TCEQ REGULATORY GUIDANCE
Remediation Division
RG-366/TRRP-21 ● Revised March 2009

Human Health Points of Exposure

Objectives: To describe and depict the on-site and off-site locations of the prescribed and alternate human health points of exposure (POEs) to environmental media as presented in §350.37 of the Texas Risk Reduction Program (TRRP) rule.

Audience: TCEQ Project Managers, Regulated Community and Environmental Professionals

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

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.html>

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Introduction

This guidance document describes and depicts the on-site and off-site locations of the prescribed and alternate human health points of exposure (POEs) to environmental media as presented in §350.37 of TRRP. POE locations are prescribed in the TRRP rule rather than being determined on a site-specific basis by a baseline risk assessment as was the case for Standard 3 of the 1993 Risk Reduction Rule (30 TAC 335). A POE is defined at §350.4(a)(66) as "**a location within an environmental medium where a receptor will have a reasonable potential to come into contact with COCs**." However, prescribed POEs are defined at §350.4(a)(67) as "**prescribed on-site and off-site locations within an environmental medium where an individual human or population will be assumed to come into contact with COCs**." For the complete or reasonably anticipated to be completed human health exposure pathways, which are determined in accordance with §350.71(c), the person shall define the POEs to environmental media as described in §350.37. Further details regarding the determination of human health exposure pathways are provided in the TCEQ guidance document titled *Exposure Pathway Evaluations* (RG-366/TRRP-9).

Prescribed POEs are presented in §350.37 for both on-site and off-site exposure of humans to chemicals of concern (COCs). This assures that any on-site response action is also protective of off-site human receptors.

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Also, this document pertains only to human health POEs to environmental media. POEs for ecological receptors are determined on a site-specific basis in response to §350.77(a). Refer to TCEQ guidance titled *Guidance For Conducting Ecological Risk Assessments at Remediation Sites in Texas* for further information on this topic. And finally, a POE may be a discrete point or may, depending upon the circumstances, be a plane, area, or volume. For ease of illustration, the human health POEs in this document are often depicted as points or planes.

The following sections of this document describe: the importance of prescribed POEs; the interrelationship between POEs and institutional controls; the prescribed human health POEs to particular environmental media; and the alternate POEs which may be applicable for class 2 or 3 groundwater.

Prescribed Human Health POEs

The TCEQ decided to use prescribed POEs to environmental media in order to specify the expectations of the agency and to reduce disagreements, thereby accelerating the response action process. By specifying the location where conformance with the protective concentration levels (PCLs) is relevant, a consistent level of performance for protection of human receptors is established. As a result, there will be less chance for the response actions at various affected properties to have unjustifiable differences in the level of protection provided to humans.

The prescribed POEs for the human health exposure pathways specifically listed in §350.71 are set by rule and may not be modified based upon a site-specific risk assessment or exposure scenario analysis. The locations of the POEs at an affected property must be identified. For example, since the POE to class 2 groundwater is defined as being throughout the groundwater protective concentration level exceedance (PCLE) zone, you will be required to identify the lateral and vertical extent of any COCs in class 2 groundwater in excess of the critical groundwater PCLs. Also, if an additional exposure pathway is specified on a site-specific basis, then a site-specific POE for that exposure pathway must be established.

The prescribed POEs are important because they define the locations within an environmental medium where the PCLs for various exposure pathways must be attained or human exposure prevented. The prescribed POEs are also important because they are a critical step in determining the size and location of the various PCLE zones. The PCLE zones are in turn used to define the performance objectives for Remedy Standard A (See §350.32) and Remedy Standard B (See §350.33).

POEs do not dictate where samples of environmental media must be collected. For example, the rule states that the residential human health POE to surface soil is within the upper 15 feet of soils. This does not mean

that all soil borings must be at least 15 feet deep. What this statement means is that all residential surface soil exposure pathways are potentially relevant across this depth interval. The depth of borings and the collection of samples for analysis are established to attain the performance-based affected property assessment objectives stated in §§350.51-350.55. For example, given an affected property where a heavy metal is distributed in shallow clay-rich soils and has not penetrated into deeper soils, then you could focus your investigation on the shallower soils and an assessment of the deeper soils may not be necessary.

However, people should be cognizant of the POE criteria in relation to the distribution of COCs so that adequate samples may be collected from appropriate locations in order to determine concentrations for POEs. Please refer to the TCEQ guidance document titled *Affected Property Assessment Requirements* (RG-366/TRRP-12) for further details regarding assessment requirements. Frequently, an existing physical control will be relied upon to prevent human exposure to affected environmental media at a prescribed POE. However, §350.37(a) states in part that "consideration of competent, existing physical controls during the pathway analysis described in §350.71(d) does not negate or otherwise supercede the POE locations specified in this section." In other words, there must remain a POE to the contaminated soil resulting from a spill even though you cover them with a parking lot. You can use such a parking lot cover as a response action under Remedy Standard B, provided it is capable of meeting the response action performance requirements and you are willing to meet the associated remedy requirements. Thus, a competent, existing physical control can be used as a response action, but cannot be used to remove the POE to soil or groundwater.

Relationship Between POEs and Institutional Controls

In order to establish an on-site or off-site POE based on commercial/industrial land use, an institutional control must be established in accordance with §350.111. Also, to establish an alternate POE to on-site or off-site property, an institutional control must be filed in accordance with §350.111. **In either of these circumstances, you must provide proof of written landowner consent for the filing of an institutional control before the TCEQ will approve the response action completion report**. However, proof of written landowner consent is not necessary if you satisfy one of the provisions described in the following paragraph. The institutional control is filed within the real property records of the affected property in order to notify future owners of any limitations on the use of the property, such as its appropriate land use. In summary, both commercial/industrial land use and alternate POEs require the filing of an institutional control and the landowner's consent with that control to be documented. Further details regarding institutional controls

are provided in the TCEQ guidance document titled *Institutional Controls* (RG-366/TRRP-16).

Proof of written landowner consent for the filing of an institutional control is not necessary in the following circumstances.

- The property is subject to a zoning or governmental ordinance that is equivalent to the deed notice, VCP certificate of completion, or restrictive covenant that would otherwise be required.
- §350.111(b)(4) states that the agency will execute a superseding deed notice for an on-site or off-site property, provided there is a change in circumstances and you adequately describe why the original notice is no longer necessary to protect human health or the environment.
- §350.111(d) provides that you do not need to obtain landowner consent for the filing of a deed notice or voluntary cleanup program certificate of completion when it is technically impracticable to attain a residential-based, Remedy Standard A response action and you adequately document the other conditions required by this section.
- §350.111(f) explains that landowner consent for a deed notice or voluntary cleanup program certificate of completion will not be required if, after your extensive and diligent inquiry, the agency concludes that you cannot find the landowner.

Also, an executed restrictive covenant signed by the landowner satisfies the need for consent when a restrictive covenant is required.

Descriptions of Prescribed Human Health POEs

This section describes and depicts the prescribed on-site and off-site human health POEs to the following environmental media:

- air (§350.37(b))
- soil (§350.37(c))
- class 1, 2, and 3 groundwaters which do not contain COCs in excess of the critical groundwater PCLs (§350.37(d))
- class 1, 2, and 3 groundwaters which do contain COCs in excess of the critical groundwater PCLs (§350.37(e)-(h))
- surface water runoff and groundwater discharges to surface water (§350.37(i))
- releases of COCs directly to surface water (§350.37(j))
- sediment (§350.37(k))

The prescribed human health POEs are based on the following definitions:

Protective concentration level (PCL) (§350.4(a)(68))—The concentration of a chemical of concern which can remain within the source medium and not result in levels which exceed the applicable human health risk-based exposure limit or ecological protective concentration level at the point of exposure for that exposure pathway.

Protective concentration level exceedance (PCLE) zone (§350.4(a)(69)—The lateral and vertical extent of all wastes and environmental media which contain chemicals of concern at concentrations greater than the critical protective concentration level determined for that medium, …

Critical protective concentration level (§350.4(a)(19)—The lowest protective concentration level for a chemical of concern within a source medium determined from all of the applicable human health exposure pathways as described in §350.71 of this title (relating to General Requirements), and when necessary, protective concentration levels for applicable ecological exposure pathways as required in §350.77 of this title (relating to Ecological Risk Assessment and Development of Ecological Protective Concentration Levels).

General (§350.37(a))

You must use the prescribed on-site and off-site POEs for humans to determine the PCLs for use with Remedy Standard A (§350.32) or Remedy Standard B (§350.33). In all of the following figures which depict POEs, the on-site land use may be either residential or commercial/industrial depending upon the circumstances. Likewise, the off-site land use may be either residential or commercial/industrial. For a residential property, the human receptor is a resident. And for a commercial/industrial property, the human receptor is a commercial/industrial worker.

Air POEs (§350.37(b))

The prescribed on-site and off-site POEs to air are depicted in Figure 1. The on-site POE to air is located within the breathing zone (2 meter height) for a human receptor, either a resident or a commercial/ industrial worker depending upon land use, located directly over COCs in soil and/or groundwater. COCs could be transported to a human receptor either as particulates (for soil) or by volatilization (for soil and groundwater). In Figure 1, the POE to air is shown as a “cloud” surrounding the head of the “stick figure” human receptor. An off-site POE is established since remedies under the TRRP rule must be protective for both on-site and off-site receptors. The off-site POE to air is within the breathing zone of a human receptor starting at the boundary with and continuing throughout the nearest off-site property. The off-site air POE is not limited to the downwind property boundary based upon the

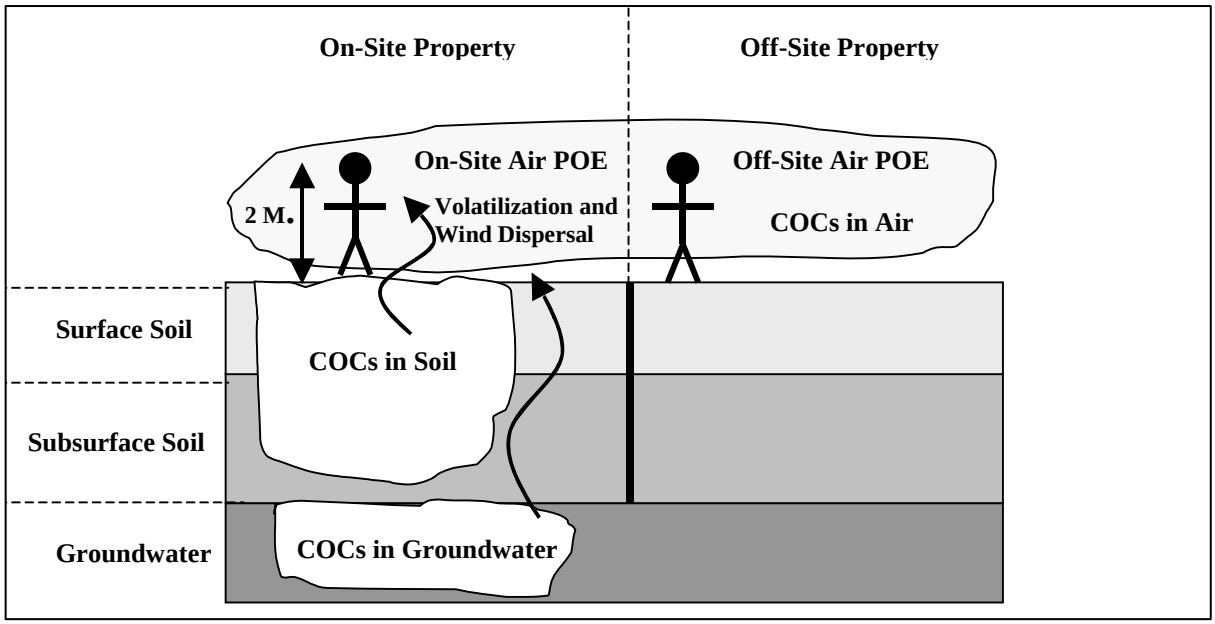


Figure 1. Air points of exposure. On-site and off-site land uses are residential or commercial/industrial, as applicable.

prevailing wind direction. This means that the COC concentrations in air must not exceed the critical PCLs for the applicable human receptor anywhere within off-site property. For example, suppose the on-site property is commercial/industrial and the off-site property is residential. In this circumstance, it would be acceptable for the person to restore the on-site property to the critical commercial/industrial air PCLs, but the critical residential air PCLs would apply at the boundary of and throughout the off-site property. If you demonstrate conformance with on-site critical commercial/industrial air PCLs determined in accordance with TRRP's tiered risk-based process, then further demonstration of protective air concentrations at the off-site property boundary will generally not be required. A specific demonstration may be required in some cases such as when the COCs and an off-site residence are in immediate proximity of the property line. However, if you base the on-site commercial/industrial air PCLs on occupational levels, then further demonstration of acceptable off-site air concentrations is more likely to be required. In a circumstance not depicted in Figure 1, when the on-site property and an off-site property meet the conditions for commercial/industrial land use assumptions, a residential POE would be established at the nearest boundary with and continuing throughout the next nearest downwind off-site property. When relevant due to the on-site release of COCs, off-site POEs to air could extend as far as necessary throughout off-site properties in order to protect human health.

