conducted on a site not classified No Action Required at Tier 1 or if a pathway(s) and chemical group(s) does not meet the no action required requirements. The objective of a Tier 2 site assessment is to collect site-specific data and, with the use of Tier 2 modeling, to determine which actual or potential receptor(s) could be impacted by chemical(s) of concern and what concentration(s) at the source are predicted to achieve protection of the receptor(s). If a Tier 2 site assessment is conducted without doing a Tier 1 assessment first, Tier 1 requirements must be included in the Tier 2. Further, a Tier 2 must be completed when free product is identified on-site.



[1]

Tier 3 Assessment

The purpose of Tier 3 Assessment (Tier 3) is to assess the risk of exposure to the chemicals of concern using other chemical fate and transport models or alternative assessment methods. A Tier 3 assessment may provide additional risk assessment data beyond a Tier 2. See Tier 2 Guidance for additional information.

No Action Required Site Classification

To obtain a no action required classification, all pathways at a site must meet the individual pathway criteria or not exceed Tier 1 levels for any pathway. If pathway conditions present an unreasonable risk to human health, safety, or the environment, the pathway shall be further assessed consistent with the risk-based corrective action provisions. However, if a pathway meets the criteria for actual and potential receptors for the pathway, then it will be classified No Action Required.

If a Tier 1 level is exceeded for any pathway, a no action required site classification may be obtained if acceptable corrective actions are implemented. Corrective Action Response options permitted for pathways failing the Tier 1 analysis are identified within this guidance. If the corrective actions cannot be implemented, a Tier 2 must be completed to evaluate those pathways not cleared at Tier 1.

If a Tier 1 level(s) is not exceeded for an individual pathway, the corresponding part of the receptor survey specific to that pathway does not need to be conducted. For example, if the maximum concentrations of chemicals of concern in groundwater and soil are below the most restrictive Tier 1 levels for the groundwater to water line pathway and soil to water line pathway, then a survey for water lines within 200 feet of the source is not required. Certain parts of the receptor survey must be conducted in accordance with instructions in the Receptor Survey regardless of the actual contaminant concentrations.

A no action required site classification may be proposed upon completion of Tier 1 if all the criteria for pathway clearance have been met for every pathway. Note, all corrective actions necessary to satisfy the criteria for pathway clearance must be conducted prior to submittal of a Tier 1 report recommending a no action required site classification. The DNR must be informed if these corrective actions require more than 90 days to complete. All documentation which supports the corrective actions must be submitted as attachments to the Tier 1 report. If the corrective actions cannot be implemented, a Tier 2 must be completed to evaluate those pathways not cleared at Tier 1.

No Further Action Certificate

When the no action required site classification has been accepted for a Tier 1 Report, the DNR will issue a no further action (NFA) certificate. The DNR will issue a NFA certificate to an owner or operator of a site from which the release has occurred, the current property owner, or other responsible party who has taken corrective action warranting classification of the site as no action required.

[1] Tier 3 is not depicted.

To obtain an NFA certificate, the DNR may request any of the following:

- Completed well plugging forms - All abandoned wells and borings with access to groundwater must be plugged according to 567-39 using DNR Form 542-1226. Contact the DNR's Water Supply Section for additional information.
- Proof of institutional controls (for example, but not limited to filed and stamped deed restrictions, certification letters, and environmental covenants)
- Copies of local ordinances or regulations which prevent placement of wells or use of groundwater
- Copies of notices to the DNR's Water Supply Section
- Copies of notices to county authorities which issue private water supply construction permits
- Report of soil excavation activities
- Report of water line replacement or relocation
- Copies of notices to utility companies which supply water to the area of concern

Conditions Requiring a Tier 2 Site Cleanup Report

1. Pathway Complete
   If a pathway is complete at Tier 1, a Tier 2 must be conducted.

2. Free Product
   If free phase product is encountered on-site, the DNR must be notified within 24 hours. The UST and Field Office staff assigned to each region of the state and their direct phone numbers are provided in Appendix A. Free product removal must be conducted in accordance with 567-135.7(4) and reported to the DNR on the Free Product Recovery Report Form (DNR Form 542-1424). If free product is present, the Tier 1 guidance document is no longer applicable for site evaluation. A Tier 2 SCR must be completed in accordance with the requirements in the Tier 2 SCR guidance document.

3. Explosive Vapor Levels
   If potentially explosive levels (≥10% LEL) are detected when conducting the explosive vapor survey, contact local emergency services and report to the appropriate DNR Field Office. The groundwater professional must notify the responsible party or party contracting the site investigation to report the contamination to the DNR in accordance with IAC 567-105. The appropriate party must begin immediate response and abatement procedures in accordance with IAC 567-135.7 and IAC 567-105, proceed with the Tier 2 assessment, and evaluate the enclosed space as an actual receptor.

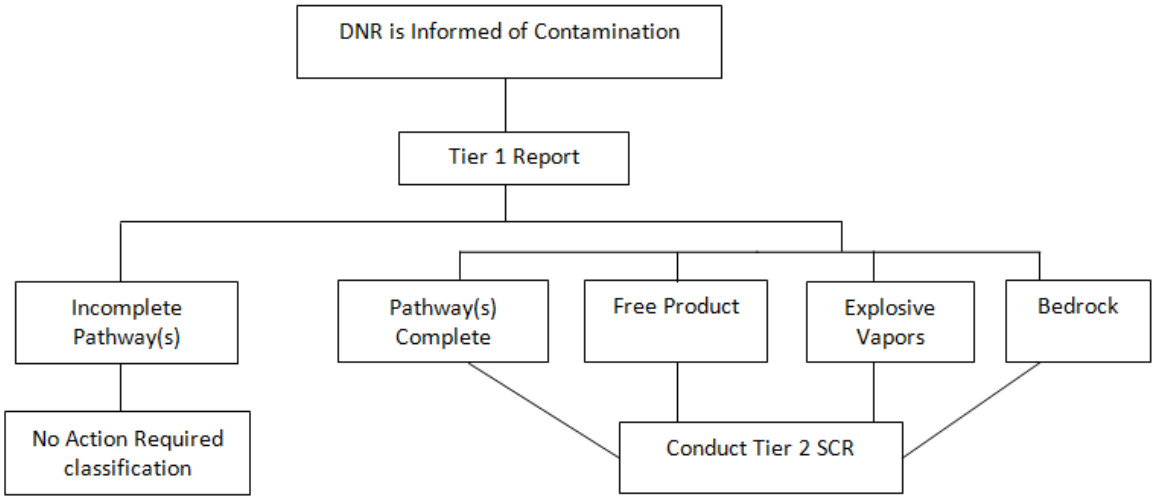
4. Shallow Bedrock
   Prior to drilling and to assist in planning, the groundwater professional should determine the potential to encounter bedrock before groundwater. These potential areas could include (1) areas where karst features or outcrops exist within one mile of the site and (2) areas where bedrock is less than 50 feet from the surface as illustrated in Appendix B. The purpose of this determination is to prevent drilling through contaminated subsurface areas and creating a preferential pathway to a bedrock aquifer.

   If the first encountered groundwater is above the bedrock with sufficient separation and aquifer characteristics to establish that it acts as a granular aquifer as provided in 567-135.10(3)"a", a Tier 1 assessment must be conducted as provided in this guidance.

   If bedrock is encountered before groundwater, a Tier 2 SCR must be completed in accordance with the requirements in the Tier 2 SCR guidance document and special bedrock procedures in 567-135.10(3).

   If the first encountered groundwater is above bedrock but near the bedrock surface, or fluctuates above and below bedrock, the groundwater professional should evaluate the sub-surface geology and aquifer characteristics to determine the potential for creating a preferential pathway. If it is determined the aquifer shows extraordinary variations or inconsistencies in groundwater flow, groundwater elevations across the site, hydraulic conductivities, or total dissolved solid concentrations among monitoring wells, a Tier 2 using special bedrock procedures must be conducted.

Tier 1 Flowchart



GENERAL INFORMATION

Statutory Authority

The Iowa Code chapter 455B and Iowa Administrative Code chapters 134, 135 authorize the DNR to regulate underground storage tanks.

Financial Responsibility

Owners and operators of active underground storage tank systems are required to maintain financial responsibility, or insurance. Owners and operators should contact their insurance carrier to begin the claim process when a release has been identified.

Tier 1 Report Form

When a Tier 1 assessment is conducted, findings must be reported in the Tier 1 Report form. A blank copy of the report can be found at the DNR UST webpage.

Tier 1 Worksheet and Flowcharts

The Tier 1 worksheet or flowcharts can be useful for identifying whether a pathway has passed or failed and what actions are required or options available at each pathway. The flowcharts are in Appendix G and the worksheet is in Appendix H - Pathway Evaluation Worksheet.

Report Preparation

The Tier 1 report cover page **must** be signed by the responsible party and a certified groundwater professional. It is the responsibility of the owner or operator to ensure the groundwater professional prepares a report appropriate for the conditions at the site. All groundwater and soil data obtained during the Tier 1 field assessment must be collected by or under the supervision of an Iowa certified groundwater professional. Currently certified Iowa groundwater professionals can be found on the Search page of the UST Professional Certifications database.

To the extent practicable, during the preparation of the Tier 1 report, use generally available hydrologic, geologic, topographic, and geographic information to minimize site-specific testing. In many instances, a space is provided in the Tier 1 report form to record a response. A response must be provided for all questions unless directed otherwise in the instructions. Please try to limit the response to the space provided. Yet, if extra space is required, reference it

as an attachment.

The Tier 1 Report must contain all the information requested; see Requirements for Report Maps and Appendices. A checklist of Tier 1 report components is included to assist with compilation. Items labeled "optional" may not be necessary. The groundwater professional is responsible for determining what site-specific information must be included to produce a complete report.

Review Process

Upon receipt of the Tier 1 report, the DNR will review the report for completeness, accuracy, and compliance with the DNR's rules. Incomplete Tier 1 reports and Tier 1 reports not submitted in the format required by this guidance and 567-135.9(11) will be rejected.

The Tier 1 report and the groundwater professional's proposed risk classification for the site shall be considered accepted unless with 90 days of receipt of the report, the DNR identifies material information in the report that is inaccurate or incomplete in accordance with 567-135.9(11).

If during the course of the Tier 1 report phase the groundwater professional determines a Tier 2 report rather than a Tier 1 report is necessary, a separate Tier 1 report should not be submitted and will not be reviewed; rather, the Tier 1 findings should be incorporated into the Tier 2 report.

Report Submittal

An electronic copy of the Tier 1 report must be submitted to the DNR within **90 calendar days from the date the petroleum release was confirmed**. Electronic copies of reports should be submitted to ust.rbcasoftwaremtbe@dnr.iowa.gov

The six-character LUST number needs to be included in all report submittals and correspondence regarding a Leaking Underground Storage Tank (LUST).

If a Tier 2 is prepared instead of a Tier 1 report, the DNR must be notified in writing **prior** to the expiration of the Tier 1 report submission deadline.

Report Submittal Extensions

Timing for submittal of the report starts when the letter requesting the Tier 1 evaluation is received by the responsible party. If, during the Tier 1 evaluation phase of the project, the Tier 1 will not be submitted within the allotted timeframe or it is determined a Tier 2 evaluation is more appropriate, then the owner or operator or certified groundwater professional must request a schedule extension, in writing in the report submittal schedule **before** the Tier 1 is due.

Schedule extension requests must be signed or co-signed by the responsible party. The request must include a reason for the time extension. The DNR will respond to the schedule request. Except under very extreme situations, only one schedule extension request will be accepted for a site. If additional schedule extensions are necessary, the certified groundwater professional may submit a letter signed or co-signed by the RP, explaining in detail the reason why the report cannot be submitted as scheduled.

Subsequent requests may not be granted. The DNR may use this information to evaluate whether to take legal or other actions. All correspondence regarding time request extensions will be made part of the site file.

Chemicals of Concern

OA1 AND OA2

A soil and groundwater sample(s) collected from a release(s) of a petroleum-regulated substance(s) must be analyzed for volatile petroleum hydrocarbons - benzene, toluene, ethylbenzene, and xylenes - also known as Iowa Method OA-1 or EPA Method 8260D.

TOTAL EXTRACTABLE HYDROCARBONS

If the release is suspected to include any petroleum-regulated substance other than gasoline or gasoline blends, or if the source of the release is unknown, a soil and groundwater sample(s) must also be tested for semi-volatile petroleum compounds-all grades of diesel fuel, fuel oil, kerosene oil, and mineral spirits-known as Total Extractable Hydrocarbons (TEH) or Iowa Method OA-2. A copy of Iowa Method OA-1 and OA-2 are available from the State Hygienic Laboratory (SHL's webpage).

METHYL-TERTIARY BUTYL ETHER (MTBE)

A groundwater sample(s) collected during any phase of the RBCA evaluation process must be tested for methyl-tertiary butyl ether (MtBE) pursuant to 567-135.18. The MtBE analyses must be performed regardless of what type of petroleum release (i.e., gasoline, diesel, fuel oil, waste oil, motor oil, hydraulic fluid, jet fuel, kerosene, and mineral spirits) is under investigation.

MtBE analysis does not need to be conducted on samples collected in association with tank closures or site checks unless the site check samples are used in Tier 1 or Tier 2 evaluations.

To assure reliable and accurate analytical results, MtBE analysis will be conducted by Gas Chromatography/Mass Spectrometry (GC/MS) using the GC/MS version of OA-1, "Method for Determination of Volatile Petroleum Hydrocarbons (gasoline)," revision 12/01/2019, or US Environmental Protection Agency Method 8260B, SW-846, "Test Methods for Evaluating Solid waste," Third Edition. Using gas chromatography as the sole analytical method will likely result in a false positive (or negative) and should be reported to the DNR.

Laboratories analyzing for MtBE must be able to meet a detection level of 15 μg/L (ppb) for water samples. MtBE is considered not present if reported as <15 ppb. MtBE is considered present if 1) the lab reports it as a positive quantified level below 15 ppb (e.g., 12 ppb) by using a detection level below 15 ppb, or 2) if the laboratory is reporting at a higher detection level (e.g.<16 ppb, <50 ppb, <200 ppb). Under these conditions, continued monitoring/ testing for MtBE is required.

Laboratories performing the analyses must run standards for MtBE on a routine basis, and standards for other possible compounds like ethyl tertiary-butyl ether (ETBE), tertiary-amyl methyl ether (TAME), diisopropyl ether (DIPE), and tertiary-butyl alcohol (TBA) to be certain of their identification should they be detected.

MtBE monitoring results must be reported to the DNR on the MtBE Sampling Results (DNR Form 542-1394).

OTHER CHEMICALS OF CONCERN

If other chemicals of concern are identified, please contact DNR to determine whether additional sampling or assessment is necessary.

SOIL GAS ANALYSIS

The National Institute for Occupational Safety and Health (NIOSH) Method 1501, or a DNR-approved equivalent method, shall be used for the analysis of soil gas for benzene and toluene vapors. NIOSH Method 1501 is published in the NIOSH Manual of Analytical Methods, 1994.

If an alternative soil gas analytical method is to be used, a proposal must be submitted to the DNR **prior** to its use. The proposal must contain a justification for the use of an alternative method and a copy of the method including information on sample preparation, calibration, quality control, equipment, and materials used in sample extraction and analysis and calculations used to determine concentrations of chemicals of concern.

As of September 1, 1998, soil gas samples from LUST sites must be analyzed by a laboratory which has met the certification criteria for soil gas analysis through the State Hygienic Laboratory.

CERTIFIED LABORATORY REQUIRED

To analyze a soil and water sample(s) related to a release of a petroleum-regulated substance a laboratory must be certified pursuant to 567-83, 135.16. A list of certified laboratories may be obtained from the SHL webpage.

LABORATORY DATA SHEETS

Provide a copy of all laboratory data sheets, including those for Total Dissolved Solids analyses (if applicable.), Chain of Custody forms, chromatograms, and associated quantitative reports for the waste oil, diesel, and gasoline standards used by the laboratory. The laboratory analytical report must state whether the sample tested matches the laboratory standard for waste oil, diesel, or gasoline. Additionally, chromatograms for soil and groundwater samples with the maximum concentrations of BTEX and TEH-D, -WO must be submitted. Chromatograms for all other sample analyses should be maintained by the laboratory and available upon request by the DNR.

QUALITY CONTROL/QUALITY ASSURANCE PROCEDURES

The quality control/quality assurance (QC/QA) procedures used during the site investigation must be at least as stringent as those contained in DNR's LUST Quality Assurance Plan. A copy of the DNR's LUST Quality Assurance Plan may be found at the DNR UST webpage. See also the DNR wide QC/QA procedures as an additional resource. The groundwater professional must provide DNR a copy of the QC/QA plan designed for the site, field notes, and chain of custody forms on request.

IOWA TIER 1 LEVEL LOOK-UP TABLE

	Exposure Pathway	Receptor	Group 1				Group 2	
			Benzene	Toluene	Ethylbenzene	Xylenes	Diesel*	Waste Oil
Groundwater (µg/L)	Groundwater Ingestion	Actual	5	1,000	700	10,000	1,200	400
		Potential	290	7,300	3,700	73,000	75,000	40,000
	Groundwater Vapor to Enclosed Space	All	1,540	20,190	46,000	NA	2,200,000	NA
	Groundwater to Water Line	PVC or Gasketed Mains	7,500	6,250	40,000	48,000	75,000	40,000
		PVC or Gasketed Service Lines	3,750	3,120	20,000	24,000	75,000	40,000
		PE/PB/AC Mains or Service Lines	200	3,120	3,400	19,000	75,000	40,000
	Surface Water	All	290	1,000	3,700	73,000	75,000	40,000
Soil (mg/kg)	Soil Leaching to Groundwater	All	0.54	42	15	NA	3,800	NA
	Soil Vapor to Enclosed Space	All	1.16	48	79	NA	47,500	NA
	Soil to Water Line	All	2.0	3.2	45	52	10,500	NA

- NA: Not applicable. There are no limits for the chemical for the pathway, because for groundwater pathways the concentration for the designated risk would be greater than the solubility of the pure chemical in water, and for soil pathways the concentration for the designated risk would be greater than the soil concentration if pure chemical were present in the soil.
- TEH: Total Extractable Hydrocarbons. The TEH value is based on risks from naphthalene, benzo(a)pyrene, benz(a)anthracene, and chrysene.
- Diesel*: Standards in the Diesel column apply to all low volatile petroleum hydrocarbons except waste oil.

Assumptions Used for Iowa Tier 1 Look-Up Table Generation:

1. Groundwater ingestion pathway. The maximum contaminant levels (MCLs) were used for Group 1 chemicals. The target risk for carcinogens for actual receptors is 10-6 and for potential receptors is 10-4. A hazard quotient of one, and residential exposure and building parameters are assumed.
2. Groundwater vapor to enclosed space pathway. Residential exposure and residential building parameters are assumed; no inhalation reference dose is used for benzene; the capillary fringe is assumed to be the source of groundwater vapor; and the hazard quotient is 1 and target risk for carcinogens is 1x10-4.
3. Groundwater to water line. This pathway uses the same assumptions as the groundwater ingestion pathway for potential receptors, including a target risk for carcinogens of 10-4.
4. Surface water. This pathway uses the same assumptions as the groundwater ingestion pathway for potential receptors, including a target risk for carcinogens of 10-4, except for toluene which has a chronic level for aquatic life of 1,000 as in the definition for surface water criteria in 567-135.2(455B).
5. Soil leaching to groundwater. This pathway assumes the groundwater will be protected to the same levels as the groundwater ingestion pathway for potential receptors, using residential exposure and a target risk for carcinogens of 10-4.
6. Soil vapor to enclosed space pathway. The target risk for carcinogens is 1x10-4; the hazard quotient is 1; no inhalation reference dose is used for benzene; residential exposure factors are assumed; and the average of the residential and nonresidential building parameters is assumed.
7. Soil to water line pathway. This pathway uses the soil leaching to groundwater model with nonresidential exposure and a target risk for carcinogens of 10-4.

In addition to these assumptions, the equations and parameter values used to generate the Iowa Tier 1 Look-Up Table are described in 567-135 Appendix A.

SOIL GAS TARGET LEVELS

Exposure Pathway	Unit of Equivalents	Chemicals of Concern	
		Benzene	Toluene
Soil Vapor to Enclosed Space	Soil Gas ($\mu g/m^3$)	600,000	9,250,000
	(ppm)	190	2,500

TIER 1 PATHWAY EVALUATION

General Tier 1 Procedure

The objective of the Tier 1 field investigation is to identify maximum concentrations of chemicals of concern associated with a release(s) originating on a site. Further, the Tier 1 assessment requires a determination of whether a pathway is complete, an evaluation of actual or potential receptors, a determination of whether conditions are satisfied for obtaining no further action clearance for individual pathways or for obtaining a complete site classification of no action required, and, if necessary, a corrective action response.

Placement and depth of borings and monitoring wells must be sufficient to determine the vertical extent of soil contamination, an adequate description of site stratigraphy, and a reliable determination of groundwater flow direction. At Tier 1, the point of exposure for receptors and the point of compliance is the location of the presumed source of a release. The presumed source of the release is the location(s) of soil and groundwater showing the maximum concentration(s) of chemicals of concern.

