TCEQ REGULATORY GUIDANCE
Remediation Division
RG-366/TRRP-12 ● Revised May 2010

Affected Property Assessment Requirements under TRRP

Objectives: This document outlines the requirements for defining the three-dimensional extent of the affected property and protective concentration level exceedance zone pursuant to the Texas Risk Reduction Program (TRRP).

Audience: Regulated Community and Environmental Professionals

References: The Texas Risk Reduction Program (TRRP) rule, together with conforming changes to related rules, is contained in 30 Texas Administrative Code Chapter 350. The TRRP rule was initially published in the September 17, 1999 Texas Register (24 TexReg 7413-7944). The rule was amended in 2007 (effective March 19, 2007; 32 TexReg 1526-1579) and 2009 (effective March 19, 2009; 34 TexReg 1861-1872).

Find links for the TRRP rule and preamble, Tier 1 PCL tables, and other TRRP information at: www.tceq.state.tx.us/remediation/trrp/.

TRRP guidance documents undergo periodic revision and are subject to change. Referenced TRRP guidance documents may be in development. Links to current versions are at: www.tceq.state.tx.us/remediation/trrp/guidance.

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Introduction

When addressing an unauthorized release of a chemical of concern (COC) under TRRP, the person is required to conduct an affected property assessment in accordance with §350.51. The affected property assessment has many goals and purposes such as:

- identifying source areas and types of COCs,
- characterizing the geologic and hydrogeologic properties of the area that influence COC fate and transport,
- determining COC migration pathways, and
- evaluating exposure pathways.

This information is then used to determine the nature and extent of COCs. To that end, this document provides guidance to aid in establishing assessment levels, explains how to define the affected property and

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protective concentration level exceedance (PCLE) zones, and discusses some issues that may be encountered that warrant specific consideration.

Determining the Assessment Level

The term "assessment level" is used in TRRP to denote the concentration to which the three-dimensional extent of a COC in the environment must be assessed. The assessment level always includes human health exposure pathway considerations, and when appropriate, ecological exposure pathways considerations. An assessment level is typically a calculated risk-based value that factors in different exposure considerations for different environmental media (e.g., surface soil, subsurface soil, groundwater) as well as COC-specific physical and chemical properties, and toxicity factors. Human health considerations are based on residential exposure.

Table 1 identifies some site-specific inputs that are necessary to determine the assessment level. With the exception of source area size considerations and standard exposure pathways, the different topics are addressed in other guidance documents. See the documents referenced in Table 1 for details on those subjects. With regard to more explanation of their bearing on setting assessment levels, see TCEQ guidance document *Affected Property Assessment Planning* (RG-366/TRRP-6).

Table 1. Important Information for Establishing Assessment Levels.

Topic	Impact	Guidance Document
Target COCs	The assessment must consider the appropriate COCs since assessment levels are COC-specific values that reflect the toxicity and chemical/physical properties of the COC.	TRRP-10
Groundwater Classification[1]	Groundwater classification establishes relevant exposure pathways.	TRRP-8
Applicability of Ecological Risks[2]	An assessment level includes ecological screening benchmarks and PCLs when there are ecological exposure concerns. Ecological levels can be lower than the human health-based assessment levels.	RG-263 (revised)
Method Quantitation Limits/Background[3]	The MQL or background concentration may substitute for the assessment level when it is a higher value.	TRRP-13 (MQL) TRRP-15 (Background)
Source Area Size	Assessment levels for certain exposure pathways are dependent on the source area size of the COC.	This document

1. If unknown, assume Class 1 groundwater.
2. Can set assessment levels initially on human health and later define ecological PCLs, but at risk of mobilizing for additional assessment.
3. Establishing a background concentration is optional, but it may prevent setting assessment levels inappropriately low for a COC, such as an inorganic COC that is naturally occurring in the environment.

There are some practical limits for assessment levels. When the calculated assessment level is within the background concentration range for the COC or is less than the method quantitation limit (MQL) for the most sensitive standard available method for that COC, then the background concentration range or the MQL is the assessment level. Also, if the person satisfactorily demonstrates that all reasonably available analytical technology has been used to show that the COC concentration cannot be measured to the MQL due to sample-specific interferences, then the sample detection limit (SDL) can be used as the assessment level. More thorough discussions of background concentrations, including anthropogenic background concentrations and acceptable practices for establishing background concentrations, and MQLs are presented in TCEQ guidance documents *Representative Concentrations* (RG-366/TRRP-15) and *Review and Reporting of COC Concentration Data* (RG-366/TRRP-13), respectively.

This section explains the basis of an assessment level, identifies necessary information and considerations for setting an assessment level, and details how the assessment level for each environmental medium is determined.

Assessment Level Basis

Both human health and ecological exposure pathways are considered in setting applicable assessment levels. For human health exposure pathways, assessment levels are based primarily on residential Tier 1 protective concentration levels (PCLs). However, for the soil-to-groundwater (^{GW}Soil) exposure pathways, the assessment level can be based on a Tier 1, 2 or 3 PCL. See *Tiered Development of Human Health PCLs* (RG-366/TRRP-22) for further information on the tiered process. Tier 1 PCL tables are available for download at www.tceq.state.tx.us/remediation/trrp/trrppcls.html. Refer to the TCEQ guidance document *Tier 1 PCL Tables* (RG-366/TRRP-23) for additional guidance on choosing the appropriate Tier 1 PCL.

Prior to setting assessment levels for ecological concerns, complete a Tier 1 Exclusion Criteria Checklist to determine the existence of complete and potentially significant ecological exposure pathways at the affected property. If the property does not meet the exclusion criteria, the person may either submit a reasoned justification or conduct an expedited stream evaluation, either of which may be used to conclude the ecological risk assessment process. See Section 2.0 of *Guidance for Conducting Ecological Risk Assessments at Remediation Sites in Texas* (RG-263 (revised)) for further information on the reasoned justification or expedited stream evaluation. If it is determined that further ecological evaluation is needed, proceed into Tiers 2 or 3 of the ecological risk assessment process to set the applicable ecological assessment levels (see Section 1.5 of RG-263 (revised)). See the *Human Health and Ecological*

Assessments section of this document for further ecological assessment discussion.

Setting the Assessment Levels for Each Environmental Media

This section works through the process of setting the assessment levels. Assessment levels are determined for each COC in each affected environmental medium for the applicable residential human health or ecological exposure pathways. Table 2 lists the minimum applicable exposure pathways for each environmental medium and lists the TRRP nomenclature for the exposure pathways. The nomenclature is also used to refer to the PCL for an exposure pathway. There may be other pathways specific to the affected property (Table 2) that must be taken into account when determining assessment levels. An example of a fairly common exposure pathway not specified in rule is soil erosion due to surface runoff and deposition in surface water and sediment. TCEQ guidance document *Determining PCLs for Surface Water and Sediment* (RG-366/TRRP-24) discusses exposure pathways to consider when surface water and sediment are affected or threatened.

Assessment Level Notes
The term assessment level includes, as appropriate for the affected property, the evaluation of human health exposure pathways, ecological exposure pathways, the MQL, and background concentrations.

Table 2. Assessment Levels for Human Health Exposure Pathways.

Exposure Pathway	Exposure Pathway Nomenclature	Environmental Medium
Combined ingestion, dermal contact, inhalation of volatile and particulate emissions, and ingestion of aboveground and below-ground vegetables with COCs in soil.	$^{Tot}Soil_{Comb}$	Surface soil
Inhalation of volatile COC emissions from soil.	$^{Air}Soil_{Inh\text{-}V}$	Subsurface soil
Protection of groundwater from soil leachate.	$^{GW}Soil$*	Surface and subsurface soil
Ingestion of COCs in groundwater.	$^{GW}GW_{Ing}$	Class 1 and 2 groundwater
Management of COCs in Class 3 groundwater.	$^{GW}GW_{Class3}$	Class 3 groundwater
Inhalation of volatile COC emissions from groundwater.	$^{Air}GW_{Inh\text{-}V}$	Upper-most Class 1, 2 or 3 groundwater
Other completed or reasonably anticipated to be completed exposure pathways such as groundwater COC discharging to the surface water or sediment.	^{SW}GW, ^{Sed}GW	All environmental media
*$^{GW}Soil$ includes: $^{GW}Soil_{Ing}$, $^{GW}Soil_{Class3}$, $^{Air}GW\text{-}Soil_{Inh\text{-}V}$, and $^{GW}Soil$ for secondary MCLs, as applicable.		

Consideration of Source Area Size for Cross-Media Exposure Pathways

Tier 1 PCLs for cross-media exposure pathways are calculated for 0.5-acre and 30-acre source area sizes. A cross-media exposure pathway is an exposure pathway where there is COC transport from the source area in one environmental medium (e.g., soil) to the point of exposure in another environmental medium (e.g., air). Cross-media exposure pathways include $^{GW}Soil$, $^{Air}Soil_{Inh\text{-}V}$ and $^{Air}GW_{Inh\text{-}V}$. The size of the source area is important because if other factors are held constant, the larger the source area, the higher the COC concentration that is delivered to the exposure point. Therefore, as source area size increases, the PCL decreases. Source area size is not relevant for exposure pathways that do not include a COC transport component (e.g., $^{GW}GW_{Ing}$).

The source area is the portion of an environmental medium with COC concentrations that are leaching, dissolving or emitting an unprotective COC concentration to a point of exposure. The source area is not the primary release source such as a tank or a pipe. However, the source area is generally at or below the primary release source, such as a tank, drum, or landfill. Unfortunately, when multiple sources or diffuse sources are present, identifying the source area may be difficult.

Assessment Level Notes

Because the 30-acre assessment level is a lower value than the 0.5-acre assessment level, consider using a 30-acre source area as the delineation criteria from the start to reduce mobilizations for additional assessment.