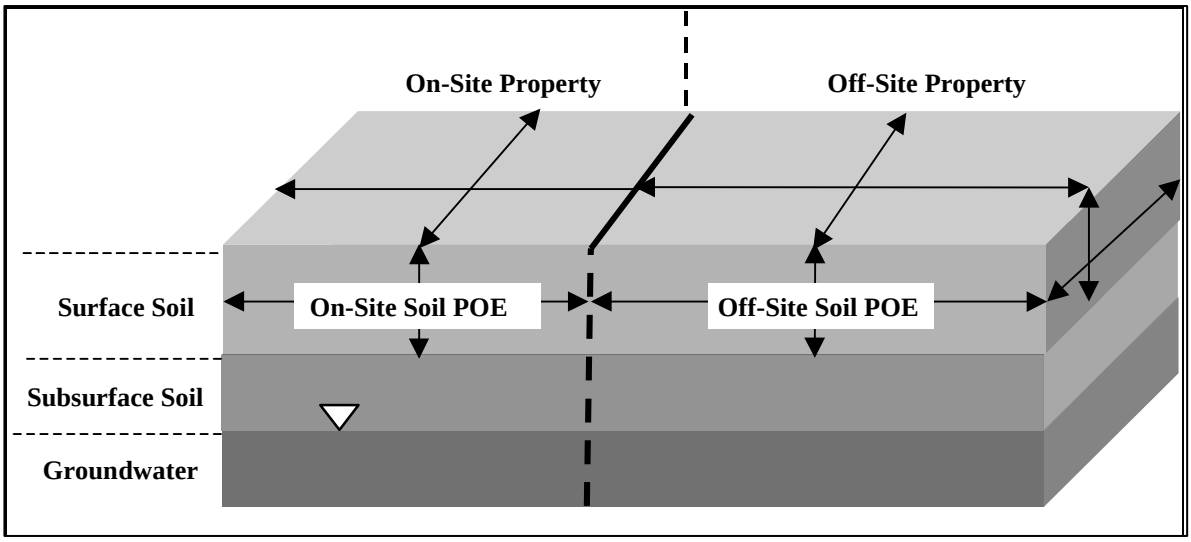


Figure 2. Soil points of exposure. On-site and off-site land uses are residential or commercial/industrial, as applicable. ▽ designates top of groundwater-bearing unit.

Soil POEs (§350.37(c))

The prescribed on-site and off-site POEs to soil are depicted in Figure 2. The on-site POE to soil for both residential and commercial/industrial land use is throughout the surface soil. As depicted in Figure 3, surface soil is generally the upper 15 feet of the soil zone for residential land use and the upper 5 feet of the soil zone for commercial/industrial land use. Further discussions explain exceptions to these generic depths. An off-site POE to soil is established in order to demonstrate protection for off-site human receptors. The off-site POE to soil is throughout the surface soil starting at the nearest boundary with and continuing throughout neighboring off-site properties. For example, assume that the on-site property is commercial/industrial and the nearest off-site property is

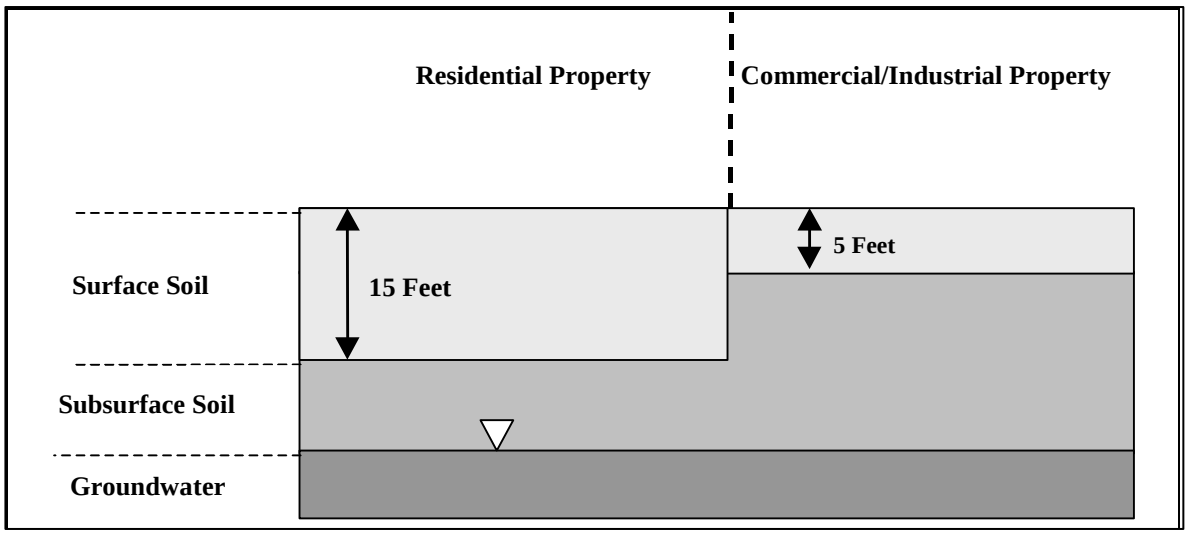


Figure 3. Surface soil, subsurface soil, and groundwater for residential and commercial/industrial properties. ▽ designates top of groundwater-bearing unit.

residential. You could use the critical commercial/industrial and residential PCLs to determine the soil PCLE zones on the on-site and off-site properties, respectively. When relevant, due to the release and migration of COCs, off-site POEs to soil could extend as far as necessary throughout the surface soils on neighboring properties in order to protect human health.

An understanding of the definitions for "surface soil," "subsurface soil," and "bedrock" is essential in order to determine the POEs to soil at a variety of affected properties with different hydrogeologic characteristics. A representation of these three environmental media at typical residential and commercial/industrial properties is presented in Figure 3.

The definitions for these media are:

Surface soil (§350.4(a)(88))—For human health exposure pathways, the soil zone extending from the ground surface to 15 feet in depth for residential land use and from ground surface to 5 feet in depth for commercial/industrial land use; or to the top of the groundwater-bearing unit or bedrock, whichever is lesser in depth.

Subsurface soil (§350.4(a)(86)—For human health exposure pathways, the portion of the soil zone between the base of the surface soil and the top of the groundwater-bearing unit(s).

Bedrock (§350.4(a)(7))—The solid rock (that is, consolidated, coherent, and relatively hard naturally formed material that cannot normally be excavated by manual methods alone) that underlies gravel, soil, or other surficial material.

As shown in Figure 3, for both residential and commercial/industrial affected properties, the soil zone from the land surface to the top of the groundwater-bearing unit consists of surface soils and subsurface soils. Unless shallow groundwater or bedrock is present, the depth of surface soils at residential and commercial/industrial affected properties is 15 feet and 5 feet, respectively. If the top of the groundwater-bearing unit and/or the top of bedrock occurs at a shallower depth, then the shallower of these depths defines the depth of surface soils.

To illustrate these considerations, Figure 4 depicts three examples described as affected properties A, B, and C with varying depths to the top of the groundwater-bearing unit and to bedrock.

Surface soils and subsurface soils in these examples are determined as follows:

- For affected property A, surface soils constitute the upper 15 feet of soils for residential land use or the upper 5 feet for commercial/industrial land use. The generic values for surface soil thickness are used since the top of the groundwater-bearing unit occurs at a depth of 17 feet and due to the absence of bedrock at the

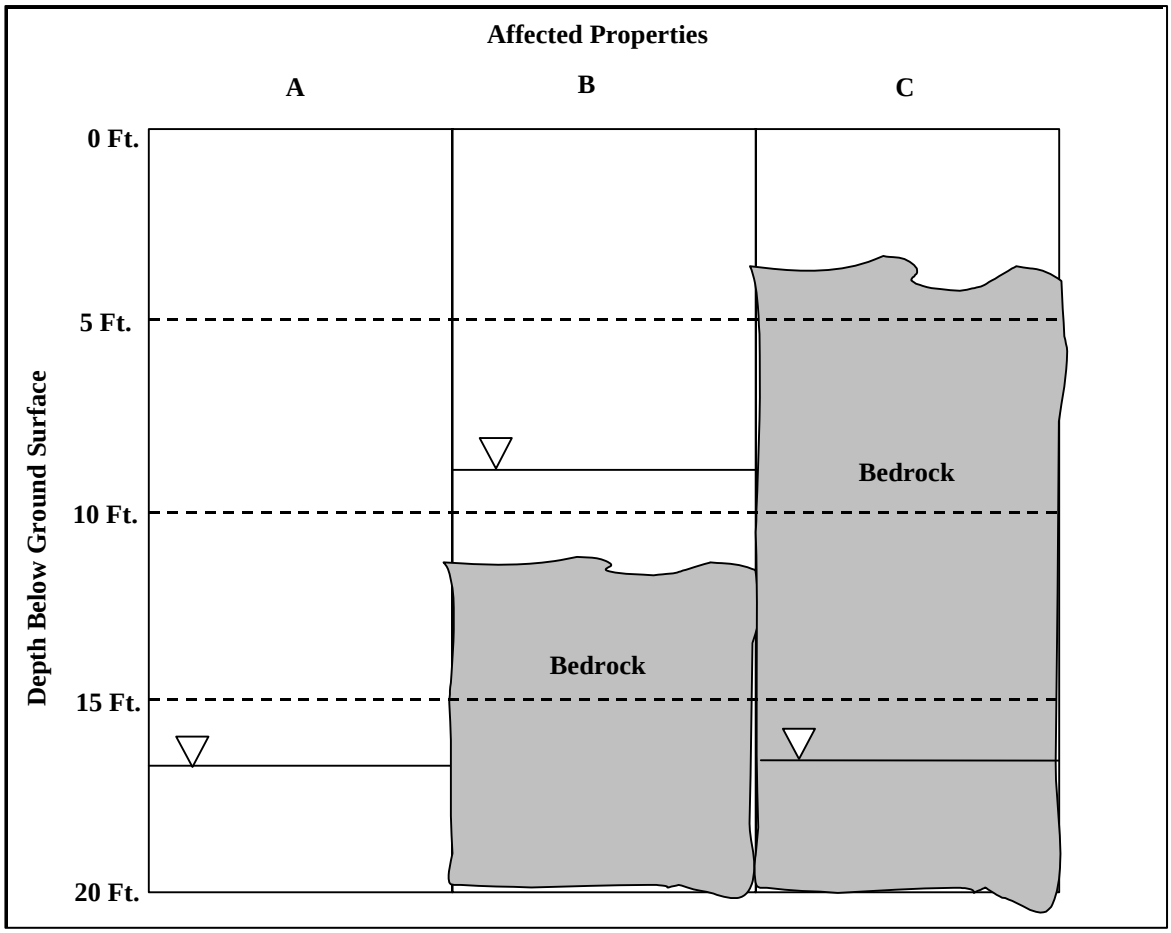


Figure 4. Definition of surface and subsurface soils at affected properties A, B, and C. Land use for each scenario could be either residential or commercial/industrial.
▽ designates top of groundwater-bearing unit.

property. In this example, subsurface soils for residential land use are the materials between 15 and 17 feet. Subsurface soils for commercial/industrial land use are between 5 and 17 feet.

- At affected property B, the top of the groundwater-bearing unit is at a depth of 8 feet while the top of bedrock is at a depth of 12 feet. Eight feet is the shallower of these two depths. For affected property B, surface soil consists of the upper 8 feet of soils for residential land use and the upper 5 feet for commercial/industrial land use. The surface soil thickness for residential land use is based upon the depth to the top of the groundwater-bearing unit rather than the generic value of 15 feet in this example. However, the surface soil thickness for commercial/industrial land use remains based on the generic value of 5 feet rather than the depth to the top of the groundwater-bearing unit In this example, there are no subsurface soils for the residential property and subsurface soils on the commercial/industrial property are in the depth range from 5 to 8 feet.
- At affected property C, the top of bedrock occurs at a depth of 4 feet and the top of the groundwater-bearing zone occurs at 17 feet. Four

feet is the shallower of these two depths. Thus, for affected property C, the upper 4 feet of soils constitute surface soils for both residential and commercial/industrial land uses. And for both land uses, the bedrock between 4 and 17 feet is classified as subsurface soil material.

However, there are at least three site-specific considerations discussed in the following paragraphs which could yield a different thickness for surface soils at a particular affected property.

The first clarification involves those hydrogeologic settings where the elevation of the top of the groundwater-bearing unit varies substantially in different seasons throughout the year. In such a situation, you should use an annual average depth to the top of the groundwater-bearing unit as the thickness of the surface soil if such depth is less than 15 feet or 5 feet, as applicable, depending upon the land use of the particular affected property.

The second clarification pertains to those hydrogeologic settings where a zone is saturated but does not meet the definition of a groundwater-bearing unit (e.g., perched water). In order to be a groundwater-bearing unit a geologic zone must have a hydraulic conductivity of at least 1×10^{-5} centimeters/second. You may not use the presence of a saturated geologic zone which is not a groundwater-bearing unit as justification to modify the generic value for surface soil thickness. As an example, Figure 5 depicts an affected property which is underlain by a clay shale. This clay shale has a hydraulic conductivity less than 1×10^{-5} centimeters/second and is saturated at a shallow depth. The depth to the saturated zone in the clay shale is not a relevant factor in determining the thickness of surface soils. Figure 5 depicts residential land use on the left and commercial/industrial land use on the right. For both of the land uses, the top of the water-saturated clay shale occurs at a depth of only 2 feet. For both land uses the top of a groundwater-bearing unit occurs at a depth of 22 feet. Thus, for residential land use, the soils above 15 feet are surface soils and the soils between 15 feet and 22 feet are subsurface soils. For commercial/industrial land use, surface soils are located from the land surface to 5 feet and subsurface soils are located between 5 feet and 22 feet. The presence of the water-saturated zone in the clay shale does not change this determination. However, if such a water-saturated zone that does not meet the definition of a groundwater-bearing unit is located within surface soil, then you may not need to evaluate the complete list of exposure pathways for that water-saturated zone. Please see the TCEQ guidance document titled *Exposure Pathway Evaluations* (RG-366/TRRP-9) for a description of the exposure pathways and PCLs applicable to various environmental media.

The third clarification pertains to “bedrock-like material” which does not meet the “solid rock” criteria.