Pathway Assessment

A pathway is considered complete if a chemical of concern has a route by which it may reach an actual or potential receptor. The pathways to be evaluated at Tier 1 are:

- Groundwater ingestion pathway;
- Soil leaching to groundwater pathway;

- Groundwater vapor to enclosed space pathway;
- Soil vapor to enclosed space pathway;
- Groundwater to water line pathway;
- Soil to water line pathway;
- Surface water pathway.

Receptor Evaluation

The receptors of concern for each pathway which must be evaluated are identified in the pathway-specific sections of this guidance. Receptors are divided into two categories - actual and potential.

Actual receptors include drinking and non-drinking water wells, public water systems, enclosed spaces, conduits, and surface waterbodies that, when impacted by chemicals of concern, may result in exposure to humans and aquatic life, explosive conditions, or other adverse effects.

Potential receptors are also considered in the receptor evaluation. Potential receptors are receptors not in existence at the time a Tier 1, Tier 2, or Tier 3 assessment is conducted, but could reasonably be expected to exist within 20 years. A protected groundwater source is also a potential receptor because of its possible future use as drinking water.

Source

At Tier 1, "source" refers to the maximum concentrations of chemicals of concern, regardless of the origin of the petroleum release.

Pathway Clearance

If the maximum concentrations of chemicals of concern do not exceed the applicable Tier 1 levels in the Tier 1 Look-up Table for a pathway, or if a pathway is incomplete, further assessment of that pathway is not required (the pathway obtains "clearance"). If the maximum concentrations for all chemicals of concern within a designated group of chemicals are below the Tier 1 levels, no further action is required regarding that group of chemicals (see Tier 1 Table for list of Group 1 and Group 2 chemicals).

However, if in the course of conducting further site assessment, data indicates the Tier 1 levels for a cleared pathway is exceeded, the pathway must be reevaluated as part of the Tier 2 or Tier 3 assessment. Pathways that do not achieve clearance (pathways complete) must then be evaluated under the applicable Tier 2 or Tier 3 assessment procedure. A no action required site classification only applies when all pathways obtain no action required classification.

Corrective Action Response

If the maximum concentrations exceed a Tier 1 level, there are four basic corrective action response options conduct a Tier 2, apply institutional controls, sever a pathway by plugging wells or removing water lines, or in limited circumstances, excavate contaminated soil to below the Tier 1 levels. Additionally, the owner or operator may be required to provide notifications of site conditions to authorities, such as the DNR's Water Supply Section, utility companies supplying water services, and county authorities responsible for issuing private water supply construction permits. Corrective action responses permissible for each pathway are identified in the pathway-specific sections of this guidance. Technological controls are not acceptable at Tier 1.

TIER 1 PATHWAY SPECIFIC GUIDANCE

The procedures for evaluating the seven pathways of concern are described below. The flow charts in the Appendix G may also be used as guides to evaluate pathways, but should not be used exclusive of this guidance.

Groundwater Ingestion Pathway

The groundwater ingestion pathway addresses the potential for human ingestion of petroleum-regulated substances from existing drinking water wells, existing non-drinking water wells, or potential drinking water wells that could

access a usable contaminated groundwater source. The term "protected groundwater source" is intended to identify sources of groundwater considered usable as drinking water. (Refer to Sampling Requirements within this guidance for more information on protected groundwater source.)

Pathway Completeness

This pathway is considered complete if there is a drinking well or non-drinking water well within 1,000 feet of the source or the first encountered groundwater meets the definition of a protected groundwater source.

Receptor Evaluation

A drinking water well within 1,000 feet of the source area is considered an actual groundwater ingestion receptor. Tier 1 levels for actual receptors are applied to drinking water wells. A non-drinking water well within 1,000 feet of the source area is considered a potential groundwater ingestion receptor. Tier 1 levels for potential receptors are applied to non-drinking water wells. Potential receptor points of exposure exist for the entire area if the first encountered groundwater is a protected groundwater source. Tier 1 levels for potential receptors apply to protected groundwater sources. Any combination of these receptors may exist and each must be addressed using the applicable Tier 1 level and appropriate corrective action response.

Pathway Clearance

If the pathway is incomplete, no further action is required for this pathway.

If the maximum concentrations of chemicals of concern do not exceed the applicable Tier 1 levels for actual or potential receptors, no further action is required for this pathway. If groundwater is not encountered during the investigation and the requirements for depth of drilling have been met and vulnerable bedrock is not encountered, this pathway cannot be evaluated and no further action is required for this pathway.

Corrective Action Response

If the pathway is complete and the maximum concentrations on site exceed the applicable Tier 1 levels for either actual or potential receptors a Tier 2 may be completed or an effective institutional control implemented. For example, limiting drinking water well installation is an acceptable form of institutional control.

If the pathway is complete regarding drinking water wells and the maximum concentrations exceed the Tier 1 levels for actual receptors, the pathway can be cleared by plugging all drinking water wells within 1,000 feet.

If the pathway is complete regarding non-drinking water wells and the maximum concentrations exceed the Tier 1 levels for potential receptors, the pathway can be cleared by plugging all non-drinking water wells within 1,000 feet.

If a protected groundwater source exists and the maximum concentrations exceed the Tier 1 levels for potential receptors, the institutional control must prohibit the use of the protected groundwater source within 1,000 feet of the contamination source area. The owner or operator must also provide notification of the site conditions on the appropriate DNR form to the DNR's Water Supply Section and to the designated county authority responsible for issuing private water supply construction permits as provided in 567-49. If an institutional control is not obtained, a Tier 2 must be conducted for this pathway.

If the receptor type is potential because of an existing protected groundwater source and the maximum concentrations are below the Tier 1 levels for potential receptors but exceed the Tier 1 levels for actual receptors, the owner or operator must provide notification of the site conditions on the appropriate DNR form to the DNR's Water Supply Section and to the designated county authority responsible for issuing private water supply construction permits as provided in 567-49.

Soil Leaching to Groundwater Pathway

This pathway addresses the potential for soil contamination to leach to groundwater. At Tier 1, this pathway evaluates risk of human exposure only through the groundwater ingestion pathway.

Pathway Completeness
If the groundwater ingestion pathway is complete, the soil leaching to groundwater pathway is considered complete.

If groundwater is not encountered during the course of the investigation, the requirements for depth to drilling have been met, and bedrock has not been encountered, a survey for actual drinking and non-drinking water wells must be conducted.

If actual wells exist within 1,000 feet of the source, this pathway is complete.

Receptor Evaluation
Drinking water wells, non-drinking water wells, and protected groundwater sources are receptors for this pathway; however, only one Tier 1 level for each chemical of concern is applied to all receptor types.

Pathway Clearance
If the pathway is incomplete, no further action is required for this pathway.

If the maximum concentrations of chemicals of concern in soil do not exceed the Tier 1 levels, no further action is required for this pathway.

Corrective Action Response
If the Tier 1 levels are exceeded for this pathway, the options are to conduct a Tier 2, establish institutional controls which satisfy the conditions applicable to the groundwater ingestion pathway as described previously, or excavate contaminated soil for the purpose of removing all soil exceeding the Tier 1 levels in accordance with 567-135.9(7)"h" and the Corrective Action Response section of this guidance document.

Groundwater Vapor to Enclosed Space Pathway

This pathway addresses the potential for vapors from contaminated groundwater to migrate to enclosed spaces where humans could inhale chemicals of concern at unacceptable levels. This pathway evaluation assumes the health-based Tier 1 levels will also adequately protect for any short-term or long-term explosive risks.

Pathway Completeness
If groundwater is encountered, this pathway is always considered complete for purposes of Tier 1 and must be evaluated. This pathway is incomplete if groundwater is not encountered during the course of the investigation, the requirements for depth of drilling have been met, and bedrock is not encountered before groundwater.

Receptor Evaluation
For the purpose of Tier 1, subsurface enclosed spaces are receptors and specifically include buildings with basements, storm and sanitary sewers, and underground utility vaults. Existing subsurface enclosed spaces and potential subsurface enclosed spaces are considered and the same Tier 1 level for each chemical of concern is applied regardless of receptor type. Additionally, an explosive vapor survey of existing enclosed spaces must be conducted in accordance with procedures in Receptor Survey section.

Pathway Clearance
If the maximum concentrations of chemicals of concern do not exceed the Tier 1 levels *and* there are no explosive levels of vapors in enclosed spaces, no further action is required for this pathway.

Soil gas measurements (taken for the soil vapor to enclosed space pathway evaluation) may NOT be used to obtain clearance for the groundwater vapor to enclosed space pathway.

Corrective Action Response
If the maximum concentrations exceed the Tier 1 levels for this pathway, the options are to conduct a Tier 2 or implement an institutional control. The institutional control must effectively eliminate and prohibit the placement of subsurface enclosed spaces within 500 feet of the source.

If potentially explosive levels (≥10% LEL) are detected when conducting the explosive vapor survey, contact local emergency services and report to the appropriate DNR Field Office. The groundwater professional must notify the responsible party or party contracting the site investigation to report the contamination to the DNR in accordance with IAC 567-105. The appropriate party must begin immediate response and abatement procedures in accordance with IAC 567-135.7 and IAC 567-105, proceed with the Tier 2 assessment, and evaluate the enclosed space as an actual receptor.

If soil gas measurements (taken for the soil vapor to enclosed space pathway evaluation) exceed the soil gas target levels and a Tier 2 is the corrective action selected, both the soil vapor to enclosed space pathway and the groundwater vapor to enclosed space pathway must be evaluated at Tier 2.

Soil Vapor to Enclosed Space Pathway

This pathway addresses the potential for vapors from contaminated soils to migrate to enclosed spaces where humans could inhale chemicals of concern at unacceptable levels. This pathway evaluation assumes the health-based Tier 1 levels will also adequately protect for any short-term or long-term explosive risks.

Pathway Completeness

This pathway is always considered complete for purposes of Tier 1 and must be evaluated.

Receptor Evaluation

For the purpose of Tier 1, subsurface enclosed spaces are receptors and specifically include buildings with basements, storm and sanitary sewers, and underground utility vaults. Existing subsurface enclosed spaces and potential subsurface enclosed spaces are considered and the same Tier 1 level for each chemical of concern is applied regardless of receptor type. If a Tier 1 level for soil is exceeded, soil gas samples may be collected in accordance with procedures in the Sampling Requirements section of this guidance document. Soil gas measurements are evaluated against the soil vapor target levels for pathway clearance. Additionally, an explosive vapor survey of existing enclosed spaces must be conducted in accordance with procedures in the Receptor Survey section of this guidance document.

Pathway Clearance

If the maximum concentrations of chemicals of concern in soil do not exceed the Tier 1 levels *and* no explosive levels of vapors have been identified, no further action is required for this pathway.

If the maximum concentrations in soil exceed the Tier 1 levels, but soil gas measurements and confirmation samples taken at the location of maximum soil concentrations do not exceed the soil gas target levels *and* no explosive levels of vapors have been identified, no further action is required for this pathway.

Corrective Action Response

The corrective action response options for this pathway are to conduct a Tier 2, establish institutional controls which effectively eliminate and prohibit the placement of subsurface enclosed spaces within 500 feet of the source, or excavate contaminated soil for the purpose of removing all soil which exceeds the Tier 1 levels in accordance with 567-135.9(7)"h" and the Corrective Action Response section.

If the maximum soil concentrations exceed the Tier 1 levels for this pathway and the soil gas measurements exceed the soil gas target levels, or if no soil gas measurements were taken, corrective action is required.

If explosive vapors are detected, even if maximum soil concentrations do not exceed Tier 1 levels, corrective action is required.

If potentially explosive levels (≥10% LEL) are detected when conducting the explosive vapor survey, contact local emergency services and report to the appropriate DNR Field Office. The groundwater professional must notify the responsible party or party contracting the site investigation to report the contamination to the DNR in accordance

with IAC 567-105. The appropriate party must begin immediate response and abatement procedures in accordance with IAC 567-135.7 and IAC 567-105, proceed with the Tier 2 assessment, and evaluate the enclosed space as an actual receptor.

If soil gas measurements exceed the soil gas target levels and a Tier 2 is the corrective action selected, both the soil vapor to enclosed space pathway and the groundwater vapor to enclosed space pathway must be evaluated at Tier 2.

If soil gas measurements exceed the soil gas target levels and excavation is the corrective action selected, soil gas measurements must be taken again after the excavation has been completed. The post-excavation soil gas measurements must be taken outside the excavated area, but near the area expected to exhibit the highest soil gas concentrations.

For example, if the maximum benzene concentration remaining in soil after an excavation is 1.5 mg/kg from a sidewall sample, soil gas measurements should be collected near that sidewall in native soil. If the post-excavation soil gas measurements exceed the soil gas target levels, **both the soil vapor to enclosed space pathway and the groundwater vapor to enclosed space pathway must be evaluated at Tier 2.**

Groundwater to Water Line Pathway

This pathway addresses the potential for creating a drinking water ingestion risk due to chemicals of concern in groundwater contacting susceptible water lines and diffusing into the drinking water.

Pathway Completeness

This pathway is considered complete for actual receptors if there is an existing water line within 200 feet of the source and the first encountered groundwater is less than 20 feet below the ground surface. The pathway is considered complete for potential receptors if the first encountered groundwater is less than 20 feet below the ground surface. All current and any available historical groundwater elevation information must be considered and the estimated seasonal high level must be used for determining pathway completeness.

Receptor Evaluation

For the purposes of Tier 1 assessment, existing water lines and potential water lines are receptors. The **most restrictive** Tier 1 level for each chemical of concern is applied. If the construction material of the water line receptors can be accurately identified and documented, you may apply the appropriate Tier 1 level according to water line receptor type. Documentation can include, but is not limited to, who was contacted and when the contact was made, water main/line material, and the installation date.

Water Line Receptor and Non-Receptor Types[2]

EXAMPLES OF RECEPTER TYPES	
PVC or gasketed mains	Polyvinyl Chloride (PVC) Ductile Iron mains with rubber or unknown gaskets Cast Iron mains with rubber or unknown gaskets Iron mains with Neoprene gaskets
PVC or gasketed service lines	Polyvinyl Chloride (PVC) Ductile Iron service lines with rubber or unknown gaskets Cast Iron service lines with rubber or unknown gaskets
PE/PB/AC mains or service lines	Polyethlyene (PE) Polybutylene (PB) Asbestos cement (AC or transite) mains and service lines

[2] This is not a comprehensive list. Other types of water lines and mains may exist.

EXAMPLES OF NON-RECEPTOR TYPES[3]	
Water service lines	Copper service lines without gaskets
Water line mains	Iron water line with petroleum resistant gaskets
Gaskets and Joints	FKM gaskets Viton gaskets Portland cement mortar joints Welded joints Leadite or leaded joints

Pathway Clearance

If the pathway is not complete, no further action is required for this pathway. If the pathway is complete and the maximum concentrations of all chemicals of concern do not exceed the most restrictive Tier 1 levels, no further action is required for this pathway.

If the Tier 1 levels are exceeded, but no water lines currently exist within 200 feet of the source, any utility company which could supply water service to the area must be notified of conditions at the site including the potential impact to water lines should they later be installed using DNR Form 542-1531. After the DNR has been informed that the utility company has been notified, no further action will be required for this pathway regarding potential receptors.

Corrective Action Response

If the maximum concentrations exceed the Tier 1 levels for this pathway, the options are to conduct a Tier 2, replace all existing water lines within 200 feet of the source with appropriate piping material and petroleum-resistant gaskets or relocate the lines beyond the 200-foot distance. Any utility company that could supply water service to the area must be notified of all existing water lines currently in contact with contaminated groundwater or which have the potential to come in contact with contaminated groundwater. If a Tier 2 is to be conducted, utility notification may be postponed until the Tier 2 is completed.

Soil to Water Line Pathway

This pathway addresses the potential for creating a drinking water ingestion risk due to chemicals of concern in soil permeating water lines and diffusing into the drinking water.

Pathway Completeness

This pathway is considered complete for actual receptors if a water line exists within 200 feet of the source and contaminant concentrations of a chemical of concern exceed the Tier 1 level for that chemical of concern. This pathway is always considered complete for potential receptors.

Receptor Evaluation

For the purposes of Tier 1, existing water lines and potential water lines are receptors. However, only one Tier 1 level for each chemical of concern is applied regardless of receptor type.

Pathway Clearance

If the pathway is complete for either actual or potential receptors and the maximum concentrations in soil do not exceed the Tier 1 levels for this pathway, no further action is required for this pathway.

If the pathway is not complete for actual receptors, no further action is required for this pathway.

If the pathway is not complete for actual receptors, but the Tier 1 levels are exceeded, any utility company supplying water service to the area must be notified of conditions at the site (DNR Form 542-1531), including the potential impact to water lines if they are installed in the future. After the DNR has been informed that the utility company has been notified, no further action will be required for this pathway regarding potential receptors.

[3] Water lines using these materials are currently not considered receptors. This table is subject to change.

Corrective Action Response

If the maximum concentration of any chemical of concern exceeds the Tier 1 levels for any construction material or gasket category in this pathway, the options are to conduct a Tier 2, replace all existing water lines within 200 feet of the source with appropriate piping material and petroleum-resistant gaskets, relocate the water lines in question beyond the 200 foot distance, or excavate contaminated soil for the purpose of removing all soil which exceeds any of the Tier 1 levels in accordance with 567-135.9(7)"h" and the Corrective Action Response section.

Any utility company that could supply water service to the area must be notified of all existing water lines currently in contact with contaminated soil or could potentially be in contact with contaminated soil using DNR Form 542-1531. If a Tier 2 is required, notification of water line impacts may be postponed until completion of a Tier 2.

Surface Water Pathway

This pathway addresses the potential for contaminated groundwater to impact a surface waterbody creating a risk(s) to human health and aquatic life.

Pathway Completeness

This pathway is considered complete if a surface waterbody is present within 200 feet of the source. For purposes of Tier 1, a surface waterbody includes both general use segments and designated use segments as provided in 567-61.3(1).

Receptor Evaluation

The Tier 1 levels for this pathway only apply to designated use segments of a surface waterbody as defined in 567-61.3(1) and 61.3(5). The point of compliance is the source area with the maximum concentrations of chemicals of concern. General use segments of a surface waterbody as provided in 567-61.3(1)"a" are only subject to the visual inspection criteria as required in 567-135.9(10)"c" and the Receptor Survey section. Designated use segments must also be visually inspected.

Under administrative rules, and to maintain compliance with the Clean Water Act, it is presumed all perennial streams and rivers are attaining the highest level of recreational and aquatic life uses and should be protected for uses such as swimming and fishing. This concept of assigning all perennial streams the highest use designation, unless an assessment shows the stream is unable to support those uses, is referred to as "rebuttable presumption". If information is not available to show a different designation is appropriate, a surface waterbody should be considered as A1 - Primary Contact Recreational Uses and B(WW-1), Warm Water Type 1 Aquatic Life Uses.

If you have any questions, please check with the DNR's Water Quality Standards Coordinator.

Pathway Clearance

If the pathway is not complete, no further action is required for this pathway.

If the pathway is complete and the maximum concentrations do not exceed the Tier 1 levels *and* there is no sheen or residue attributable to this site, no further action is required for assessment of this pathway.

To obtain pathway clearance if a sheen or residue is present, the groundwater professional must adequately justify that the origin of the sheen or residue is not the subject site.

To obtain pathway clearance if a sheen or residue is present but not considered to be a petroleum-regulated substance, a sample must be laboratory analyzed to confirm it is not a petroleum-regulated substance.

Corrective Action Response

If the maximum concentrations of chemicals of concern exceed the Tier 1 levels for designated use segments or there is a petroleum sheen or residue attributable to the site, a Tier 2 must be completed.

If a sheen or residue is present, the DNR must be immediately notified.

SUMMARY PAGES

Cover Page

Complete the Tier 1 Report cover page, including the following:

- The responsible party and certified groundwater professional **must** sign the cover page;
- The street address is complete, including city and zip code. The street address is sufficient for site identification purposes. However, if a rural route, box number, or street without a house number is used, then the legal description, as listed in a deed or mortgage, must be provided using the township, range, and ¼, ¼, ¼, ¼ section.
- If a no further action certificate is requested, the site's legal description, as listed in a deed or mortgage, must be provided. If the space provided on the cover page is insufficient, then the legal description may be submitted as an attachment.

Site Data Summary

Complete the Site Data Summary including the following:

- All soil and groundwater samples are to be analyzed for OA1 (Group 1 chemicals are benzene, toluene, ethylbenzene, and xylene (BTEX)). If the release is suspected to include a petroleum-regulated substance other than gasoline or gasoline blends, or if the source of the release is unknown, then all soil and groundwater samples must also be analyzed for OA2 (Group 2 chemicals are total extractable hydrocarbons diesel (TEH-D) and waste oil (TEH-WO)). Soil and groundwater samples collected during any phase of the RBCA evaluation process must be tested for methyl-tertiary butyl ether (MtBE) pursuant to 567-135.18. MtBE analyses must be performed regardless of what type of petroleum release (i.e., gasoline, diesel, fuel oil, waste oil, motor oil, hydraulic fluid, jet fuel, kerosene, and mineral spirits) is under investigation.
- If free product is present on-site or the site is a bedrock site, then completion of the Tier 1 Report is not allowed and a Tier 2 Site Assessment is required instead. Select "yes," then notify the DNR in writing that site conditions warrant a Tier 2 (e.g., the presence of free product, bedrock is encountered before groundwater, or explosive vapors are identified). The Tier 2 Report must be submitted to the DNR within 180 days from notification. Please refer to the Tier 2 Guidance for additional information.

