



Focus on Developing Ground Water Cleanup Standards Under the Model Toxics Control Act

from Department of Ecology's Toxic Cleanup Program

Background

The Washington Department of Ecology (Ecology) adopted changes to the Model Toxics Control Act (MTCA) Cleanup Regulation, chapter 173-340 WAC, on February 12, 2001. These changes became effective on August 15, 2001. This document provides an overview of the requirements and procedures for developing ground water cleanup standards under this revised regulation.

What is a ground water cleanup standard?

A ground water cleanup standard consists of a concentration (cleanup level) that must be met at a specified location within the ground water (point of compliance). It also includes any additional regulatory requirements that may be specified in applicable state or federal laws.

How is ground water classified for the purpose of establishing ground water cleanup levels?

The establishment of ground water cleanup levels depends on the classification of ground water under the regulation as either potable (a current or potential source of drinking water) or nonpotable. The classification of ground water depends on the highest beneficial use expected to occur under both current and future site use conditions. Unless it can be demonstrated that ground water is not a current or potential source of drinking water based on the criteria set forth in WAC 173-340-720(2), ground water is classified as potable to protect drinking water beneficial uses. Ecology expects that the ground water beneath most contaminated sites will be classified as potable.

Is there an exception to the requirement that potential sources of drinking water must be classified as potable for the purpose of establishing cleanup levels?

Yes. Even if the ground water is classified as a potential future source of drinking water under the criteria set forth in WAC 173-340-720(2), Ecology recognizes that there may be sites where there is an extremely low probability that the ground water will be used as a source of drinking water. These are sites that are so close to nonpotable or unpalatable surface waters (such as salt water) that a pumping well would draw in the nonpotable or unpalatable water. An example of this situation would be the shallow ground water in close proximity to marine waters such as on Harbor Island in Seattle. In these cases, the ground water may be classified as nonpotable for the purpose of establishing ground water cleanup levels. See WAC 173-340-720(2)(d).

What options are available for establishing cleanup levels for potable ground water?

The regulation requires ground water cleanup levels to be based on the reasonable maximum exposure expected to occur under both current and future site conditions. For potable ground water, this means that the cleanup level must be set at a concentration that would allow the water to be safely used as a source of drinking water. The regulation provides three options for establishing cleanup levels for potable ground water – **Method A, Method B, and Method C** (see **Figure 1**). Each of these methods and the criteria for their use are described below.

When may Method A be used to establish cleanup levels for potable ground water and how is a Method A cleanup level established?

Method A may be used to establish cleanup levels for potable ground water at routine sites and sites with relatively few hazardous substances.

Under Method A (see **Figure 2**), the cleanup level is based on the most stringent of the following concentrations:

- **Concentration listed in Table 720-1.** The cleanup level must be at least as stringent as the concentration listed in Table 720-1.
- **Concentrations established under applicable state and federal laws.** The cleanup level must be at least as stringent as the most stringent concentration established under applicable state and federal laws.
- **Concentration based on surface water beneficial uses.** Unless it can be demonstrated that the hazardous substances are not likely to reach surface water, the cleanup level must be at least as stringent as the surface water cleanup level established in accordance with WAC 173-340-730.

If neither Table 720-1 nor the applicable state and federal laws provide a value, then the Method A cleanup level is based on the natural background concentration or the practical quantitation limit (PQL), whichever is higher.

When may Method B be used to establish cleanup levels for potable ground water and how is a Method B cleanup level established?

Method B may be used to establish cleanup levels for potable ground water at any site.

Method B is divided into two tiers: **Standard** and **Modified**. Under both standard and modified Method B (see **Figure 3**), the cleanup level is based on the most stringent of the following concentrations:

- **Concentrations established under applicable state and federal laws.** The cleanup level must be at least as stringent as the most stringent concentration established under applicable state and federal laws.
- **Concentrations that protect human health.** The cleanup level must be at least as stringent as the concentrations that protect human health.

For hazardous substances for which sufficiently protective, health-based concentrations have been established under applicable state and federal laws, the most stringent of those concentrations is used. A concentration established under applicable state and federal laws is sufficiently protective if the excess cancer risk does not exceed 1 in 100,000 (1×10^{-5}) and the hazard quotient does not exceed one (1). If the concentration is not sufficiently protective, then either the concentration must be adjusted downward in accordance with WAC 173-340-720(7)(b) or a protective concentration must be calculated using the equations provided in the regulation.

For hazardous substances for which health-based concentrations have not been established under applicable state and federal laws, a protective concentration must be calculated using the equations provided in the regulation.

Under standard Method B, protective concentrations are calculated using the standard equations and default assumptions provided in the regulation (**see Table 1**). These equations and default assumptions ensure that a widely divergent population can safely use the ground water as a source of drinking water.

Under modified Method B, specified default assumptions may be adjusted based on site-specific or chemical-specific data. The regulation describes which parameters may be adjusted and how they may be adjusted.

- **Concentration based on surface water beneficial uses.** Unless it can be demonstrated that the hazardous substances are not likely to reach surface water, the cleanup level must be at least as stringent as the surface water cleanup level established in accordance with WAC 173-340-730.