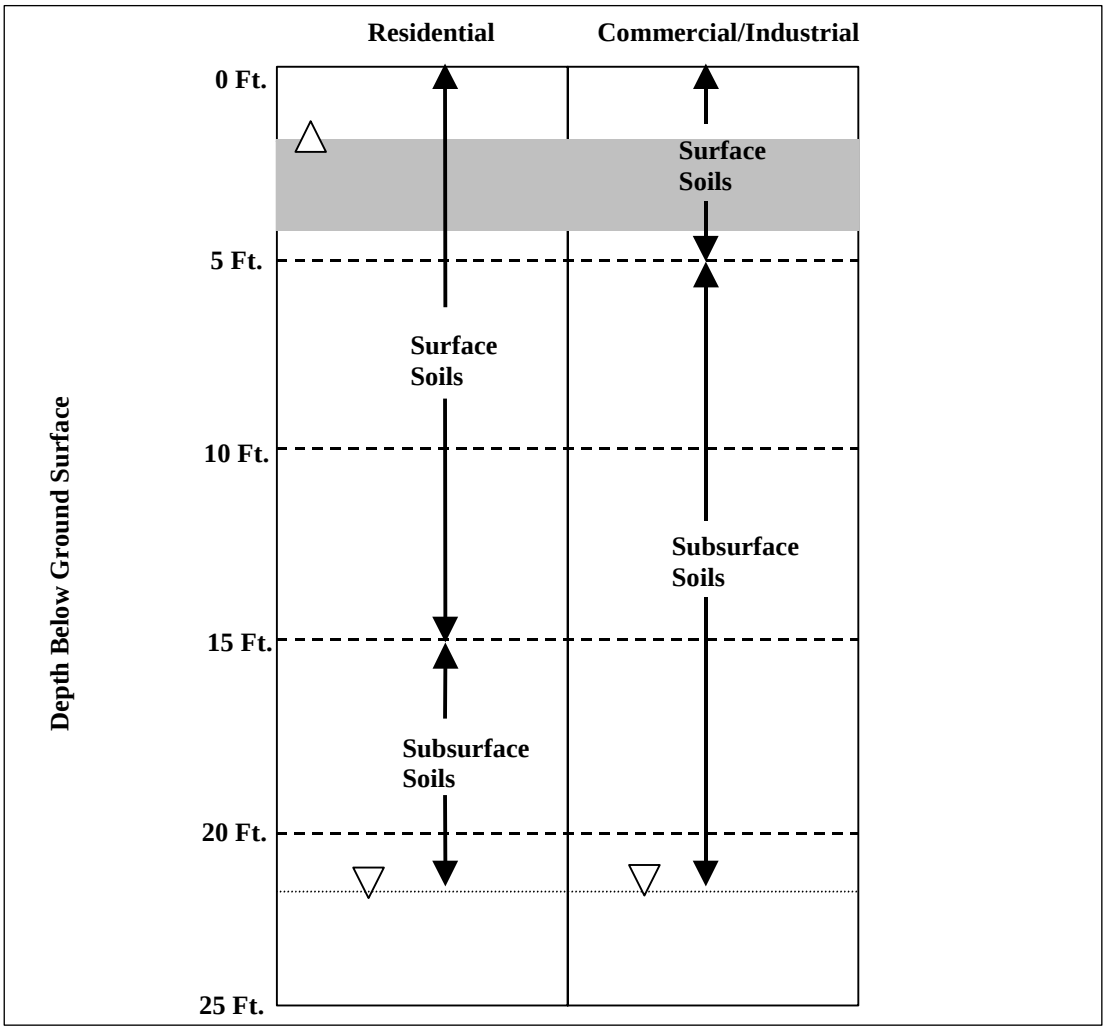


Figure 5. Lack of effect of saturated non–groundwater-bearing unit on the determination of surface and subsurface soils.
▽ designates top of groundwater-bearing unit.
△ designates top of saturated but non–groundwater-bearing unit (i.e., perched water).
■ designates clay shale.

To be bedrock, an earthen material must be a "consolidated, coherent, and relatively hard naturally formed material that cannot normally be excavated by manual methods alone." The bedrock limit on the depth of surface soils was inserted in the TRRP rule to prevent requiring this material to be removed, decontaminated, and/or controlled based upon dermal contact, ingestion, or vegetable consumption concerns because there is a small potential for such exposure to ever occur. In order to use this language to vary the default thickness of surface soils, you must demonstrate that the geologic material in question satisfies the "solid rock criteria." Bedrock is captured within the general meaning of soils as well.

Whether an affected soil unit is surface or subsurface soil is important because different exposure pathways and PCLs apply to surface and subsurface soils. Under circumstances at most affected properties, application of the surface and subsurface soil PCLs is all that is required

to protect human health and the environment from soil materials. While materials below the top of the groundwater-bearing unit are by definition neither surface nor subsurface soils, they are still considered to be "soils" under TRRP. The term "soil" is used broadly and inclusively. You must assess and determine PCLs for these deeper soils in special circumstances. Please see the TCEQ guidance document titled *Affected Property Assessment Requirements* (RG-366/TRRP-12) for further details regarding the requirements for an affected property assessment. POEs for direct exposure to these deeper soils are not established. Instead, compliance with the PCLs for the deeper soils is typically determined by analyzing water samples from a threatened groundwater-bearing unit.

Groundwater POEs (§350.37(d)–(h))

Figure 6 depicts the process for determining human health POEs under various circumstances for class 1, 2, or 3 groundwater. You should initially determine the on-site and off-site POEs to the uppermost groundwater-bearing unit by proceeding as far as necessary through this flowchart. You should also determine on-site and off-site POEs to successively deeper groundwater-bearing units in a similar fashion if there is a reasonable cause to believe that a unit may contain one or more COC in excess of its critical groundwater PCL.

POEs for Class 1, 2, and 3 Groundwaters that *Do Not* Contain COCs in Excess of the Critical Groundwater PCLs (§350.37(d))

The prescribed on-site and off-site POEs to class 1, 2, and 3 groundwaters with no COC in excess of a critical groundwater PCL are depicted in Figure 7. The prescribed on-site POE to such unaffected groundwater is throughout the lateral and vertical extent of the on-site portion of the uppermost groundwater-bearing unit. The prescribed off-site POE to unaffected groundwater is throughout the uppermost groundwater-bearing unit on the nearest boundary with the closest hydraulically downgradient off-site property. Note that the off-site POE is within the vertical extent of the uppermost groundwater-bearing unit at the boundary between on-site and off-site properties rather than being throughout the lateral extent of the uppermost groundwater-bearing unit throughout the off-site property. The soil and groundwater performance objective associated with these POEs is that on-site and off-site unaffected groundwater does not become affected over time.

§350.37(d) does not apply on a COC-by-COC basis. This means that if **any** COC exceeds its critical PCL, then the groundwater does not meet the conditions for application of this section. However, §350.37(f), (g), or (h) would apply depending upon the classification of the affected groundwater.

Also, the presence of COCs in excess of critical groundwater PCLs within the uppermost groundwater-bearing unit beneath an affected property

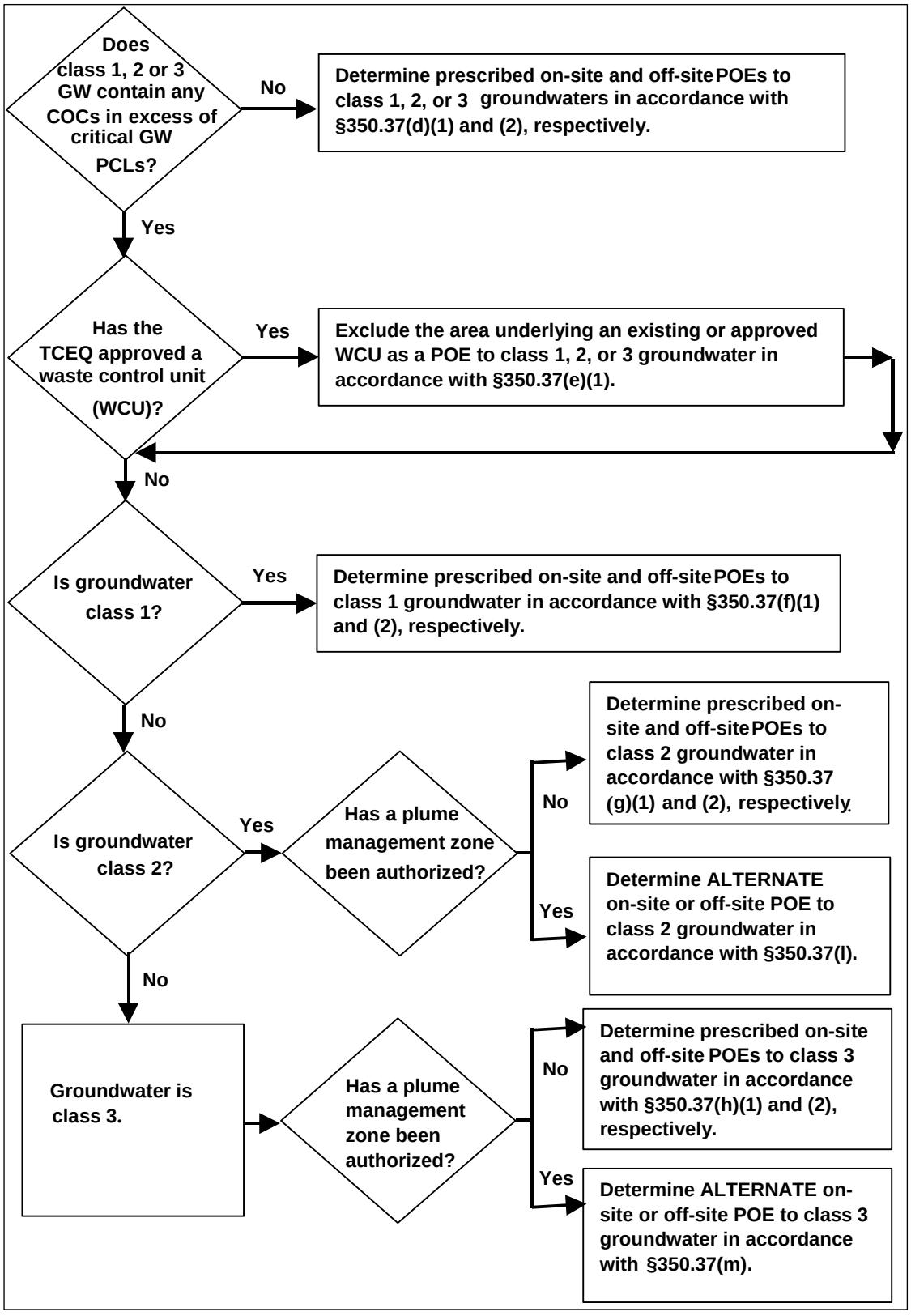


Figure 6. Determining human health points of exposure to class 1, 2, and 3 groundwaters (GW).

does not mean that §350.37(d) would not apply to lower groundwater-

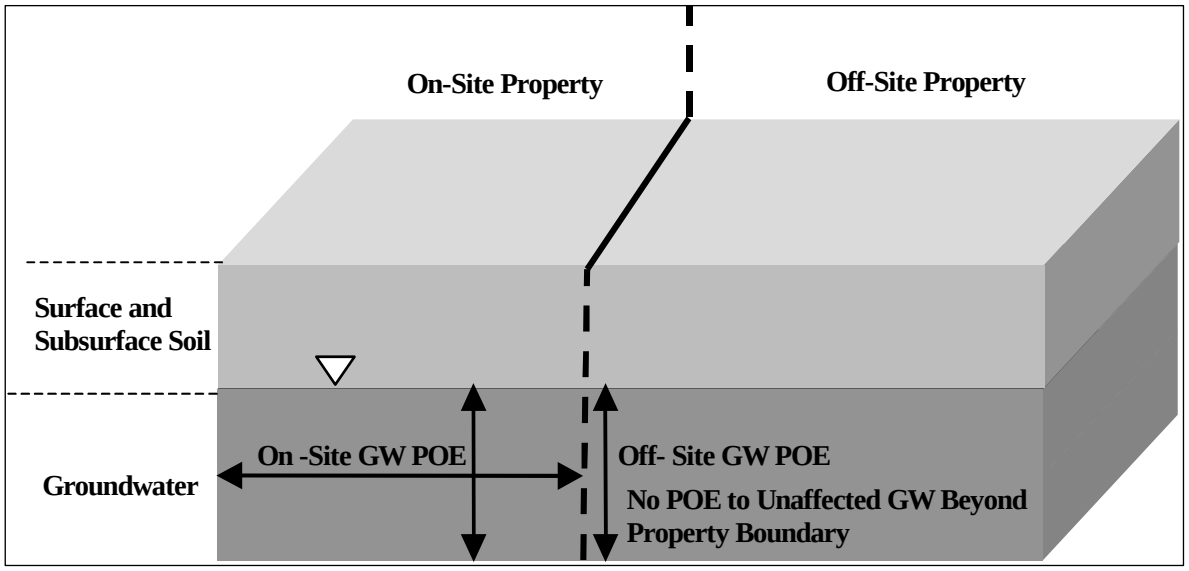


Figure 7. Points of exposure to class 1, 2, or 3 groundwater (GW) that does not contain COCs in excess of the critical groundwater PCLs. On-site and off-site land uses are residential or commercial/industrial, as applicable. ▽ = top of groundwater-bearing unit.

bearing units at that property. The commission stated in the preamble for the final rule that persons should interpret "the uppermost groundwater-bearing zone" to mean not only the groundwater-bearing unit closest to the ground surface, but also the first unaffected groundwater-bearing unit. For example, if there are four groundwater-bearing units, and the first three are affected, but the deepest (that is, fourth) groundwater-bearing unit is not affected, then §350.37(d) would apply to that fourth groundwater-bearing unit, but not the upper three. As a result, you would have the responsibility to keep that fourth groundwater-bearing unit from receiving COCs in excess of the critical groundwater PCLs from source areas on your property.

