Land Quality Division

Guidance for Identification of Hot Spots

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State of Oregon
Department of
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Quality

Errata: *Page 14. The definition of hot spot and the factor for calculating risk to non-T&E species were corrected 6/5/2007.*

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1.0 INTRODUCTION

The 1995 amendments to Oregon Revised Statute *[ORS 465.315]* and 1997 amendments to the Hazardous Substance Remedial Action Rules *[OAR 340-122]*, commonly referred to as the Environmental Cleanup Rules, require that certain actions be taken for "hot spots" of contamination. These actions are: a) the identification of hot spots as part of the Remedial Investigation and Feasibility Study and b) the treatment of hot spots, to the extent feasible, as part of a remedial action selected or approved by the Director of the Department of Environmental Quality (DEQ). In contrast, the cleanup statute and rules specify a preference for the least costly remedy for non-hot spots. In short, the intent of the hot spot rule is to require treatment only for the worst contamination, as opposed to preferring treatment for all contamination at the site.

The objective of this guidance is to assist DEQ staff and other interested parties in identifying hot spots of contamination. Project managers are encouraged to exercise professional judgment in applying this guidance to identify hot spots and should be cognizant of how the identification of hot spots at a cleanup site can affect the type and cost of the remedy. Guidance on evaluating the feasibility of treating hot spots can be found in the Department's *Guidance for Conducting Feasibility Studies*. Additional Department guidance pertaining to the identification of hot spots are listed in Appendix A. For information on these or other guidance policies call the Department's Waste Management and Cleanup (WMC) Division at (503) 229-5913 or 1-800-452-4011 (toll free in Oregon). Information about WMC guidance documents also can be found on the Department's web site at http://www.deq.state.or.us/wmc/cleanup/guidance.htm.

1.1 Definition of Hot Spots

The definition of hot spots depends upon the medium that is contaminated. Generally, for water, a hot spot exists if contamination results in a significant adverse effect on the beneficial use of that resource and if restoration or protection of the beneficial use can occur within a reasonable amount of time. For media other than water, a hot spot exists if the site presents an unacceptable risk and if the contamination is highly concentrated, highly mobile or cannot be reliably contained. These definitions will be discussed in more detail in Sections 2 and 3.

1.2 Purpose of Identifying Hot Spots

ORS 465.315 requires the Director of DEQ to select or approve a remedial action requiring treatment of hot spots to the extent treatment is feasible. The Environmental Cleanup Rules address the treatment requirement for hot spots and state that the Department shall select or approve a remedial action that *[see OAR 340-122-090]:*

- *(a) Is protective of present and future public health, safety and welfare and of the environment, as specified in OAR 340-122-040;*
- *(b) Is based on balancing of remedy selection factors, as specified in OAR 340-122-090 (3) and*
- *(c) Treats hot spots of contamination to the extent feasible, as specified in OAR 340-122-090 (4).*

This treatment requirement for hot spots is subject to the remedy selection balancing factors and criteria listed in OAR 340-122-090(4), which specifies that a higher threshold be applied in evaluating the

reasonableness of costs for treating hot spots of contamination, whether such treatment occurs onsite or in conjunction with excavation and off-site disposal.[1] Therefore, the purpose of identifying hot spots is to provide the information needed to evaluate the feasibility of various remedial action alternatives in light of the requirement to treat hot spots if feasible.

1.3 Applicability

The Environmental Cleanup Rules require the identification of hot spots when conducting a Remedial Investigation and Feasibility Study [see OAR 340-122-080 and -085]. However, simple sites with contamination limited to soil and meeting the requirements of OAR 340-122-045 (SOCLEAN) may utilize the Numeric Soil Cleanup Levels without the need to identify and treat hot spots of contamination. Furthermore, the treatment requirement for hot spots does not apply to removal actions conducted under OAR 340-122-070.

1.4 Organization of Guidance

This guidance identifies the types of information necessary for characterizing hot spots, describes how this information can be collected and evaluated, and explains the approach for characterizing hot spots in various types of environmental media. Consistent with the definition of hot spots provided in the Environmental Cleanup Rules, these media are addressed in the following order:

Water (Section 2)
- Groundwater
- Surface Water

Media Other Than Groundwater and Surface Water (Section 3)
- Soil
- Drummed Waste and Contaminated Debris
- Sediments
- Sludges
- Non-Aqueous Phase Liquids (NAPLs)

Throughout this guidance numerous sections of the Environmental Cleanup Rules are quoted. These quotations are shown in *italics*. For a more detailed reading, the specified sections of the Environmental Cleanup Rules should be reviewed in full.