When may Method C be used to establish cleanup levels for potable ground water and how is a Method C cleanup level established?

Method C may be used to establish cleanup levels for potable ground water at a site where it can be demonstrated that such levels comply with applicable state and federal laws, that all practicable methods of treatment have been used (to minimize releases to the ground water and to restore the ground water), that institutional controls are in place, and that one or more of the following conditions exist:

- The Method A or B cleanup levels are below technically possible concentrations;
- The Method A or B cleanup levels are below area background concentrations; or
- The attainment of Method A or B cleanup levels has the potential for creating a significantly greater overall threat to human health or the environment than attainment of Method C cleanup levels.

Under Method C (**see Figure 4**), cleanup levels are established the same as under Method B, except that concentrations that are protective of human health are calculated using a less stringent target cancer risk for individual hazardous substances (1 in 100,000) and less stringent default exposure assumptions (**see Table 1**).

What options are available for establishing cleanup levels for nonpotable ground water?

The regulation provides two basic options for establishing cleanup levels for nonpotable ground water – (1) conduct a site-specific risk assessment to establish Method B cleanup levels or, if the site qualifies under the criteria described above, Method C cleanup levels; or (2) use the potable ground water cleanup levels where the expense and time of a site-specific risk assessment is not worthwhile.

If a site-specific risk assessment is conducted, the cleanup level must be based on the highest beneficial use of the ground water and the reasonable maximum exposures expected to occur under both current and potential future site uses. The regulation provides a general framework for a site-specific risk assessment; however, equations and exposure assumptions are not provided and would need to be developed on a site-specific basis.

Are there any special considerations for establishing ground water cleanup levels for petroleum mixtures?

Yes. Cleanup levels must be established for the total petroleum hydrocarbon (TPH) mixture as a whole, as well as for individual hazardous substances (TPH components) within the mixture, such as benzene, ethylbenzene, toluene, and xylene.

When using Method A, use the values for TPH and TPH components in Table 720-1 as cleanup levels, paying particular attention to the requirements in the footnotes. The TPH values have been pre-calculated for various petroleum products using assumed product compositions.

Under Method B and Method C, the cleanup levels for individual TPH components are established just like they would be for any other hazardous substance, as described above.

To establish site-specific TPH cleanup levels under Method B or C, the composition of the petroleum mixture in the ground water must be determined. Determining the composition requires the analysis of either the ground water or the source of the contamination (the product itself or contaminated soil) for petroleum fractions and other toxic components likely to be present. See Table 830-1 for a list of contaminants to test for when establishing cleanup levels for petroleum mixtures. If the analysis is based on the product or contaminated soil composition, a ground water composition must be predicted using a fate and transport model under WAC 173-340-747, such as the 3-phase or 4-phase model.

The actual or predicted ground water composition is used in Equation 720-3 to calculate a total petroleum hydrocarbon (TPH) cleanup level that takes into account the combined noncarcinogenic effects of the petroleum mixture. This TPH cleanup level may need to be adjusted downward to take into account the cleanup levels for individual petroleum components. A further adjustment may be necessary if modeling or ground water monitoring indicates biological degradation of residual petroleum would result in violation of the drinking water standards for other chemicals. This is most likely to be a concern for naturally occurring metals such as arsenic, iron and manganese that can be brought into solution by depletion of oxygen in the ground water during petroleum degradation.

Are there any additional considerations when establishing ground water cleanup levels?

Yes. Ground water cleanup levels may need to be adjusted either downward or upward based on the following additional considerations:

- **Downward adjustment based on total site risk:** Ground water cleanup levels for individual hazardous substances may need to be adjusted downward to take into account the additive health effects resulting from exposure to multiple hazardous substances and/or multiple exposure pathways. The cleanup levels need only be adjusted if the hazard index exceeds 1 or the total excess cancer risk exceeds 1 in 100,000. This requirement does not apply when using Method A.
- **Downward adjustment to cleanup levels based on applicable state and federal laws:** Ground water cleanup levels based on applicable state and federal laws that exceed an excess cancer risk of 1 in 100,000 or a hazard quotient of 1 must be adjusted downward so that the total excess cancer risk does not exceed 1 in 100,000 and a hazard index of 1.
- **Downward adjustment based on nonaqueous phase limitation:** For organic hazardous substances and total petroleum hydrocarbons, the ground water cleanup level must not exceed a concentration that would result in nonaqueous phase liquid being present in or on the ground water.
- **Upward adjustment based on natural background and PQL:** Ground water cleanup levels for individual hazardous substances must not be set below the practical quantitation limit (PQL) or natural background concentration, whichever is higher.

Where in the ground water do cleanup levels have to be met?

The "point of compliance" defines the point or points on a site where cleanup levels must be met. The term includes both "standard" and "conditional" points of compliance.