And finally, the presence of COCs in excess of the critical groundwater PCLs in the uppermost groundwater-bearing unit beneath only a neighboring property cannot be used to conclude that §350.37(d) does not apply to the uppermost groundwater-bearing unit beneath the **on-site** property. The on-site POE is described in §350.37(d)(1) as being "throughout the uppermost groundwater-bearing unit." The off-site groundwater POE is described in §350.37(d)(2) as "throughout the uppermost groundwater-bearing unit on the nearest boundary with the closest hydraulically downgradient off-site property." The agency purposefully did not extend the off-site groundwater POE to beneath neighboring properties. When stating that the uppermost groundwater-bearing unit does not contain COCs in excess of the critical groundwater PCLs, the uppermost groundwater-bearing unit being referenced is beneath the affected property in question rather than throughout the regional extent of the groundwater-bearing unit. Thus, the presence or absence of COCs with concentration levels in excess of the critical PCLs in the uppermost groundwater-bearing unit below neighboring properties

is not a relevant factor in determining whether §350.37(d) applies to the on-site uppermost groundwater-bearing unit. One effect of this is that you cannot use the presence of COCs in the uppermost groundwater-bearing unit beneath a neighboring off-site property to conclude that the uppermost groundwater-bearing unit beneath your property is affected. As a result, you cannot base the soil-to-groundwater response objectives for an on-site soil PCLE zone on the assumption that the uppermost groundwater-bearing unit is regionally affected. If the uppermost on-site groundwater-bearing unit, regardless of its classification, does not contain COCs in excess of the critical groundwater PCLs, then units, facilities, and areas must be managed such that the uppermost on-site groundwater-bearing unit does not become affected over time.

General Provisions for POEs for Class 1, 2, and 3 Groundwater (§350.37(e))

§350.37(e) describes two general provisions which may, depending upon the circumstances at an affected property, apply to define the location of human health POEs to class 1, 2, or 3 groundwater containing COCs in excess of critical groundwater PCLs.

First, Figure 8 depicts the specifications of §350.37(e)(1). This subsection specifies that in the event there is an existing PCLE zone in class 1, 2, or 3 groundwater beneath a waste control unit then, with the approval of the executive director, the area underlying the waste control unit may be excluded as a POE to groundwater. This means that a response action would not be required to restore the groundwater PCLE zone directly under a waste control unit to the critical groundwater PCLs. A *waste control unit* is defined at §350.4(a)(91) as "a municipal or industrial solid waste landfill, including those Resource Conservation and Recovery Act

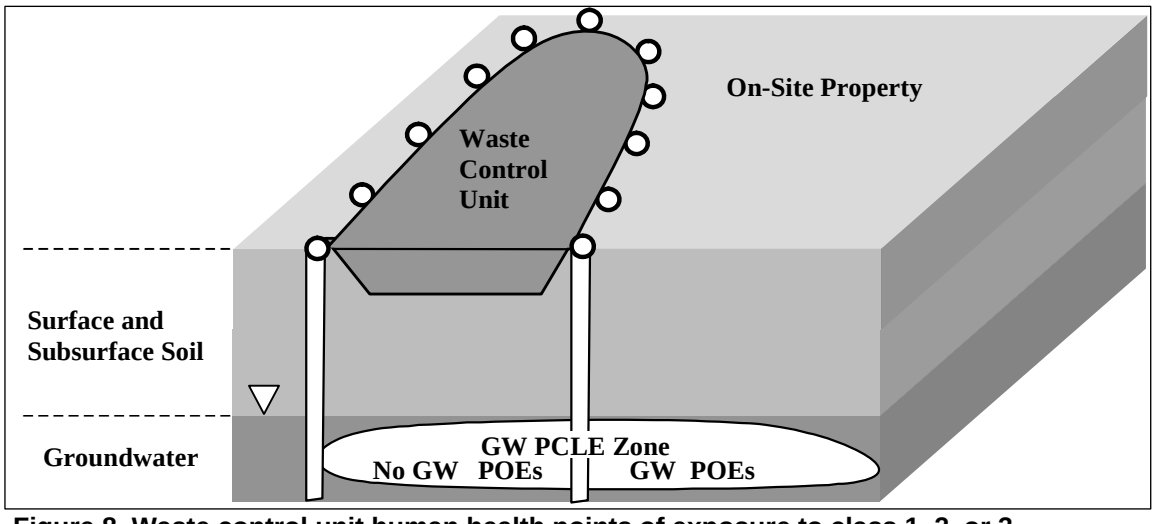


Figure 8. Waste control unit human health points of exposure to class 1, 2, or 3 groundwater (GW).
▽ = top of groundwater-bearing unit.
O = point of exposure to groundwater via monitoring wells

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." Please note that a waste control unit has both a liner system and an engineered cap. You will have to demonstrate that the unit in question meets these requirements before the commission will approve its designation as a waste control unit. POEs do apply beyond the boundary of the waste control unit. Requirements for use of a waste control unit as part of a Remedy Standard B response action are described at §350.33(f)(2) of the rule. This provision was adopted so that you will not be forced to place potential migration pathways, such as borings and monitor wells, through the cap and liner systems of a waste control unit.

Second, §350.37(e)(2) specifies the manner in which groundwater travel time setback distances will be determined. Later sections of this document specify the circumstances when the POEs to class 1, 2, and 3 groundwater are based on a groundwater travel time setback distance. The setback distance is established at two years groundwater travel time upgradient of the closest downgradient property. In other words, a 2 year setback distance is measured from the property boundary and is equal to the estimated distance that groundwater will travel in two years. In Figure 9, the distance from the current boundary of the groundwater PCLE zone to the inner dashed line represents the distance groundwater travels in one year. Likewise, the distance from the current boundary of the groundwater PCLE zone to the outer dashed line represents the distance that

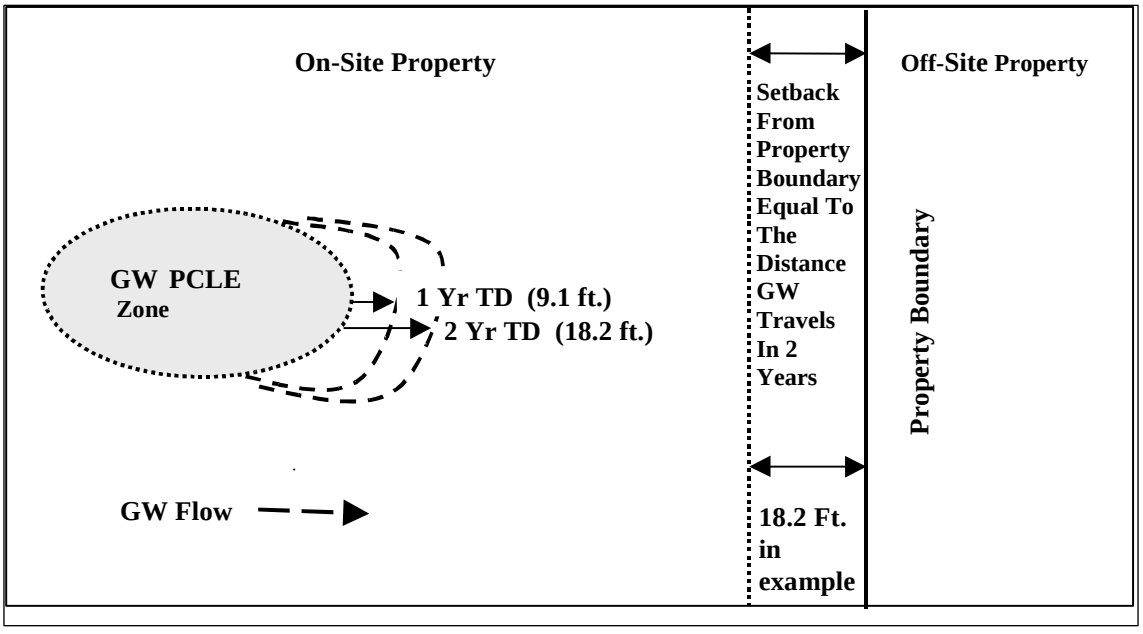


Figure 9. Determination of groundwater travel time setback distance. On-site and off-site land uses are residential or commercial/industrial, as applicable. 1 Yr TD and 2 YR TD are the distance groundwater travels at the affected property in 1 and 2 years, respectively. A setback distance from the property boundary is established based on a 2-year travel time to protect the groundwater on the off-site property.

groundwater travels in 2 years. The estimated distance that groundwater travels in two years is used as the setback distance.

§350.37(e)(2) states that groundwater travel time setback distances shall be based upon groundwater seepage velocity. Groundwater seepage velocity is dependent upon hydraulic gradient, hydraulic conductivity, and effective porosity. Groundwater seepage velocity typically is determined mathematically from the following equation derived from Darcy's Law:

$$V = (K \times dh/dl) / n_e$$

Where:

V = Groundwater seepage velocity (L/T)
K = Hydraulic conductivity (L/T)
dh/dl = Hydraulic gradient (L/L)
n_e = Effective porosity (unitless)

Seepage velocity is proportional to hydraulic conductivity and hydraulic gradient and inversely proportional to effective porosity. Please refer to *Contrasts in Data Needs for Tiers 1, 2, and 3* (RG-366/TRRP-11) for a description of how site-specific values for hydraulic conductivity and hydraulic gradient should be determined and when literature values for these parameters may be used.

As an example travel time setback distance calculation, assume that the uppermost groundwater-bearing unit at an affected property is silty sand with a hydraulic conductivity of 0.1 ft/day. Also assume the hydraulic gradient of the water table is 0.1 ft/ft. And finally, the effective porosity of the silty sand is estimated as 0.400. Using these values, the groundwater seepage velocity is estimated as 9.1 ft/year in the following manner:

V = (0.1 ft/day x 0.1 ft/ft)/0.400 = .025 ft/day x 365 day/year = 9.1 ft/year

A one-year travel time setback distance in this example is 9.1 feet. The two year travel time setback distance is 18.2 feet.

POEs for Class 1 or Class 2 Groundwaters that Contain COCs in Excess of the Critical Groundwater PCLs (§350.37(f)–(g))

Figure 10 depicts the prescribed on-site human health POEs for affected class 1 or 2 groundwater. These on-site POEs are described in §350.37(f)(1) and (g)(1) of TRRP. Figure 11 shows the prescribed off-site human health POEs to class 1 or 2 groundwater. These off-site POEs are described in §350.37(f)(2) and (g)(2). The class 2 groundwater prescribed POEs may be modified by the specification of alternate POEs in accordance with §350.37(l) when adopting a plume management zone under Remedy Standard B. Class 1 groundwater prescribed POEs may not be modified.

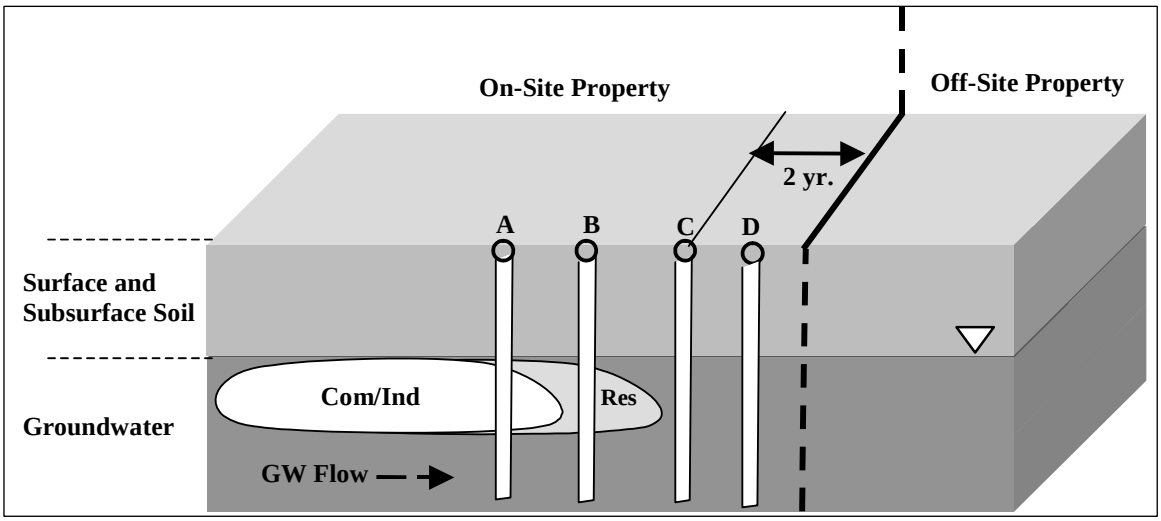


Figure 10. On-site points of exposure to class 1 or 2 groundwater (GW) that contains one or more COCs in excess of its critical groundwater PCL. On-site and off-site land uses are residential or commercial/industrial, as applicable.
▽ = top of groundwater-bearing unit.
O = point of exposure to groundwater via monitoring wells
Com/Ind = commercial/industrial GW PCLE zone
Res = residential GW PCLE zone

In Figure 10, the primary POE to affected class 1 or 2 groundwater is a well which may be completed at all locations throughout the on-site groundwater PCLE zone. This POE is throughout the on-site commercial/industrial PCLE zone if the on-site land use is commercial/industrial. This circumstance is depicted by the groundwater well labeled POE A. This groundwater well is presumed to be located at all locations within the commercial/industrial groundwater PCLE zone. If the on-site land use is residential, then this POE to groundwater is throughout the on-site residential groundwater PCLE zone. This is shown as a groundwater well located at POE B. This groundwater well is presumed to be located at all locations within the residential groundwater PCLE zone. In summary, this portion of the rule requires a POE to class 1 or 2 groundwater to be established whenever a critical groundwater PCL is exceeded on-site. When there is a class 1 or 2 groundwater PCLE zone either Remedy Standard A or B must be attained.