1.5 Generic Hot Spot Levels

In order to facilitate the identification of hot spots and streamline the investigation and cleanup process for contaminated sites, the Department plans to develop generic hot spot levels. The generic hot spot levels may be used in place of site-specific calculations as long as the characteristics of the cleanup site are consistent with the conceptual site model used to develop the generic hot spot levels. When the generic hot spot levels are not appropriate, site-specific hot spot levels must be calculated.

[1] Excavation and off-site disposal by itself does not qualify as "treatment" [see OAR 340-122-115(54)].

Use of the generic hot spot levels is optional and does not constitute a requirement under the Environmental Cleanup Rules. These levels should help in the tentative identification of hot spots during the initial stages of site characterization. Early identification of hot spots will aid in focusing subsequent site characterization data collection thereby reducing investigation costs. As more site specific information becomes available, hot spot levels may need to be revised accordingly. Of course, generic hot spot levels may not need to be revised if additional information confirms the validity of the conceptual site model and assumptions used in generating the generic hot spot levels.

1.6 Information Requirements and Timing Considerations For Hot Spot Identifications

The information typically collected during a Remedial Investigation and Feasibility Study should be sufficient for identifying hot spots. This information includes: the delineation of the nature and extent of contamination; identification of current and reasonably likely future land use(s) and beneficial use(s) of water; identification of significant contaminant migration routes and exposure pathways; and an evaluation of the protectiveness and feasibility of various remedial action alternatives. As such, the identification of hot spots should require little or no data in addition to that typically collected during a Remedial Investigation and Feasibility Study.

Early identification of hot spots will help focus the Remedial Investigation and Feasibility Study. As such, the Department recommends that hot spots be characterized as early as possible during site characterization. However, since components of the hot spot assessment and evaluation are performed in the Remedial Investigation, Risk Assessment and Feasibility Study, in some cases, the hot spot assessment may be incomplete until relatively late in the process.[2]

2.0 GROUNDWATER AND SURFACE WATER

The Environmental Cleanup Rules define hot spots in groundwater and surface water as:

> *OAR 340-122-115(31)(a): For groundwater or surface water, hazardous substances having a significant adverse effect on beneficial uses of water or waters to which the hazardous substances would be reasonably likely to migrate and for which treatment is reasonably likely to restore or protect such beneficial uses within a reasonable time, as determined in a feasibility study.*

Assessing a site for groundwater and surface water hot spots will require an evaluation of significant adverse effects on the current and reasonably likely future beneficial use(s) of the water and water to which the hazardous substances would be reasonably likely to migrate. If any significant adverse effects exist or are likely to occur in the future, it then will be necessary to determine if treatment is reasonably likely to restore or protect these beneficial use(s) within a reasonable period of time. This process is illustrated in Figures 2-1 and 2-2 and discussed below in more detail.

As specified above, hot spots must be identified based on significant adverse effects on the beneficial use(s) of water at the facility **and** waters to which the hazardous substances would be reasonably likely to migrate. Any determination of the extent that hazardous substances would be reasonably likely to migrate

[2] See OAR 340-122-080 subsections (6) and (7) and OAR 340-122-085(5)(a)(A).

needs to be made on a site-specific basis. The criteria that should be considered in making this determination include the nature and extent of the contamination as well as the geological, hydrological and hydrogeological properties of the groundwater aquifer or surface water body. Examples of more specific criteria include: the mobility and velocity of contaminants and their breakdown products, probability of natural attenuation or bioaccumulation, presence of pathways through confining layers (e.g., poorly constructed or abandoned wells), integrity and permeability of barriers to migration, and magnitude of related uncertainties.