- **Standard point of compliance:** The standard point of compliance for ground water is defined as throughout the site from the uppermost level of the saturated zone extending vertically to the lowest most depth which could potentially be affected by the site.
- **Conditional point of compliance:** Where it can be demonstrated that it is not practicable to meet the ground water cleanup levels at the standard point of compliance within a reasonable restoration time frame, Ecology may approve a conditional point of compliance as close as practicable to the source of the contamination, not to exceed the property boundary (except as provided below).
- **Off-property conditional point of compliance:** A conditional point of compliance may be set beyond the property boundary in the following three specific situations, subject to several conditions specified in WAC 173-340-720(8)(d):

1. **Properties abutting surface water:** Where the ground water cleanup level is based on protection of surface water beneficial uses and the property containing the source of contamination abuts surface water, Ecology may approve an off-property conditional point of compliance located within the surface water as close as practicable to point or points where ground water flows into the surface water.
2. **Properties near, but not abutting surface water:** Where the ground water cleanup level is based on protection of surface water beneficial uses and the property containing the source of contamination is located near, but not abutting surface water, Ecology may approve an off-property conditional point of compliance located as close as practical to the source of contamination, not to exceed the point or points where the ground water flows into the surface water.
3. **Area-wide conditional point of compliance:** Where there are multiple sites with commingled plumes of contamination that are not practical to address separately, Ecology may approve an area-wide conditional point of compliance located as close as practicable to each source of contamination, not to exceed the extent of ground water contamination.

See **Figures 5 and 6** for a visual depiction of the available options for establishing a ground water point of compliance.

May the department establish more stringent cleanup levels?

Yes. The department may establish cleanup levels that are more stringent than those required under the applicable method when the department determines, based on a site-specific evaluation, that such levels are necessary to protect human health and the environment. The establishment of more stringent cleanup levels must comply with WAC 173-340-702 and 173-340-708.

What measurements are required to demonstrate compliance with ground water cleanup levels?

When ground water cleanup levels have been established at a site, the ground water must be sampled to demonstrate compliance with cleanup levels. Monitoring of nearby surface waters may also be required where cleanup levels are based on protection of surface water. Generally, several locations are sampled for at least a year, and often several years, to take into account spatial and seasonal variability in the ground water quality. Compliance is determined for each location sampled by analyzing the data using statistical procedures specified in the regulation.

For More Information / Special Accommodation Needs

If you would like more information on setting cleanup standards or cleaning up sites, please call us toll-free at **1-800-826-7716**, or contact your regional Washington State Department of Ecology office listed below. Information about site cleanup, including access to a variety of technical guidance documents, is also accessible through our Internet address: <http://www.ecy.wa.gov/programs/tcp/cleanup.html>.

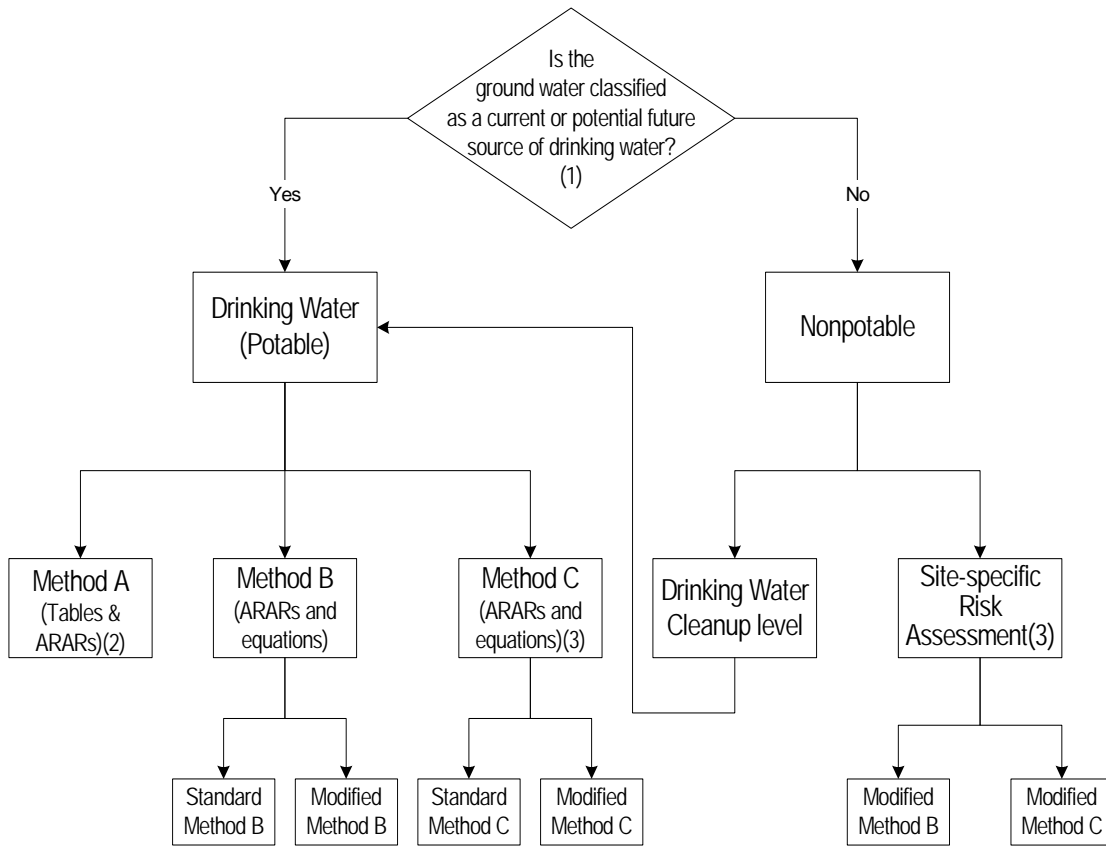
Regional Office	Phone / *TTY	Regions/Counties
Northwest	425/649-7000	Island, King, Kitsap, San Juan, Skagit, Snohomish, Whatcom
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Figure 1: Options for Establishing Ground Water Cleanup Levels under WAC 173-340-720



NOTES

(1) See the criteria in WAC 173-340-720(2).