The determination of source area size can be somewhat subjective. Therefore, the rule standardized the source area size determination to expedite establishing the appropriate assessment level [§350.75(b)(2)]. Begin with a 0.5 acre-based assessment level. Map the lateral extent of COC concentrations in the environmental medium that exceeds the assessment level (affected) and determine if the surface area of the portion of the environmental medium that is affected (affected surface area) for that COC is less than or greater than 0.5 acres (Table 3). If the affected surface area is less than or equal to 0.5 acres, then use the 0.5 acre-based assessment level. As an example in Figure 1, the assessment level in surface soil for COC X is based on the 0.5-acre $^{GW}Soil_{Ing}$ PCL. Using the 0.5-acre assessment level, the affected surface area of COC X in surface soil is less than 0.5 acres. Therefore, the 0.5 acre-based assessment level is the proper value to use.

Table 3. Definition of Source Area Size

Tier 1	If the affected surface area is ≤0.5 acres, use the 0.5-acre assessment level If the affected surface area is >0.5 – ≤30 acres, use the 30-acre assessment level If the affected surface area is >30 acres based on §350.75(b)(2) methodology, use an assessment level established under Tier 2 or 3 methodologies for site-specific source area size.
Tier 2 or 3	The volume of COCs in an environmental medium that is leaching, dissolving, or emitting unprotective COC concentrations to the point of exposure.

In situations where the *affected surface area* using a 0.5 acre-based assessment level is greater than 0.5 acres, but less than or equal to 30 acres, then use a 30 acre-based assessment level (Table 3). As can be seen in Figure 1, the *surface area* of benzene concentrations exceeding the 0.5-acre assessment level is 4 acres. Since 4 acres is greater than 0.5 acres, but less than 30 acres, the 30-acre assessment level must be used. If the extent of COC concentrations is not already defined to the 30 acre-based assessment level, then further assessment is required to achieve that end.

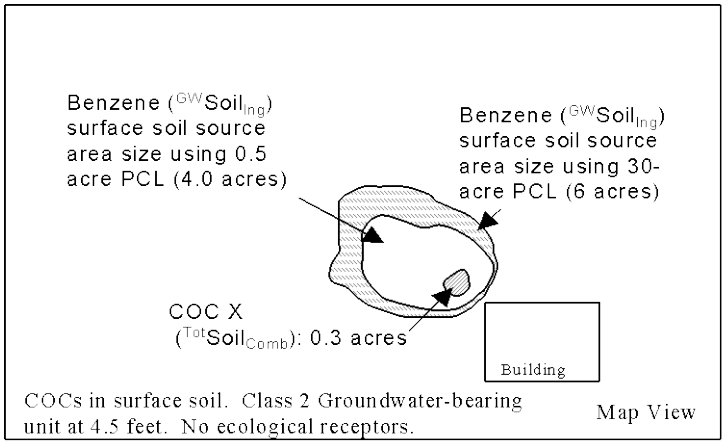

Figure 1. Source area size using Tier 1 PCLs

Figure 1. Source area size using Tier 1 PCLs..

The rule does not address the situation where the *affected surface area* is greater than 30 acres as with benzene in groundwater in Figure 2. In such a situation, it is recommended that the person define the source area site-specifically, and establish an assessment level accordingly using Tier 2 or 3 methodologies (Table 3). The source area will typically be the area containing non-aqueous phase liquid (NAPL) and the highest COC concentrations. In

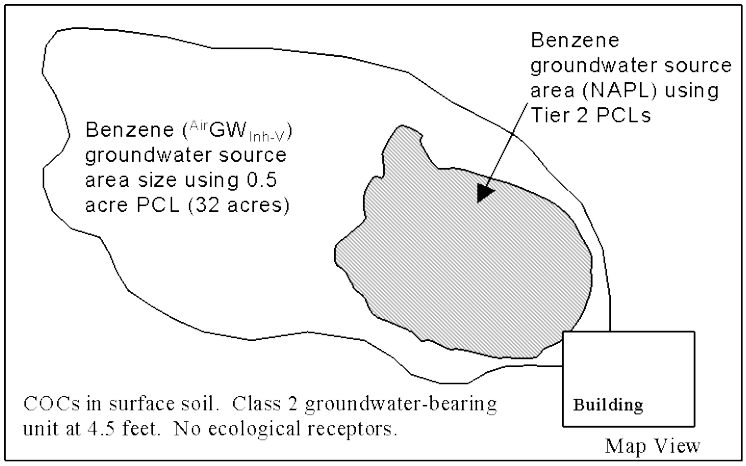

Figure 2. Source area size using Tier 2 PCLs

Figure 2. Source area size using Tier 2 PCLs..

the example in Figure 2, it was determined that the groundwater source area is the NAPL in contact with the groundwater-bearing unit. This also emphasizes the point that while delineation of the boundary of the affected property is necessary, it is just as important to adequately define the areas of highest COC concentrations. This information is useful for not only determining the source area size, but will be needed later in the response action process when evaluating effective remedies.

Keep in mind that the source area size is defined in terms of the *affected surface area* size for each COC in each environmental medium. Therefore, the source area for one COC may be less than 0.5 acres while the source area for another COC in the same environmental medium may be larger than 0.5 acres.

There is another factor to keep in mind. Because the ^{GW}Soil exposure pathway is applicable to *both* surface and subsurface soil, the *same* source area size (the largest of the source area size in surface or subsurface soil) should be assumed for surface and subsurface soil for a given COC.

Groundwater Assessment Level

Table 4 lists the exposure pathways used to determine the groundwater assessment level. The assessment level is the lowest value for the applicable human health and ecological exposure pathways. Use residential exposure factors for both residential and commercial/industrial property alike. If the classification of the groundwater is unknown, assume it is Class 1 (see TCEQ guidance document *Groundwater Classification* (RG-366/TRRP-8) for further information).

A Note About Assessment Levels

For site-specific reasons, assessments may be directed to proceed to concentrations lower than assessment levels defined according to the procedures described in this section. Typically, this would occur due to concern over other reasonably anticipated to be completed exposure pathways. For example, there may be concern that groundwater COCs are discharging to surface water. Additional investigation may be required to fully investigate the possibility.

Table 4. Groundwater Assessment Levels.

Class 1 or 2 Groundwater[1]	Class 3 Groundwater[1]
Lowest of:	Lowest of:
Tier 1 $^{GW}GW_{Ing}$ (residential)	Tier 1 $^{GW}GW_{Class3}$ (residential)
Tier 1 $^{Air}GW_{Inh\text{-}V}$ (residential)	Tier 1 $^{Air}GW_{Inh\text{-}V}$ (residential)
Tier 2 or 3 Ecological PCL[2]	Tier 2 or 3 Ecological PCL[2]
Other exposure pathway anticipated to be complete[3]	Other exposure pathway anticipated to be complete[3]

1. All delineation requirements also include the higher of background concentrations or the MQL/SDL if greater than the others.
2. Typically not applicable to groundwater.
3. For example, groundwater discharge to surface water (^{SW}GW) or sediment (^{Sed}GW).

Soil Assessment Level

Figure 3 identifies the key decision points and suggested sequence for establishing soil assessment levels.

The assessment level can be different in surface soil than in subsurface soil. Refer to Table 5 for the criteria used to determine soil assessment levels. The assessment level in surface soil is the lowest of the values for the Tier 1 $^{Tot}Soil_{Comb}$, ^{GW}Soil determined under Tier 1, 2, or 3, any applicable ecological exposure pathway, and for any other applicable exposure pathways such as soil runoff to surface water or sediment (Table 5). The assessment level for subsurface soil is lowest of the values for the Tier 1 $^{Air}Soil_{Inh\text{-}V}$, ^{GW}Soil determined under Tier 1, 2, or 3, and any other applicable exposure pathway. All human health assessment levels are determined using residential exposure factors. However, as discussed later in the *Focused On-Site Soil Assessment* section of this document, there is the ability to focus the assessment on defining the PCLE zone which may be either residential or commercial/industrial based. Concentrate the assessment on the 0.5-acre assessment level. If the mapped *affected source area* is greater than 0.5 acres, then use the 30 acre-based assessment level (Figure 3).

For both surface soil and subsurface soil, the background concentrations or MQL may become the assessment level when the background concentration exceeds the human health and ecological PCLs, or the MQL using the most sensitive available analytical method is higher than the PCL and background concentrations. For example, the Tier 1 ^{GW}Soil PCL for lead is 3.0 mg/kg, but since the Texas-specific median background concentration is 15 mg/kg [§350.51(m)], the background concentration of 15 mg/kg (or a higher site-specific background concentration) substitutes for the assessment level.

Ecological Soil Definitions and Assessment Levels

Ecological exposure pathways are typically limited to the soil interval between ground surface and a depth of five feet. However, that five-foot interval is subdivided into surface soil (ground surface to a depth of six inches below grade) and subsurface soil (six inches to five feet below grade) (Table 5). The ecological assessment level for these two soil intervals may be different values. Therefore, take particular care to include the correct ecological assessment level for the proper soil interval when comparing the ecological and human-health-based assessment levels.

Vertical Assessment Considerations

Unless a groundwater assessment has been completed, define the vertical extent of COC concentrations in soil vertically to the background

concentrations or to the MQL for the most sensitive standard available method for the COC; whichever is higher (Table 5, Figure 4). The purpose of this requirement is to determine whether groundwater is affected. If the upper-most groundwater-bearing unit is encountered prior to reaching background concentrations or the MQL in soil, then sample groundwater to determine if it is affected by the COC release. If a groundwater assessment has been completed, then the vertical assessment may terminate at the assessment level, regardless of whether the groundwater is affected or not. In this instance, the groundwater assessment must involve direct sampling of groundwater. Other special considerations are discussed later concerning §350.75(i)(7)(C).