When the on-site land use is commercial/industrial, an additional on-site prescribed POE for class 1 or 2 groundwater must be established based upon residential land use, unless the residential groundwater PCLE zone already extends off-site. This additional POE is shown as POE C in Figure 10. POE C is located at a distance of two years groundwater travel time upgradient of the nearest boundary with the closest hydraulically downgradient off-site property.

In the circumstance where the residential-based groundwater PCLE zone already extends beyond the two-year setback distance but not off-site, the

POE is set at the existing limit of the residential groundwater PCLE zone. This is shown as POE D in Figure 10.

Prescribed POEs C and D are required when commercial/industrial land use is assumed for on-site properties in order to protect the quality of class 1 or 2 groundwater under adjoining properties. If you are an owner of a commercial/industrial property, then you may choose to allow an on-site residential groundwater PCLE zone to migrate below your property. However, you may not allow this on-site residential groundwater PCLE zone to migrate closer than 2 years groundwater travel time upgradient of an off-site property. It makes no difference, pertaining to this requirement, whether the off-site property is presently being used for residential or commercial/industrial purposes. Also, if the residential PCLE zone is already within the two-year setback distance, then no further migration is allowed.

In Figure 11, the primary off-site POE to affected class 1 or 2 groundwater is a well which may be completed at all locations throughout an off-site groundwater PCLE zone. This POE is throughout the off-site commercial/industrial groundwater PCLE zone if the land use is commercial/industrial. This is depicted as POE A. To state this more simply, if a groundwater PCLE zone has migrated from source areas on your property to a neighboring property, then you must respond to that affected groundwater. Additionally where the off-site land use is commercial/industrial, you must establish an additional POE for residents. This residential POE is established at all locations beyond the existing limit of the off-site residential groundwater PCLE zone. This is

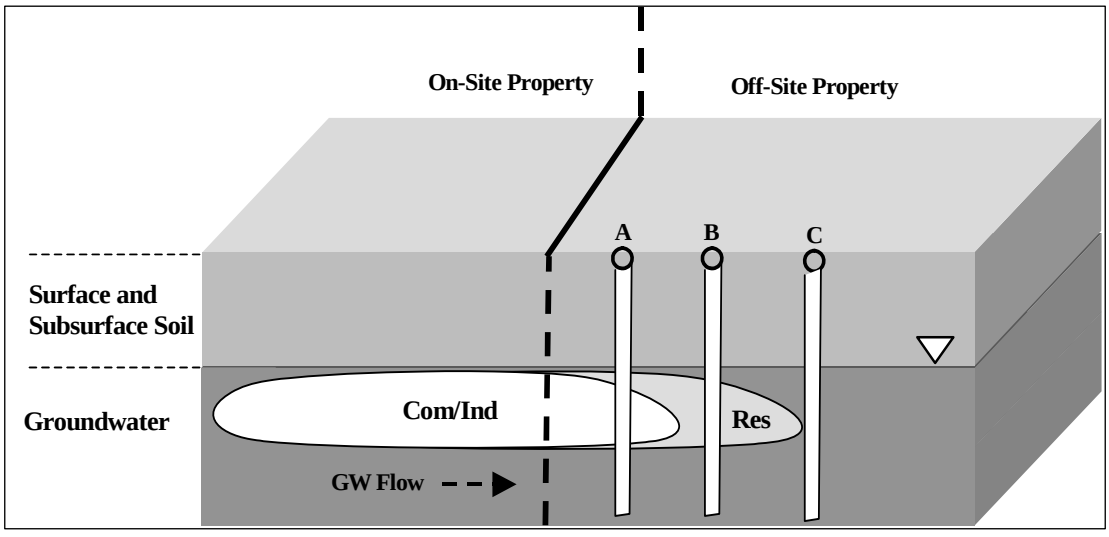


Figure 11. Off-site points of exposure to class 1 or 2 groundwater (GW) that contains one or more COCs in excess of its critical groundwater PCL. On-site and off-site land uses are residential or commercial/industrial, as applicable.
▽ = top of groundwater-bearing unit.
O = point of exposure (POE) to groundwater via monitoring wells
Com/Ind = commercial/industrial GW PCLE zone
Res = residential GW PCLE zone

shown as POE C on Figure 11. This means that even if the off-site property is commercial/industrial, you must not allow the residential groundwater PCLE zone to expand. This preserves that off-site commercial/industrial property owner's flexibility to use his property for residential purposes in the future.

If the off-site land use is residential, then this POE is throughout the off-site residential groundwater PCLE zone. This is shown as POE B, in Figure 11.

POEs for Class 3 Groundwaters that Contain COCs in Excess of the Critical Groundwater PCLs (§350.37(h))

Figure 12 presents the prescribed on-site POEs for affected class 3 groundwater. These POEs are described in §350.37(h)(1). The PCLs for class 3 groundwater are not based upon ingestion and are 100 times greater than the groundwater ingestion PCLs established for class 1 and 2 groundwater. The primary on-site POE to affected class 3 groundwater is at all locations throughout an on-site groundwater PCLE zone. The groundwater PCLE zone is defined by concentrations greater than ${}^{GW}GW_{Class\ 3}$ for the applicable on-site land use. If the on-site land use is commercial/industrial, then the on-site POE is throughout the commercial/industrial groundwater PCLE zone. This is depicted as POE A. However, if the on-site land use is residential, then the on-site POE is throughout the residential groundwater PCLE zone. POE B represents the residential POE (and also includes the commercial/industrial PCLE zone).

The prescribed off-site POEs for affected class 3 groundwater are depicted in Figure 13. These off-site POEs to class 3 groundwater are described in

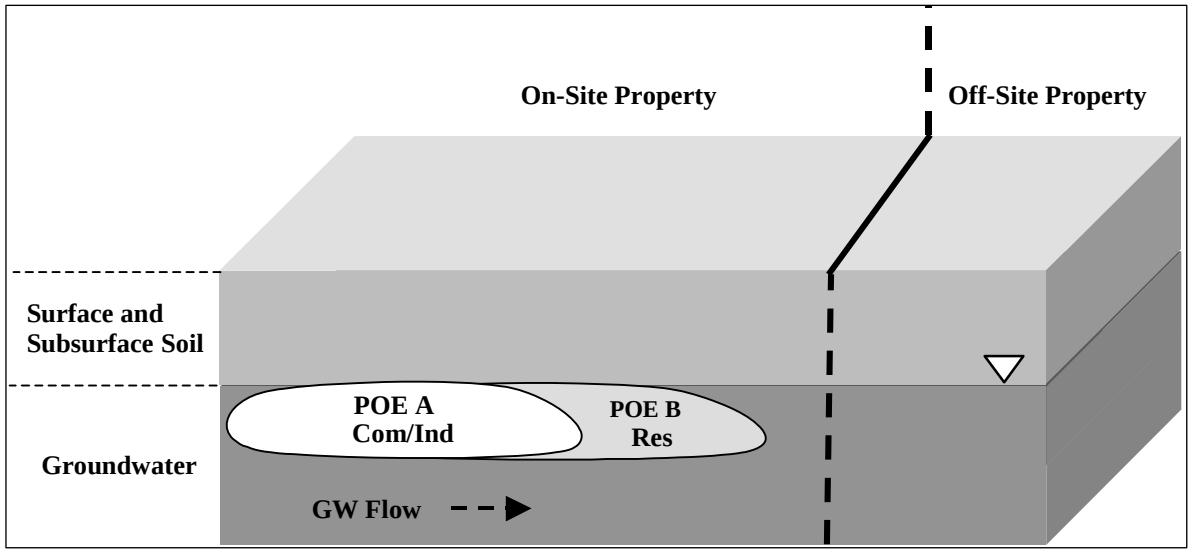


Figure 12. Affected class 3 groundwater on-site points of exposure. On-site and off-site land uses are residential or commercial/industrial, as applicable.
▽ = top of groundwater-bearing unit.
POE A throughout on-site commercial/industrial groundwater PCLE zone
POE B throughout on-site residential groundwater PCLE zone
Com/Ind = commercial/industrial GW PCLE zone
Res = residential GW PCLE zone

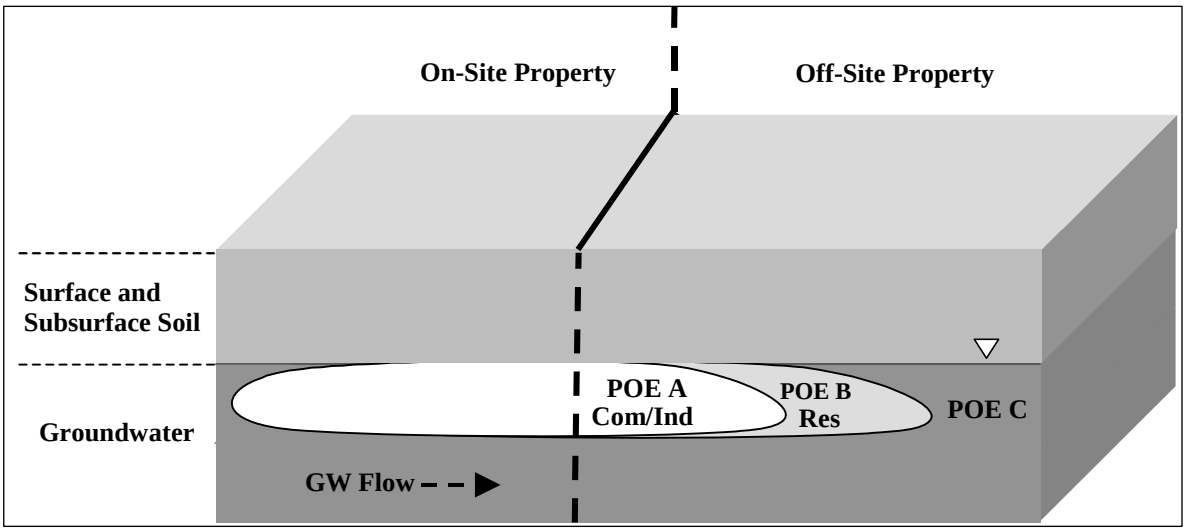


Figure 13. Affected class 3 groundwater off-site points of exposure. On-site and off-site land uses are residential or commercial/industrial, as applicable.
▽ = top of groundwater-bearing unit.
POE A throughout on-site commercial/industrial groundwater PCLE zone
POE B throughout on-site residential groundwater PCLE zone
POE C all locations beyond existing limit of off-site residential groundwater PCLE zone.
Com/Ind = commercial/industrial GW PCLE zone
Res = residential GW PCLE zone

§350.37(h)(2). The primary off-site POE to class 3 groundwater is at all locations throughout an off-site groundwater PCLE zone. This groundwater PCLE zone is defined by all concentrations greater than ${}^{GW}GW_{Class\ 3}$ for the applicable off-site land use. The off-site groundwater PCLE zone includes only those COCs sourced from the on-site release. As depicted by POE A, if the off-site land use is commercial/industrial, then the off-site POE is throughout the commercial/industrial groundwater PCLE zone. Also, if the off-site land use is commercial/industrial, then an additional off-site POE represented as POE C must be established. This POE is established at, and at all locations beyond, the existing limit of the off-site residential-based groundwater PCLE zone.

This means that you may not permit a residential-based class 3 groundwater PCLE zone to continue to migrate underneath a neighboring property even if that property is classified as commercial/industrial.

And finally, if the off-site land use is residential, then the off-site POE is throughout the residential groundwater PCLE zone as depicted by POE B (and also includes the commercial/industrial PCLE zone).

POEs for: Surface Water Runoff or Groundwater Discharges to Surface Water (§350.37(i)); Releases of COCs Directly to Surface Water (§350.37(j)); and Sediment (§350.37(k))

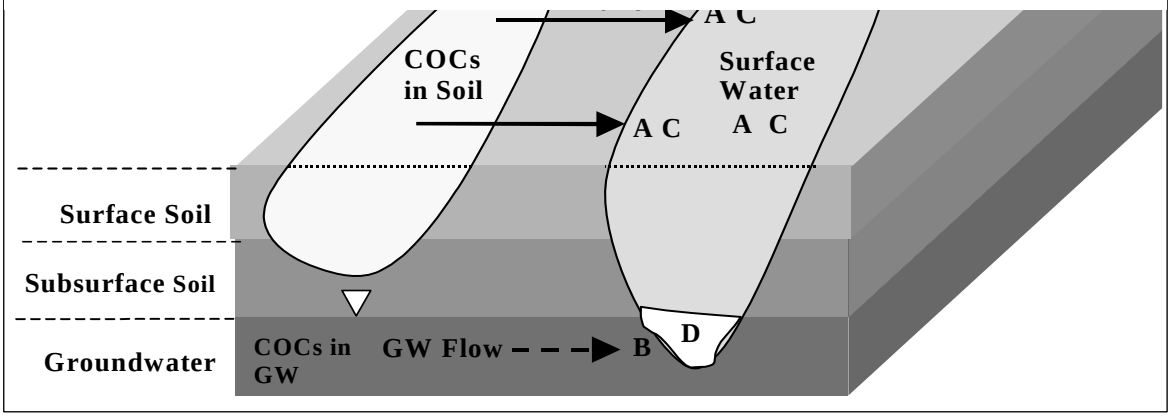
Figure 14 depicts the location of the POEs for:

- surface water runoff or groundwater discharges to surface water;

- releases of COCs directly to surface water; and
- sediment

POEs A and B in Figure 14 represent the POEs for surface water runoff and groundwater discharges to surface water, respectively. These POEs are defined at §350.37(i). The prescribed POE is at the point of surface water runoff or groundwater discharge into and throughout the extent of any on-site or off-site surface water body meeting the definition of surface water in the state as presented in §307.4 (relating to General Criteria). This includes the surface water body at the initial point of entry and other water bodies that may be affected by COCs. The POE for a groundwater release to surface water is within the groundwater-bearing unit at the point where it discharges into the surface water body. Because this location may be difficult to access, groundwater monitoring wells are often placed somewhat upgradient of the discharge zone. Groundwater monitoring results from this location and Tier 2 or 3 fate and transport equations are typically used to determine whether the applicable PCL, that is, ^{SW}GW, is presently exceeded or will be exceeded at the actual POE. Additional information regarding determining whether a surface feature constitutes "surface water in the state" and calculating ^{SW}GW and ^{Sed}GW values is presented in the TRRP guidance document for surface water (RG–366/TRRP–24).