Pathway Evaluation Summary

Complete the Pathway Evaluation Summary for all pathways. Select "passed" or "failed" for chemical groups for every pathway. If analysis for OA2 is not required, then select "N/A." Corrective action or a Tier 2 Site Assessment must be completed for any failed pathways. For each failed pathway, select the corrective action(s) completed, including date completed, or "Go to Tier 2."

An acceptable corrective action measure(s) can be selected on the Pathway Evaluation Summary and Corrective Action Documentation - optional section.

Corrective Action Documentation - optional

Provide a narrative description of activities conducted to address a failed pathway(s). Additional documentation, i.e., well plugging forms, excavation maps, and sampling results, can be attached as additional appendices.

If, upon completion of the Tier 1 assessment, a pathway(s) is cleared by conducting corrective action, yet a Tier 2 is still required to evaluate another pathway(s), the initial corrective action may be postponed until the Tier 2 Site Assessment is completed. Indicate in the space provided those pathways with proposed corrective actions to be postponed, including leaving "Date Completed" blank. The DNR expects the pathway(s) that is postponed will be addressed in the Tier 2 Site Assessment.

SITE CHRONOLOGY AND CURRENT CONDITIONS

Site history, including underground storage tank ownership and operational history, must be provided.

Site Chronology

Site chronology includes, but is not limited to, the following:

- Historical tank information, including the number, capacity, and contents of tanks, dates of installation and removal, and what was stored, used, and sold on site;
- Whether aboveground or underground storage tanks (or both) have been used on- site;
- Mailing addresses, including city and zip code, of current or former owners and tank operators;
- List of any contracts or agreements between land owners, tank owners and tank operators;
- All known subsurface or aboveground releases, estimated quantity of release(s), and nature of release(s);
- All remediation or other corrective action measures conducted.

Current Site Conditions

Current site conditions, including on-site and in-use underground storage tank(s), current ownership and operation status, must be provided. Current site conditions include but are not limited to the following:

- Tank information, including the number, capacity, and contents of tanks, date of installation, most recent tank and piping tightness test results, a summary of leak detection results for the most recent quarter, and confirmation that the leak detection methods and results have been reviewed and no release is indicated.
- Leak detection results for the most recent quarter may also be submitted as supporting documentation of the integrity of the tank system. Please explain any testing anomalies, as necessary, and explain any repairs made to the system.
- Current proof of financial responsibility, as required by 567-136.
- If applicable, coverage of corrective action under any applicable financial assurance mechanism or other financial assistance, i.e., whether the petroleum release being investigated is covered by the Iowa Comprehensive Petroleum Underground Storage Tank Fund.
- UST Inspection Reports

SAMPLING REQUIREMENTS

General Information

The main objective of Tier 1 field assessment is to identify **maximum concentrations** of chemicals of concern in soil and groundwater and to determine whether free product is present. Additionally, the placement and depth of borings must be sufficient to determine: the source(s) of contamination, the vertical extent of soil contamination, a description of site stratigraphy, and the groundwater flow direction.

Where to Sample

MONITORING WELL PLACEMENT

A minimum of three permanent groundwater monitoring wells, subject to the limitations on maximum drilling depths as defined below, must be installed to measure groundwater contamination. At least one well must be placed at each suspected source of release. At a minimum, well locations shall include the pump island with the greatest field screening level, each current and former underground storage tank basin, and at other suspected sources of releases if field screening shows greater levels than at the pump islands or tank basins. A well must be installed in a presumed downgradient direction and within 30 feet of the source with the greatest field screening level. Three of the wells must be placed in a triangular arrangement to determine groundwater flow direction.

Where the circumstances which prompt a Tier 1 assessment identify a discrete source and cause of a release, and the groundwater professional is able to rule out other suspected sources or contributing sources such as pump islands, piping runs and tank basins, the application of field screening and groundwater well placement may be limited to the known source. However, a minimum of three groundwater monitoring wells is still required.

SOIL SAMPLE COLLECTION

Pursuant to 567-135.9(1)"f", the objective of soil sampling is to identify the maximum concentrations of soil contamination in the vadose and saturated zones and to identify sources of releases. Soil samples must be taken

from borings with the greatest field screening levels even if the boring will not be converted to a monitoring well.

Soil samples collected for laboratory analysis should be placed in contaminant-free glass containers with Teflon-lined caps or lids provided by the testing laboratory. The soil should be disturbed as little as possible during analytical sample collection. The analytical sample containers should be labeled and filled to the top with no discernible headspace between the lid and the sample. After collection the samples should be refrigerated or placed on ice. The samples must be transported to the laboratory within 72 hours of collection.

Soil samples should be collected separately for field screening and laboratory analysis as soon as possible after the surface of the soil has been exposed to the atmosphere. The soil split spoon or core sample recovery should first be examined for evidence of contamination (e.g. staining, odor, or sheen). If obvious signs of contamination are present, a sample should be collected from the area of the core and containerized. If no obvious sign of contamination or other distinctive characteristic is observed, an analytical soil sample may be collected from any portion within each one foot interval.

In order to allow for analytical sample selection based on Field Screening results, an undisturbed portion of the soil core may be immediately transferred to a resealable polyethylene freezer bag labeled with the sampling depth, sealed with no headspace, and placed on ice in a cooler. After the sampling interval(s) has been determined from separate soil samples collected for field screening, the analytical sample(s) may be collected from the undisturbed bagged core sample.

At a minimum, soil and groundwater samples must be collected for analysis from all borings converted to monitoring wells. Depending on field screening results or other observations, it may be necessary to collect soil from the saturated and unsaturated zones and from soil layers of different composition to obtain representative samples of the vertical distribution of contamination. If no vapors are detected, soil must be collected from just above the estimated water table, or where discoloration or odor indicates potential petroleum contamination.

Further, more than one soil sample may be necessary to vertically characterize soil contamination, especially if the vapor measuring device used detects maximum readings in several locations, staining is observed, or odor is noted. Otherwise, confirmation soil sampling may be required at a later date.

If multiple zones in a borehole cause the screening device to reach a maximum reading to the point that the vapor measurement at a specific soil interval cannot be determined, multiple soil samples for laboratory analysis should be collected from each zone so the maximum soil concentrations from that borehole can be determined. Within the Tier 1 Report, provide an explanation as to where soil sample(s) were collected and why.

If a pre-approved budget only provides for one sample per boring, the DNR recommends contacting the funding source for budget approval for additional samples if these situations occur and more than one soil sample from a boring may be warranted.

POSSIBLE SAMPLE LOCATION(S)

Location	Minimum Required Screening[4] (this is screening ONLY, NOT required soil samples)	Minimum Required Monitoring Wells and Soil Samples
Overall		Three placed in a triangular arrangement to measure groundwater flow direction
Each Tank Basin (former & current)	Minimum of one soil boring on each side of each tank basin, or if tanks no longer exist, below each tank into native soil	One per tank basin
Pump Islands (former & current)	Minimum of one soil boring per pump island	One at the pump island with the greatest concentrations
Piping	Minimum of one soil boring per 20 feet of piping. However, if documentation shows pipe joints are farther apart, then the minimum is one soil boring for each piping joint.	One for piping if screening indicates greater concentrations than tank basin or pump island
Other Source Areas	One for other areas if screening indicates greater concentrations than tank basin or pump island	Any other areas of actual or suspected releases
Presumed Downgradient[5]	One downgradient and within 30 feet of the source with the maximum screening	

[4] Fill pipe locations, closure reports, previously submitted assessment reports for this site or adjacent LUST sites, groundwater flow direction, etc., should be used as guides to indicate where screening should be performed.

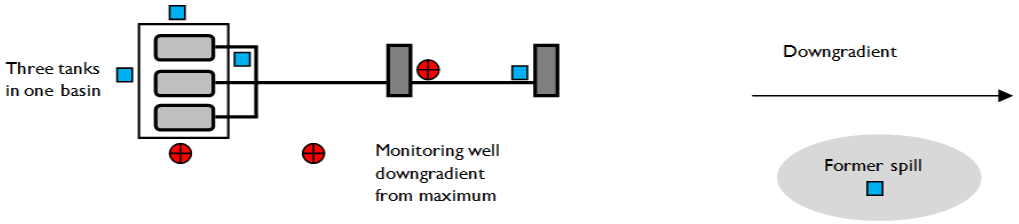
[5] Local surface topography, previously submitted assessment reports for this site or adjacent LUST sites, etc., should be used as guides to indicate groundwater flow direction.

POSSIBLE SAMPLING SCENARIOS

Screening & Monitoring for Example 1

Meets screening requirements

Monitoring well at highest screening; both groundwater & soil samples required = 10 feet



Example 1 - Minimum	Number of Monitoring Wells
Three tanks in one basin	1
Two pump islands	1
Piping screening less than tank/island screening	0
Spill screening in other area less than tank/island screening	0
Downgradient	1
TOTAL	3[6]

Example 2 - Average Large Site	Number of Monitoring Wells
Six tanks in two tank basins	2
Six pump islands	1
Piping screening in several places > tank/island	1
Spill screening in other area < tank/island	0
Downgradient	1
TOTAL	5

Example 3 - Large & Contaminated Site	Number of Monitoring Wells
10 tanks in 3 tank basins	3
20 pump islands	1
Piping screening in several places > tank/island	1
Spill screening in other areas > tank/island	1
Downgradient	1
TOTAL	7

[6] The total number of samples will be twice the number of wells - e.g. three groundwater and three soil.

EXPLORATORY METHODS

Soil samples should be collected with split spoon or continuous core sampling equipment using hollow-stem auger or direct push technologies (e.g. geoprobe). Soil sampling from solid augers is not acceptable. Soil sampling using hand augers can be acceptable but the necessity for using this sampling method must be explained and justified.

The core sampler used must be capable of producing a soil core of a minimum diameter of one and one-half inches and provide sufficient recovery to allow for collection of representative samples for laboratory analysis and continuous field screening (at least every foot).

To minimize the possibility of cross-contamination from reusable core sampling equipment, the equipment must be washed with a detergent solution (e.g., Liquinox or equivalent) and rinsed before each use.

MONITORING WELL CONSTRUCTION DESIGN

Monitoring well development is part of well construction. A well should be developed by using a surge block and bailing or other equally effective method. Proper well development can remove fines from the well bore and filter pack to reduce turbidity in the groundwater sample and provide a more representative sample. Monitoring well development should produce a hydraulic conductivity value that accurately reflects the surrounding saturated formation.

Site-specific conditions may result in variations in well design and construction. The upper portion of the borehole must be sealed to prevent infiltration from the surface. Monitoring wells must be clearly labeled and screens must be factory-fabricated. The screens must be long enough to accommodate seasonal groundwater level fluctuations. At a minimum, well screens must extend at least five feet above and below the static water level; ten feet is preferred.

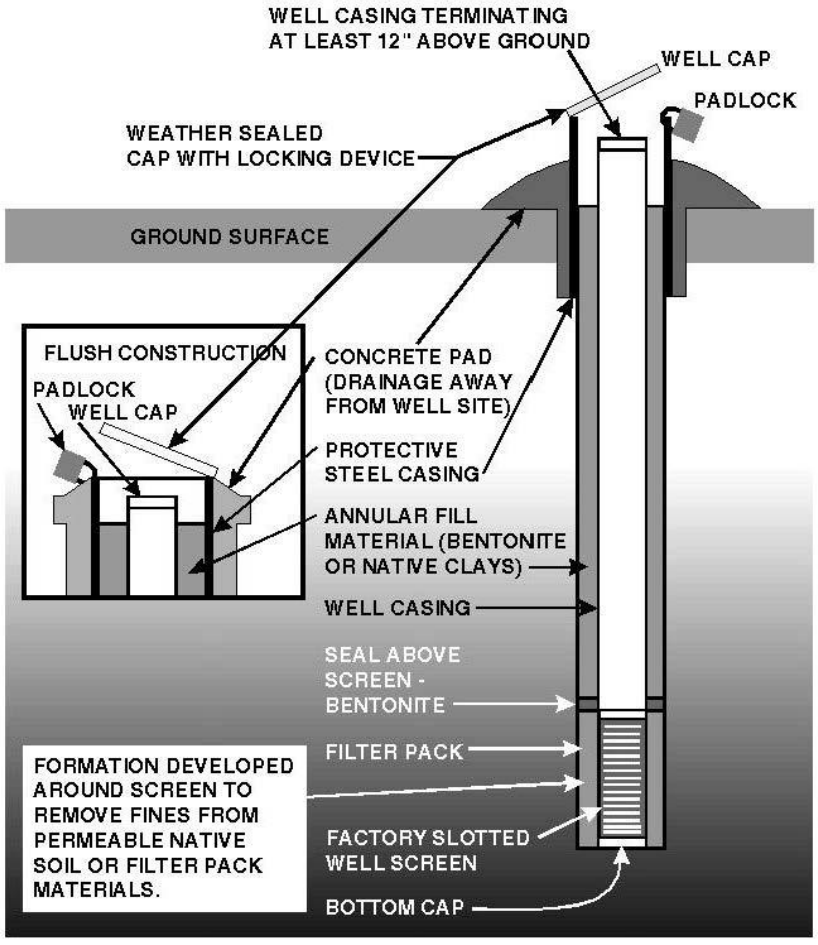


Figure 1. Suggested Monitoring Well Construction

Generally, a monitoring well is installed with a minimum of three feet of solid casing above the screened interval and a minimum two inch diameter screen and casing. If the water table is shallow (less than three feet), or the monitoring well screen and casing to be used are less than 2 inches in diameter discuss the situation with the DNR project manager before constructing the monitoring well(s).

Boreholes advanced for monitoring well installation must be of sufficient diameter to allow for a minimum of 2 inches of annular space between the borehole wall and the well screen and casing. This annular space is needed to facilitate uniform placement of filter pack and sealing materials surrounding the well screen and casing.

Groundwater sampling from open boreholes is not acceptable for Tier 1 assessment. Groundwater sampling from a temporary monitoring well may sometimes be acceptable if a permanent well cannot be installed, but the sampling methods must be explained and justified within the Tier 1 Report. If a temporary well is used, the well must be constructed similarly to a permanent well, including but not limited to a filter pack, well screen, and casing.

Within the Tier 1 report, well development should be explained. Also, Soil Boring Logs and Monitoring Well Construction Diagram Form (DNR Form 542-1392) is available to detail drilling information, subsurface materials, monitoring well construction, and static water table changes over time. If necessary, use more than one sheet for each borehole and well.

MONITORING WELL CONSTRUCTION PERMIT

The DNR does not require construction permits for the installation of monitoring wells required for the completion of a Tier 1 assessment. However, installation of monitoring wells should be in accordance with all applicable state and local regulations.

BORING DEPTH FOR SAMPLING

While drilling groundwater monitoring wells, if groundwater is encountered, drilling must continue to the maximum of 10 feet below the first encountered groundwater (if all PIDs are less than 10 ppm) or to the bottom of soil contamination as estimated by field screening (soil vapor less than 10 ppm). If groundwater is not encountered, drilling must continue to the deeper of ten feet below the soil contamination as estimated by field screening (soil vapor less than 10 ppm) or 75 feet from the ground surface.

BORING DEPTH FOR SCREENING

Soil borings used only for screening to locate a source need not be drilled to groundwater, but at a minimum, must be drilled to a depth of five feet below the base of existing tanks, dispensers, and piping, or five feet below the estimated base of former tanks, dispensers and piping. Additionally, **drilling must continue until field screening indicates decreasing levels of contamination and less than 10 ppm vapor reading.**

SOIL GAS SAMPLING (OPTIONAL)

Soil gas sampling may be conducted, but is not required, if the concentrations of chemicals of concern in the soil exceed the Tier 1 levels for the soil to enclosed space pathway. Soil gas must be sampled within 5 feet of the location of maximum soil concentrations and at a depth above the water table expected to exhibit the highest gas reading based on field screening and analytical results.

If Tier 1 levels for soil vapor to enclosed space are exceeded for multiple chemicals of concern and the soil maximum concentration locations are different for each chemical, soil gas sampling must be conducted at each location(s) to clear the receptor pathway. For example, *if* every Tier 1 level for soil vapor to enclosed space was exceeded and if every chemical had a soil maximum at a different location, you would need to measure soil gas at four places (for B, T, E and TEH-diesel; neither X or TEH-waste oil have Tier 1 levels for the vapor pathways). Soil gas sampling conducted when the interval of maximum soil concentrations is submerged below the water table, it cannot be used to clear a pathway. If soil gas sampling is conducted under these conditions and fails, the soil gas pathway s is considered complete and a Tier 2 should be conducted.

Two gas samples must be taken at least two weeks apart, with one of the samples taken during a seasonal period of lowest groundwater elevation and, if applicable, below the frost line. The DNR may consider exemption from the requirement for sampling during the seasonal period of lowest groundwater elevation if the certified groundwater professional can provide adequate justification for why the samples can be considered representative. If soil gas fails the first sample, the pathway fails at Tier 1. If the soil gas sample passes, a second soil gas sample is required only to confirm that the first one is below Tier 1 target levels.

The following exploratory methods may be used to obtain soil vapor samples:

Option 1: A hollow, small-diameter (minimum half inch, maximum three inch outside diameter), threaded steel casing fitted with a loose-fitting end plug is driven to the appropriate sampling depth. The casing is retracted a minimum of 12 inches to expose the soils in the sidewalls. The end plug should fit such that it remains in place at the bottom of the hole when the casing is retracted. The top of the casing is capped. Allow the soil air to stabilize for at least one hour after installation before sampling. Option 1 is a single use soil gas sampling method. Each subsequent soil gas sampling event conducted utilizing this method, including confirmation sampling, must be conducted at a new soil gas sample point. When direct-push technologies are used as a means of obtaining soil vapor samples, analysis using portable equipment is not acceptable. Samples must be collected using specialized sampler tubes and sent to a laboratory for analysis.

Option 2: A small-diameter (preferred three inch) augured boring no more than eight inches in diameter is extended to the appropriate sampling depth. Borings should not be drilled deeper, then plugged back to the appropriate depth. A hollow, one inch diameter, threaded PVC casing perforated or screened in the lower 12 inches is placed in the borehole. The perforated or screened interval should be positioned so that it spans the one-foot interval of the maximum soil contamination. Sand backfill is placed to a depth not to exceed 18 inches above the bottom of the boring, covering the perforated section of the casing. The remainder of the borehole must be filled with bentonite and hydrated to seal around the casing. The top of the casing is capped. Allow the soil air to stabilize for at least 24 hours before collecting the initial soil gas sample from an auger-installed sampling point.

The depth need not exceed the typical depth of the receptor being evaluated, e.g., samples may be collected from a depth of approximately 8 to 10 feet to clear a potential basement receptor, or from a depth of 20 feet if an actual sanitary sewer was installed 20 feet below the ground.

COLLECTING A SOIL GAS SAMPLE

Soil gas samples must be collected and analyzed using NIOSH Method 1501 or a DNR- approved equivalent. Soil gas is collected by means of adsorption onto solid activated carbon media. Glass tube samplers which comply with NIOSH Method 1501 and piston- type vacuum samplers are available commercially. The vacuum sampler used must be capable of drawing two hundred milliliters (200 ml) of casing air through the carbon media by either single or incremental operation.

The pump must be factory calibrated according to manufacturer's specifications, and fitted with an indicator which visibly shows when the sampling cycle has been completed. Flow rates must be verified and volume checks must be conducted immediately prior to and immediately after sampling. NIOSH Method 1501 specifies a maximum sampling flow rate of 0.20 L/min. for benzene and toluene.

To ensure soil gas samples are not drawn too quickly over the activated carbon media, it may be necessary to install a flow restrictor between the sample tube and the pump. The flow restrictor must be calibrated to a flow rate of less than or equal to 200 ml/min. Sampling equipment must be cleaned prior to each sampling event and stored to prevent cross-contamination. Cleaning of equipment must occur away from the sampling location and sufficient time must be allowed for the evaporation of any cleaning solvents which may interfere with chemical analysis.

Care should be taken to avoid mixing atmospheric air with soil gas sample during sampling. The preferred way to do this is to replace the casing cap during sampling with a rubber stopper or specialized casing cap with a hole through it just large enough to accommodate the sampling tube and tubing. If an alternative method is used to seal the

casing during sampling (aluminum foil, plastic, putty, etc.), the groundwater professional must provide a description of the method used and provide justification why the sealing technique is adequate.