2.1 Significant Adverse Effect on Beneficial Uses of Water

This section provides a brief description of the regulatory requirements for identifying the beneficial use(s) of water and determining whether the beneficial use(s) have been significantly affected. OAR 340-122-080(3)(f) lists the criteria to be considered in identifying the current and reasonably likely future beneficial use(s) of water in the locality of the facility. This list includes:

> *(A) Federal, state, and local regulations governing the appropriation and/or use of water;*
> *(B) Nature and extent of current groundwater and surface water uses;*
> *(C) Suitability of groundwater and surface water for beneficial uses;*
> *(D) The contribution of water to the maintenance of aquatic or terrestrial habitat:*
> *(E) Any beneficial uses of water which the Water Resources Department or other federal, state or local program is managing in the locality of the facility; and*
> *(F) Reasonably likely future uses of groundwater and surface water based on:*
> *(i) Historical land and water uses;*
> *(ii) Anticipated future land and water uses;*
> *(iii) Community and nearby property owners' concerns regarding future water use;*
> *(iv) Regional and local development patterns;*
> *(v) Regional and local population projections; and*
> *(vi) Availability of alternate water sources including, but not limited to, public water supplies, groundwater sources, and surface water sources;*

Guidance on identifying the current and reasonably likely future beneficial use(s) of water can be found in the Department's *Guidance for Beneficial Water Use Determinations.*

The Environmental Cleanup Rules provide a hierarchical approach for determining if the beneficial use(s) of water have been significantly adversely affected. Specifically, OAR 340-122-115(50) defines significant adverse effect on beneficial use(s) of water, or waters to which the hazardous substances would be reasonably likely to migrate, as current or reasonably likely future exceedance of:

> *(a) Applicable or relevant federal, state or local water quality standards, criteria, or guidance;*
> *(b) In the absence of applicable or relevant water quality standards, criteria, or guidance, the acceptable risk level; or*
> *(c) If subsections (a) and (b) of this section do not apply, the concentration of a hazardous substance indicated by available published peer-reviewed scientific information to have a significant adverse effect on a current or reasonably likely future beneficial use of water.*

Appendix B provides the recommended format for determining if site contamination presents a significant adverse effect on the beneficial use(s) of water.

Appendix C identifies and describes some of the water quality standards, criteria and guidance which may be applicable or relevant in assessing significant adverse effects on beneficial use(s) of water. Examples include the National Primary Drinking Water Standard Maximum Contaminant Levels (MCLs) and National Secondary Drinking Water Standards for drinking water use. When two or more standards are applicable or relevant for the same beneficial use, the more stringent should be used in assessing significant adverse effects on the beneficial use.

In the absence of applicable or relevant water quality standards, criteria, or guidance, the acceptable risk level is used to define a significant adverse effect on beneficial use(s) of water. In this case, the baseline risk[3] calculated for exposures to the contaminated water are compared to the acceptable risk levels defined in OAR 340-122-115. If the baseline risk for these exposures exceeds the acceptable risk levels, then the contamination poses a significant adverse effect on the (current or reasonably likely future) beneficial use(s) of the water.

In situations where there are no applicable or relevant water quality standards, criteria or guidance and there are no risks as described above, the definition of significant adverse effect is based on available published peer-reviewed scientific information. For example, this information might include possible industry-specific specifications for acceptable water quality.

In order to assist in the determination of significant adverse effects, the Department plans to develop generic significant adverse effect levels for residential drinking water. These generic levels would be derived from National Primary Drinking Water Standard MCLs, Secondary Drinking Water Standards and risk-based concentrations representative of the acceptable risk level.

2.2 Reasonable Time for Treatment to Restore or Protect Beneficial Uses of Water

This section describes the criteria for determining whether it is reasonably likely that treatment can restore or protect the beneficial use(s) of water within a reasonable time. This evaluation is necessary to determine if any significant adverse effects on beneficial use(s) of water may constitute hot spots.

2.2.1 Determining "Whether Treatment can Restore or Protect the Beneficial Use(s) within a Reasonable Time"

As required by the Environmental Cleanup Rules, the feasibility study must evaluate whether treatment can restore or protect the significantly effected beneficial use(s) of water within a reasonable time.[4] This evaluation may be done using the following suggested two step process.