If a groundwater assessment documents that the groundwater is affected by COCs, then the entire soil column bounded horizontally by the assessment level from the ground surface to the top of the lowest affected groundwater-bearing unit may be considered a PCLE zone (Figure 4). Declaring the entire soil column a PCLE zone means that no further vertical soil delineation above the lowest affected groundwater-bearing unit is needed for purposes of defining the affected property. However, a soil response action will be required. This may be a preferred option when the affected soil is overlain by a physical control such as an impervious cover and that cover may suffice as a control remedy. By assuming the soil beneath an impervious cover is a PCLE zone, the degree of assessment beneath that cover can be minimized. However, additional characterization of the soil may be needed to design an appropriate response action or to ensure the impervious cover is large enough, or will otherwise meet the performance requirements.

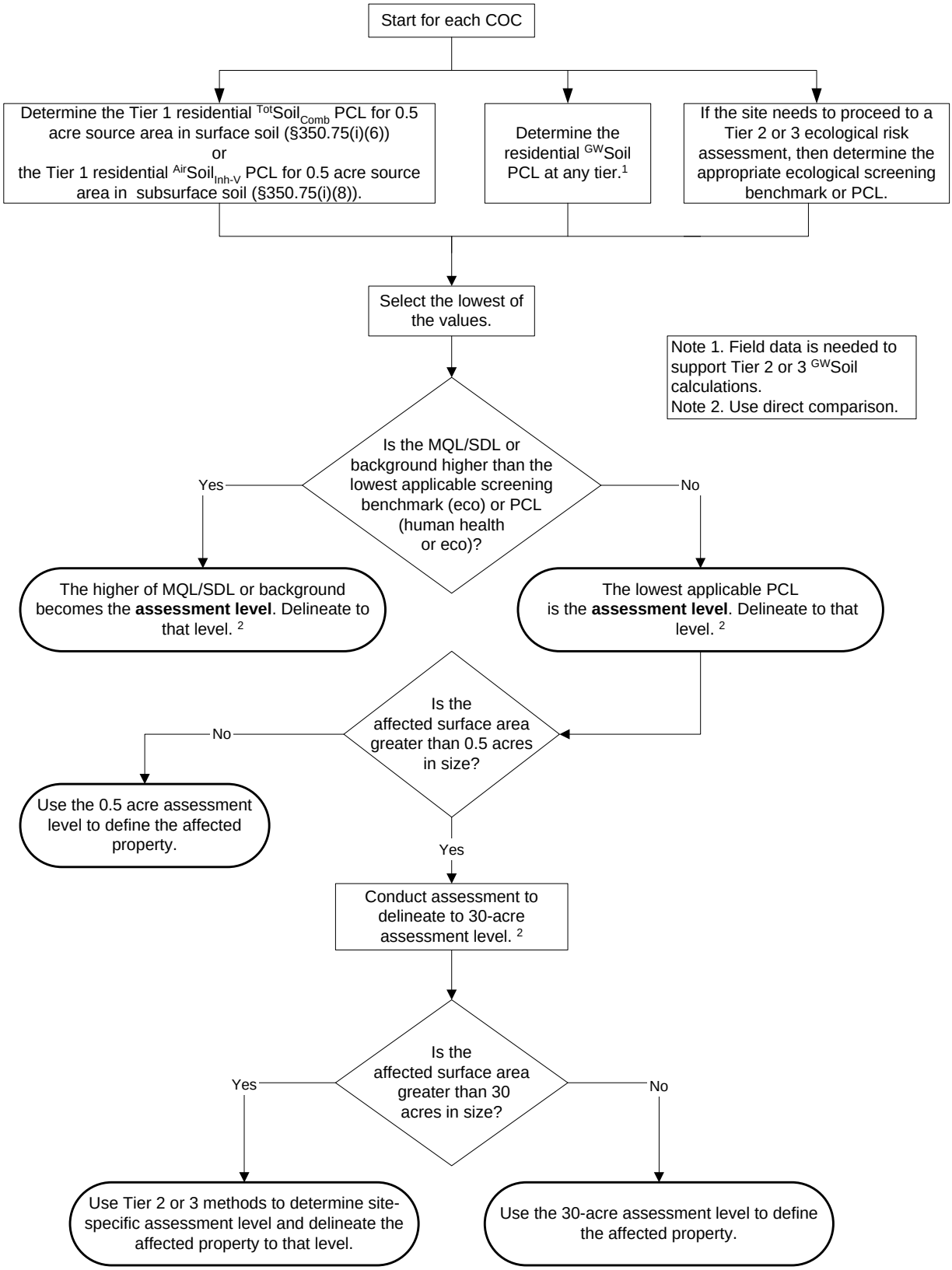

Figure 3. Determining Soil Assessment Levels

Table 5. Soil Assessment Levels.

Surface Soil[1] (0-15 ft.) [2]	**Subsurface Soil1** (>15 ft.) [2]
Lowest of: (residential)	Lowest of: (residential)
Tier 1 $^{Tot}Soil_{Comb}$	Tier 1 $^{Air}Soil_{Inh\text{-}V}$
Tier 1 $^{GW}Soil$ [3]	Tier 1 $^{GW}Soil$[3]
or Tier 2 $^{GW}Soil$	or Tier 2 $^{GW}Soil$
or Tier 3 $^{GW}Soil$	or Tier 3 $^{GW}Soil$
Tier 2 or 3 Ecological PCL (0 to 0.5 feet)	Other exposure pathway anticipated to be complete
Tier 2 or 3 Ecological PCL (0.5 to 5 feet)	Other exposure pathway anticipated to be complete
Other exposure pathway anticipated to be complete	Other exposure pathway anticipated to be complete

1. All delineation requirements also include the higher of background concentrations or the MQL/SDL if greater than the others.
2. Or to the depth of bedrock or the upper-most groundwater-bearing unit if within this interval.
3. $^{GW}Soil$ includes: $^{GW}Soil_{Ing}$, $^{GW}Soil_{Class3}$, $^{Air}GW\text{-}Soil_{Inh\text{-}V}$, and $^{GW}Soil$ for secondary MCLs, as applicable.

Additional Requirements for Assessment of the Vertical Extent for Soil COCs

- If groundwater has not been assessed: higher of MQL/SDL or background concentrations.
- If groundwater has been assessed: standard assessment level, or evidence of groundwater protectiveness (§350.75(i)(7)(C)).
- If groundwater has been assessed and is impacted, option to declare soil PCLE zone.

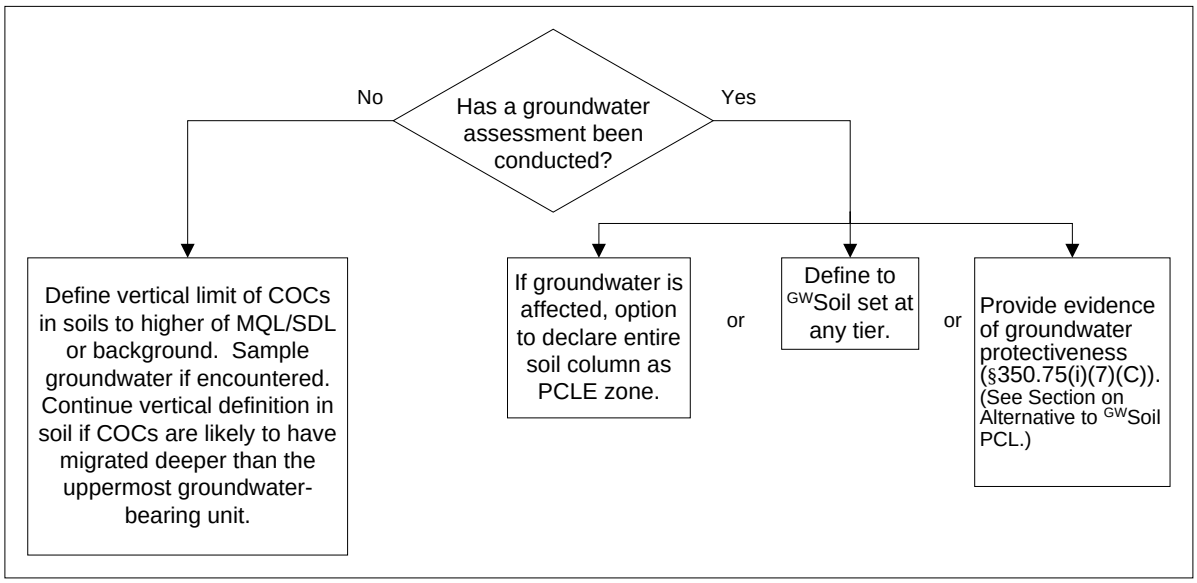

Figure 4. Vertical Soil Delineation..

Defining the Affected Property

The affected property includes the entire on-site and off-site extent of environmental media (soil, groundwater, air, surface water and sediment) with COC concentrations equal to or greater than the assessment level applicable for residential land use and the groundwater classification. The affected property is a three-dimensional determination of affected environmental media.

Figure 5 illustrates several key points about an affected property. First, the extent of an affected property is not limited by real estate boundaries. As can be seen in Figure 5, an affected property can extend over different property holdings (i.e., onto on-site property and off-site properties). Assessments will frequently need to progress onto off-site properties.