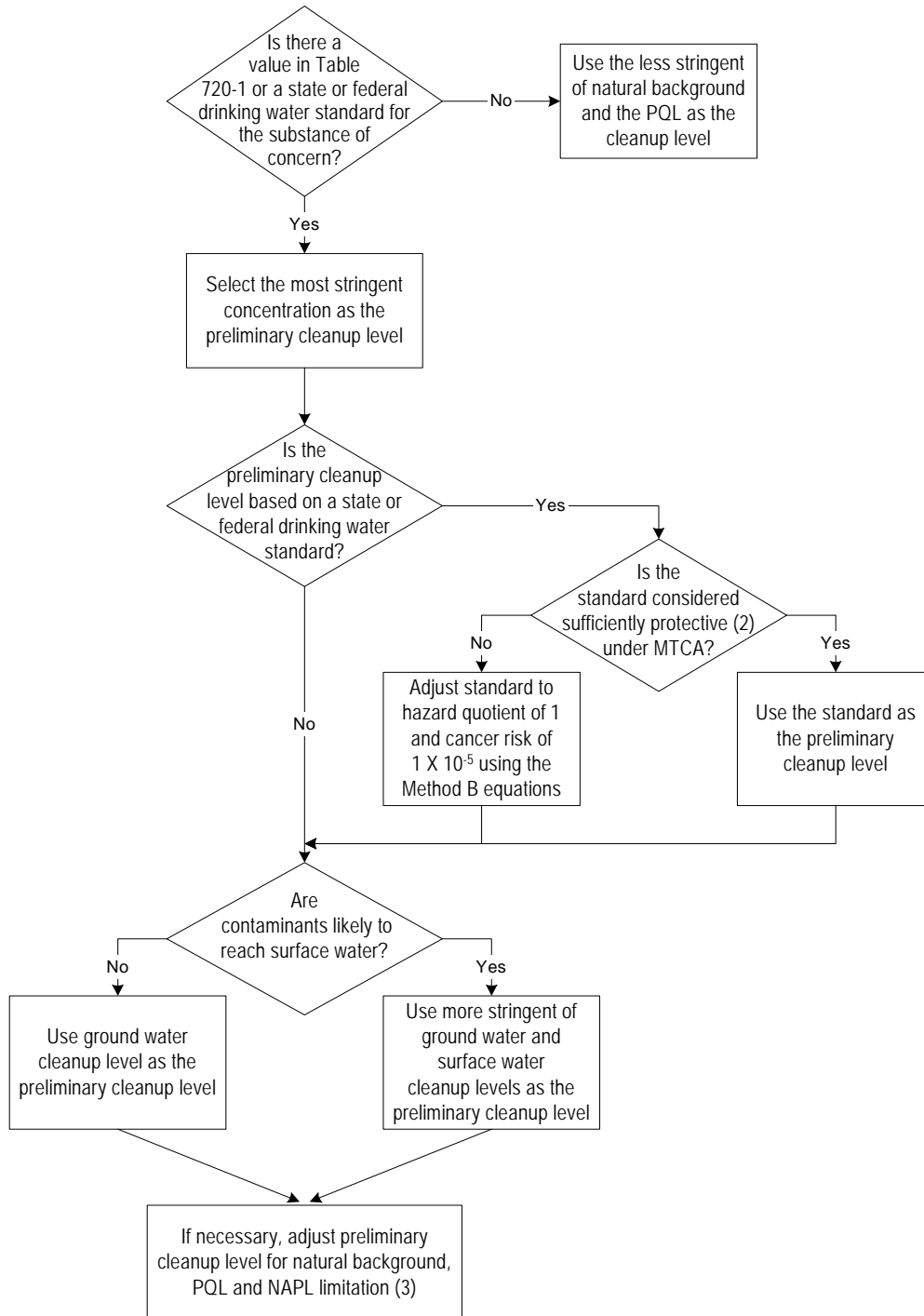
(2) Method A may only be used at qualifying sites. See WAC 173-340-704.

(3) Method C may only be used at qualifying sites. See WAC 173-340-706.

ARARs = Applicable and Relevant and Appropriate State and Federal Laws. See WAC 173-340-710 & 720.