Figure 14. POEs for: Surface water runoff or groundwater discharges to surface water; COCs directly to surface water; and sediment.
A = POE for surface water runoff to surface water
B = POE for groundwater discharges to surface water
C = POE for releases of COCs directly to surface water
D = POE for sediment
▽ designates top of groundwater-bearing unit



The POE for releases of COCs directly to surface water is discussed in §350.37(j) and is depicted as POE C in Figure 14. The prescribed POE for releases directly to surface water is at the point of entry of COCs into and throughout the extent of any surface water body meeting the definition for surface water in the state. For example, any COCs spilled directly into surface water are subject to this provision.

The POEs for sediment are described in §350.37(k) and are depicted as POE D in Figure 14. TRRP specifies that the prescribed POE to sediment is "within the upper one-foot of sediment beneath any surface water body meeting the definition of surface water in the state … ." The human health POE for direct exposure to sediment is throughout the upper one-foot of sediment for that portion of a surface water body less than 2 meters deep. There is no human health POE for direct exposure to sediment where a surface water body is more than two meters deep. For surface water bodies with fluctuating levels, the water depth used to determine the need for a sediment POE should be the expected depth of the water body in a normal year, during a period when people are expected to recreate in that surface water body. For intermittent water bodies, both sediment and surface soil POEs may apply. Please refer to the TRRP guidance document for surface water (RG-366/TRRP-24) for further explanation.

Description of Alternate POEs for Class 2 and 3 Groundwater

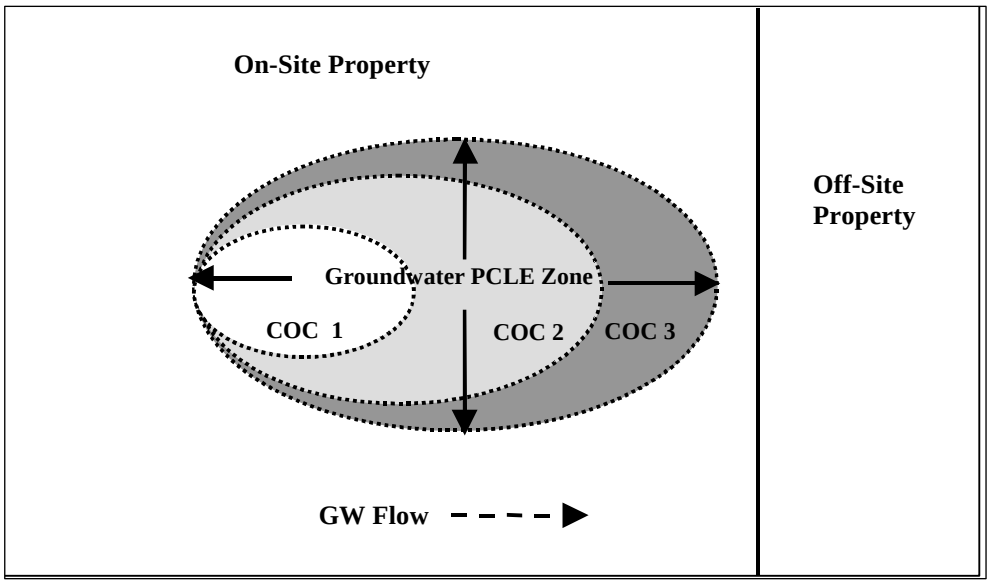
With appropriate demonstration and agency authorization, a plume management zone (PMZ) may be used to respond to a PCLE zone in class 2 or 3 groundwater in accordance with §350.33(f)(4). A PMZ for class 2 or 3 groundwater specifies an alternate groundwater POE which will be used in place of the prescribed POE. A PMZ cannot be authorized for a PCLE

zone in class 1 groundwater. The primary advantage of a PMZ is that the POE to groundwater is changed from a prescribed location throughout the groundwater PCLE zone to an alternate location established at the boundary of the PMZ. There is a boundary to the PMZ in all directions but for simplicity, the discussion is focused on the downgradient direction. Different rules apply for establishing the location of the downgradient boundary of a PMZ in class 2 and class 3 groundwater. The maximum distance "X" between the groundwater PCLE zone and the downgradient boundary of the PMZ is specified in §350.37(l) and (m) for class 2 and 3 groundwater, respectively.

The location of the boundary of the groundwater PCLE zone is an important factor in monitoring compliance with PMZ requirements. For both class 2 and class 3 groundwater, the location of the downgradient boundary of the PMZ is based upon the location of the **residential** groundwater PCLE zone, even for commercial/industrial properties. For class 2 groundwater, the allowable growth of a groundwater PCLE zone is based in part upon the current length of the residential groundwater PCLE zone at the time the response action plan is submitted. Figure 15 depicts how a groundwater PCLE zone is determined when several COCs with different migration capacities are present. The COC which migrates the farthest in a particular direction with a concentration greater than the critical groundwater PCL defines the limit of the groundwater PCLE zone in that direction. The length of the PCLE zone is determined at the time of response action plan submittal. When this evaluation is performed for all COCs in all directions, the extent of COCs exceeding critical PCLs is

Figure 15. Determination of boundary of groundwater PCLE zone. In this example, the extent of COC 3 above the critical groundwater PCL determines the extent of the groundwater PCLE zone. COC 3 is the most mobile COC. A separate groundwater PCLE zone is not established for each of the individual COCs.

defined. This defines the limits of the groundwater PCLE zone. In the example in Figure 15, COC 3, which has the largest individual PCLE zone, defines the boundary of the groundwater PCLE zone. Thus, a PCLE zone is based upon all COCs present in an affected groundwater-bearing unit rather than on a COC-by-COC basis.



Flexibility to establish alternate POEs to class 2 or 3 groundwater is not automatic. Establishment of a PMZ requires the person to make appropriate demonstrations and to secure agency approval. The groundwater classification system is used to determine general eligibility; however, site-specific appropriateness must also be demonstrated. In this regard, §350.33(f)(4)(A) itemizes potentially adverse effects on groundwater and surface water quality which must be considered. Of course, the broad performance that must be demonstrated is that neither human health nor the environment is endangered by the PMZ. Also, to establish an alternate POE on on-site or off-site property which you do not own, an institutional control must be filed in accordance with §350.111. Except in the circumstances listed in the previous discussion, "Relationship Between POEs and Institutional Controls," proof of landowner consent is necessary for the filing of an institutional control.

Alternate POEs to Class 2 Groundwater under Remedy Standard B (§350.37(l))

The rule specifies the requirements for a PMZ in class 2 groundwater in the following circumstances:

- when the residential groundwater PCLE zone is entirely on-site;
- when the residential groundwater PCLE zone has migrated onto neighboring property; and
- to determine whether a residential groundwater PCLE zone will be allowed to migrate onto off-site property.

These circumstances are described in §350.37(l)(1), (2), and (3), respectively and are depicted in Figures 16, 18, and 19, respectively. The establishment of a combined groundwater PCLE zone in class 2 groundwater is depicted in Figure 17. The allowable PCLE growth for a PMZ in class 2 groundwater is described in §350.37(l)(4) and is depicted in Figure 20. These subjects are discussed sequentially below.

Alternate On-Site POEs to Class 2 Groundwater (§350.37(l)(1))

TRRP in §350.37(l)(1)(A) specifies that the on-site POE to class 2 groundwater may be modified to be a well for residents completed at the on-site downgradient boundary of a PMZ. A PMZ is the current length of the residential groundwater PCLE zone determined at the time of response action plan submittal plus an additional length "X" determined in accordance with §350.37(l)(4). Figure 16 depicts an on-site PMZ in class 2 groundwater. Once the PMZ has been authorized there is no longer a POE to groundwater at any location throughout the on-site residential-based groundwater PCLE zone. Instead, the POE is a groundwater well located a distance "X" downgradient of the PCLE zone at the boundary of the PMZ.

Generally groundwater PCLE zones which have resulted from separate sources are managed as separate problems. However, §350.37(l)(1)(B) states that with site-specific approval for certain situations, a number of

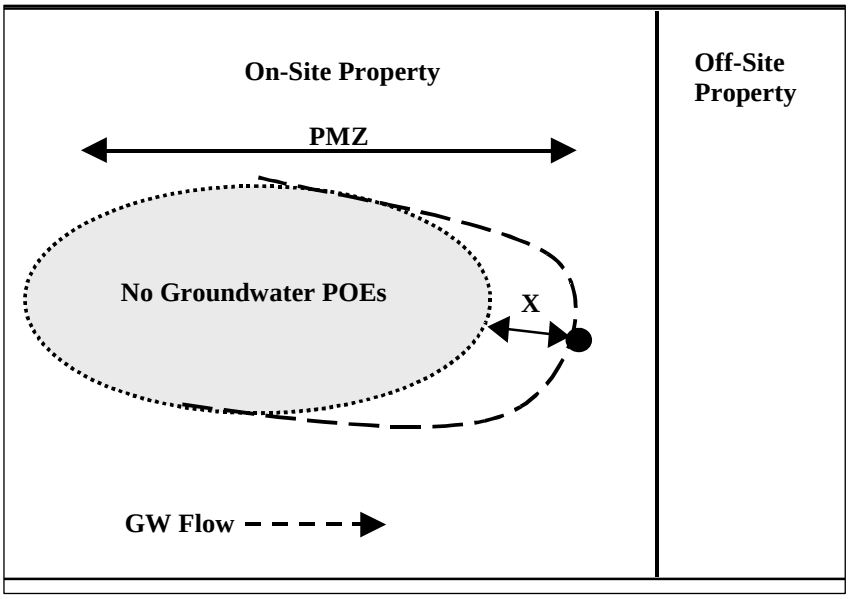


Figure 16. Alternate on-site POE to class 2 groundwater. On-site and off-site land uses are residential or commercial/industrial, as applicable.
▪ residential-based groundwater PCLE zone
● alternate PCE
X additional length authorized by §350.37(l)(4)

separate PMZs may be joined into a single combined PMZ. The alternate POE for the combined PMZ is determined in the same fashion as depicted in Figure 16. These circumstances are described as follows:

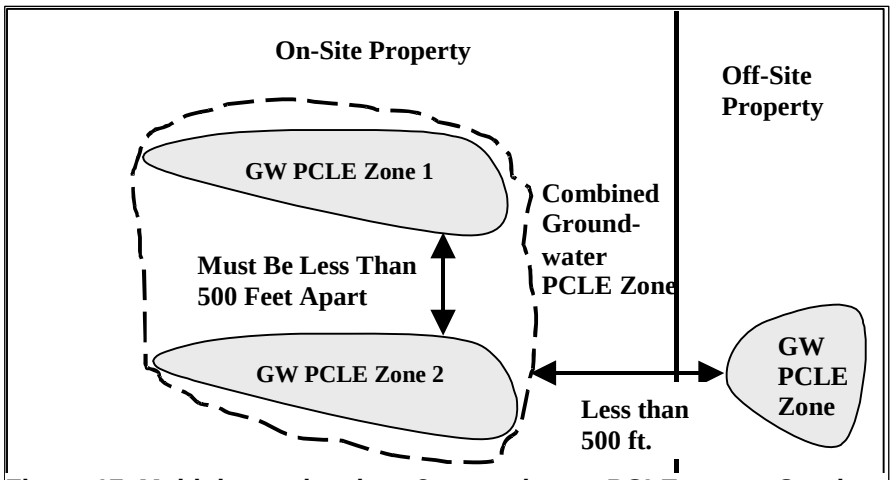


Figure 17. Multiple on-site class 2 groundwater PCLE zones. On-site and off-site land uses are residential or commercial/industrial, as applicable. A combined on-site groundwater PCLE zone may be formed provided this is feasible and appropriate and the individual groundwater PCLE zones are within 500 feet of one another.

- multiple on-site PMZs exist, and have commingled, or
- multiple on-site PMZs are within 500 feet of one another such that management as a combined PMZ is more feasible and appropriate.

Note that this flexibility is granted upon approval for the management of on-site groundwater PCLE zones. This flexibility does not extend to allow on-site sourced groundwater PCLE zones to be combined with off-site sourced groundwater PCLE zones. Figure 17 depicts two on-site residential-based groundwater PCLE zones which are associated with different sources. These on-site PCLE zones may, with approval, be combined into one groundwater PCLE zone provided such action is feasible and appropriate and the zones are less than 500 feet apart. However, the off-site groundwater PCLE zone may not be included in the combined zone even though it is within 500 feet. The off-site groundwater PCLE zone cannot be included because it has an off-site rather than on-site source area. Combining on-site sourced groundwater PCLE zones is not precluded in the event they extend off-site.

Alternate POEs for Off-Site Properties with Class 2 Groundwater that Contains Residential-Based Groundwater PCLE Zone (§350.37(l)(2))

When determining the location of an alternate POE associated with a PMZ on off-site property, the TRRP rule distinguishes between those off-site properties which presently contain a residential-based groundwater PCLE zone and those which do not. If the off-site property presently contains a residential groundwater PCLE zone and the PMZ has been authorized, then according to §350.37(l)(2) an alternate POE to class 2 groundwater

may be established at the off-site downgradient boundary of the PMZ. This alternate POE replaces the prescribed POE and there is no longer a POE to groundwater within the PMZ. As shown in Figure 18, the PMZ includes the length of the residential groundwater PCLE zone plus an additional length "X." The maximum allowed growth for a PCLE zone in class 2 groundwater is the smallest of the criteria described in §350.37(l)(4).