Consult NIOSH Method 1501 and the instructions provided by the manufacturer of the sampler device for specific sampling procedures. The following general procedures are recommended to obtain a representative soil gas sample:

1. Attach a sufficient length of rubber tubing to the sampling pump to form an air tight seal between the pump and the sampling interval.
2. Break the tip of the sampler tube and fasten the tube securely to the free end of rubber tubing with the arrow of the sampler tube pointing toward the pump.
3. Insert the sampler tube and rubber tubing into the casing and position it so the inlet of the sampler tube is at the middle of the screened interval (above, but within 6 inches of, the bottom of the casing.)
4. Draw a 200 ml volume of soil air through the sampler tube and immediately withdraw it from the borehole casing.
5. Disconnect the sampler tube from the rubber tubing and seal the tube using the caps provided by the vendor.

Standard handling and transporting procedures are used for the sampler tubes, including the processing of chain-of-custody forms. Samples must be analyzed for benzene and toluene pursuant to NIOSH Method 1501, which requires blanks be collected in accordance to QA/QC procedures. Analysis of at least one sample blank must be conducted with each soil gas sampling event for quality assurance.

CHECKING THE STATIC WATER LEVELS

The depth of the water table in the vicinity of the soil gas sample location must be verified and recorded each time a soil gas sample is collected. Sometimes the depth of the water table is not critical to collecting a viable sample, e.g., when the soil maximum interval is clearly above the water table. However, most soil gas sampling is conducted in conditions such that the relationship between the water table and the well depth is significant. Do not collect a soil gas sample if the water table is above or within the screened interval of the soil gas well.

Moisture may collect at the bottom of a soil gas well because the bottom of the well is at the water table, or water could be trapped in the cap at the bottom of the well screen. If the sampling tube is placed at the bottom of the well versus the middle of the screened interval, water could be drawn into the sampling tube instead of vapor.

Do not run a water level probe down the casing to check for water in the soil gas well prior to sampling. Running a half-inch or three-quarter inch diameter probe down then up a one- inch pipe could act as a piston pump moving air and significantly changing the soil gas concentrations at the bottom of the soil gas well. Instead, measure water levels in two or more nearby groundwater monitoring wells to determine static water table depth, then extrapolate the water depth to the soil gas well.

If there are no nearby monitoring wells, and a water level measurement can only be obtained at the soil gas well itself, the top of the casing must be resealed after taking the water level measurement and a minimum of one hour stabilization time must be observed prior to collecting the soil gas sample.

Field Screening

Field screening must be used to determine the vertical extent of soil contamination and assist in selection of soil samples for laboratory analysis. All soil core samples must be screened continuously (at least every foot) using appropriate vapor screening instruments as well as observations recorded for other field techniques including visual and olfactory observations. Soil core samples must be screened the entire length of the boring and drilling must continue until the contamination is no longer detected, i.e., vapor readings are below 10 ppm. Acceptable field vapor screening instruments include photoionization detectors (PID), flame ionization detectors (FID), or other similar vapor analyzers. Equipment must be evaluated against a standard at the beginning and end of each day at the site and, if necessary, calibrated according to the manufacturer's specifications. Observations and vapor screening results must be documented on DNR Form 542-1392.

Continuous field screening of soil can be performed by direct screening of confined vapors from the core sample or by containerizing selected portions of the soil core, allowing headspace to develop, then screening the headspace with an acceptable vapor screening instrument. The method for field screening and equipment used to screen must be discussed in the field screening results section of the report.

Classification of Soils

Use the US Department of Interior, Bureau of Reclamation Unified Soil Classification System to classify soils and subsurface materials on boring logs. Narratives should also be provided to further describe observations like staining, odor, or sheen and characteristics like color, texture, grain size, sorting, moisture content, composition, and origin (e.g. loess, alluvial, or till).

Elevation Measurements

All elevations are to be reported as feet above sea level (ASL). Each must be referenced to a National Geodetic Datum permanent control point/benchmark. All ASL measurements taken at the site must be determined by a differential survey to the benchmark. Variations from this requirement must receive prior approval from the DNR. Ground surface elevations must be measured to the nearest 0.1 foot. Top of casing elevations and static water levels must be measured to the nearest 0.01 foot. An adequate number of water levels must be measured in each well to determine the static water level.

Groundwater

SAMPLING

Water levels must be measured and monitoring wells must be purged of stagnant water in the casing prior to collecting groundwater for sample analysis. Generally, removal of water to dry conditions or three times the well volume of water is considered sufficient to obtain a groundwater sample representative of the surrounding formation.

Purging must continue until water quality measurements have stabilized. Low-flow purging is acceptable if water quality parameters are monitored. Once the well has been sufficiently purged, groundwater should be allowed to recharge to the original measured static water level before sample collection, when possible.

Groundwater sampling must be conducted in accordance with generally accepted industry standards.[7] Within the Tier 1 Report, provide sampling procedures and justification.

HYDRAULIC CONDUCTIVITY

Hydraulic conductivity is a measure of the capacity of a porous medium (rock or soil) to transmit water. It relates the specific discharge (volume per unit area) flowing through a porous material to the gradient (change in hydraulic head per unit distance).

The DNR has determined that acceptable data for the computation of hydraulic conductivity (K) can be generated by performing small volume slug tests on near surface aquifers at LUST sites. This actual computation of K must be performed utilizing the Bouwer-Rice slug test data reduction method (Bouwer, H. 1989. The Bouwer and Rice Slug

[7] Refer to the following publications for additional guidance on well purging and groundwater sampling:

- American Society for Testing and Materials. http://www.astm.org/1996. ASTM Standards on Groundwater and Vadose Zone Investigations: Drilling, Sampling, Well Installation and Abandonment Procedures. ASTM Publication Code Number (PCN): 03-418196-38;
- American Petroleum Institute. 1989. A Guide to the Assessment and Remediation of Underground Petroleum Releases. API Publication 1628, 3rd edition. American Petroleum Institute;
- US Environmental Protection Agency, 1993. Subsurface Characterization and Monitoring Techniques: A Desk Reference Guide. EPA/625/R-93/003a;
- US Environmental Protection Agency, 1986. RCRA Ground-Water Monitoring Technical Enforcement Guidance Document. OSWER-9950.1

Test - An Update, Groundwater, Vol. 27, No. 3, pg. 304-309.) and must be reported in the units of **meters per day** (m/day).

Hydraulic conductivity has a wide range of possible values (extremely large dynamic range) and each data reduction method used to determine the hydraulic conductivity requires some degree of interpretation. In an attempt to standardize the process of deriving K the DNR is offering the following comments and recommending the following procedures be considered.

1. If the site geology includes porous and permeable lithologies such as clean sands, gravels, and some alluvium types, large values of K may be expected. Special precautions should be taken during data acquisition to guarantee initial water level changes are adequately sampled. Where these lithologic types are present, manual measurement and recording of water levels during the slug test is not acceptable. The DNR recommends the use of an electronic data logger. The logger must be capable of measuring the water level at a minimum of every 0.25 seconds from the initiation of the test. The logger must also have adequate capacity to store the data for a period sufficiently long so the water level reaches 90% of its static value.
2. The Bouwer-Rice slug test data reduction method is not straightforward and requires interpretation of a complex (log) data plot. Each groundwater professional should become familiar with the physical principles underlying the method and the approximations associated with the interpretation of the data displays.
3. The DNR has experience using two software implementations of the Bouwer-Rice slug test data reduction method. They are:
    - AQTESOLV by Geraghty & Miller.
    - BRSLUG by LaDon Jones (Iowa State University)
    - While the DNR does not require use of a specific program, the results from any program used should be able to be replicated. If a program other than AQTESOLV or BRSLUG is used, the groundwater professional must identify the program name, version, vendor name, address, and phone number.
4. Key well and aquifer parameters associated with the software-assisted computation of K must be carefully considered. The data set may include, but is not limited to, the radius of the well casing, radius of the test well, saturated thickness of the aquifer, vertical height of water in the test well, and length of screen through which water may enter the well. The effective casing radius, which is used to account for the thickness and porosity of the filter pack, must either be manually calculated or may, in some cases, be calculated by a computer program. If using AQTESOLV DOS Version 1.14, the calculation must be done manually and the effective radius value entered in lieu of the radius of casing value. BRSLUG Versions 1.0 and 1.1, AQTESOLV DOS Version 2.12 and Windows Version 1.17 will automatically complete the calculation based on a porosity value entered by the user. A default value of 15% must be used for gravel pack porosity. An alternative value which is greater than 15% may be used if a justification is provided. The user also enters the time (t) versus draw down (y) data and assigns a weight value to each entry. A weight value of zero (0) should be assigned to all recovery values after 90% of the initial draw down has been reached.
5. The DNR will accept non-software assisted reduction of slug test data. However, the probability of an arithmetic error is very high. Should a groundwater professional choose this manual technique, then:
    - All intermediate computations must be included in an organized, well documented and neat fashion.
    - Carefully plotted data display on semi-log printed graph paper is required.
6. The interpretation portion of the Bouwer-Rice slug test data reduction method should be approached with caution. If a "double straight line effect" is observed, the best fit line should be adjusted to exclude the initial data points which may be attributed to drainage of the filter pack[8]. The adjusted line must also exclude the data which deviates from the straight line as time increases, i.e., recovery greater than 90% of initial draw down.
7. Slug tests must be conducted in at least three wells which, based on the stratigraphy of the site, can be expected to yield the largest value of hydraulic conductivity. If less than three wells are used for slug tests, proper justification must be provided for DNR review. Slug-out tests must be conducted on partially penetrating wells. In the event partially penetrating wells cannot be installed, slug-in tests must be conducted. The adjustment for the porosity of the filter pack in this case should not be conducted. **Only the largest of the**

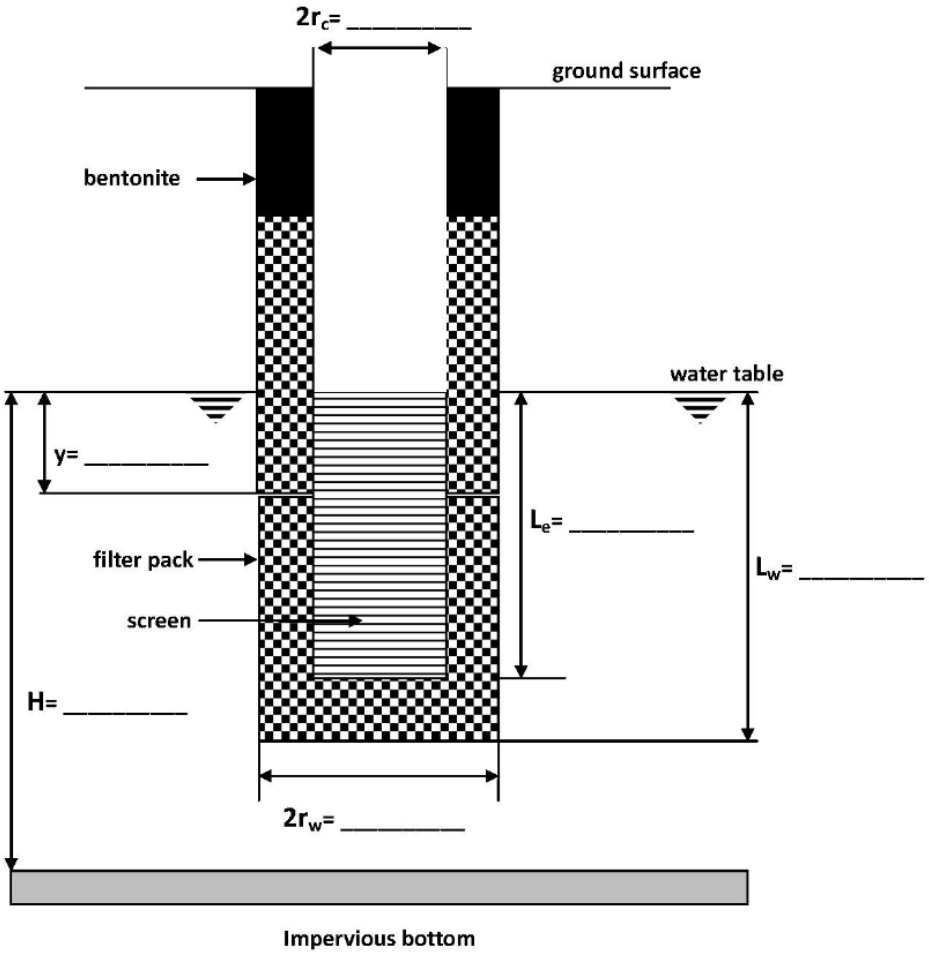
[8] *See* The Bouwer and Rice Slug Test - An Update

K values computed for a site is used for the Tier 1 pathway evaluation. Averaging calculated hydraulic conductivity values is not acceptable.

If groundwater and bedrock are not encountered during the course of the Tier 1 investigation, hydraulic conductivity testing is not required and the groundwater will **not** be considered protected. If bedrock is encountered above groundwater at any time, the groundwater will be considered protected regardless of hydraulic conductivity testing. The following variables used in hydraulic conductivity calculations must be provided:

1. Well number.
2. Well depth.
3. Initial static water level
4. Volume of slug removed (or volume of slug added, if slug-in test)
5. Saturated thickness of the aquifer being tested (i.e., vertical distance from the static water table to an impermeable layer) (designated "H" or "D").
6. Length of screened portion through which water enters during slug test recovery (designated "L_e").
7. Vertical distance from the static water table to the bottom of the well (designated "L_w"). For a properly screened well, where the static water level is within the screened region, "L_w" and "L_e" are equal.
8. Radius of the well casing (designated "r_c").
9. Radius of the well (radius of casing plus thickness of the gravel pack) (designated "r_w").
10. Effective radius (calculated based on the thickness and porosity of the gravel pack) (designated "r_e").
11. Initial drawdown in the well (designated "y_o"; minimum initial drawdown should exceed 1.0 feet). When the filter pack is more permeable than the surrounding soil, the filter pack drains faster, usually the first 10-50% of the drawdown distance. Thus, in graphing the rate for the drawdown to return to static water level, the first straight line would be the filter pack drainage, and the second straight line would be the soil drainage (K). It is important to record the initial data for filter pack drainage, or the first straight line may be missed. For example, if the filter pack drains in 2-3 seconds and the first measurement recorded is at 5 seconds, the filter pack drainage would be missed and the first straight line should be used for the K of the soil. Do not use the last 10% of the drawdown distance for K.
12. Recovery data [time (t) versus drawdown data (yt); drawdown is calculated as distance between observed water level and initial static water level]

Because K is important, the DNR will review K closely in RBCA evaluations. The K may need to be recalculated if a filter pack porosity of 0.15 m/d was not used and it appears it would make a significant difference. The K may need to be re-measured if it does not match the boring log or inadequate data is provided to check for accuracy.



PROTECTED GROUNDWATER SOURCE

A protected groundwater source is a saturated bed, formation or group of formations with a hydraulic conductivity of at least 0.44 meters per day (m/d) and a total dissolved solids of less than 2,500 milligrams per liter (mg/l).

GROUNDWATER FLOW DIRECTION

The groundwater flow direction must be determined from water level elevations taken from at least three wells in a triangular arrangement. If more than three wells have been installed on site, water level elevations from additional wells must also be used to determine flow direction. Monitoring wells and survey data from adjacent sites may be used, but is not required. However, all groundwater level measurements must be collected on the same date. An adequate number of water levels must be measured in each well to determine the static water level. Static water levels must be measured to the nearest 0.01 foot and ground surface elevations must be measured to the nearest 0.1 foot. All elevations must be reported as feet above sea level (ASL), and referenced to a National Geodetic Datum benchmark.

TOTAL DISSOLVED SOLIDS

The minimum Total Dissolved Solids (TDS) value is used to determine whether a protected groundwater source is present. If all hydraulic conductivity measurements are less than 1.44 meters per day, analysis for TDS is not necessary. If any of the hydraulic conductivity measurements exceed 0.44 meters per day, groundwater samples may be collected from the wells used to determine hydraulic conductivity and analyzed for Total Dissolved Solids (TDS). If TDS is not determined, it will be assumed to be less than 2,500 mg/L.

RECEPTOR SURVEY

If portions of the receptor survey are not conducted because the applicable Tier 1 levels are not exceeded, then "Unknown" should be selected on the Site Data Summary page.

The receptor survey conducted at Tier 1 may be insufficient if a Tier 2 is required and an additional receptor survey may be necessary.

Wells

Active, properly abandoned, and plugged groundwater wells within 1,000 feet of the source must be identified. A groundwater professional must differentiate between drinking water wells and non-drinking water wells. A drinking water well is any groundwater well used as a source for drinking water by humans and any groundwater well used primarily for the final production of food or medicine for human consumption.

A non-drinking water well is any groundwater well not defined as a drinking water well including a groundwater well which is not properly plugged in accordance with DNR rules in 567-39, 49. One exception is an extraction well used as part of a remediation system.

An extraction well, monitoring well that is neither a drinking water well nor non-drinking water well, and closed loop geothermal well are not considered receptor(s). An inactive well, a well that has not been properly abandoned pursuant to 567-39, and an open-loop geothermal well(s) must be evaluated, at a minimum, as a non-drinking water well receptor.

When applicable, a copy of DNR Form 542-1226 for wells plugged in accordance with 567-39 must be provided. Copies may be obtained from the county assessor's office or the DNR's Water Supply Section.

Well Search[9]

On-site well survey

An on-site survey must be conducted to identify all the wells in a 300-foot radius of the source. If there are any indications of water wells, all land owners within the 300-foot radius must be contacted. Provide information and documentation explaining how the on-site well survey was conducted. For example, if a written survey is done and details about the survey, including, but not limited to, a copy of the survey, how many were sent, and how many replies were received. Well information is available from public entities, including the DNR's Water Supply Section and county health or zoning departments.

Well Search

A well search report from the DNR's Facility Explorer application must be provided. You can log into Facility Explorer using your DNR assigned A&A login ID.

To run a well search report follow the instructions below:

1. Login (top right corner).
2. Search by LUST or UST number in the Program ID Box.
3. Check the All Wells layer checkbox (this can only be seen when you are logged in).
4. Go to the Radius tab and click on Set Center Point then click on the UST/LUST location.
5. After the radius is displayed, go to the Reports drop down menu and select Well Search. If the green radius circle does not appear, click the refresh page button on your internet browser.
6. The Well Search report will open in a separate window. For best formatting results, use the print button on this window (not the file menu print command on your internet browser).

Enclosed Spaces and Conduits

The following enclosed spaces and conduits must be evaluated as follows:

1. All water mains, sanitary sewer mains and storm sewer mains within 500 feet of the source must be identified.
2. All buildings and water line receptors within 200 feet of the source(s) must be identified and evaluated, including mains, service lines, and gaskets as described in Water Line Receptor and Non-Receptor Types

[9] Please note, it is recommended to not rely solely on the DNR Facility Explorer for well information. It is a tool and not all inclusive.

according to 567-135.9(8) and 135.9(9).

Provide the following for each enclosed space or conduit identified:

- Construction, including diameter, material, backfill, and slope;
- Flow direction;
- Burial depth to the top of the utility or confined space; and,
- Relationship to the groundwater level

Explosive Vapor Survey

The purpose of the explosive vapor survey is to identify immediately hazardous conditions. At a minimum, an explosive vapor survey must be conducted in areas where the buildup of explosive vapor levels could occur such as, but not limited to, basements, crawl spaces and utility access ways.

This survey must be conducted in the nearest subsurface enclosed spaces in ALL directions and in any places with a history of vapor problems. Records filed with the Hazardous Substance Incident Tracking Database (data now incorporated into the DNR Field Office Compliance Database) and Underground Storage Tank Section, State Fire Marshall's Office, County Health Department, and the local police and fire department should be examined to determine whether any vapor problems have been reported in the area.

If potentially explosive levels (≥10% LEL) are detected when conducting the explosive vapor survey, contact local emergency services and report to the appropriate DNR Field Office. The groundwater professional must notify the responsible party or party contracting the site investigation to report the contamination to the DNR in accordance with IAC 567-105. The appropriate party must begin immediate response and abatement procedures in accordance with IAC 567-135.7 and IAC 567-105, proceed with the Tier 2 assessment, and evaluate the enclosed space as an actual receptor.

An explosive vapor survey may not be required in all cases. If the Tier 1 levels for both vapor pathways are not exceeded, an explosive vapor survey is not required. An explosive vapor survey is also not required if buildings, confined spaces, or utility access ways are not located within 500 feet of the source (i.e. soil and groundwater maximum locations). If an explosive vapor survey is not conducted, adequate justification for not conducting the survey must be provided.

Explosive Vapor Survey Procedures

The following procedures are recommended when conducting an explosive vapor survey:

1. An explosimeter must be used to take vapor readings.
2. Start at the utility access way nearest to the site. Work outwardly from the source to determine whether vapors are present, where vapors may be entering, and the extent of impacted area.
3. Check each utility access cover and take readings for oxygen and percentage explosion level. Repeat measurements at mid-depth and water level or bottom of conduit.
4. Check air flow directions to determine if dilution of vapors is occurring.
5. Check lift stations near the site.
6. Check confined spaces and occupied structures. Record the names and addresses of buildings, residences and owners.
7. Check for vapors in basements, sewer drains, and near any foundation cracks.

Surface Waterbody

A surface waterbody includes general use segments and designated use segments as defined in 567-61.3(1). All surface waterbodies, i.e., lakes, ponds, rivers, streams, intermittent stream beds, drainage ditches, within 200 feet of the source must be identified and visually inspected for a sheen on the water surface and any residue along a stream bank or bed. The following procedures are recommended:

Stream bank

1. Look for bare soil areas along the lower bank where the seep of petroleum products may be surfacing and killing vegetation.