Further examination of Figure 5 also reveals that an affected property can be comprised of different affected environmental media. For example, an affected property can be comprised of affected surface soil, affected subsurface soil, and/or affected groundwater. Affected sediment and surface water can be part of an affected property. All of the environmental media *affected* by a

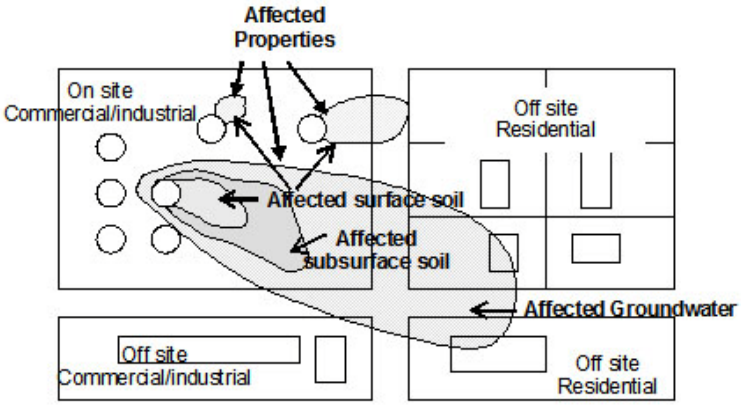

Figure 5. Relationship Between Affected Media, the Affected Property, and Property Boundaries (map view)..

given release incident comprise the affected property.

Determine the extent of the affected property by a *direct comparison* of the measured concentration for each COC at each sampling location in each environmental medium to the applicable assessment level. All those sampling locations with COC concentrations in excess of the assessment level constitute the affected property. COC concentrations within a specific medium may be contoured by inference and interpolation between data points, or by other means appropriate for evaluation of the affected property limits. It is not appropriate to use an average of COC concentrations to identify the affected property. Refer to *Determining Representative Concentrations* (RG-366/TRRP-15) for more information on when averaging can be used and acceptable statistical methods for averaging.

In some instances, the direct comparison approach to defining the affected property will result in a "Swiss cheese" effect where the "holes" in the affected property are areas where measured concentration levels are less than the assessment level. In general, the person has the discretion to "lump" the concentration "holes" into the affected property, or to exclude the concentration "holes" from the affected property as is preferable to the person upon considering such factors as real property line boundaries, notification implications under §350.55, or other factors such as data sufficiency upon which to define the concentration islands. There is further discussion of the issue of "holes" in the Defining the PCLE Zone section of this document.

Finally, Figure 5 illustrates that there may be more than one affected property at any given property or facility. If there are release incidents affecting different portions of environmental media, then there are affected properties for each of those release incidents.

Conduct the assessment in a manner most likely to detect the presence and distribution of COCs above the applicable assessment level considering the nature of the release and site conditions. Collect representative samples from all environmental media that are, or could be, affected by tailoring the sampling regime to each situation based on the location and type of release, COC characteristics, and geologic and hydrogeologic considerations. Use rapid assessment techniques (e.g., push tools, narrow diameter wells, on-site analytical) when appropriate as discussed in TCEQ guidance document *Affected Property Assessment Planning* (RG-366/TRRP-6). Anticipate the need for appropriately located monitoring points for long-term monitoring. Ongoing groundwater monitoring is critical to identify and evaluate the trends in COC concentrations and distribution, groundwater flow, geochemical parameters, and groundwater gradient information that are important for determining appropriate response actions. The number and location of sampling points, as well as sampling depth, are site-specific depending on

the nature and location of the release, characteristics of the COCs, the geology and hydrogeology of the area, and other site-specific factors.

As an example of defining the affected property, Figure 6 depicts a subset of all the sampling points and COC X concentrations measured at each of these sampling locations. The same property is illustrated in Figure 7 with the affected property depicted. The applicable assessment levels for COC X are presented in Table 6. In this example where soil and groundwater are the only affected environmental media, the affected property is the extent of soil and groundwater that contains COC concentrations in excess of the assessment levels. Because of this, the residential soil depths are used regardless of the land use of the property. Therefore, as illustrated in Figure 7, the affected property consists of all locations with COC X concentrations in excess of the assessment levels presented in Table 6, both on the on-site commercial/industrial property and on the adjacent residential property (based on 0.5-acre source area size).

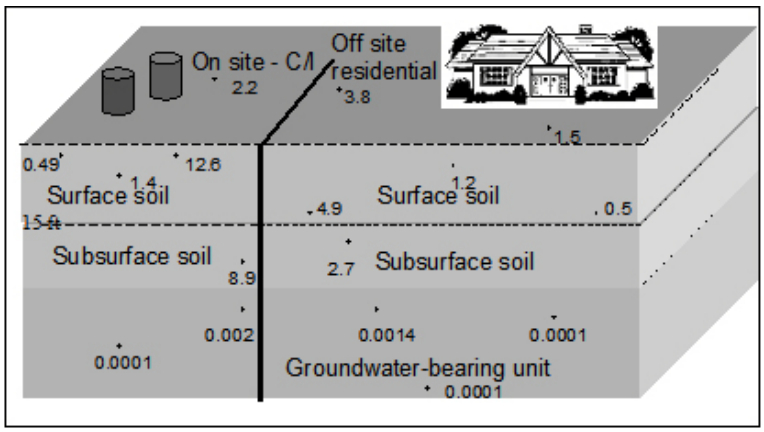

Figure 6. Sampling points and COC X concentrations (mg/kg and mg/L).

Table 6. Defined Assessment Levels for COC X

Environmental Medium	Exposure Pathway	Tier 1 PCL Value	Assessment Level
Surface soil	$^{Tot}Soil_{Comb}$ **or** $^{GW}Soil_{Ing}$	0.56 mg/kg **or** 7.6 mg/kg	0.56 mg/kg
Subsurface soil	$^{Air}Soil_{Inh\text{-}V}$ **or** $^{GW}Soil_{Ing}$	850 mg/kg **or** 7.6 mg/kg	7.6 mg/kg
Class 2 groundwater	$^{GW}GW_{Ing}$ **or** $^{Air}GW_{Inh\text{-}V}$	0.0002 mg/l **or** 390 mg/l	0.0002 mg/l

Soil Assessment

As previously discussed, the vertical assessment typically will need to be completed to the MQL or background concentration in order to definitively determine whether groundwater is affected. Focus the vertical assessment on evaluating the distribution and maximum concentration of COCs in the soil source area to identify the areas of maximum concentration. Investigate the vertical extent of the COC in soil to background concentrations, to the MQL, or to the upper-most groundwater-bearing unit. Ideally, a demonstration will be made that COC concentrations decrease with depth. To present the best case, show a separation between the vertical limit of the COC (that is, above background concentration or the MQL) and groundwater, but this is not mandatory. Although the vertical assessment is conducted to the MQL or background concentration, the affected property is determined using the assessment levels. In other words, the lower limit or extent of the affected property in soil is not based on background or the MQL unless one of those values is the assessment level. Map the affected soil in both cross-sectional and planar views using the assessment level.

Tier 2 or 3 ^{GW}Soil PCL

Note that use of a Tier 2 or 3 $^{GW}Soil_{Ing}$ PCL in the example in Table 6 would only impact the subsurface soil assessment level. Only consider developing Tier 2 or 3 $^{GW}Soil_{Ing}$ PCLs for the assessment level when the Tier 1 $^{GW}Soil_{Ing}$ PCL is limiting the assessment level (i.e., the lowest value).

Not every boring has to be drilled to groundwater, the MQL, the background concentrations, or even to the assessment level. For example, some borings may be intended to characterize the nature of the source area. However, a sufficient number of appropriately located sampling points must be used to define the vertical extent of affected soil and to determine the potential for an impact to groundwater-bearing units.

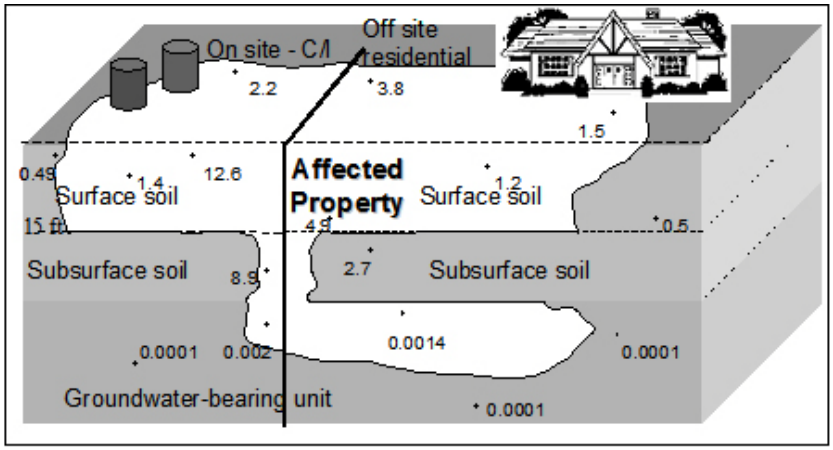

Figure 7. Affected Property Determination (mg/kg and mg/L).

In some instances a groundwater investigation may be warranted despite conclusions drawn from the soils assessment that groundwater is not affected. Some examples of such instances may be:

- where a mobile COC is released into highly permeable soil such that lateral spreading is minimized and therefore the chances of missing the presence of COCs in the soils are large;
- areas with highly fractured or karst geology;
- high density of groundwater use in the area; or
- a groundwater impact in the area is documented by other information and the property in question is being evaluated to determine if it is a possible source of the affected groundwater.

Note that when groundwater is not encountered within an assessed soil interval it does not mean that there is no threatened groundwater beneath the affected soil zone. The person must still develop assessment levels and PCLs to protect against impact to the underlying groundwater. Assume the upper-most groundwater at an affected property is Class 1 groundwater unless site-specific data prove the groundwater is Class 2 or 3.