Alternate POEs for Off-Site Properties with Class 2 Groundwater that Currently Do Not Contain a Residential-Based Groundwater PCLE Zone (§350.37(l)(3))

§350.37(l)(3) presents the conditions under which you can allow a residential-based groundwater PCLE zone to migrate onto an off-site property which does not currently contain a residential-based groundwater PCLE zone. You can allow a groundwater PCLE zone to migrate onto an off-site property that currently does not contain the PCLE zone provided you can demonstrate that the off-site class 2 groundwater in question has no reasonably anticipated future beneficial use. To allow such migration onto an off-site property you must also secure written concurrence from that off-site landowner unless the property is subject to zoning or a governmental ordinance which is equivalent to the institutional control that would otherwise be required. You cannot allow a groundwater PCLE zone to migrate onto off-site property in either of the following two circumstances: you cannot demonstrate that the groundwater has no reasonably anticipated future beneficial use; or you

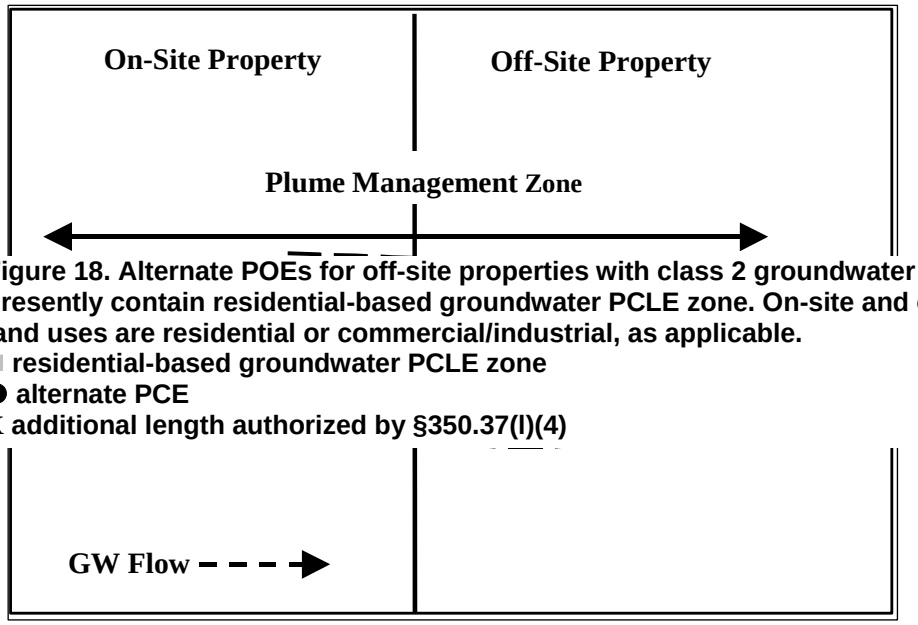


Figure 18. Alternate POEs for off-site properties with class 2 groundwater which presently contain residential-based groundwater PCLE zone. On-site and off-site land uses are residential or commercial/industrial, as applicable.
▪ residential-based groundwater PCLE zone
● alternate PCE
X additional length authorized by §350.37(l)(4)

cannot secure off-site landowner written consent to an institutional control, unless an equivalent zoning or governmental ordinance is in place. These two circumstances are depicted in Figure 19 as Situation A and Situation B.

For Situation A, the demonstration that the off-site class 2 groundwater has no reasonably anticipated future beneficial use has been successfully made and the landowner has given written consent for the establishment of an institutional control. In this case you may establish a PMZ which extends onto an off-site property. The alternate off-site POE to class 2 groundwater is a well for residents completed at the off-site boundary of the PMZ. The PMZ includes the current length of the residential-based PCLE zone plus an additional length "X" determined in accordance with §350.37(l)(4).

Situation B represents the circumstance where the demonstration cannot be made that the off-site class 2 groundwater does not have a reasonably anticipated future beneficial use. Thus, the PMZ will not be allowed to extend onto that off-site property. This determination does not necessarily mean that a PMZ could not be authorized. A PMZ could be established on-site with an additional length "X" determined in accordance with §350.37(l)(4).

There are three types of factors which will be used to determine whether a particular off-site class 2 groundwater-bearing unit has a reasonably anticipated future beneficial use. First, the rule in §350.37(l)(3)(C) presents the initial factors which will be considered when making this determination. These are:

- the existing quality of groundwater considering non-point sources of COCs and their cumulative impact on the groundwater quality;
- the lack of use of the groundwater based on the presence of superior water supplies;
- the proximity and withdrawal rates of groundwater users (see §350.52(2)(A)); or
- the property is subject to zoning or governmental ordinance which is equivalent to the deed notice, VCP certificate of completion, or restrictive covenant that otherwise would have been required.

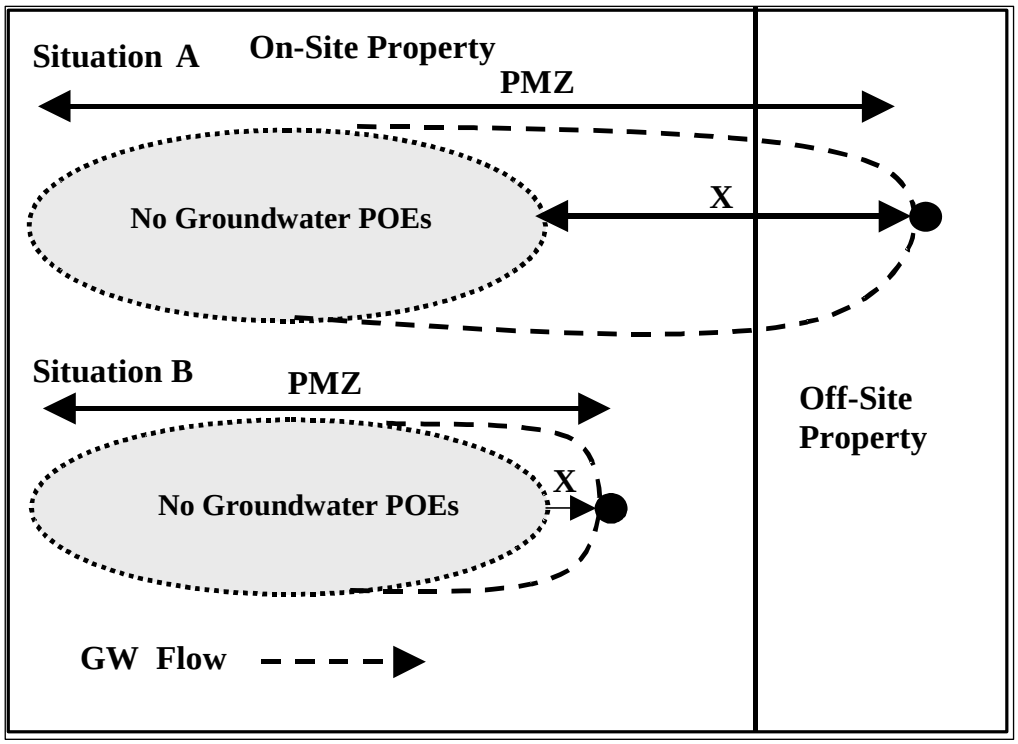


Figure 19. Alternate POEs for off-site properties with class 2 groundwater which currently do not contain a residential-based groundwater PCLE zone. On-site and off-site land uses are residential or commercial/industrial, as applicable.
▪ residential-based groundwater PCLE zone
● alternate PCE
X additional length authorized by §350.37(l)(4)
Situation A: Off-site class 2 groundwater has no reasonably anticipated future beneficial use and an off-site PMZ is authorized.
Situation B: Off-site class 2 groundwater has a reasonably anticipated future beneficial use and an off-site PMZ is not authorized, but on-site PMZ is authorized.

Second, the information collected in response to §350.52 for the groundwater classification is relevant. Is the groundwater-bearing unit clearly, or just barely, a class 2 groundwater resource? The regulatory guidance document on this subject titled *Groundwater Classification* (RG-366/TRRP-8) is relevant to this determination. Since the determination pertains to reasonably anticipated future beneficial use, the intrinsic value of a groundwater-bearing unit will also play an important role in this determination. Intrinsic value is determined through an evaluation of groundwater yield and natural quality. Thus, it is not enough to demonstrate that a groundwater-bearing unit is not presently being used. You must make the added demonstration that there is no reasonable potential for the groundwater-bearing unit to be used for a beneficial purpose in the future. And third, there are site-specific circumstances which can influence this determination.

A demonstration that a groundwater-bearing unit has no reasonably anticipated future beneficial use does not remove the requirement for you to file an institutional control with the landowner's consent for any off-site POE based on commercial/industrial land use or an alternate POE,

except in those circumstances where zoning or a governmental ordinance is demonstrated to be equivalent to a deed notice, VCP certificate of completion, or restrictive covenant that would otherwise be required.

§350.37(l)(3)(C) provides the opportunity for you to demonstrate that a groundwater-bearing unit has no reasonably anticipated future beneficial use as a result of zoning or a governmental ordinance. To take this path, you must demonstrate that a particular zoning or governmental ordinance is equivalent to a deed notice, VCP certificate of completion, or restrictive covenant that otherwise would have been required. The agency will accept zoning and governmental ordinances as acceptable equivalent institutional controls if:

- the zoning or governmental ordinance is by its terms sufficient to provide the control that is required to be protective of human health and the environment;
- the zoning or governmental ordinance provides notice of the COCs left in place and that the zoning or ordinance is necessary to prevent exposure to the COCs;
- the zoning or governmental ordinance applies to both current and future uses for the land covered; and
- the zoning or governmental ordinance cannot be modified or rescinded without the consent of the TCEQ.

Reliance on an equivalent zoning or governmental ordinance addresses only the institutional control issue. It does not circumvent or otherwise supercede the POE criteria. Therefore, plume management zones may only be established for class 2 or 3 groundwater, and this approach does not modify the groundwater classification established pursuant to §350.52. Additionally, ecological impacts or other hazards must be addressed in accordance with TRRP.

In the circumstance where zoning or a governmental ordinance cannot be demonstrated to be equivalent to a deed notice, VCP certificate of completion, or restrictive covenant, the zoning or ordinance can still influence the groundwater response decisions at an affected property. In particular, existing zoning or a governmental ordinance can be a very important factor in response to §350.33(f)(4)(A) regarding whether a PMZ should be authorized at all at an affected property, as well as for deciding if there is a reasonably anticipated future beneficial use. Please refer again to Situation B on Figure 19. This diagram could represent the circumstance where, based in part on the presence of zoning or a governmental ordinance, the affected property is determined to satisfy the criteria for authorization of an on-site PMZ zone. However, this particular zoning or ordinance is determined to not be equivalent to a deed notice, VCP certificate of completion, or a restrictive covenant. Thus, while an on-site PMZ is authorized, in this example that PMZ is not approved to extend onto the off-site property that currently does not contain the PCLE

zone. However, it is possible in a different example that an equivalent zoning or governmental ordinance could bolster the case of no anticipated future beneficial use and therefore support an off-site PMZ.

Maximum Additional Length of PMZ in Class 2 Groundwater-Bearing Unit (§350.37(l)(4))

The total length of a PMZ within a class 2 groundwater-bearing unit consists of the current length of the residential-based groundwater PCLE zone plus an additional length "X" determined in accordance with §350.37(l)(4). The maximum additional length of the PMZ, that is "X," is illustrated in Figure 20 and is the smallest of the following applicable distances:

A. up to 500 feet beyond the current length of the residential-based groundwater PCLE zone;

B. a length of up to 0.25 times the current length of the residential-based groundwater PCLE zone (that is, up to 25% additional plume length);

C. to within two years groundwater travel time of the closest hydraulically downgradient off-site property when:

- the off-site property owner has not provided written concurrence to allow the recording of an institutional control; or
- the off-site property does not contain the residential-based PCLE zone and the groundwater has a reasonably anticipated future beneficial use;

D. at the current downgradient extent of the residential-based PCLE zone when the residential groundwater PCLE zone is already within the two-year groundwater travel time setback distance from off-site property; or

E. the distance to the surface water POE.

Thus, for a PMZ in a class 2 groundwater-bearing unit, the additional length for a PMZ varies between 0 and 500 feet, depending upon the circumstances at a particular affected property.

The smallest of the five criteria, A through E, is normally used to determine the maximum expansion of a groundwater PCLE zone within a class 2 groundwater resource at an affected property. However, when the closest hydraulically downgradient off-site property is subject to zoning or governmental ordinance which is equivalent to the institutional control that would otherwise be required, criteria C and D do not apply. The discussion regarding §350.37(l)(3) has previously described the requirements for demonstrating that zoning or a governmental ordinance is equivalent to a deed notice, VCP certificate of completion, or a restrictive covenant. In essence, this provision means that if an

enforceable ordinance with an equivalent effect to one of the institutional controls accepted by TRRP prohibits use of the class 2 groundwater on an off-site property, then criteria C and D which are designed to protect that off-site groundwater resource will not be used as factors to limit groundwater PCLE zone growth. Instead criterion A, B, or E, depending upon which results in the shortest distance at a particular affected property, will be the limiting factor determining what growth, if any, will be allowed for a PMZ.

In the example illustrated in Figure 20, for the assumed PCLE zone size in scenarios A-C and E, "X" would be defined by scenario B since that scenario defines the shortest distance "X."

Alternate POEs to Class 3 Groundwater under Remedy Standard B (§350.37(m))

The TRRP rule specifies in §350.37(m) that, provided a PMZ has been authorized in response to §350.33(f)(4), you may establish an alternate on-site or off-site POE to class 3 groundwater. Unlike class 2 groundwater, the PCL for class 3 groundwater is not based upon groundwater ingestion. Instead the PCL to be applied at the alternate POE to class 3 groundwater is ${}^{GW}GW_{Class\ 3}$ which is 100 times greater than the residential-based ${}^{GW}GW_{Ing}$. Upon approval of the PMZ, there is no POE to groundwater throughout the groundwater PCLE zone and the groundwater POE is located at the downgradient limit of the PMZ.