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Figure 2: Establishing Method A Potable Ground Water Cleanup Levels under WAC 173-340-720(3)⁽¹⁾



NOTES

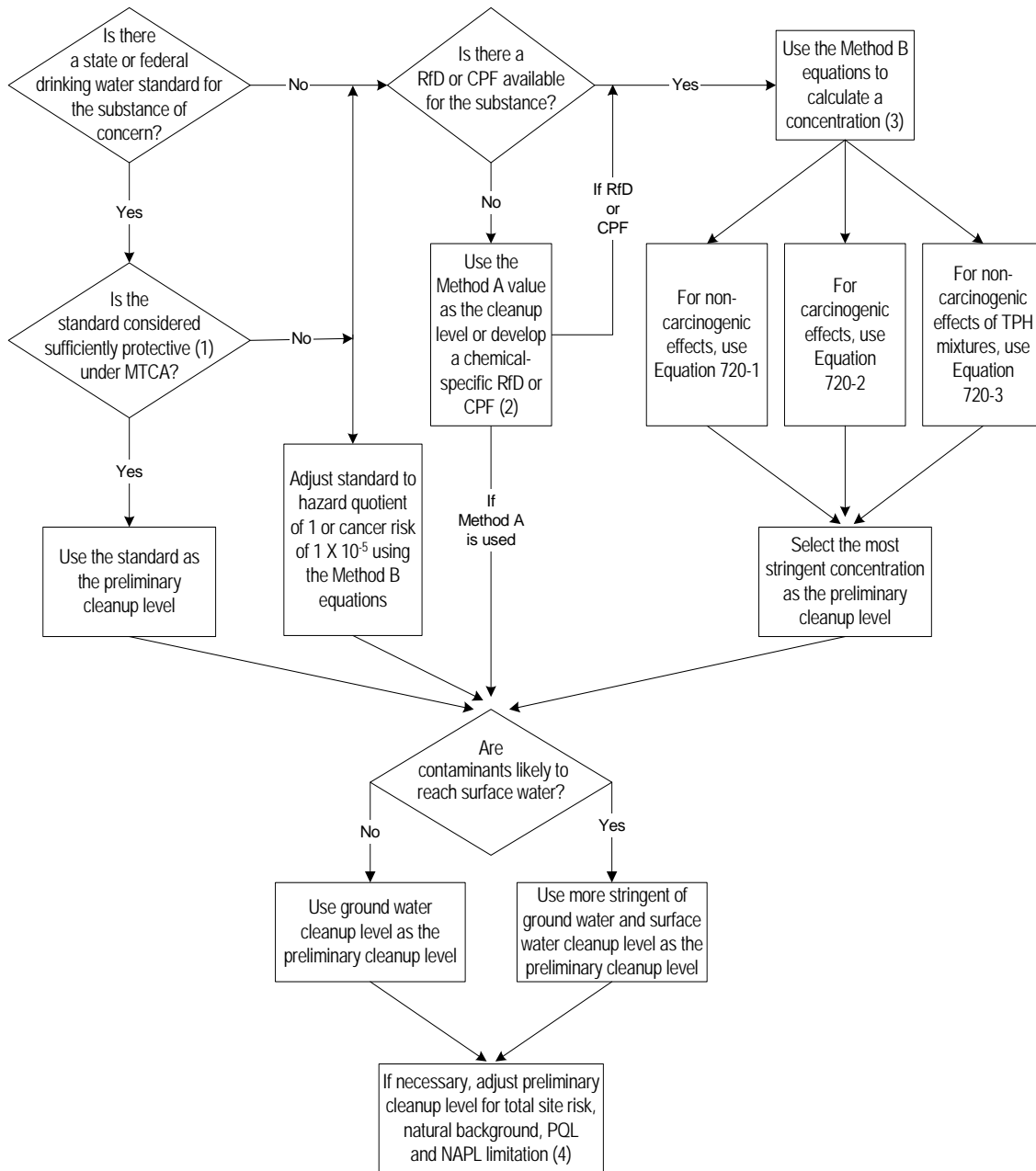
(1) Method A can only be used at qualifying sites. See WAC 173-340-704.

(2) The standard must be based on a hazard quotient of 1 or less or a cancer risk of 1×10^{-5} or less to be considered sufficiently protective. The Method B equations may be used to determine if a standard is sufficiently protective. See WAC 173-340-720(7)(b).

(3) See WAC 173-340-720(7).

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Figure 3: Establishing Method B Potable Ground Water Cleanup Levels under WAC 173-340-720(4)