Groundwater Assessment

If the uppermost groundwater-bearing unit is encountered before the vertical limit of COCs is determined (COC concentration greater than background concentrations or the MQL), then collect representative groundwater samples. Define the vertical extent of COCs in groundwater to below the assessment level. This requirement is met by collecting a representative sample from within an affected groundwater-bearing unit at a depth that represents the vertical limit of COC transport in that unit, or by collecting a representative groundwater sample from a deeper groundwater-bearing unit with concentrations less than the assessment level.

Note that some COCs, tetrachloroethylene for example, have a specific gravity greater than that of water and relatively high mobility characteristics in the subsurface environment. Because of this, such COCs have a natural tendency to migrate downward when present at aqueous concentrations near saturation or as a NAPL. In such situations, discrete vertical sampling to the bottom of the groundwater-bearing unit and possibly sampling of the deeper groundwater-bearing units may be necessary, depending on the hydrogeologic factors and COC chemical/physical properties.

If there is the potential for cross-contamination of the deeper groundwater-bearing unit, avoid drilling in the proximity of COCs until particular caution can be taken during drilling and well installation to prevent cross contamination between the upper groundwater bearing unit to the lower groundwater bearing unit. In this situation, evaluate the deeper groundwater-bearing unit by sampling at a sufficient number of

appropriate locations outside the COC-affected groundwater in the upper groundwater-bearing unit then working inward, or by sampling existing water supply wells if appropriate considering well design, construction, and relevant proximity. Remember that the groundwater gradient or COC flow direction may be different in the deeper zone. The deeper zone may also be a different groundwater resource classification than the shallower zone.

If migration to another, deeper groundwater-bearing unit is not possible (i.e., reasonably probable) based on the nature of the hydrogeology and the chemical and physical properties of the COCs, it is not necessary to sample the deeper groundwater-bearing unit. For example, if a person demonstrates that a sufficient thickness and lateral extent of a confining layer underlies the first groundwater-bearing unit, it may not be necessary to sample the deeper unit to determine if it is affected.

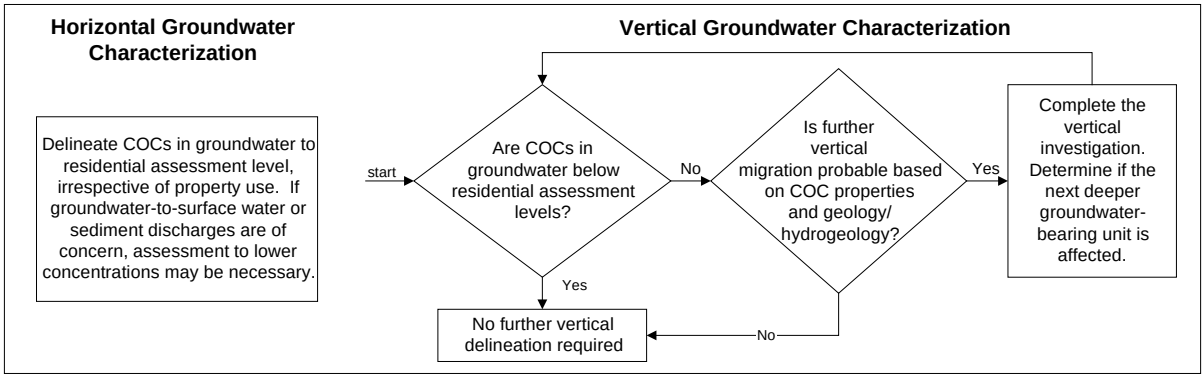

Figure 8. Groundwater Delineation Criteria

In order to complete the assessment of affected groundwater, define the extent of COC concentrations in groundwater that exceeds the assessment level both on site and off site. Figure 8 illustrates the logic that can be followed to comply with the groundwater assessment requirements.

Figure 9 is an example of the horizontal delineation of a COC X impact to groundwater. This example assumes that there is no threat of surface water impact and no ecological concerns. The assessment level for COC X as illustrated is 0.0002 mg/L.

As illustrated in Figure 9, the assessment was conducted by installing groundwater monitoring points or wells and collecting groundwater samples for measurement of COC concentrations in the groundwater. The assessment is not completed until the extent of COC concentrations in excess of the assessment level is determined. In this example, the assessment had to be extended to off-site properties. The extent of concentrations in excess of assessment levels must be adequately defined, but this does not necessarily mean that the groundwater at each individual tract of land within the limits of the affected property has to be

sampled. The location of each sampling point should be carefully considered and purposeful.

Surface Water and Sediment Assessment

Surface water bodies and associated sediments within or near the affected area should be initially considered as potential exposure pathways. The need to assess a surface water body should be based on probable migration pathways, including surface runoff as well as groundwater discharge to surface water and sediment. Do not ignore drainage ditches or intermittent streams that transport runoff to increasingly larger streams. When investigating potential groundwater-to-surface water discharge, sample the groundwater at or immediately upgradient of the zone of groundwater discharge to surface water to determine if COCs in groundwater have or are likely to discharge to surface water or sediment. Further assessment of the discharge area, such as seeps, sediments, and springs, will likely be needed should the monitoring points indicate the presence of COCs.

A common issue with regard to surface water is deciding when it is threatened or affected by a release. For example, an assessment is conducted to define the affected groundwater. Within a few hundred feet downgradient of the affected groundwater, a surface water body is present. Because assessment levels are not readily available for all surface water or sediment exposure pathways, conservatively evaluate the reasonable potential for the groundwater COC to reach the surface water body or sediment at a concentration in excess of the higher of background concentrations for the COC, or the MQL for the most sensitive standard available method. Consider factors such as potential for hydraulic connection between groundwater and surface water, observed rate of COC concentration attenuation with distance, and other related factors. In instances where groundwater could be discharging to surface water in excess of MQL/background concentrations, assess the extent of COC concentrations in groundwater in the direction of flow to surface water to the MQL or background concentrations to determine if the COCs are reaching the surface water body. If the COCs are reaching the surface water body, then PCLs for the surface water body and/or sediment must be established.

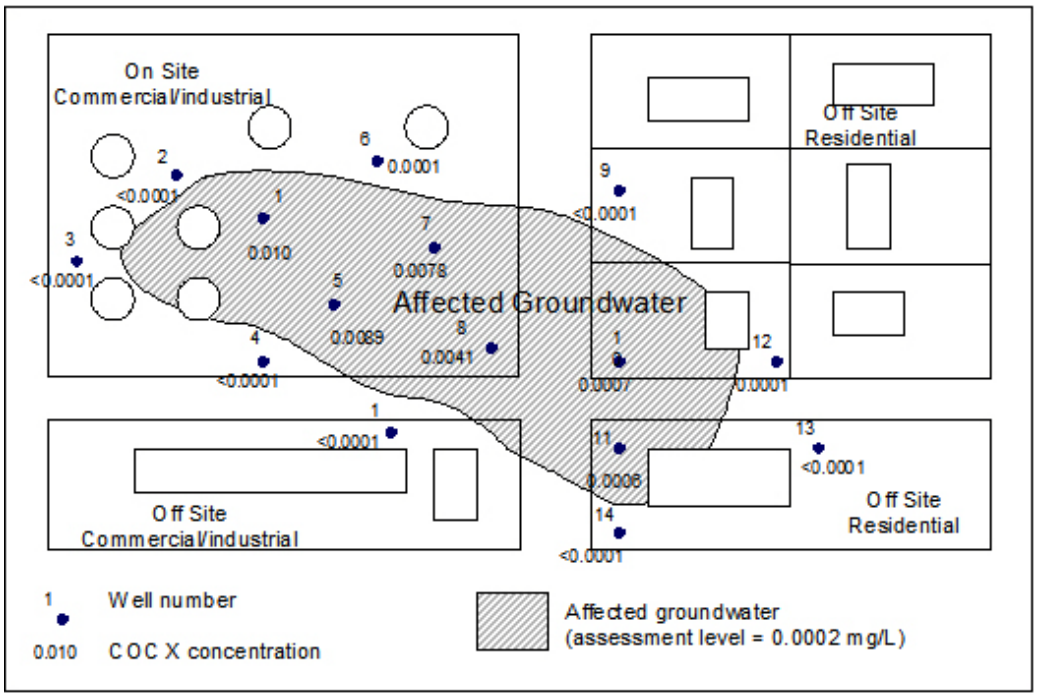

Figure 9. Horizontal Delineation of COC X in Groundwater.

Refer to the document *Determining PCLs for Surface Water and Sediment* (RG-366/TRRP-24) for additional information on surface water and sediment assessment. Monitor groundwater at the point of discharge to surface water to determine the COC concentrations discharging to surface water [§350.51(f)]. When evaluating groundwater discharges to surface water, the rule limits use of surface water samples to confirmation of a groundwater-to-surface water dilution factor, or to ensure that discharging groundwater plumes do not result in exceedances of surface water quality standards in significant areas of the surface water body [§350.75(i)(4)(F)]. Certainly, where a surface water body receives COCs from multiple current and historical sources from the same affected property (for example, from groundwater, direct discharge, and surface runoff) it is appropriate to sample the surface water. With regard to sediment, sediment sampling is usually necessary when there is a release to a surface water body.

Assessment Levels and Affected Property in the APAR

The size and extent of the affected property may range from a large area that includes the entire on-site property and several off-site properties, to a small portion of a single property. There may be more than one affected property on a given facility, particularly when there are multiple, separate source areas at a large property. The affected property is a composite of the individual affected properties for each COC. Take into account all affected environmental media to map out the horizontal and vertical

extent of the affected property. For example, even though COCs in soils at the ground surface may encompass only a small area, the extent of any COCs in the groundwater also defines the extent of the affected property on-site and off-site. Illustrate the affected property in the Affected Property Assessment Report (APAR) form (TCEQ-10325/APAR) using maps and cross sections and provide supporting documentation for the determination of applicable assessment levels, particularly when using Tier 2 or 3 PCLs as the assessment level (e.g., ^{GW}Soil). Information for different COCs can be consolidated into as few maps and cross-sections as possible, provided the information is legible and readily discernable.