2. During the growing season, look for dead or dying vegetation along or below the high-water mark. Inspect the dead vegetation to determine whether death was caused naturally or by coating with petroleum residues. The residues usually will cause localized portions of the plant to be stressed or to die. A coating of slightly shiny, brown/black dirt-type particles (the mixture of petroleum products and the suspended/ floating material found in the stream) may occur on the vegetation. The dead or dying vegetation will likely be in small patches or clumps, not large expanses as would occur if the vegetation were dying from being inundated for a long time.

Stream bed

1. Similar to the vegetation coating but potentially more evident; a shiny-spongy brown/black dirt-type coating may occur on the material found along a previous water line.
2. Also look in the areas that become isolated pools when the stream no longer flows. The petroleum residue will tend to accumulate in these isolated pools, coating the stream bed material including branches, rocks, and debris.

If a sheen or residue is evident or has been reported, the groundwater professional must investigate to reasonably determine its source. If, in the opinion of the groundwater professional, the sheen is not associated with the underground storage tank site, an adequate justification must be provided. If, in the opinion of the groundwater professional, the sheen is not a petroleum-regulated substance, a sample must be laboratory analyzed using Iowa Methods OA-1 or EPA Method 8260D and OA-2 and in accordance with 567-135.16 to confirm it is not a petroleum-regulated substance.

TIER 1 CORRECTIVE ACTION RESPONSE

No Action Required Site Classification

To be classified No Action Required (NAR), each pathway must meet the requirements for pathway clearance as specified in 567-135.9(12). If a pathway does not meet the requirements, then the DNR will require a Tier 2.

No Further Action Certificate

If the DNR determines a NAR classification is appropriate, a No Further Action (NFA) certificate can be obtained pursuant to 567-135.12(10). To obtain an NFA certificate, the following information is needed for the DNR to prepare and issue the certificate:

1. A copy of the most recent deed or contract of sale with an accurate and complete legal description. NOTE: A legal description obtained from a tax form is not acceptable.
2. A copy(s) of the Abandoned Water Well Plugging Record(s) (DNR Form 542-1226), if not already submitted.

Upon closure, Abandoned Water Well Plugging Record (DNR Form 542-1226) is required to be completed and submitted to the following two entities:

DNR LUST Coordinator
6200 Park Ave Ste 200
Des Moines, IA 50321

DNR Water Supply Section
6200 Park Ave Ste 200
Des Moines, IA 50321

If additional information is needed regarding well plugging procedures, the designated county or the DNR's Water Supply Section can be contacted. A monitoring well may be retained on-site for future use. However, if the monitoring well is retained on-site, the DNR must be notified in writing regarding the reason for retention and a written plan for monitoring well maintenance and security. Monitoring wells must be fitted with lockable protective devices and clearly labeled.

Iowa Administrative Code 567-134 requires a person who provides subsurface soil contamination and groundwater consulting services or who contracts to perform or supervise remediation or corrective action services at leaking underground storage tank sites be a certified groundwater professional.

Once the No Further Action certificate is issued by the DNR, the responsible party is responsible for filing it with the county recorder's office pursuant to Iowa Code section 455B.474(1)(a)(8)(c). Please discuss the NAR classification and NFA certificate with the funding agency, if applicable, and how these items will influence future assessment or remediation funding for the site.

Compliance Monitoring and Confirmation Sampling

Compliance monitoring is not an acceptable corrective action at Tier 1. If applicable Tier 1 levels are exceeded at Tier 1, a Tier 2 is required. Except as part of the soil gas sampling procedures, confirmation sampling to verify that a sample does not exceed any Tier 1 levels is not required. However, the DNR retains the authority to require confirmation sampling from soil borings or groundwater monitoring wells if a no action required classification is being proposed at Tier 1 and the DNR has a reasonable basis to question the validity of the samples based on, for example, the seasonal bias of the sampling, evidence of multiple sources of releases, marginal groundwater monitoring well locations, static water level above the screened interval, anomalous results, or analytical variability.

Institutional Controls

The purpose of an institutional control is to restrict access to or use of property such that an applicable receptor could not be exposed to chemicals of concern for as long as the target level is exceeded at applicable points of exposure and compliance.

An institutional control can include any of the following:

1. A law of the United States or the state
2. A regulation issued pursuant to federal or state laws
3. An ordinance or regulation of a political subdivision where real estate subject to the institutional control is located
4. Pursuant to Iowa Code 558 et seq., a restriction of the use of or activities occurring at real estate which are embodied in a covenant running with the land which:
    - Contains a legal description of the real estate
    - Is properly executed
    - Is recorded in the appropriate office of the county where the real estate is located
    - Adequately and accurately describes the institutional control
    - Is in the form of a covenant as set out in Appendix F or in such a manner reasonably acceptable to the DNR
5. Any other institutional control the owner or operator can reasonably demonstrate that it will reduce the risk of a release throughout the period necessary to protect human health and the environment.

If an institutional control is used to obtain pathway clearance, complete documentation of the institutional control, e.g., copies of ordinances or deed restrictions must be provided before the DNR will approve pathway clearance or a NAR classification. It must be clear in the documentation that the institutional control will cover the entire area of concern (e.g., RID plume). Documentation may be provided as an appendix to the Tier 2 Report.

City and County Ordinances

A city or county well ordinance may be used as an institutional control to restrict the installation of drinking and non-drinking water wells.

The DNR has an approved list of city and county ordinances. For those that have been approved, the groundwater professional does not have to submit copies of the ordinance but does have to submit supporting documentation, such as written acknowledgement from the County Department of Health, or the county sanitarian, that a copy of the local ordinance, the local authority's certification letter, and applicable receptor ID maps depicting the area of concern has been received. The County then is asked to sign a certification letter that states they would require any applicant for a county permit to obtain all local approvals and, based on the supporting documents provided, they would not likely permit a well within the area of concern.

A model certification letter to be signed either by the local or county authority with private well restriction and

permitting authority can be found on the DNR UST webpage.

In addition, a second model certification letter should be prepared by the County Department of Health or county sanitarian and submitted to the DNR with the local authority certification letter. Please review and revise the document to fit site-specific circumstances (e.g. bedrock sites). **Print letters on official letterhead and ensure the name and official title of the signatory is printed or typed below the signature.** A signed letter serves as acknowledgement the administrating authority received documentation about the LUST site, had the opportunity to review the materials, verified the site is within the scope of the ordinance, and is willing to enforce it. If a county refuses to sign a certification letter when a DNR accepted ordinance exists, the DNR should be notified. Please be aware, reclassification of a pathway or site by use of institutional controls is not in effect until the documents have been reviewed and accepted by the DNR.

If relying on a local ordinance within a county that does not have delegated permitting authority from the DNR, it should be documented that a local certification letter, including all supporting documentation, has been sent to the DNR's Water Supply Section.

Additional information regarding city ordinances can be found on the DNR UST webpage.

Environmental Covenant

In 2005, the Iowa General Assembly passed The Uniform Environmental Covenants Act (UECA), which creates a real estate instrument to address contamination that exists on a property. An environmental covenant is a type of institutional control. A responsible party is expected to use the model environmental covenant developed by the DNR. If the terms are modified, please identify those suggested revisions and submit for DNR review. Overall, the environmental covenant should identify the objective, specific activity(s), and use limitation(s) appropriate for the site.

It is recommended the environmental covenant be approved by intended signatories prior to submittal to the DNR. Also, until all signatories have been obtained, the covenant should not be recorded with the appropriate county office. Although it is preferred that the covenant and supporting documentation be submitted by an Iowa licensed attorney, the DNR can also accept documents prepared by the certified groundwater professional.

Additional documentation submitted with the environmental covenant should include, but is not limited to:

1. Property interest certification.
    A. An attorney may submit a letter documenting a sufficient title and lien research has been conducted identifying all necessary legal and equitable interests and that they have given preliminary consent. This would include at a minimum all fee title owners by deed, contract sellers, buyers and assignees, mortgagees, lessees and other consensual lien holders. The letter should certify that, in the opinion of the attorney, obtaining signatures of the identified parties satisfies legal requirements necessary to validate the covenant.
    B. A non-attorney preparing the covenant and supporting documentation is required to complete the property ownership form available on the DNR UST Webpage.
2. Proof of ownership. Documentation of the legal capacity of all signatories must be submitted. This will usually be in the form of a deed or contract for deed, mortgage instrument, lease, or other consensual lien instruments which document the legal capacity as an individual or other entity, such as a partnership, corporation, or other business organization.
3. Map or appropriate diagram. A map or diagram depicting the boundaries as described in the environmental covenant should be included. The purpose of this document is to allow the DNR to confirm that the area legally described corresponds to the area to be restricted. The map or diagram should have sufficient legal description, accuracy, and information to allow the reviewer to trace boundaries of the site as legally described. It is recommended the preparer highlight the boundaries of the legally described property subject to the covenant. The preparer needs to certify the depicted area corresponds to the area legally described in the covenant.
4. Summary of Purpose. The certified groundwater professional should submit a narrative summary of the

activity and use limitations in the covenant, the potential exposure(s) it is intended to regulate, and any other purpose(s) the covenant intends to accomplish. The certified groundwater professional should attach, or refer to, technical documents in the submittal, including groundwater or soil plume maps that identify the area(s) of concern and area(s) being restricted. Please acknowledge whether the environmental covenant is being used in combination with any other institutional control.

A certified, recorded copy of the environmental covenant must be sent to each person who signs the covenant, including the DNR. In addition, a copy must be submitted to the jurisdiction in which the property is located.

Additional information regarding completing and submitting an environmental covenant can be found on the DNR UST DNR UST webpage.

Note: Drafts of environmental covenants should be submitted electronically as Word documents.

Modification or Termination of Institutional Controls

If the DNR determines that an institutional control has been violated, removed, or is otherwise no longer effective for the purpose intended, regardless of the issuance of an NFA certificate or previous site classification, the responsible party may be required to re- evaluate site conditions and take further action as deemed necessary by the DNR. This requirement to re-evaluate the site remains with the responsible party regardless of whether or not the responsible party owns the property at the time the re-evaluation is required. Failure to complete a required re-evaluation is a violation of Iowa law and can result in enforcement action against the responsible party. Note that all signatories to an environmental covenant are required to notify the DNR if they become aware of conditions constituting a breach of the activity and use limitations.

If a site is classified no action required (NAR) subject to the existence of an institutional control, the owner of the property subject to that institutional control may request, at any time, that the DNR terminate the institutional control requirement. The DNR shall terminate the requirement for an institutional control if the property owner demonstrates that site conditions warranting the control no longer exist. This may be accomplished through completion of a Tier 2 Site Assessment for the affected pathway(s) or other appropriate assessment as determined by the DNR.

Replacement or Relocation of Water Lines

If a water line exists within 200 feet of a soil or groundwater source exceeding a Tier 1 level for the groundwater to water line pathway or soil to water line pathway, then replacing the water line with appropriate construction or relocating the water line is an acceptable corrective action.

Prior to replacing or relocating water lines, the utility company which supplies water service to the area must be contacted and give approval for such activities. If the water lines are to be replaced, a non-gasketed piping material must be used or the gaskets must be composed of petroleum-resistant materials; *see* Water Line Receptors and Non-Receptors Types. If the water lines are to be relocated, they must be placed beyond 200 feet of the contamination source(s). An adequate investigation of the relocation area must be conducted to assure the lines are not placed into contaminated soil or groundwater. A file search and pedestrian survey are recommended to determine whether there are other UST or LUST sites in the area of pipe relocation.

A report of the water line replacement / relocation activities must be provided as an appendix to the Tier 1 report. The report must include the following:

1. Documentation of authorization from the utility company which supplies water service to the area.
2. If the water lines are replaced, identification of the replacement material, backfill material, and burial depth of reconstructed water line(s).
3. If the water lines are relocated, identification of the backfill and burial depth of the relocated lines, and a brief description of the efforts taken to assure the new location is not contaminated.
4. A scaled site diagram with the following illustrated:
    - Pertinent site features such as buildings, roads, utilities, etc.,

- Soil and groundwater contamination in relation to the water line(s) prior to replacement/relocation,
- If the water lines are relocated, the location of the new lines (an additional map with appropriate scale to show the new location of the lines may be necessary), if the water lines are replaced with different materials or gaskets, the location and mapped extent of the replaced water lines.

Soil Excavation as Corrective Action

Soil excavation for the purpose of removing contaminated soil which exceeds the Tier 1 levels is permissible for the soil leaching to groundwater pathway, soil vapor to enclosed space pathway, and soil to water line pathway. If groundwater contamination appears shallow and contiguous with soil contamination, then over-excavation may be an appropriate option. Field screening and sampling **may** be conducted prior to excavation to estimate the extent of contamination. In accordance with 567-135.12(11), field screening and soil sampling **must be** conducted during excavation.

The excavation must remove the area of soil with concentrations above the Tier 1 levels for the affected pathway. If excavation is conducted, additional soil sampling is necessary to demonstrate that after excavation the remaining soil concentrations do not exceed the Tier 1 levels for the affected pathway.

At a minimum, one soil sample must be collected for **field screening** every 100 square feet of the base and sidewalls of the excavated area. Field screening shall include the use of a photoionization detector (PID), flame ionization detector (FID), or another similar vapor analyzer, and visual and olfactory observations. Observations and vapor screening results must be documented.

Soil samples must be collected from points indicated by high vapor readings (greater than 10 ppm), or observed contamination, and at least one soil sample collected for **laboratory analysis** for every 400 square feet of the base and sidewalls of the excavated area. The soil samples with the highest screening levels and indications of petroleum contamination will be sent to the laboratory for appropriate analysis. At a minimum, one sample from each sidewall and the base of the excavation must be collected and analyzed. Samples for laboratory analysis shall be collected from not more than one foot into the base and sidewalls of the excavated area. Soil samples should be collected as soon as possible after the excavation of the base or sidewall is completed.

All samples shall be shipped to a certified laboratory within 72 hours of collection. Samples shall be refrigerated and protected from freezing during shipment to the laboratory. All soil samples must be analyzed for benzene, toluene, ethylbenzene, and xylenes and MtBE in accordance with 567-135.16. If appropriate, OA-2 analyses must be conducted for total extractable hydrocarbons for diesel and waste oil.

Excavated contaminated soils must be properly disposed at a sanitary landfill or permitted landfarm in accordance with 567-100, 101, 102, 120, and 121. If land application of petroleum contaminated soils is used as a means of treatment, multi-use and single-use landfarming agencies shall submit the following notification form to the DNR Wallace Building and DNR field office with jurisdiction over the landfarm before land application; however, at least 30 days' notification is encouraged.

The landfarming permit application (DNR Form 542-8128) may be found on the DNR UST webpage. Otherwise, additional information regarding landfarming, including a listing of sites that have been permitted to conduct landfarming for petroleum contaminated soils, can be found below.

PERMITTED PETROLEUM CONTAMINATED SOIL LANDFARMERS

Permit Number	Permit Name	Expiration Date	Phone	Field Office ID
Address1	Address2	City	State	Zip
77-SDP-67-10	Evora Consulting	7/28/2022	515-256-8814	5
1801 Industrial Cir		West Des Moines	IA	50325
09-SDP-09-07	Blackhawk Environmental Testing, Inc.	5/9/2022	319-984-6600	1
113 Castle Ln	PO Box 85	Denver	IA	50622
77-SDP-56-05	Seneca Environmental Services, Inc.	5/15/2023	563-332-9465	5
17851 244th Ave		Bettendorf	IA	52722
29-SDP-12-16	OMG Midwest	4/10/2022	515-422-5437	6
2401 SE Tones Dr Ste 13		Ankeny	IA	50021
78-SDP-29-07	American Backhoe Co., Inc.	11/4/2022	712-227-0107	4
PO Box 335		Crescent	IA	51526
78-SDP-23-05	Pierce Pump, Inc	1/11/2024	712-482-6413	4
513 N Hwy	PO Box 427	Oakland	IA	51560

Excavation Reporting

A report of excavation activities must be provided in Appendix 32 of the Tier 2 Report. The report must include the following:

1. Brief narrative of the excavation, including contractor/excavator name and dates of initiation and termination, description of how and where contaminated soil was disposed, abandoned USTs encountered, groundwater infiltration and disposition, monitoring wells destroyed, etc.;
2. Results of field screening and observations
3. Copies of the analytical data obtained from the soil samples;
4. Description of backfill material and compaction methods;
5. Scaled site diagram with the following illustrated:
   - Area of the original contamination
   - Dimensions and limits of the excavation
   - Field screening sampling locations
   - Location of soil samples submitted for laboratory analysis
   - Groundwater sampling, borehole, and monitoring well locations
   - Pertinent site features such as buildings, roads, utilities, etc.
   - Groundwater flow direction
6. Photographs of the excavation

Expedited Corrective Action

An owner, operator, or responsible party may conduct corrective actions at the site so long as the DNR UST Project Manager receives notice of the expedited cleanup activities within 30 calendar days of their commencement, the owner, operator, or responsible party complies with the provisions of 567-135; and the corrective action does not include active treatment of groundwater other than:

- As previously approved by the DNR;
- Free product recovery pursuant to 567-135.7(4); or
- Soil excavation.

Excavation may be conducted at any time including in conjunction with a Tier 1. The purpose of expedited corrective action is to provide a mechanism for limited and prompt remediation without unnecessary delays for proposal

submittal and DNR review. It is not intended to be a substitute for a site check or tiered evaluation.

Adequate sampling must be conducted to determine the levels of contaminants in soil before and after the excavation. Groundwater sampling shall be required as provided in either 567-135.6(3)b, site check procedures, or 567-135.9(1), Tier 1 site assessment procedures. A report of the excavation which includes the information listed in the previous subsection must be submitted as part of a site check report or as an appendix to the Tier 1.

REQUIREMENTS FOR REPRT MAPS AND APPENDICES

Attach the following maps and appendices at the end of the Tier 1 Report in the order listed below. Title each appendix consistent with the bold print. Each appendix should be numbered and titled as listed in bold print and attached in the same order listed. Ensure all maps are legible, have a north arrow, scale, and legend. If possible, maps should be prepared on 8.5 x 11-inch paper or reduced to that size by a single or double fold, preferably with north at the top of the page. Additional reports containing pertinent data not required by the Tier 1 assessment may be submitted as attachments.

The receptor survey conducted at Tier 1 may be insufficient if a Tier 2 is required and an additional receptor survey may be necessary.

1. **Topographic Site Map**
   Provide a topographic map of the site and surrounding area developed from work done at the site, city surveys where available, or USGS maps. Legible contour elevation differentials no greater than 20 feet must be provided. If a local survey, city survey, or USGS map is used, identify the map scale and date of map.

2. **Site Plan Map**
   The site plan map must identify and display, at a minimum, the following:
   - Location and content of existing and removed USTs, product lines, and dispensers
   - Groundwater sampling, borehole, and monitoring well locations
   - Site features, including but not limited to property boundaries, buildings, roads, wells, waterways, and sinkholes
   - Street names
   - Subsurface utility locations, including sewer and water (see water line evaluation)
   - North arrow, preferably at top of the page
   - Scale of map (e.g., scale 1 inch = 20 to 50 feet)
   - Legend (or key) as applicable depicting pertinent site features

3. **Site Vicinity Map**
   The site vicinity map should be legible and clearly identify the site in relation to surrounding features, such as existing zoning, site property boundaries, roads, waterways, sinkholes, and existing structures (schools, hospitals, childcare facilities, other LUST sites). The map should be scaled between 200 and feet per inch.

4. **Field Screening Map**
   The Field Screening Map should illustrate field screening sample locations in relation to an existing (or former) tank system and an area of a suspected release(s), including the field screening sample point with the highest vapor reading and depth at which it was found, e.g., 310 ppm at 15’ bgs. Additionally, this map should include the locations of the tank basin(s), piping, dispensers, on-site and surrounding buildings, road names, and subsurface utilities. Last, include the vapor screening device used (i.e., PID, FID) in the map legend.

5. **Soil Contamination Map(s)**
   Provide soil contamination maps depicting sample locations and soil analytical results used for the Tier 1 site analysis, including data obtained from the Tier 1 field assessment, tank closures, site checks, or other investigations of the release at the site. A map must be submitted for each chemical of concern exceeding a Tier 1 level. A separate map for each chemical of concern is not necessary if each can be clearly labeled on one map,

with an exception of a benzene map, which must be submitted regardless of concentration. Al so, a TEH map must be submitted, regardless of concentration, if TEH was included in the site sampling, with the exception if TEH-Waste Oil in identified in soil, then a TEH-Waste Oil map is not required. A map must be submitted if a replacement soil boring and/or soil gas point is installed. If soil gas samples were collected, the soil gas map must include the soil gas sample locations label(s) and indicate the soil gas analytical results.