The additional length "X" incorporated into the PMZ is determined by establishing the downgradient boundary of the PMZ. Unlike the 500 foot maximum additional distance established for alternate POEs in class 2 groundwater, there is no maximum additional distance specified for alternate POEs to class 3 groundwater. The smallest of the following distances, measured from the current downgradient boundary of the residential-based class 3 groundwater PCLE zone, defines the maximum allowable expansion for the downgradient PMZ boundary:

- to within two years groundwater travel time upgradient of:
  - the closest hydraulically downgradient off-site property for which the landowner has not provided written concurrence to allow the recording of an institutional control for situations where zoning or a governmental ordinance does not serve as the institutional control; or
  - the downgradient limit of a zoning or governmental ordinance that serves as the institutional control; or
- the distance to a surface water POE.

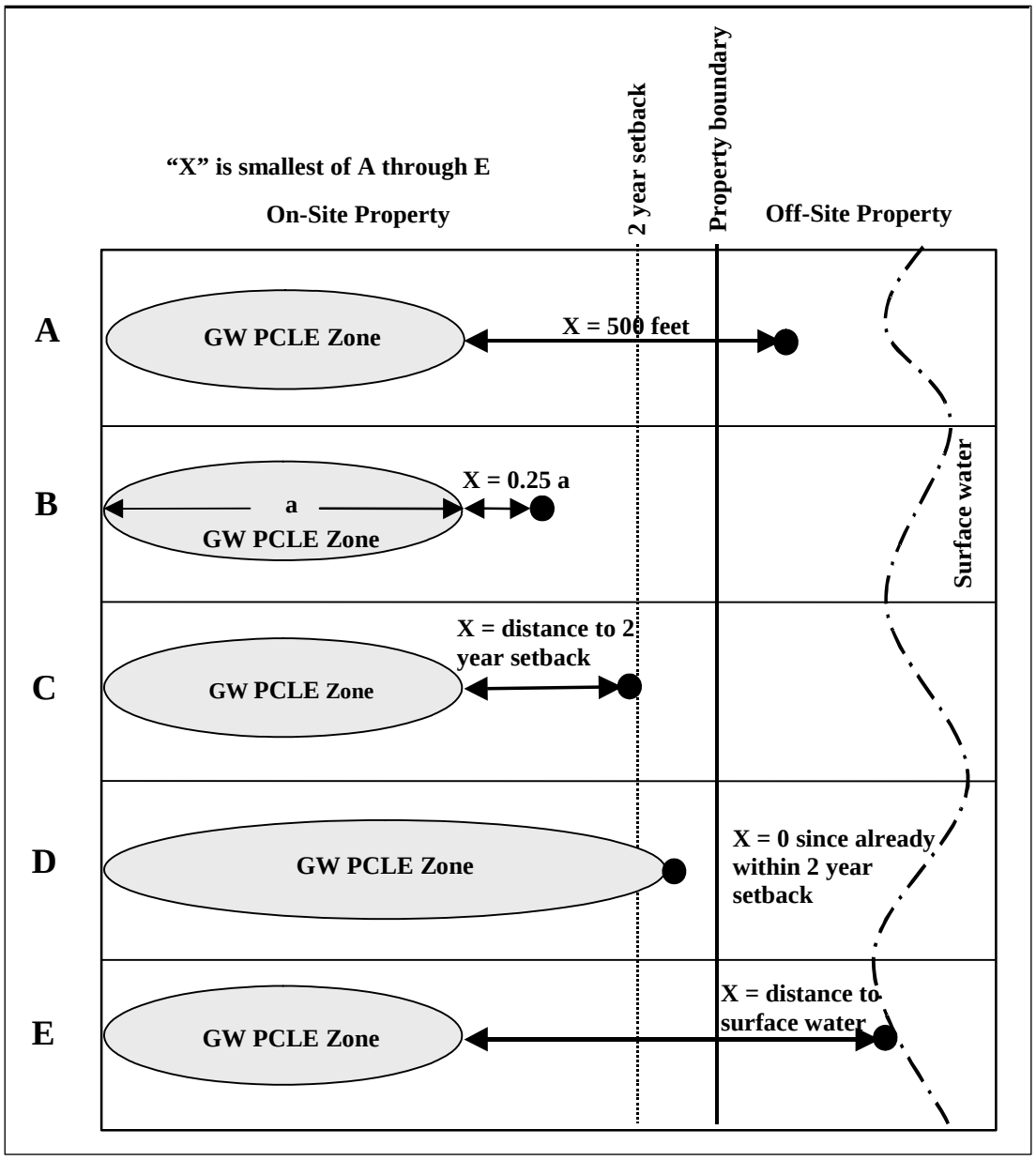


Figure 20. Maximum additional length (X) of PMZ in class 2 groundwater-bearing unit is the smallest of criteria A through E (§350.37(l)(4)).“X” is the additional length beyond the current residential-based groundwater PCLE zone that is allowed to be included in a PMZ.
● = location of the downgradient boundary of the PMZ for each of the scenarios

A previous discussion in this document describes the determination of groundwater travel time setback distance and is relevant to establishing the alternate POE to class 3 groundwater. Also, to qualify as a “zoning or governmental ordinance that serves as the institutional control”, such zoning or governmental ordinance must be equivalent to the deed notice, VCP certificate of completion, or restrictive covenant that otherwise would be required. The previous discussion regarding §350.37(l)(3)(C) provides relevant criteria which should be used to determine whether a zoning or governmental ordinance is an equivalent replacement for the institutional control otherwise required by the TRRP rule.

Figures 21 and 22 depict the location of the alternate POE to class 3 groundwater in greater detail for two different circumstances.

Figure 21 depicts the situation where the zoning or governmental ordinance is determined to be equivalent to a deed notice, VCP certificate of completion, or restrictive covenant. In this instance, the additional distance "X" to the PMZ boundary is determined based on the smaller of: 1) the distance to two years groundwater travel time upgradient of the downgradient limit of the zoning or governmental ordinance that serves as the institutional control; and 2) the distance to a surface water POE. In this case the written concurrence of an off-site landowner for the recording of an institutional control is not needed prior to allowing a groundwater PCLE zone in class 3 groundwater to migrate onto an off-site property. No site-specific institutional control will be required in this case for the PMZ because an equivalent zoning or governmental ordinance will be relied upon instead to protect human health and the environment. In the example depicted in Figure 21, the shorter of these two distances is to two years groundwater travel time upgradient of the downgradient boundary of the zoning or governmental ordinance.

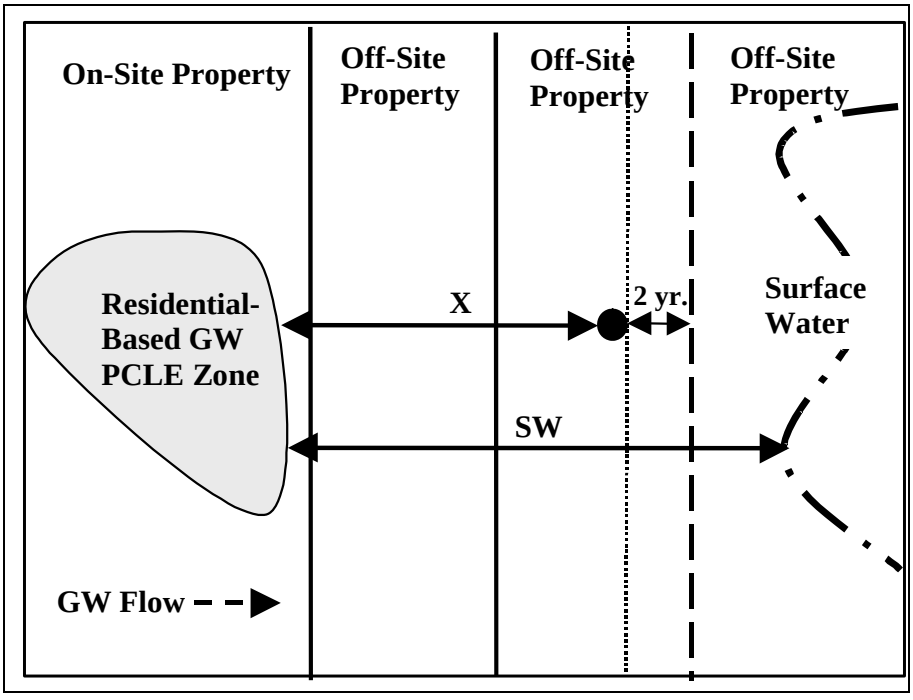


Figure 21. Maximum additional length of PMZ in class 3 groundwater-bearing unit when zoning or governmental ordinance is determined to be equivalent to a deed notice, VCP certificate of completion, or restrictive covenant (§350.37(m)).
X = additional length beyond the current residential-based groundwater PCLE zone that is allowed to be included in a PMZ
SW = distance to surface water (a greater distance)
● = alternate POE to class 3 groundwater
[long-dashed line] = downgradient boundary of zoning or governmental ordinance which is equivalent to deed notice, VCP certificate of completion, or restrictive covenant
[dotted line] = 2-year setback from downgradient boundary of zoning or governmental ordinance

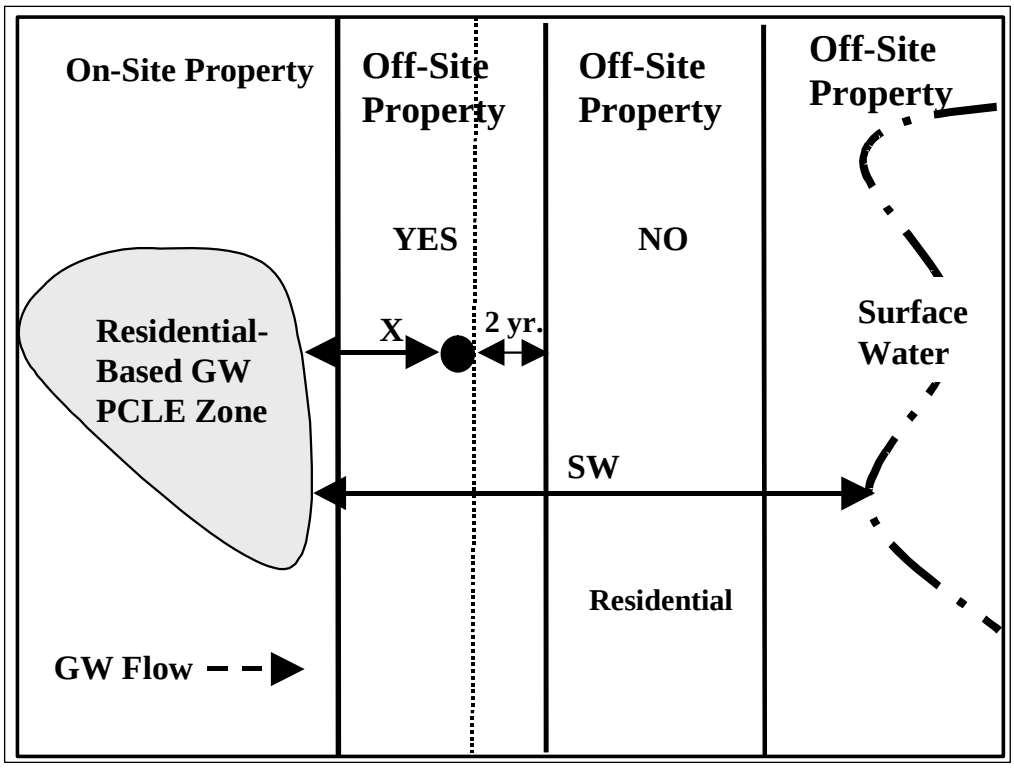


Figure 22. Maximum additional length of PMZ in class 3 groundwater-bearing unit when zoning or governmental ordinance is determined to be equivalent to a deed notice, VCP certificate of completion, or restrictive covenant (§350.37(m)).
X = additional length beyond the current residential-based groundwater PCLE zone that is allowed to be included in a PMZ
SW = distance to surface water (a greater distance)
● = alternate POE to class 3 groundwater
[long-dashed line] = downgradient boundary of zoning or governmental ordinance which is equivalent to deed notice, VCP certificate of completion, or restrictive covenant
YES = off-site landowner concurs with recording of an institutional control
NO = off-site landowner does not concur with recording of an institutional control
[dotted line] = 2-year setback from downgradient boundary of zoning or governmental ordinance

Figure 22 depicts the situation where the zoning or governmental ordinance is determined to not be equivalent to a deed notice, VCP certificate of completion, or restrictive covenant. In this instance, the additional distance "X" to the PMZ boundary is determined based upon the smaller of: 1) the distance to two years groundwater travel time upgradient of the closest hydraulically downgradient off-site property for which the landowner has not provided written concurrence to allow the recording of an institutional control for situations where zoning or a governmental ordinance does not serve as the institutional control; and 2) the distance to a surface water POE. In this case, a deed notice, VCP certificate of completion, or restrictive covenant will be required for all affected properties. You may not allow a groundwater PCLE zone in class 3 groundwater to migrate onto an off-site property unless you have received written concurrence from that off-site landowner for the

recording of an institutional control. As implied, though, if you do secure written concurrence from an off-site landowner for the recording of an institutional control, then you may allow a groundwater PCLE zone in class 3 groundwater to expand onto that off-site property. Figure 22 depicts an example where the first downgradient off-site landowner is willing to file an institutional control but the second downgradient off-site landowner is not. The POE to surface water is located beyond either the on-site property or these two off-site properties. Therefore, in this example, the alternate POE to class 3 groundwater is located two years groundwater travel time upgradient of the property boundary between the first and second downgradient off-site properties.