Defining the PCLE Zones

Under TRRP, the assessment process is not only to identify the affected property, but also to collect sufficient data to identify the PCLE zones for all affected environmental media. Therefore, do not just focus the assessment on determining the edge of the COC extent, but also provide sufficient detail within the affected environmental media to identify the areas requiring a remedy.

The PCLE zone is the volume of an environmental medium affected by a COC in excess of the critical PCL, and is that portion of the affected property that must be addressed with a remedy (either through removal, decontamination, or control). Detailed delineation of PCLE zones is necessary to effectively evaluate options for, and the design of, response actions. If the COC concentrations in an environmental medium are all below the PCLs and the environmental medium has been adequately assessed, then a response action for that COC in that environmental medium will not be needed.

The PCLE zone differs from the affected property in that the PCLE zone is based on the critical PCL (commercial or residential, Tier 1, 2 or 3), whereas, the affected property is defined by the assessment level. In some situations, particularly when the critical PCL is based on Tier 1 residential levels, the affected property and the PCLE zone will be the same. In many cases, however, the PCLE zone will be a smaller volume than the affected property because the critical PCL can be a different (and usually higher) concentration than the assessment level.

Define Critical PCLs

The critical PCL can be human-health based, ecological-based, or either the MQL, or background concentrations when those are higher. It is simply the lowest of the values considering each of the applicable PCLs for an environmental medium. For discussion purposes, the term critical PCL includes not only the lowest risk-based PCL, but also the MQL or

background concentrations if those are higher values. The term critical PCL is introduced in the rule for convenience in explaining the basis for a PCLE zone. However, in practice, compliance with each individually applicable PCL must be evaluated on its own merit. Refer to the discussion in the rule at §350.78(c). For details on determining critical PCLs, refer to the TCEQ document *Critical PCLs* (RG-366/TRRP-25).

Keep in mind that the definitions of surface soil and subsurface soil differ depending on the land use, and therefore, the critical PCL may be different with a corresponding change in the volume of environmental media exceeding the critical PCL. For example, if the on-site property is commercial/industrial, apply the critical PCL for surface soil to the upper five feet of soil. If the COCs extend off site onto residential property, apply the critical PCL for surface soil to the upper fifteen feet of off-site soil and the critical PCL for subsurface soil to the off-site soil below fifteen feet in depth.

Figure 10 is an example of how the PCLE zones can differ based on land use and environmental media. This figure illustrates the PCLE zones in both a map view and cross-sectional view at a hypothetical affected property for COC X. Again, only a subset of all sampling points is depicted. The critical PCLs for COC X using Tier 1 PCLs are listed in Table 7 (based on 0.5-acre source area size). Note in Table 7 that the critical PCLs are different for the surface soil for the residential and commercial/industrial property. This is because those critical PCLs reflect the different values for $^{Tot}Soil_{Comb}$ for commercial/industrial and residential property. However, also note that the critical PCLs are the same for the subsurface soil in Table 7. The combination of several factors results in this. First, note that for both land uses the $^{GW}GW_{Ing}$ PCL for COC X, from which $^{GW}Soil$ is derived, is the same value. This will be the case when there is a federally promulgated maximum contaminant level (MCL) for a COC. When there is an MCL for a COC, the $^{GW}GW_{Ing}$ PCL for that COC is the same value for residential and commercial/industrial land use. Second, the $^{GW}Soil$ PCL for both land uses in this example is based on Tier 1 and the same source

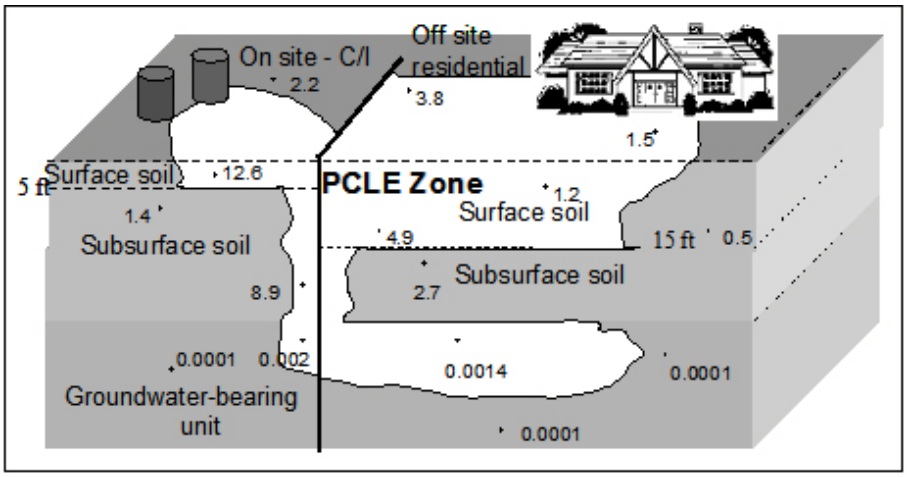

Figure 10. PCLE zone determination (mg/kg and mg/L).

area size. Therefore, the resulting $^{GW}Soil_{Ing}$ PCL is the same value for the two different land uses in this example.

Also, note that on the commercial/industrial property, the surface soil zone extends to a depth of 5 feet while on the residential property it extends to 15 feet (Figure 10). Thus not only does the critical PCL differ between the two properties, but the depth at which it applies also differs. Again, the critical PCL for subsurface soil is the same value for the two properties in this example, but the depths at which it applies are different. Therefore, the PCLE zones on commercial/industrial and residential properties are based on different information and as such, the PCLE zone at boundaries between commercial/industrial and residential properties can have some interesting "edge" effects (Figure 10).

Table 7. Example Critical PCLs for COC X in Figure 9.

Environmental Medium	Critical PCL for Residential Land Use	Critical PCL for Commercial/Industrial Land Use
Surface soil	0.56 mg/kg	2.4 mg/kg
Subsurface soil	7.6 mg/kg	7.6 mg/kg
Groundwater (Class 1 or 2)	0.0002 mg/L	0.0002 mg/L

Defining the PCLE Zone

Compare the concentration of the COC in samples from the affected property to the critical PCL to determine the extent of the PCLE zone. The simplest way to do this is to directly compare the COC concentration at each sampling point to the critical PCL and delineate the PCLE zone in that manner. COC concentrations within a specific medium may be contoured by inference and interpolation between data points, or by other means appropriate for evaluation of the PCLE zone limits. If direct comparison is used, the same concentration "Swiss cheese hole" phenomenon can occur as discussed in the affected property discussions. Likewise, the person has discretion whether to lump in or exclude the concentrations "holes" into the defined PCLE zone. However, concentrations in excess of the critical PCL cannot be allowed to encroach into those holes. PCLE zones are generally not allowed to expand [§350.32(f), §350.33(f)(1)(B), §350.37(l)(3)(B)]. This is most significant when the "hole" corresponds to an off-site property that does not otherwise contain the PCLE zone.

There is an option to use statistical methods to calculate a representative concentration of the COC and to then compare that statistically-derived representative concentration to the critical PCL to define the PCLE zone. Refer to *Determining Representative Concentrations* (RG-366/TRRP-15) for details on statistical representation of concentration data and for statistical comparisons to critical PCLs.

Present PCLE Zone in APAR

If there are determined to be any soil and/or groundwater PCLE zones, then illustrate the zone(s) in map view and in cross-sections in the APAR using iso-concentration lines for each COC in each environmental medium. The PCLE zone map(s) and cross-section(s) illustrate the extent of environmental media that requires a response action for that COC. Document the derivation of any Tier 2 or 3 PCLs and any other information used to determine the critical PCL and the PCLE zones. Information for different COCs can be consolidated into as few maps and cross-sections as possible, provided the information is legible and readily discernable.

Comparison of Affected Property and PCLE Zone

Table 8 outlines the differences between the assessment level and the critical PCL. As noted, the assessment level is a conservative (more stringent) value based on residential exposure criteria for the human health PCLs whereas the critical PCL encompasses all the flexibility allowed by rule for determining PCLs at any tier and for the applicable land use. See TCEQ guidance documents *Tiered Development of Human Health PCLs* (RG-366/TRRP-22) and *Guidance for Conducting Ecological Risk Assessments for Remediation Sites in Texas* (RG-263 (revised)) for detailed explanation of the tiered processes to calculate human health and ecological PCLs.

Table 8. Distinction Between Assessment Level and Critical PCL.

	Assessment Level	Critical PCL
Use:	Defines the affected property (delineation criteria)	Defines the PCLE zone (cleanup criteria)
Based on:	Tier 1 residential human health PCLs (except the ^{GW}Soil PCL which can be Tier 1, 2 or 3), ecological screening benchmarks (Tables 3-1 to 3-4 of RG-263 (revised)), Tier 2 or 3 ecological PCLs, MQL, background concentrations	Human health PCLs at any tier and for either land use, Tier 2 or 3 ecological PCLs, MQL, background concentrations
Implication:	Standard values	Allows more site-specific inputs

Like the affected property, the PCLE zone is also comprised of affected environmental media, but in this case, the PCLE zone is the lateral and vertical extent of all environmental media within an affected property that contains COCs at concentrations greater than the critical PCL. The PCLE zone is the volume of environmental media that must be removed, decontaminated, and/or controlled in some fashion to adequately protect human health and the environment [§350.4(a)(69)]. Therefore, for each affected property, there may or may not be a PCLE zone (Figure 11). If

there is no PCLE zone, then no response action is necessary. The size of a PCLE zone should never be larger than its associated affected property, and it may be substantially smaller than the affected property.