6. **Groundwater Contamination Map(s)**
   Provide groundwater contamination maps depicting sample locations and analytical results used for the Tier 1 site analysis, including data obtained from the Tier 1 field assessment and other investigations of the release at the site. A map must be submitted for each chemical of concern exceeding a Tier 1 level. A separate map for each chemical of concern is not necessary if each can be clearly labeled on one map, with an exception of a benzene map, which must .be submitted regardless of concentration. Also, a TEH map must be submitted, regardless of concentration, if TEH was included in the site sampling, with the exception if TEH-Waste Oil in identified in soil, then a TEH-Waste Oil map is not required. If soil gas samples were collected, the soil gas map must include label the soil gas sample locations label(s) and indicate the soil gas analytical results.

7. **Groundwater Flow Direction Map**
   Provide a groundwater flow map based on work done at the site and the adjacent area. Identify the following on the map:
   - All wells installed on site;
   - Groundwater elevations measured for each well;
   - Groundwater flow direction (with an arrow);
   - Wells used to determine hydraulic conductivity and;
   - Date groundwater elevations were measured.

   If a sufficient amount of data has been collected, groundwater contours, labeled with the contour elevations, may be added to the map. Also, wells constructed in different aquifers must be identified.

8. **Well Survey Map**
   Provide a site area map identifying all groundwater wells, including drinking water wells and non-drinking water wells, within 1,000 feet of the source. Additionally, provide a 300’ well survey map. Ensure both maps are appropriately scaled. A well search through Facility Explorer.

9. **Enclosed Space and Conduit Map**
   Provide a site area map which identifies enclosed space and conduit within specified distance of the source, including the following:
   - 200’ Survey. All buildings and water service lines should be identified within 200 feet radius of the source;
   - 500’ Survey. All water mains, sanitary sewer mains and storm sewer mains should be identified within 500 feet of the source;
   - Explosive vapor survey. At a minimum, an explosive vapor survey should be done in the nearest subsurface enclosed spaces in ALL directions and in any places with a history of vapor problems. If the Tier 1 levels for both vapor pathways are not exceeded, an explosive vapor survey is not required unless there has been a history of vapor problems related to the site. The groundwater professional must provide a specific justification for NOT conducting an explosive survey. See 567-135.9(3)h.
   - Investigation due to impacts off-site. When required by the DNR, owners and operators of UST systems must follow the procedures in 567-135.6(3) to determine if the UST system is the source of off-site impacts. These impacts include the discovery of regulated substances (such as the presence of free product or vapors in soils, basements, sewer and utility lines, and nearby surface and drinking waters) that has been observed by the DNR or brought to its attention by another party. See 567-135.6(2).

   If the enclosed space is a residential property, provide a copy of the access agreement or identify the owner / tenant of the property and date of the survey. Number all enclosed spaces and conduits on the map to coordinate with “conduit number” from the Enclosed Space / Conduit Survey Table in the Tier 1 report form.

10. **Surface Water Map**
    Provide a site map which identifies all surface water bodies within 200 feet of the source. Ensure the map is appropriately scaled.

11. **Tank and Line Tightness Test Results**
    If active tanks exist on-site, a copy(s) of the most recent tank system tightness test results, supporting field data, description of the leak detection method, and a summary of results must be submitted. Although a summary is preferable, a copy(s) of leak detection results for the most recent quarter may be submitted as supporting documentation. Additional information regarding UST regulations can be found on the DNR UST webpage.

12. **Laboratory Data Sheets**
    Provide a copy of all laboratory data sheets, including those for Total Dissolved Solids analyses (if applicable.), Chain of Custody forms, chromatograms and associated quantitative reports for the waste oil, diesel, and gasoline standards used by the laboratory. The laboratory analytical report must state whether the sample tested matches the laboratory standard for waste oil, diesel, or gasoline. Additionally, chromatograms for soil and groundwater samples with the maximum concentrations of BTEX, TEH-D, and TEH-WO must be submitted. Chromatograms for all other sample analyses should be maintained by the laboratory and available upon request by the DNR.

13. **Soil Boring and Monitoring Well Construction Diagram**
    Provide DNR Form 542-1392 for each soil boring and monitoring well installed, including boring logs and well construction diagrams for the Tier 1 assessment and any historic investigations. The soil boring log/well construction diagram must indicate the casing, screen material, screen slot size, vapor screening results, and soil sample(s) collected for laboratory analysis (if applicable). Additionally, at least one static water level measurement must be taken and indicated at the bottom of the log for each boring and well installed at the site. The static water level symbol “v” should be used to represent the water level at the time of sampling.

14. **Hydraulic Conductivity Measurements**
    Complete a Hydraulic Conductivity Well Diagram (DNR Form 542-0262) for each well tested, then attach to the report. Include a copy of the plots of time versus drawdown data and field data collected and used to determine the hydraulic conductivity. Indicate the units (meters, feet, seconds, etc.) for each field variable. Provide a copy of any calculations done by hand.

15. **Well Logs**
    Provide copies of all available well logs for drinking water wells and non-drinking water wells and, when applicable, copies of DNR Form 542-1226 for wells plugged according to 567-39.

APPENDICES

Appendix A - Quick Links

567 Iowa Administrative Code chapter 134

567 Iowa Administrative Code chapter 135

Certified Groundwater Professional Online Search

DNR Customer Service: (515) 725-8200

DNR Field Office Home Page

DNR Home Page

DNR Records Center
Open 8:00am - 4:30pm Monday through Friday, except for state holidays, for the public to view open records relating to environmental and conservation interests.

Landfarming, DNR Solid Waste Section

Leaking Underground Storage Tank Database

Underground Storage Tank Section Homepage

Appendix B - Abbreviations

Abbreviation	Meaning
AC	Asbestos Cement (transite) mains and service lines
ASL	Above Sea Level
AST	Aboveground Storage Tank
BGS	Below Ground Surface
BTEX	Benzene, Toluene, Ethylbenzene, Xylene
CA	Corrective Action
CGWP	Certified Groundwater Professional
CoC	Chemicals of Concern, includes all chemicals identified in Tier 1 Lookup Table
Conc	Concentration, refers to the amount of CoCs and contamination determined by chemical analysis
Contam	Contamination, presence of CoCs at site
CS	Confirmation Samples, chemical analysis of SG, soil, or GW to verify site conditions
DNR	Iowa Department of Natural Resources
DW	Drinking Water
DWW	Drinking Water Well
EC	Environmental Covenant
FID	Flame Ionization Detector
ft	Feet
GC/MS	Gas Chromatography/Mass Spectrometry
GT	Greater Than, also known as >
GW	Groundwater
GW2WL	Groundwater to Water Line pathway *See* (Tier 1) 567-135.9(8), (Tier 2) 567-135.10(8)
GWI	Groundwater Ingestion pathway *See* (Tier 1) 567-135.9(4), (Tier 2) 567-135.10(4)
GWV2ES	Groundwater Vapor to Enclosed Space pathway *See* (Tier 1) 567-135.9(6), (Tier 2) 567-135.10(6)
HR	High Risk
IAC	Iowa Administrative Code
Inst	Institutional, example Institutional Control
K	Hydraulic Conductivity
LEL	Lower Explosive Limit
LR	Low Risk
LT	Less Than, also known as <
LUST	Leaking Underground Storage Tank
m/d	meters/day
MCL	Maximum Contaminant Level
mg/L	milligrams per liter
MtBE	Methyl-tertiary Butyl Ether
MW	Monitoring Well
NAR	No Action Required
NC	Not Classified
ND	Non-Detectable, or Non-Detect

Abbreviation	Meaning
NFA	No Further Action
OA1	Group 1 chemicals benzene, toluene, ethylbenzene, and xylene (BTEX)
OA2	Group 2 chemicals total extractable hydrocarbons diesel (TEH-D) and waste oil (TEH-WO)
OE	Over-excavation or excavation
O/O	Owner/Operator
PB	Polybutylene
PE	Polyethlyene
PoC	Point of Compliance
PoE	Point of Exposure
Pot	Potential
PGWS	Protected Groundwater Source
PID	Photoionization detector
ppb	parts per billion
ppm	parts per million
PVC	Polyvinyl Chloride
RBCA	Risk-Based Corrective Action
Rcptr	Receptor
RP	Responsible Party
Req	Required
S2WL	Soil to Water Line pathway *See* (Tier 1) 567-135.9(9), (Tier 2) 567-135.10(9)
SCR	Site Cleanup Report
SG	Soil Gas
SHL	State Hygienic Laboratory
SL2GW	Soil Leaching to Groundwater Pathway *See* (Tier 1) 567-135.9(5) ,(Tier 2) 567-135.10(5)
SSTL	Site-Specific Target Level
SV2ES	Soil Vapor to Enclosed Space pathway *See* (Tier 1) 567-135.9(7), (Tier 2) 567-135.10(7)
SW	Surface Water pathway *See* (Tier 1) 567-135.9(10), (Tier 2) 567-135.10(10)
T1	Tier 1 Assessment, *see* 567-135.9
T2	Tier 2 Site Cleanup Report *See* 567-135.10
TDS	Total Dissolved Solids
TEH-D	Total Extractable Hydrocarbons Diesel
TEH-WO	Total Extractable Hydrocarbons Waste Oil
TL	Target Level, a concentration of a chemical of concern determined from default values or computed using designated formulations
Tech	Technological, as in reference to technological controls
Tier 2	Tier 2 Site Cleanup Report
UST	Underground Storage Tank
ug/L	micrograms per liter
W	Water
WL	Water Line

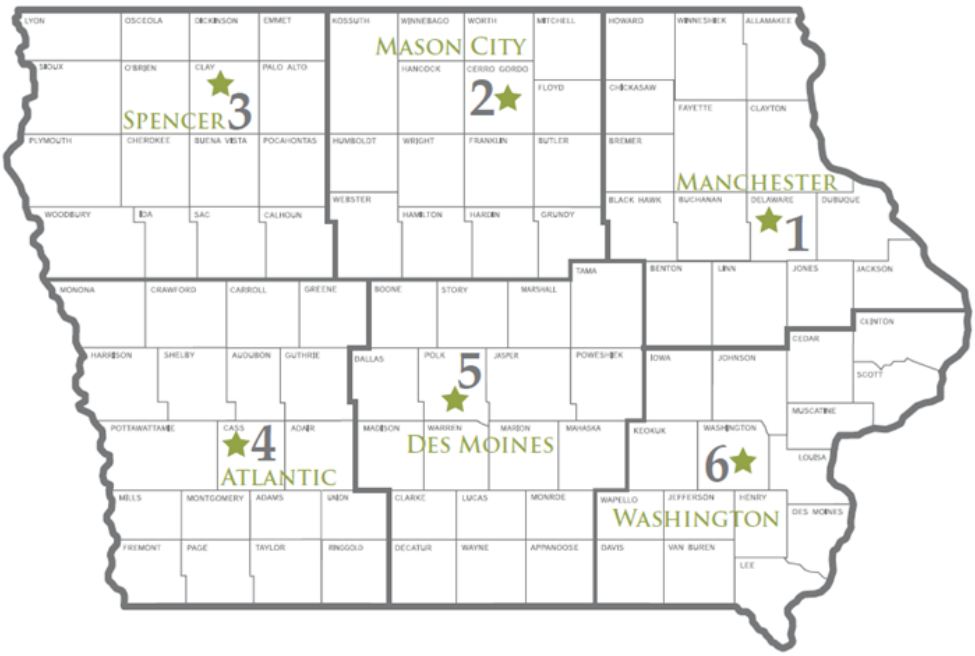
Appendix C - UST Section Staff Contact Information

The Underground Storage Tanks (UST) Section is responsible for the regulation of underground storage tank systems used for the storage of regulated substances, primarily petroleum products. Section staff works with site owners regarding detection, prevention, and correction of UST product releases.

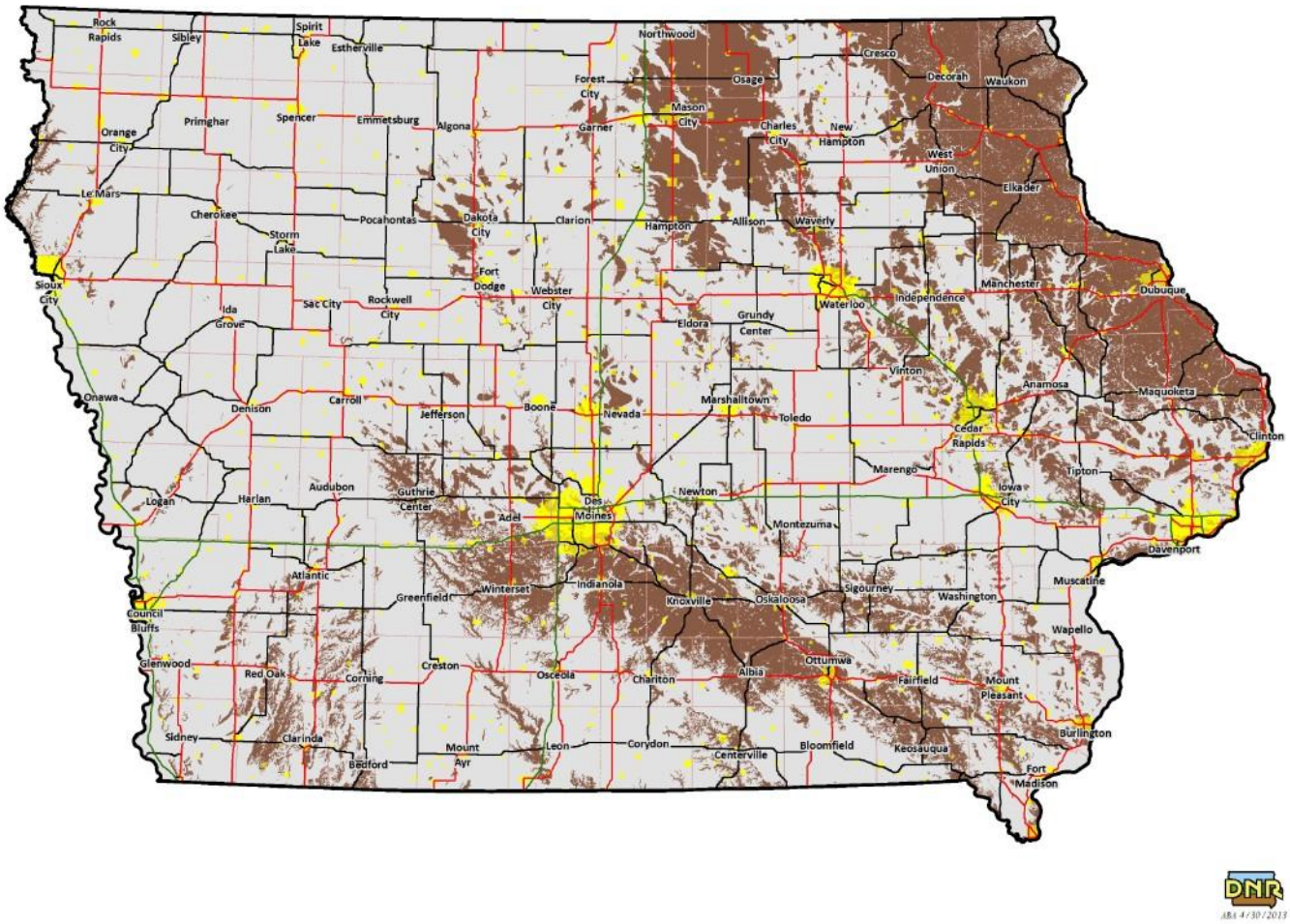
Appendix D - Field Office Contact Information

The Field Services and Compliance Bureau includes six field offices throughout the state. Field Office Staff conduct routine inspections of all facilities permitted by the Environmental Services Division, including Leaking Underground Storage Tank sites. Additionally, Field Office Staff responds to spills, address public complaints, assist in dispute resolution, and work with other local and state and federal agencies to educate the public and regulated community and protect Iowa's nature resources.

Field Office 1 1101 Commercial Ct Ste 10 Manchester 52057 (563) 927-2640	Field Office 2 2300 15th St SW Mason City 50401 (641) 424-4073	Field Office 3 1900 N Grand Spencer 51303 (712) 262-4177	Field Office 4 1401 Sunnyside Ln Atlantic 50022 (712)243-1934	Field Office 5 6200 Park Ave Ste 200 Des Moines 50321 (515) 725-0268	Field Office 6 1023 W Madison Washington 52353 (319) 653-2135
Allamakee Benton Blackhawk Bremer Buchanan Chickasaw Clayton Delaware Dubuque Fayette Howard Iowa Jackson Jones Linn Winneshiek	Butler Cerro Gordo Floyd Franklin Grundy Hamilton Hancock Hardin Humboldt Kossuth Mitchell Webster Winnebago Worth Wright	Buena Vista Calhoun Cherokee Clay Dickinson Emmet Ida Lyon O'Brien Osceola Palo Alto Plymouth Pocahontas Sac Sioux Woodbury	Adair Adams Audubon Carroll Cass Crawford Fremont Green Guthrie Harrison Mills Monona Montgomery Page Pottawattamie Ringgold Shelby Taylor Union	Appanoose Boone Clarke Dallas Decatur Jasper Lucas Madison Mahaska Marion Marshall Monroe Polk Poweshiek Story Tama Warren Wayne	Cedar Clinton Davis Des Moines Henry Iowa Jefferson Johnson Keokuk Lee Louisa Muscatine Scott Van Buren Wapello Washington