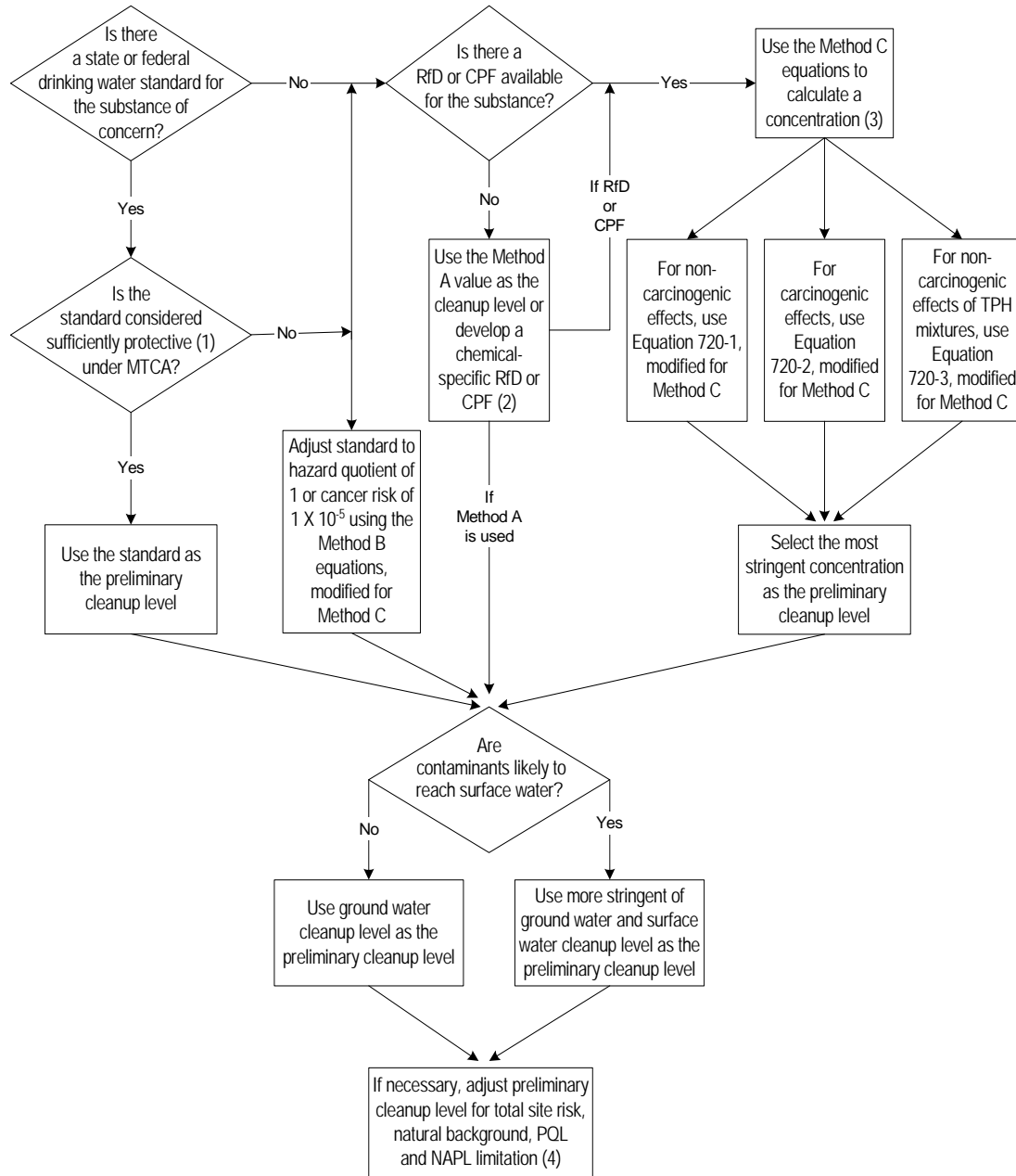


NOTES

- (1) The standard must be based on a hazard quotient of 1 or less or a cancer risk of 1×10^{-5} or less to be considered sufficiently protective. The Method B equations may be used to determine if a standard is sufficiently protective. See WAC 173-340-720(7)(b).
- (2) Chemical-specific reference dose (RfD) or cancer potency factor (CPF) must be developed in consultation with Ecology, EPA, DOH and SAB. This process has been completed for RfDs for petroleum fractions and these values are available from Ecology. Note that the Method A TPH values cannot be used under Method B because they are based on an assumed composition that may not be representative of the site.
- (3) Use equations with default values for Standard Method B. Selected default values may be changed under Modified Method B. See WAC 173-340-720(4)(c). For TPH, an additional adjustment may be necessary to prevent biodegradation from resulting in exceedances of MCLs.
- (4) See WAC 173-340-720(7).

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Figure 4: Establishing Method C Potable Ground Water Cleanup Levels under WAC 173-340-720(5)