To gain additional insights, compare Figures 7 and 10 to see the contrast between the affected property and the PCLE zone in this example. The affected property for both the commercial/industrial property and the residential property is based on Tier 1 residential assessment level of 0.56 mg/kg for surface soil, 7.6 mg/kg for subsurface soil, and 0.0002 mg/L for groundwater (Figure 7). Because Tier 1 PCLs are used, the assessment levels and critical PCLs are the same for the residential property. However, the PCLE zone on the commercial/industrial property is different from the affected property (Figure 10). This is due to the different surface soil depths and use of commercial/industrial critical PCLs as opposed to residential assessment levels. Therefore, when using Tier 1 assessment levels and PCLs, the affected property and the PCLE zones are identical except on the commercial/industrial property where exposure pathways for commercial/industrial property use can be applied in determining the critical PCL.

Special Considerations

The following section addresses some particular considerations the person must take into account when conducting the affected property assessment.

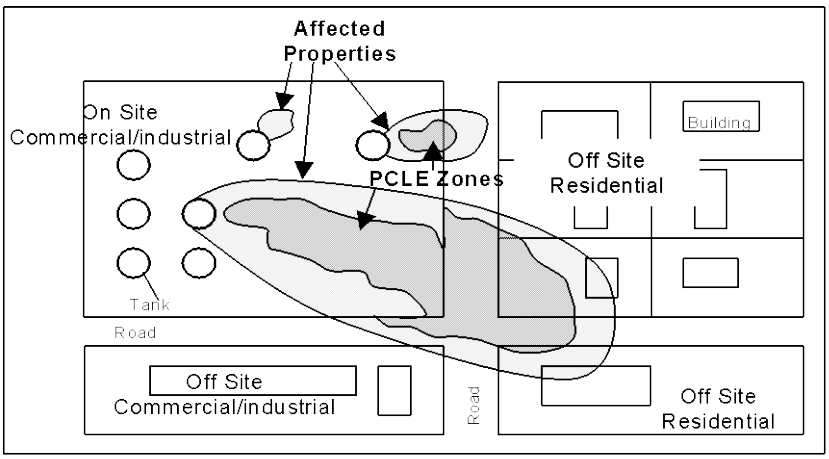

Figure 11. Relationship Between Affected Properties and PCLE Zones.

Figure 11. Relationship Between Affected Properties and PCLE Zones..

Actual Exposures or COC Migration

If actual exposure conditions exist or other immediate steps are necessary to prevent exposure or continued COC migration, report such situations to the TCEQ Region Office and initiate interim response actions to prevent further exposure and address COC migration [§350.1]. The interim actions must be carefully considered to address all relevant exposures. For example, if a household is exposed to COCs in well water through drinking water and showering, then the provision of bottled water for drinking is not adequate to prevent exposure to the COCs if the residents are still showering in the affected water. The person does not have to complete the assessment before conducting an interim response action to

reduce risks or COC migration (§350.1). Such response actions could include mitigating emergency situations, removing the source of COCs and source media, abating the spread of COCs, and limiting exposure to COCs. Early source abatement may reduce costs and the time necessary to complete the project. When there are exposure concerns, the person needs to ensure compliance with §350.55. See TCEQ guidance document *Notification Requirements* (RG-366/TRRP-17) for further information.

Focused On-Site Soil Assessment

Delineation of COCs in on-site soils can be "focused" on defining the PCLE zone rather than defining the exact on-site limits of COCs exceeding the residential assessment level. This is a strategy that allows the person to concentrate the bulk of on-site data collection to the area that most likely will require a response action (the PCLE zone). This option is available for both commercial/industrial and residential land uses.

When conducting a focused assessment of on-site soils, emphasis is mostly placed on defining the COC concentrations in on-site soil to the *critical PCL* rather than to the assessment level. Even though the focus of the on-site soil assessment is to the critical PCL, always determine if COC concentrations extend off site above the assessment level. Keep in mind that the assessment level uses residential land use assumptions for the human health exposure pathways and that these residential values apply even if the adjacent property is used for commercial/industrial purposes. Collect samples to verify that COCs above the assessment level are not present off site by stepping out from the on-site soil PCLE zone and sampling near the property boundary or sampling the off-site property. If COCs are found or are likely to occur off site above the assessment level, continue the assessment off site to fully delineate the COCs to the assessment level.

Remember that a commercial/industrial land use assumption requires the filing of an institutional control in the deed records with landowner consent. See TCEQ guidance documents *Land Use Classification* (RG-366/TRRP-7) and *Institutional Controls* (RG-366/TRRP-16) for further information on commercial/industrial assumptions.

NAPL

Non-aqueous phase liquid (NAPL) entails special considerations for both assessment and response actions. When there is a possibility of NAPL being present, conduct the sampling and direct the assessment so that NAPL can be detected, delineated and characterized as well as assessing conditions that control the NAPL distribution and mobility. See *Risk-Based NAPL Management* (RG-366/TRRP-32) for details regarding NAPL.

Human Health and Ecological Assessments

Use the Tier 1 Ecological Exclusion Criteria Checklist and a site visit during the planning phase of the assessment to determine if ecological issues are of concern. If the affected property fails the checklist (and the reasoned justification or the expedited stream evaluation[1] does not result in the conclusion of the ecological risk assessment process), plan the sampling so that data from appropriate areas and depths to evaluate ecological risks are obtained during the fieldwork phase even if the actual ecological risk assessment evaluation is conducted at a later time. Define the affected property using only human health assessment levels except in areas where ecological issues are of concern (viable exposure pathways). Additionally, ecological screening benchmarks and PCLs may apply to only a portion of the affected property depending on site conditions. For instance, ecological screening benchmarks and PCLs may apply to a portion of exposed soils, but not to the soils covered by a paved parking lot. For example, as depicted in the example illustrated in Figure 12, only human health exposure pathways are of concern for Affected Property A and the southern portion of Affected Property B because they are developed and typified with human activity making them unsuitable ecological habitat. In contrast, human health and ecological exposure pathways must be evaluated in the northern portion of Affected Property B because it is undeveloped, and because surface water is involved. In ecological concern areas, delineate COCs to ecological screening benchmarks [see Tables 3-1 to 3-4 of TCEQ guidance document *Guidance for Conducting Ecological Risk Assessments at Remediation Sites in Texas* (RG-263 (revised))]. Alternatively, consider delineation to the MQL or background concentrations to avoid additional mobilizations should a subsequently established ecological PCL turn out to be less than the human health-based assessment level (background concentrations and MQLs are practical limits for ecological PCLs too). However, because Tier 2 or 3 ecological PCLs typically will need to be developed, which in some instances can be an involved process, there may be site-specific need to initiate the assessment based only on human health considerations, and risk that additional remobilization might be needed to address the ecological assessment levels.

If the MQL or background concentrations are not used to delineate COCs in areas of ecological concern, further sampling and analysis to define the affected property may be necessary if the ecological PCLs turn out to be lower values than the human health PCLs (i.e., the critical PCL), and a response action will not otherwise be required that will also address the ecological exposures.

[1] Some sampling information is required for the expedited stream evaluation. See Section 2.0 of TCEQ guidance document *Guidance for Conduction Ecological Risk Assessments at Remediation Sites in Texas* (RG-263 (revised)) for further information.

If there is the potential for ecological concerns, plan ahead to sample at the appropriate depths. Surface soil for ecological concerns is from 0 to 0.5 feet and subsurface soil is from 0.5 feet to 5 feet. Appropriate sediment sample depths will vary depending on the exposure route and receptor in question. Refer to *Guidance for Conducting Ecological Risk Assessments at Remediation Sites in Texas* (RG-263 (revised)) for details on the ecological assessment process.

If the extent of the affected property is larger than originally estimated, it may be necessary to revise the information in the Tier 1 Ecological Exclusion Criteria Checklist after the assessment using the human health-based PCLs is completed.

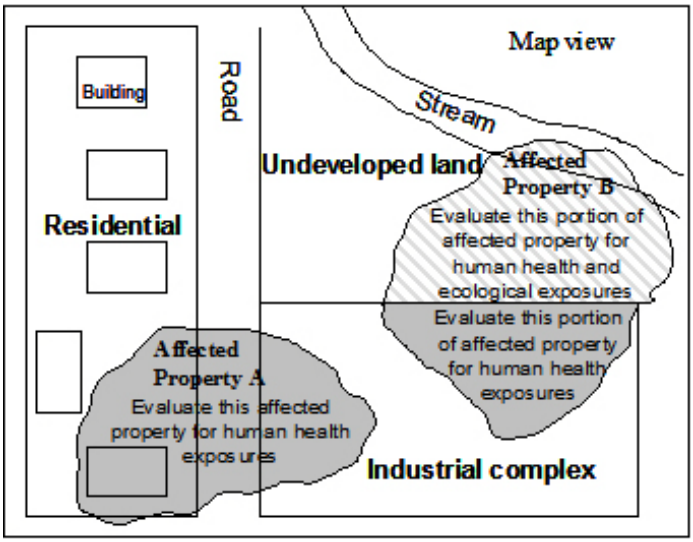

Figure 12. Areas of interest for ecological and human health exposure pathways..

Logistical Limitations

During the planning phase of the assessment, consider the need of obtaining access to off-site properties in order to fully evaluate the potential for exposure to human or ecological receptors. If access to other properties is needed, approach the off-site property owners early in the process so the fieldwork portion of the assessment can proceed as expeditiously as possible. When access to a property is denied, consider alternatives, particularly with regard to obtaining access to rights-of-way and easements. Not every property within the limits of the affected property has to be sampled. The location of each sampling point should be carefully considered and purposeful. When access is being denied to a property critical to the assessment, contact the TCEQ project manager for possible assistance.