Appendix E - Map of Iowa Depth to Bedrock 50' Foot

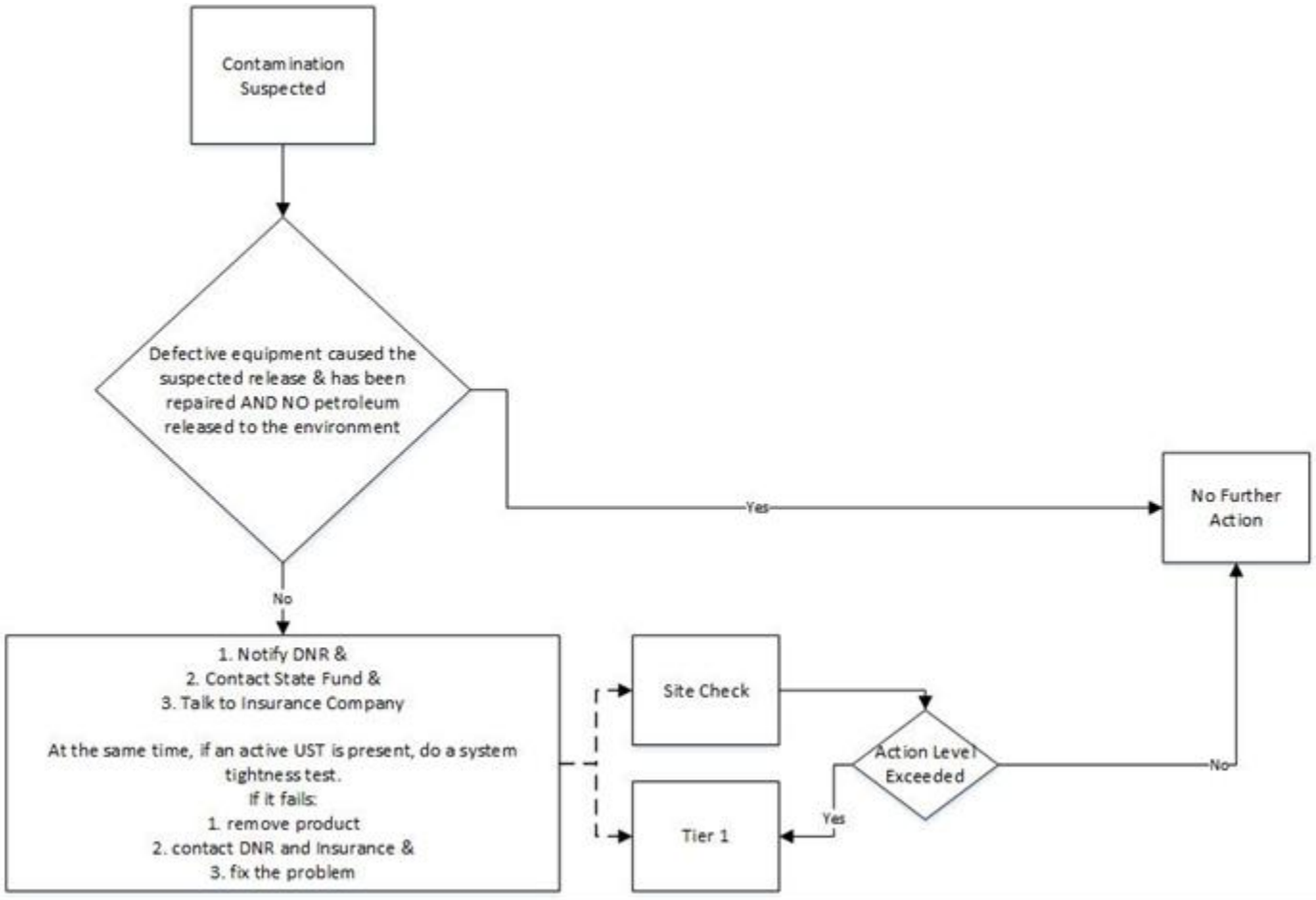


Appendix F - Blank Forms

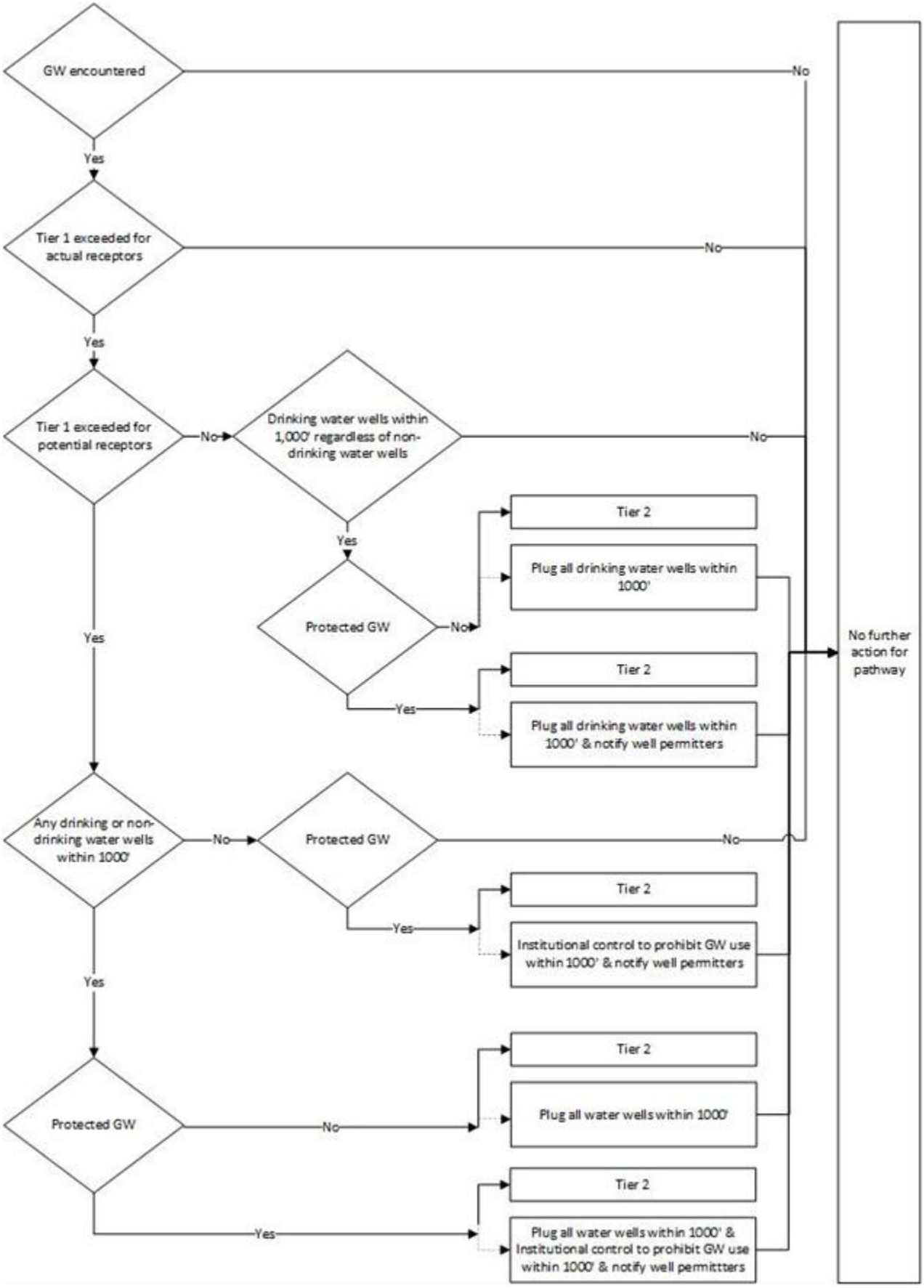
Abandoned Well Form (DNR Form 542-1226)
City or County Certification Letter Model Example
Environmental Covenant Model Example
Free Product Recovery Report (DNR Form 542-1424)
Hydraulic Conductivity Well Diagram (DNR Form 542-0262)
Landfarming Permit Application (DNR Form 542-8128)
MtBE Sampling Results (DNR Form 542-1394)
Sanitary Sewer Line Notification (DNR Form 542-1532)
Soil Boring Logs and Monitoring Well Construction Diagram (DNR Form 542-1392)
Tier 1 Report Form
Water Line Utility Notification Form (DNR Form 542-1531)
Water Supply Notification Form (DNR Form 542-1530)

Appendix G - Flowcharts

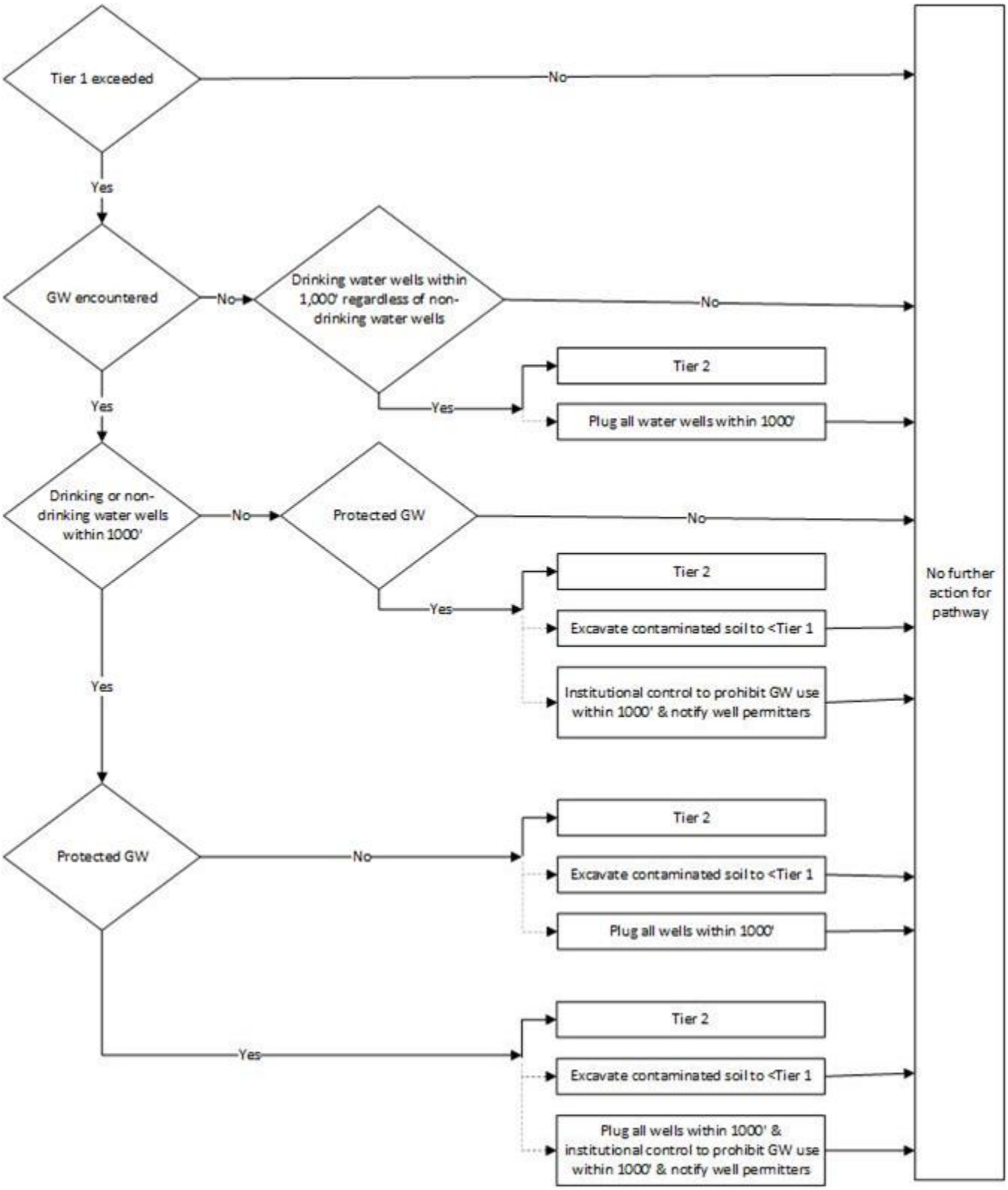
WHAT TO DO WHEN CONTAMINATION IS SUSPECTED



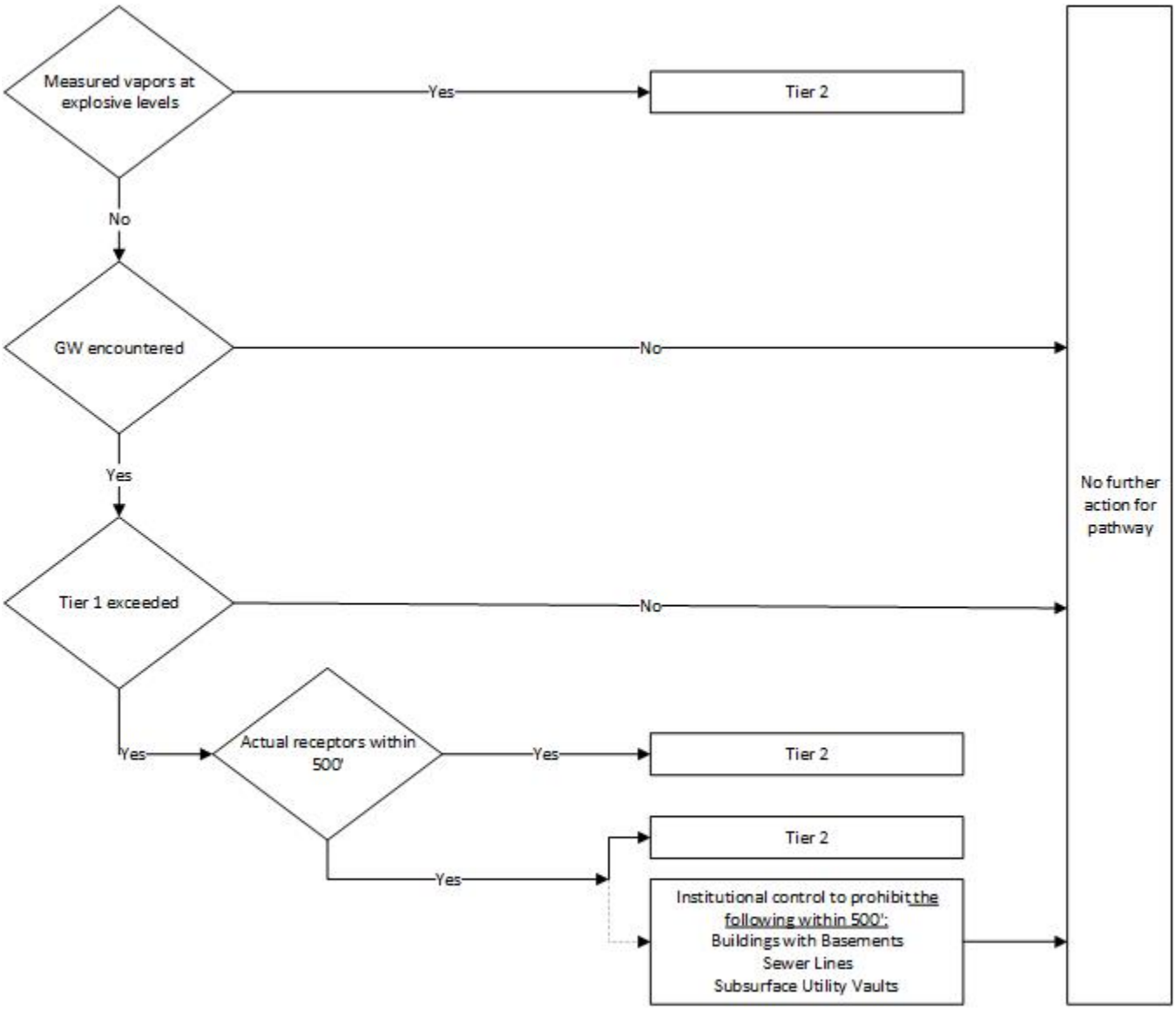
GROUNDWATER INGESTION PATHWAY



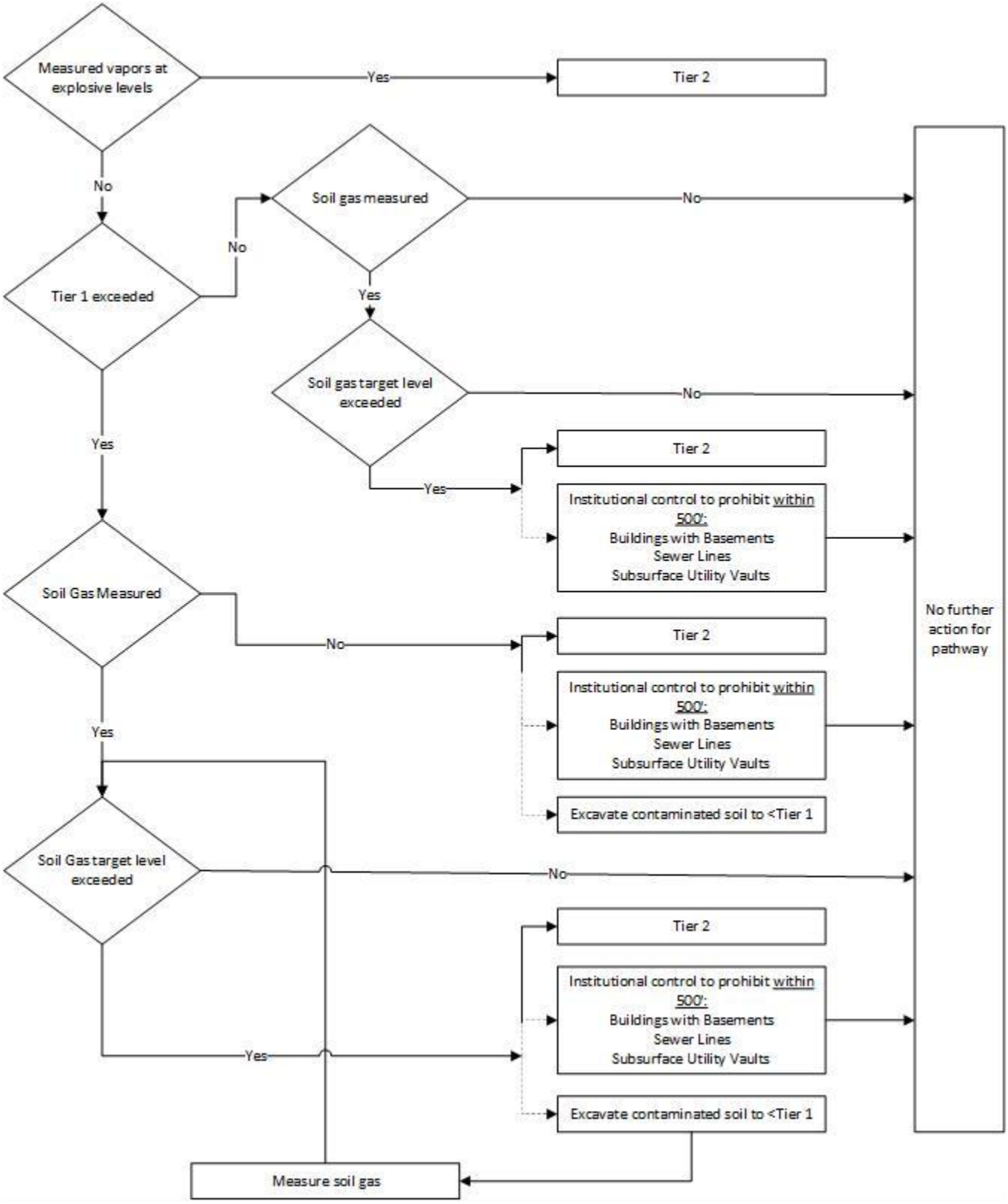
SOIL LEACHING PATHWAY



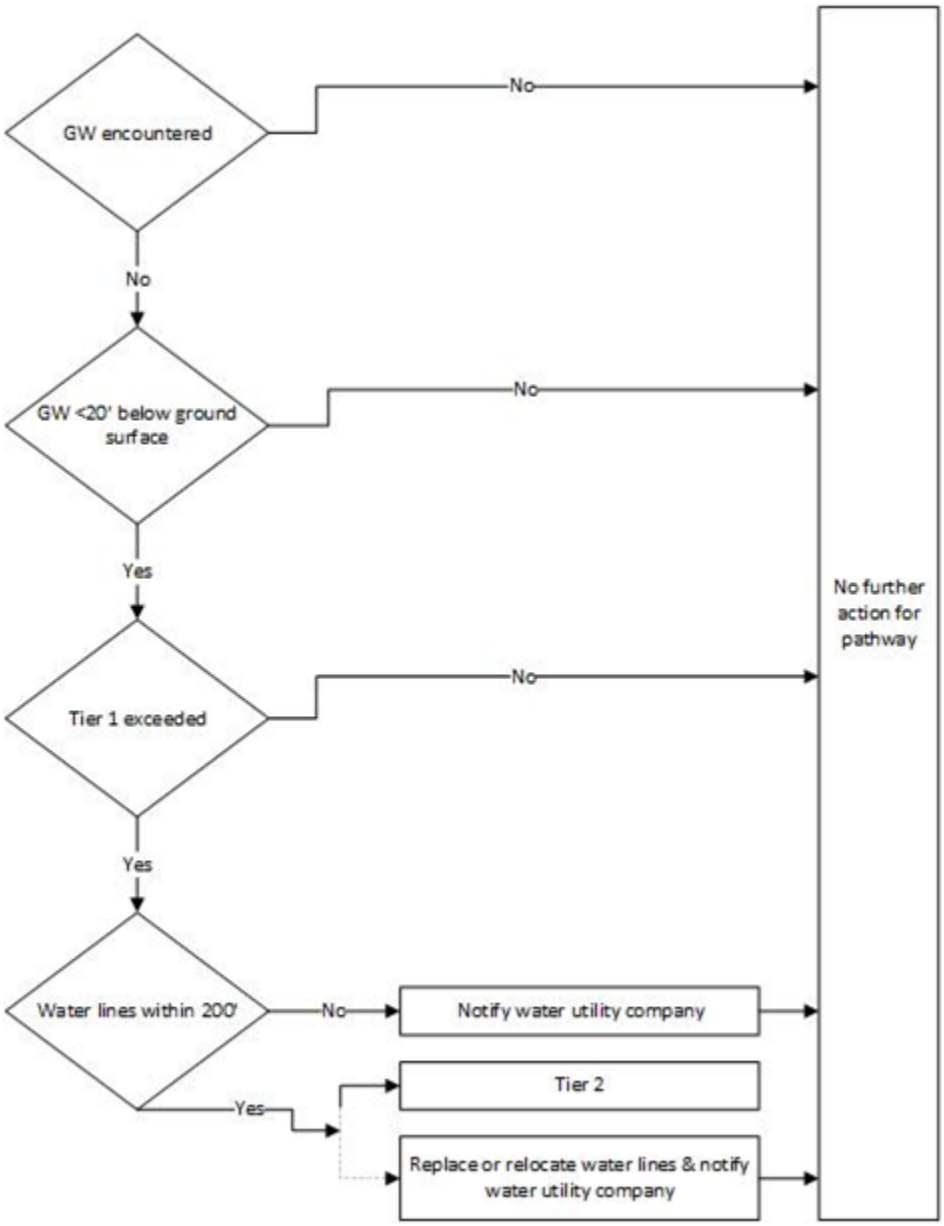
GROUNDWATER VAPOR TO ENCLOSED SPACE PATHWAY