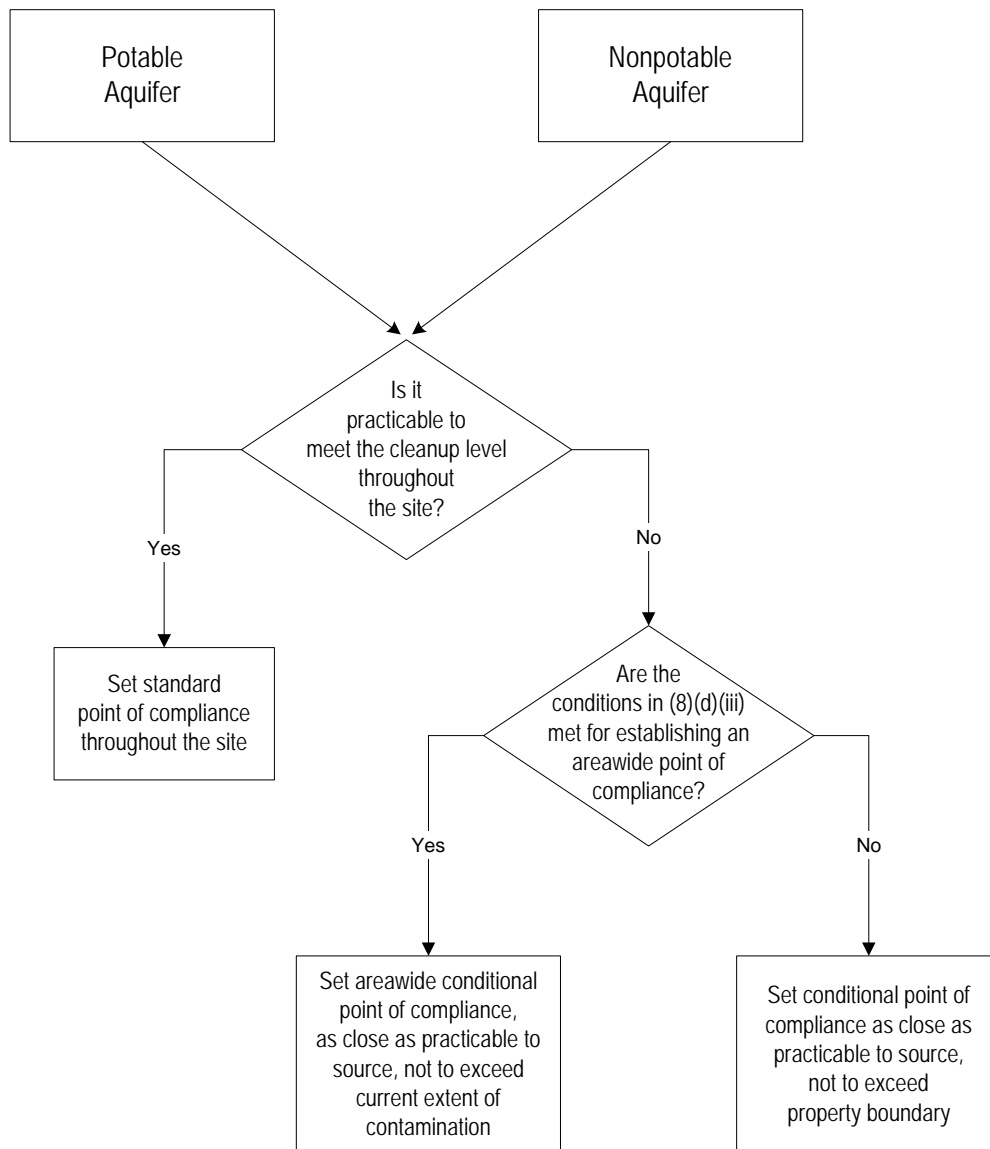


NOTES

- (1) The standard must be based on a hazard quotient of 1 or less or a cancer risk of 1×10^{-5} or less. The Method B equations, modified for Method C, may be used to determine if a standard is sufficiently protective. See WAC 173-340-720(7)(b).
- (2) Chemical-specific reference dose (RfD) or cancer potency factor (CPF) must be developed in consultation with Ecology, EPA, DOH and SAB. This process has been completed for RfDs for petroleum fractions and these values are available from Ecology. Note that the Method A TPH values cannot be used under Method C because they are based on an assumed composition that may not be representative of the site.
- (3) Use equations with default values for Standard Method C. Selected default values may be changed under Modified Method C. See WAC 173-340-720(5)(c). For TPH, an additional adjustment may be necessary to prevent biodegradation from resulting in exceedances of MCLs.
- (4) See WAC 173-340-720(7).