Site logistics may complicate delineating COCs horizontally to the assessment level, but situations where the extent cannot be fully determined due to logistical constraints will be relatively rare. For example, COC concentrations extend beneath a highway and there is no feasible way to determine the extent of affected property beneath the highway. In some situations, the person may be able to reliably project a boundary of the affected property if the data presents a consistent gradient or trend. Exhaust all reasonable possibilities for site access and sampling alternatives before resorting to projecting affected property boundaries.

Existing physical controls such as caps, paved parking lots, and buildings can serve as physical controls to prevent direct contact exposure, act as vapor or particulate (wind dispersal) barriers, and reduce infiltration of rainwater that may mobilize COCs deeper into the subsurface. The person may focus the assessment activities beyond the physical control and reduce the degree of assessment within the limits of the physical control when the physical control will be used as part of a Remedy Standard B response action. However, some assessment may be necessary to evaluate threats to underlying groundwater within the area within the physical control. Evaluate the exposure pathways and develop PCLs along with evaluating the adequacy of the physical control.

The presence of a physical control has no bearing on the determination of the size of the source area for purposes of defining the affected property. For example, if the area of surface soil exceeding the assessment level is 1.5 acres, but 1 acre of that is beneath concrete, the assessment level will still be based on 30 acres because the area affected is larger than 0.5 acres but less than 30 acres. However, if that physical control will be formally proposed and used as an effective Remedy Standard B remedy, then the area beneath the physical control can be subtracted out of source area size determination for purposes of developing a critical PCL for a COC present beyond the limits of the physical control. For example, the source area may be 1 acre in surface area. The person proposes to surface cap 0.2 acres with a parking lot that will effectively prevent exposure. The PCLs for the remaining 0.8 acres not addressed by the cap should only be based on a 0.8-acre source area size.

COC Screening

After completion of the affected property assessment, evaluate whether the COCs can be screened out from PCL development in accordance with §350.71(k). Screening under §350.71(k) is not for the initial process of deciding which COCs are to be assessed. Rather, those rule provisions are for determining which COCs must have PCLs established for evaluating whether a response action is warranted. The significance of this is that PCLs do not need to be considered for screened COCs for purposes of defining the PCLE zone. Assessment levels would have been set for these COCs in advance of the screen, however. For those COCs that cannot be screened from PCL development, establish PCLs for each COC in each affected environmental media. Even if a COC can be screened from PCL development, there may still be a need to monitor for that COC or include the COC in future sampling programs. For example, some COCs degrade to other COCs (daughter COCs) (e.g., tetrachloroethylene degrades through several intermediates to vinyl chloride). Because of a noted absence of a daughter product there may be no need to establish a PCL for it under §350.71(k), but additional monitoring for the daughter COC may be warranted. See TCEQ guidance documents *Selecting Target COCs* (RG-

366/TRRP-10), *Screening Target Chemicals of Concern from PCL Development* (RG-366/TRRP-14), and *Monitored Natural Attenuation Demonstrations* (RG-366/TRRP-33) for further information on COC selection, screening, and COC degradation, respectively.

Critical PCLs and Cumulative Adjustments

For human health pathways, if there are more than ten carcinogens or more than ten noncarcinogens within a single environmental medium, conduct a cumulative evaluation to determine if PCLs must be adjusted to lower levels. Keep in mind that additional sampling will be necessary to further define the PCLE zone if the completed assessment did not delineate concentrations to levels equal to or lower than the adjusted critical PCL. This emphasizes the need to conduct significant upfront planning and to continually evaluate data as the assessment progresses to avoid additional mobilizations. The extent of affected property will necessarily expand to encapsulate PCLE zones in the event the cumulatively adjusted PCLs are less than assessment levels. See TCEQ guidance document *Risk Levels, Hazard Indices, and Cumulative Adjustments* (RG-366/TRRP-18).

Alternative to ^{GW}Soil PCL

The vertical soil assessment provisions of §350.51(d)(2) reference another section of the rule: §350.75(i)(7)(C). Under §350.75(i)(7)(C), the person might not be required to establish the ^{GW}Soil PCL when the demonstration can be made, using appropriate data, that the existing soil COC concentrations will attain the soil response objectives for groundwater protection. The implication of including the §350.75(i)(7)(C) reference in §350.51(d)(2) is that the ^{GW}Soil PCL would not need to be considered in establishing an assessment level for that COC.

The §350.75(i)(7)(C) demonstration must use a weight-of-evidence approach considering, for example, soil sampling data (vertical extent, distribution, and maximum concentration of the COC, pattern of concentration attenuation with depth), COC properties, COC concentration trends in groundwater, probable time since release, identification of soil source areas, appropriate leachate tests, or other geologic, hydrogeologic or property-specific information. Not all of this information is necessarily required as part of any one demonstration, but there must be sufficient technical basis to support the demonstration.

An example demonstration using multiple lines of evidence is as follows. An assessment for lead at an affected property indicates that the lead was released 20 years ago, groundwater is at 10 feet in depth, and the lead is found in excess of the background concentration in only the upper 0.5

feet of soil. Based on the time since release, the limited extent of lead in the soil and the depth to groundwater, the low theoretical mobility of lead based on chemical and physical properties and site-specific soil properties, the conclusion is that groundwater is not affected or threatened by the lead. These conclusions would be supported with maps and cross-sections with COC concentrations, boring logs, appropriate and relevant soil property and hydrogeologic data (not necessarily site-specific data), and facility history information with regard to lead management. When such demonstration is approved by TCEQ, it is not necessary to establish a ^{GW}Soil PCL that is used to determine a critical PCL or assessment level for the lead. However, in this example, $^{Tot}Soil_{Comb}$ and any other reasonably anticipated to be completed surface soil exposure pathway would need to be considered in determining a critical PCL and assessment level for lead.

The rule provision may also prove a convenient and appropriate relief for situations where typically mobile COCs, such as solvents, are released into geologic formations that regionally are not considered as groundwater-bearing units and may function more as an aquitard (e.g., the Austin Chalk and Eagle Ford Shale in the Dallas area). In some instances, the groundwater-bearing unit may actually be at subsurface depths of 300-400 feet below the aquitard such that the potential for a significant impact to the deep groundwater is minor. In such situations, an evaluation of the rate of attenuation of the soil COC concentrations with depth, geologic cross-sections, and a determination of the depth to groundwater based on local or regional geologic information may be sufficient for making a demonstration. A demonstration will need to be made for each remediation case.

The specific conditions or levels of demonstration as presented in the examples are not definitive or binding for purposes of establishing guidance. For example, at another affected property the use of soil pH measurements or leachate tests, and/or groundwater data demonstrating that there is no impact to groundwater or that COC concentrations in the groundwater source area are declining may be needed to further bolster the demonstration. The key points of the examples are that demonstrations will need to be based on multiple lines of evidence and that sufficient COC assessment is needed to support the demonstration, but the appropriate level of information will vary with the situation.

If groundwater is affected, groundwater monitoring will typically be required for verification purposes as part of the demonstration of §350.75(i)(7)(C). In some instances, sufficient groundwater monitoring data may already be available. For example, quarterly groundwater monitoring data or Resource Conservation and Recovery Act (RCRA) compliance monitoring data that are relevant for the COC, area of interest, and time-period of interest, and that are of sufficient quality may be available for use. When such is not the case, then consider the timeline on which the assessment is progressing. If there is insufficient time to get

additional groundwater data for verification, then it may be best to forego use of §350.75(i)(7)(C).

Waste Control Units

A waste control unit (WCU) is a municipal or industrial solid waste landfill, including those RCRA regulated units closed as landfills, with a liner system (i.e., synthetic or clay) and an engineered cap, that has been closed pursuant to an approved closure plan, previous regulations, or will be implemented pursuant to an approved response action plan. Beneath a waste control unit, critical PCLs do not apply [§350.33(f)(2)]. Therefore, assessment of groundwater COC concentrations is not required within the boundaries of the WCU. However, this exception is not extended beyond the perimeter of the WCU. Even if a WCU has not yet been proposed to the TCEQ, go ahead and exercise this exception when there are definite plans to pursue the WCU alternative. Ultimately, if the WCU is not approved, assessment beneath that area may be required. Additionally, assessment of COC concentrations within a currently functioning WCU would typically not be conducted.

Saturated Soils

As stated previously, a primary goal of the vertical assessment is to determine if Class 1, 2 or 3 *groundwater* has been affected. The vertical assessment is complete when the *upper-most groundwater-bearing unit* is encountered before the vertical limit of COCs in soil is determined and based on hydrogeologic and COC properties, and further vertical migration to deeper groundwater-bearing units is not reasonably possible. However, if the uppermost *saturated zone* is not a groundwater-bearing unit (see §350.4(a)(40) and TCEQ document *Groundwater Classification* (RG-366/TRRP-8)), then further vertical assessment may be warranted, as the performance standard is to determine if groundwater-bearing units are affected. Threats or impacts to the *upper-most groundwater-bearing unit* must be assessed (that is, the upper-most groundwater-bearing unit underlying that low hydraulic conductivity saturated zone). Saturated soils that are not groundwater-bearing units (saturated zones with a hydraulic conductivity less than 1×10^{-5} cm/sec) may be assessed using soil PCLs, but in many cases it may be more technically appropriate to use a groundwater assessment level and PCL (e.g., $^{Air}GW_{Inh\text{-}V}$).

Commingled Releases

Frequently, as an assessment progresses, another release may be encountered and found to commingle with the release originally being assessed. In such instances, definition of the COC to the assessment level

may become complicated. To the extent reasonable, assess the COC concentrations to the assessment level. However, when further assessment seems to be unreasonable because it clearly represents the extent of the other release, contact the TCEQ and discuss the matter with a project manager to see if an appropriate endpoint can be resolved.