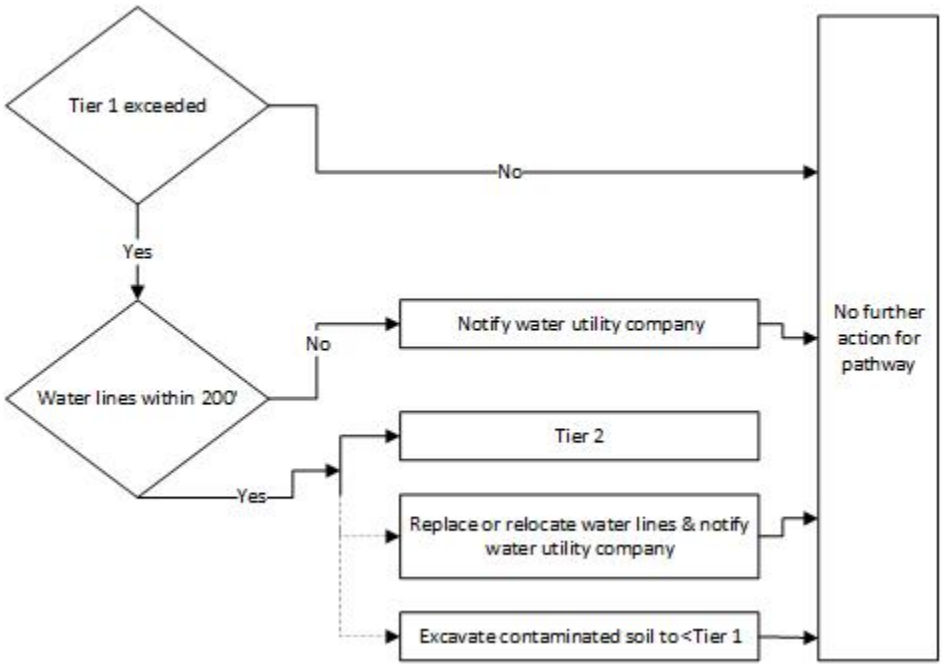
SOIL VAPOR TO ENCLOSED SPACE PATHWAY



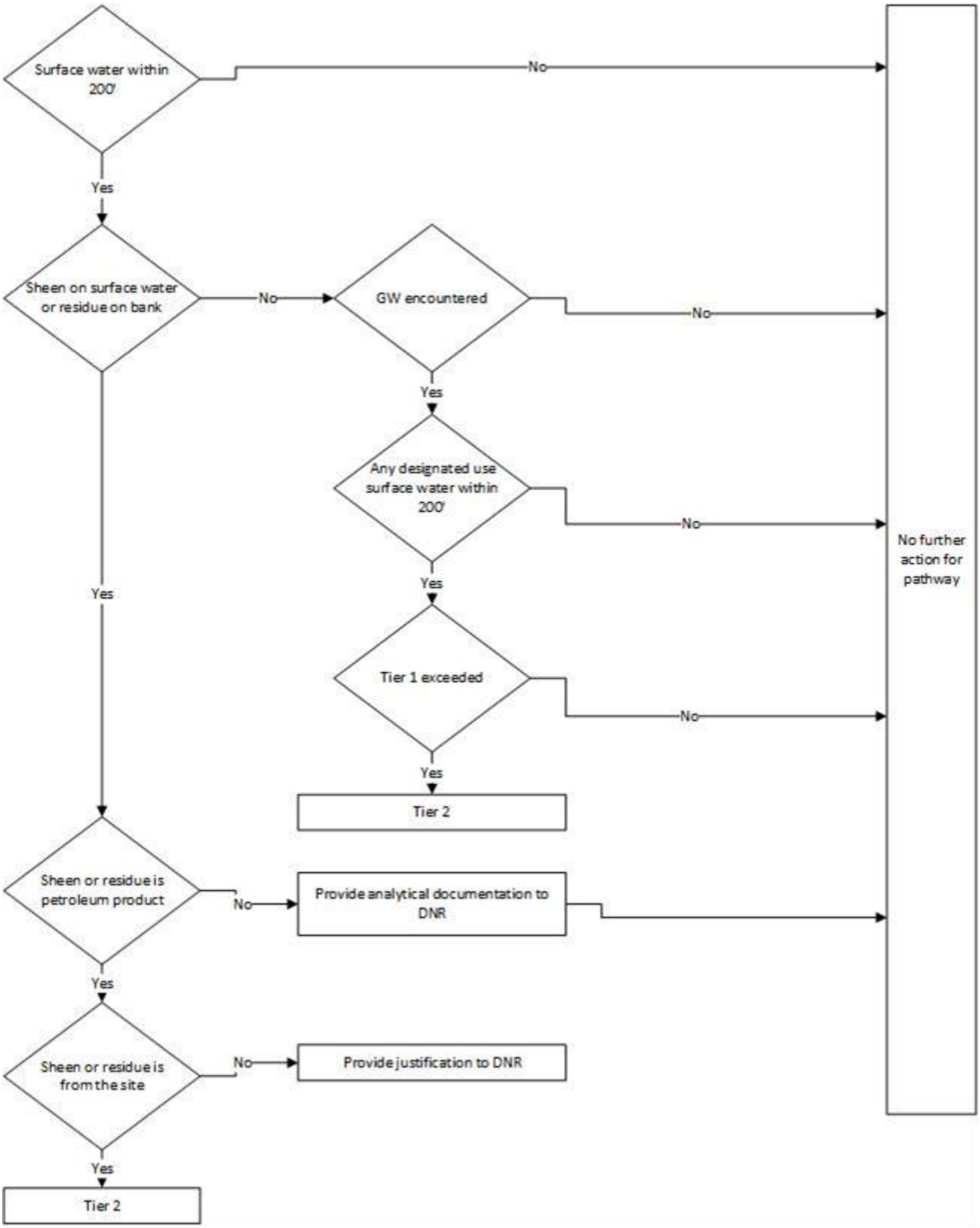
GROUNDWATER TO WATER LINE PATHWAY



SOIL TO WATER LINE PATHWAY



SURFACE WATER PATHWAY



Appendix H - Pathway Evaluation Worksheet (DNR Form 542-0897)

For each pathway, follow the sequence of questions to determine whether the pathway passes (clears) the Tier 1 evaluation. Begin by answering the first general question. Check the box next to your response to each applicable question. Your response will dictate which question should be answered next. Upon completion of the questions, complete the Pathway Evaluation Summary (page 3 of the Tier 1 Report).

General

1. While drilling, has bedrock been encountered before encountering groundwater?
   - ☐ Yes - Cease Tier 1 pathway evaluations. A Tier 2 Site Cleanup Report must be completed and all pathways must be evaluated in accordance with special bedrock procedures in Subrule 135.10(3) and the Tier 2 guidance document.
   - ☐ No - Go to 2.

2. Has free product been encountered?
   - ☐ Yes - Cease Tier 1 pathway evaluations. A Tier 2 Site Cleanup Report must be completed and all the pathways must be evaluated in accordance with the Tier 2 guidance document. Note, however, the sampling and receptor survey required for the Tier 1 assessment are also required for the Tier 2 assessment, in addition to the Tier 2 sampling requirements.
   - ☐ No - Go to the pathway-specific evaluation questions.

Groundwater Ingestion Pathway:

1. Has groundwater been encountered (subject to drilling depth requirements)?
   - ☐ Yes - Go to 2.
   - ☐ No - No further action required for this pathway.

2. Do the maximum measured concentrations of BTEX or TEH-diesel and waste oil in groundwater exceed the Tier 1 levels for actual receptors?
   - ☐ Yes - Go to 3.
   - ☐ No - Passed Tier 1 for actual receptors (also passed Tier 1 for potential receptors by default). No further action required for this pathway.

3. Are there any drinking water wells within 1,000 feet of the source?
   - ☐ Yes - Pathway complete for actual receptors. Failed Tier 1 for actual receptors. Go to 9.
   - ☐ No - Pathway incomplete for actual receptors. Go to 4.

4. Do the maximum measured concentrations of BTEX or TEH-diesel and waste oil in groundwater exceed the Tier 1 levels for potential receptors?
   - ☐ Yes - Go to 6.
   - ☐ No - Go to 5.

5. Is the first encountered groundwater a protected groundwater source?
   - ☐ Yes - Pathway complete for potential receptors. No further action clearance for this pathway can be obtained with documentation to the UST Section that notification has been provided to the DNR Water Supply Section, or the county which has delegated authority for issuing public water supply construction permits or regulating private water well construction.
   - ☐ No - Passed Tier 1. No further action required for this pathway.

6. Are there any non-drinking water wells within 1,000 feet of the source?
   - ☐ Yes - Pathway complete for potential receptors. Failed Tier 1 for potential receptors. Go to 8.
   - ☐ No - Go to 7.

7. Is the first encountered groundwater a protected groundwater source?
   - ☐ Yes - Pathway complete for potential receptors. Failed Tier 1 for potential receptors. Corrective action is required which addresses the protected groundwater source receptor (see options below).
   - ☐ No - Pathway is incomplete for actual and potential receptors. No further action required for this pathway.

8. Is the first encountered groundwater a protected groundwater source?
   - ☐ Yes - Corrective actions are required which address non-drinking water well receptors and the protected groundwater source receptor (see options below).
   - ☐ No - Corrective action is required which addresses non-drinking water well receptors (see options below).

9. Do the maximum measured concentrations of BTEX or TEH-diesel and waste oil in groundwater exceed the Tier 1 levels for potential receptors?
   - ☐ Yes - Go to 11.
   - ☐ No - Go to 10.

10. Is the first encountered groundwater a protected groundwater source?
    - ☐ Yes - Pathway complete for potential receptors. Corrective action is required which addresses drinking water well receptors (see options below) and notification must be provided to the DNR Water Supply Section, or the county which has delegated authority for issuing public water supply construction permits or regulating private water well construction.
    - ☐ No - Corrective action is required which addresses drinking water well receptors (see options below).

11. Are there any non-drinking water wells within 1,000 feet of the source?
    - ☐ Yes - Pathway complete for potential receptors. Failed Tier 1 for potential receptors. Go to 13.
    - ☐ No - Go to 12.

12. Is the first encountered groundwater a protected groundwater source?
    - ☐ Yes - Pathway complete for potential receptors. Failed Tier 1 for potential receptors. Corrective actions are required which address drinking water well receptors and the protected groundwater source (see options below).
    - ☐ No - Corrective action is required for drinking water well receptors.

13. Is the first encountered groundwater a protected groundwater source?
    - ☐ Yes - Corrective actions are required which address drinking water well receptors, non-drinking water well receptors, and the protected groundwater source receptor (see options below).
    - ☐ No - Corrective actions are required which address drinking water well receptors and non-drinking water well receptors (see options below).

Corrective Action Response Options:

No further action clearance for this pathway may be obtained if the appropriate institutional control for each affected receptor has been implemented or established. Documentation of the following institutional control activities must be provided in order to receive clearance for this pathway.

- **drinking water well receptors** - all drinking water wells within 1,000 feet of the source must be properly plugged.
- **non-drinking water well receptors** - all non-drinking water wells within 1,000 feet of the source must be properly plugged.
- **protected groundwater source receptors** - if the Tier 1 levels for actual receptors are exceeded, notification must be provided to the DNR Water Supply Section, or the county which has delegated authority for issuing public water supply construction permits or regulating private water well construction; and if the Tier 1 levels for potential receptors are exceeded, an institutional control which prohibits the use of the protected groundwater source within 1,000 feet of the source must be established.

If an institutional control cannot be implemented for any of the affected receptors, a T2 SCR must be completed.

Soil Leaching to Groundwater Pathway:

1. Do the maximum measured concentrations of benzene, toluene, ethylbenzene, or TEH-diesel in soil exceed the Tier 1 levels?
   - ☐ Yes - Go to 2.
   - ☐ No - Passed Tier 1. No further action required for this pathway.

2. Has groundwater been encountered (subject to drilling depth requirements)?
   - ☐ Yes - Go to 3.
   - ☐ No - Go to 4**.**

3. Are there any drinking water wells or non-drinking water wells within 1,000 feet of the source *or* is the first encountered groundwater a protected groundwater source?
   - ☐ Yes - Pathway complete. Failed Tier 1. Corrective actions are required to address existing drinking water well receptors, non-drinking water well receptors, and/ or the protected groundwater source receptor. Go to 5.
   - ☐ No - Pathway incomplete. Passed Tier 1. No further action required for this pathway.

4. Are there any drinking water wells or non-drinking water wells within 1,000 feet of the source?
   - ☐ Yes - Pathway complete. Failed Tier 1. Go to 6.
   - ☐ No - Passed Tier 1. No further action required for this pathway.

5. Will an institutional control which prohibits the use of groundwater within 1,000 feet of the source be established?
   - ☐ Yes - Provide documentation to the department that institutional controls have been established (i.e., existing drinking water wells and non-drinking water wells must be properly plugged and well installation within 1,000 feet must be prohibited).
   - ☐ No - Go to 7.

6. Will all drinking water wells and non-drinking water wells within 1,000 feet of the source be properly plugged?
   - ☐ Yes - Provide documentation to the department that existing drinking water wells and non-drinking water wells have been properly plugged.
   - ☐ No - Go to 7.

7. Will soil which exceeds the Tier 1 levels be excavated in accordance with the "Tier 1 Corrective Action Response" section of the Tier 1 guidance document?
   - ☐ Yes - Provide documentation to the department that contaminated soil has been excavated and sampling has been conducted to demonstrate the remaining soil contamination is below the Tier 1 levels for this pathway.
   - ☐ No - Complete a Tier 2 SCR.

Groundwater Vapor to Enclosed Space Pathway:

1. Have explosive vapor levels (> 10% LEL) been identified in any enclosed spaces within 500 feet of the source?
   - ☐ Yes - Failed Tier 1. The condition must be handled under DNR's emergency response protocols. Complete a Tier 2 SCR for this pathway.
   - ☐ No - Go to 2.

2. Has groundwater been encountered (subject to drilling depth requirements)?
   - ☐ Yes - Go to 3.
   - ☐ No - Passed Tier 1. No further action required for this pathway.

3. Do the maximum measured concentrations of benzene, toluene, ethylbenzene, or TEH-diesel and waste oil in groundwater exceed the Tier 1 levels?
   - ☐ Yes - Failed Tier 1. Corrective action is required for this pathway. Go to 4.
   - ☐ No - Passed Tier 1. No further action required for this pathway.

4. Will an institutional control which prohibits subsurface enclosed space receptors within 500 feet of the source be established?
   - ☐ Yes - Provide documentation to the department that institutional controls which prohibit and eliminate buildings with basements, sewer lines, and subsurface utility vaults within 500 feet of the source have been implemented.
   - ☐ No - Complete a Tier 2 SCR.

Soil Vapor to Enclosed Space Pathway:

1. Have explosive vapor levels (> 10% LEL) been identified in any enclosed spaces within 500 feet of the source?
   - ☐ Yes - Failed Tier 1. The condition must be handled under DNR's emergency response protocols. Complete a Tier 2 SCR for this pathway.
   - ☐ No - Go to 2.

2. Do the maximum measured concentrations of benzene, toluene, ethylbenzene, or TEH-diesel in soil exceed the Tier 1 levels?
   - ☐ Yes - Go to 5.
   - ☐ No - Go to 3.

3. Have soil gas measurements been taken?
   - ☐ Yes - Go to 4.
   - ☐ No - Passed Tier 1. No further action required for this pathway.

4. Do either the initial soil gas measurements or the confirmation gas measurements exceed the soil gas target levels?
   - ☐ Yes - Failed Tier 1. Corrective action required for this pathway. Go to 8.
   - ☐ No - Passed Tier 1. No further action required for this pathway.

5. Have soil gas measurements been taken?
   - ☐ Yes - Go to 6.
   - ☐ No - Failed Tier 1. Corrective action required for this pathway. Go to 7.

6. Do either the initial soil gas measurements or the confirmation gas measurements exceed the soil gas target levels?
   - ☐ Yes - Failed Tier 1. Corrective action required for this pathway. Go to 9.
   - ☐ No - Passed Tier 1. No further action required for this pathway.

7. Will soil which exceeds the Tier 1 levels be excavated?
   - ☐ Yes - Provide documentation to the department that contaminated soil has been excavated and sampling has been conducted to demonstrate the remaining soil contamination is below the Tier 1 levels for this pathway.
   - ☐ No - Go to 8.

8. Will an institutional control which prohibits enclosed space receptors within 500 feet of the source be established?
   - ☐ Yes - Provide documentation to the department that institutional controls which prohibit and eliminate buildings with basements, sewer lines, and subsurface utility vaults within 500 feet of the source have been implemented.
   - ☐ No - Complete a Tier 2 SCR.

9. Will an institutional control which prohibits enclosed space receptors within 500 feet of the source be established?
   - ☐ Yes - Provide documentation to the department that institutional controls which prohibit and eliminate buildings with basements, sewer lines, and subsurface utility vaults within 500 feet of the source have been implemented.
   - ☐ No - Go to 10.

10. Will soil which exceeds the Tier 1 levels be excavated?
    - ☐ Yes - Go to 11.
    - ☐ No - Complete a Tier 2 SCR.

11. Do soil gas measurements taken after completion of the excavation exceed the soil gas target levels?
    - ☐ Yes - Complete a Tier 2 SCR.
    - ☐ No - Provide documentation to the department that contaminated soil has been excavated and soil sampling and soil gas sampling have been conducted to demonstrate the remaining soil contamination and soil gas levels are below the Tier 1 levels for this pathway.

Groundwater to Water Line Pathway:

1. Has groundwater been encountered (subject to drilling depth requirements)?
    - ☐ Yes - Go to 2.
    - ☐ No - Pathway is incomplete. Passed Tier 1. No further action required for this pathway.

2. Is the first encountered groundwater less than 20 feet from the ground surface?
    - ☐ Yes - Go to 3.
    - ☐ No - Pathway incomplete. Passed Tier 1. No further action required for this pathway.

3. Do the maximum measured concentrations of BTEX or TEH-diesel and waste oil in groundwater exceed the Tier 1 levels?
    - ☐ Yes - Go to 4.
    - ☐ No - Passed Tier 1. No further action required for this pathway.

4. Are there any existing water line receptors within 200 feet of the source?
    - ☐ Yes - Pathway complete for actual receptors. Failed Tier 1. Corrective action required for this pathway. Go to 5.
    - ☐ No - Pathway complete for potential receptors. Failed Tier 1. No further action clearance for this pathway can be obtained with documentation to the UST Section that notification of the conditions at the site has been provided to the utility company which supplies water service to the area.

5. Will all water line receptors within 200 feet of the source be replaced or relocated?
    - ☐ Yes - Provide documentation to the department that water line receptors within 200 feet of the source have been replaced with non-receptor water lines or they have been relocated to a distance of greater than 200 feet of the source, ***and*** that notification of the conditions at the site has been provided to the utility company which supplies water service to the area.
    - ☐ No - Complete a Tier 2 SCR.

Soil to Water Line Pathway:

1. Do the maximum measured concentrations of benzene, toluene, ethylbenzene, xylenes or diesel in soil exceed the Tier 1 levels?
    - ☐ Yes - Go to 2.
    - ☐ No - Passed Tier 1. No further action required for this pathway.

2. Are there any water line receptors within 200 feet of the source?
    - ☐ Yes - Pathway complete for actual receptors. Failed Tier 1. Corrective action required for actual receptors. Go to 3.
    - ☐ No - Pathway complete for potential receptors. Failed Tier 1. No further action clearance for this pathway can be obtained with documentation to the UST Section that notification of the conditions at the site has been provided to the utility company which supplies water service to the area.

3. Will all water line receptors within 200 feet of the source be replaced or relocated?
   - ☐ Yes - Provide documentation to the department that water line receptors within 200 feet of the source have been replaced with non-receptor water lines or they have been relocated to a distance of greater than 200 feet of the source, *and* that notification of the conditions at the site has been provided to the utility company which supplies water service to the area.
   - ☐ No - Go to 4.

4. Will soil which exceeds the Tier 1 levels be excavated?
   - ☐ Yes - Provide documentation to the department that contaminated soil has been excavated and sampling has been conducted to demonstrate the remaining soil contamination is below the Tier 1 levels for this pathway.
   - ☐ No - Complete a Tier 2 SCR.

Surface Water Pathway:

1. Are there any surface water bodies within 200 feet of the source?
   - ☐ Yes - Pathway complete. Go to 2.
   - ☐ No - Pathway incomplete. Passed Tier 1. No further action required for this pathway.

2. Is there a petroleum sheen on the surface water body or petroleum residue along the bank of an intermittent stream bed?
   - ☐ Yes - Go to 3.
   - ☐ No - Go to 5.

3. Is the sheen or residue a petroleum-regulated substance?
   - ☐ Yes - Go to 4
   - ☐ No - Provide analytical data to verify. Go to 5.

4. Is the sheen or residue attributable to the subject site?
   - ☐ Yes - Failed Tier 1. Contact the department. Complete a Tier 2 SCR.
   - ☐ No - Go to 5.

5. Has groundwater been encountered (subject to drilling depth requirements)?
   - ☐ Yes - Go to 6.
   - ☐ No - Passed Tier 1. No further action required for this pathway.

6. Are there any designated-use segments (as provided in Chapter 567-61.3(1) and 61.3(5) of the IAC) within 200 feet of the source?
   - ☐ Yes - Go to 7.
   - ☐ No - Passed Tier 1. No further action required for this pathway.

7. Do the maximum measured concentrations of BTEX or TEH-diesel and waste oil in groundwater exceed the Tier 1 levels?
   - ☐ Yes - Failed Tier 1. Complete a Tier 2 SCR.
   - ☐ No - Passed Tier 1. No further action required for this pathway.

Appendix I - Revision Dates

12/2014 - General Updates
12/2015 - General Updates
12/2017 - Removed reference to Cunningham Lindsey replaced with AON Risk Services
7/2018 - Removed reference to Tier 1 software and incorporated the Pathway Evaluation Worksheet
1/2019 - Removed reference to AON replaced with Iowa UST Fund Program and General Updates
1/2021 - Removed MtBE soil, revised soil gas sampling option #1, revised soil sample collection, revised drilling and well construction exploratory methods, and revised field screening
1/2022 - Revised Monitoring Well Construction Design section, updated samples analysis methods, revisions resulting from Chapter 135 rule changes effective 6/23/21, and updated the Permitted Petroleum Contaminated Soil Landfarmers table
1/2025 - Removed reference to Iowa Comprehensive Petroleum Underground Storage Tank Fund Program and Budget Approvals
4/2025 - Updated links and references to DNR UST webpages
5/2026 - Added electronic report submittals and removed reference to Iowa UST Fund Program
9/2026 - Updated Iowa Administrative Code references resulting from 2023 Executive Order 10