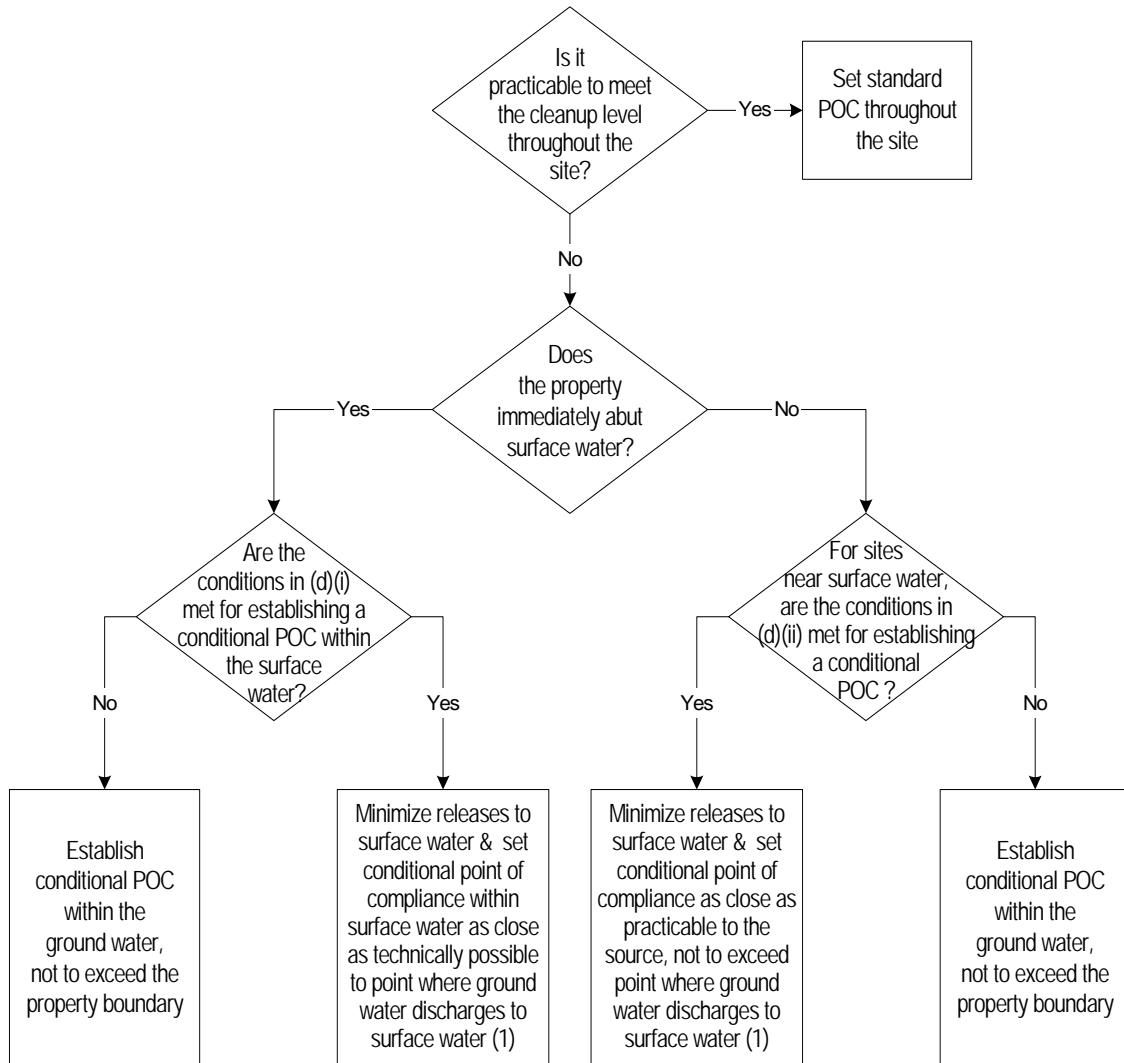
Disclaimer Notice: This figure is intended to help the user understand WAC 173-340-720. It does not establish or modify regulatory requirements.

Figure 5: Establishing a Point of Compliance for Potable and Nonpotable Ground Water under WAC 173-340-720(8)



Disclaimer Notice: This figure is intended to help the user to understand WAC 173-340-720. It does not establish or modify regulatory requirements.

Figure 6: Establishing a Point of Compliance for Ground Water Discharging to Surface Water under WAC 173-340-720(8)(d)



NOTE:

(1) May also measure compliance in upland monitoring wells along shore.

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Table 1: Summary of Default Values for Ground Water Cleanup Level Equations under WAC 173-340-720

Factor	Method B ⁽¹⁾		Method C ⁽²⁾	
	Noncarcinogens	Carcinogens	Noncarcinogens	Carcinogens
Drinking Water Ingestion Rate (DWIR)	1 <u>Liter</u> day	2 <u>Liters</u> day	2 <u>Liters</u> day	2 <u>Liters</u> day
Drinking Water Fraction (DWF) (unitless)	1	1	1	1
Average Body Weight (ABW)	16 Kg	70 Kg	70 Kg	70 Kg
Exposure Duration (ED)	6 yrs	30 yrs	6 yrs	30 yrs
Averaging Time (AT)	6 yrs	75 yrs	6 yrs	75 yrs
Chemical-specific Inhalation Correction Factor (INH) (unitless)				
<ul style="list-style-type: none"> ● Non volatile ● Volatile substances 	<p style="text-align: center;">1</p> <p style="text-align: center;">2</p>	<p style="text-align: center;">1</p> <p style="text-align: center;">2</p>	<p style="text-align: center;">1</p> <p style="text-align: center;">2</p>	<p style="text-align: center;">1</p> <p style="text-align: center;">2</p>
Chemical-specific Reference Dose (mg/kg-day)	See WAC 173-340-708(7)		See WAC 173-340-708(7)	
Chemical-specific Cancer Potency Factor (kg-day/mg)		See WAC 173-340-708(8)		See WAC 173-340-708(8)
Noncarcinogen Risk				
<ul style="list-style-type: none"> ● Hazard Quotient (HQ) ● Hazard Index (HI) 	<p style="text-align: center;">1</p> <p style="text-align: center;">1</p>		<p style="text-align: center;">1</p> <p style="text-align: center;">1</p>	
(Unitless)				
Carcinogen Risk				
<ul style="list-style-type: none"> ● Single Substance ● Total Risk 		<p style="text-align: center;">1×10^{-6}</p> <p style="text-align: center;">1×10^{-5}</p>		<p style="text-align: center;">1×10^{-5}</p> <p style="text-align: center;">1×10^{-5}</p>
(Unitless)				

(1) For allowable modifications to these default values under Modified Method B, see WAC 173-340-720(4)(c).

(2) For allowable modifications to these default values under Modified Method C, see WAC 173-340-720(5)(c).