In the first step of the evaluation, the reasonable time for treatment to restore or protect the beneficial use(s) is determined based on the importance of the water resource. Factors to consider include:

- The number of people and types of ecological receptors affected by any significant adverse effect(s) on the beneficial use(s) of the water;

[3] Baseline risk is the risk posed by hazardous substances in the absence of any remedial action (i.e., under baseline conditions).
[4] See OAR 340-122-115(31)(a) and OAR 340-122-085(5)

- The specific types of significant adverse effects the contamination may have on the beneficial use(s) of the water (e.g., are the impacts related to health, aesthetic or other effects);
- Current and reasonably likely availability and adequacy of alternative water supplies which may be used as a substitute for the impacted water.

Although the determination of "reasonable time" must be made on a site-specific basis, the Department believes that a restoration time of 30 years may be reasonable in many cases. A reasonable restoration time may be substantially greater for highly important primary water resources such as sole source drinking water aquifers or surface water supporting important ecological life. For less important beneficial uses such as landscape irrigation or less critical secondary water resources such as shallow groundwater aquifers which may be readily replaced by other primary water supplies, a reasonable restoration time may be substantially less than 30 years.[5]

In the second step of evaluating whether treatment can restore or protect the beneficial use(s) within a reasonable time, a range of remedial action alternatives is developed and evaluated, as described in the Department's *Guidance for Conducting Feasibility Studies*. As specified in OAR 340-122-085(2), this range is based on the following general response actions:

- No Action,
- Engineering and/or institutional controls [e.g., containment],
- Treatment,
- Excavation and off-site disposal without treatment [e.g., of the source areas], and
- Any combination of the above, as appropriate.

These alternatives should be developed consistent with the remedial action objects established for the site and with the goal of restoring or protecting the beneficial uses of water within the reasonable time determined, as described above.[6]

The remedial action alternatives are then evaluated for their protectiveness, as specified in OAR 340-122-040, and their feasibility based on the five remedy selection factors specified in OAR 340-122-090(3): effectiveness, long-term reliability, implementability, implementation risk, and cost reasonableness. A "higher cost threshold", as specified in OAR 340-122-090(4)(c), should be applied in evaluating the cost reasonableness of those alternatives which utilize treatment to restore or protect the beneficial uses of the water.

2.2.2 "Restoration or Protection" of Beneficial Use(s)

For the purpose of identifying hot spots in water, "to restore or protect" such beneficial use(s) means that either i) the identified beneficial use(s) is no longer significantly affected or ii) contaminant migration will not significantly affect the beneficial use(s) of other geographically distinct portions of the groundwater aquifer or surface water body.

[5] Note that a longer "reasonable time" will increase the likelihood that contaminated water will result in a hot spot.
[6] These remedial action alternatives should not necessarily be limited to only groundwater and surface water restoration or protection. Where appropriate, the alternatives also should address source areas impacting groundwater or surface water.

Restoration or protection of a beneficial water use may result from treatment of the contaminant source within the aquifer (i.e., source treatment). The objective of source treatment is to restore the aquifer. Examples of source treatment include *in-situ* bioremediation and groundwater extraction/treatment.

Restoration or protection of a beneficial water use also may utilize technologies which contain the contaminant plume. An example of a containment technology is a barrier wall which extends the contaminant's travel time and increases the residence time for intrinsic bioremediation. Another example is groundwater extraction, treatment and re-injection to control the hydraulic gradient. In these examples, the objective is to prevent contaminant migration and not necessarily to "clean up" the aquifer.

2.3. Components of the Hot Spot Report for Groundwater or Surface Water

The evaluation of hot spots in water includes an assessment of significant adverse effects on the water's beneficial use(s) as well as an assessment of the ability of treatment to restore or protect the beneficial use(s) within a reasonable time. The information used in the evaluation of water hot spots should be collected, analyzed, and presented in a concise and logical manner.

As required by OAR 340-122-080(6), the Remedial Investigation shall identify hazardous substances having a significant adverse effect on beneficial use(s) of water. The evaluation of these "potential" hot spots generally should include the following components:

1. The current and reasonably likely future beneficial use(s) of water in the locality of the facility and the significant adverse effect levels for contaminants threatening the beneficial use(s) *[see Appendix B for an example format]*.

2. Areas over which contamination currently or in the future may likely result in significant adverse effects on the beneficial use(s) of water. These areas should be identified as "potential" hot spots.

3. Any additional information or analyses that the Department deems necessary.

As required by OAR 340-122-085(5)(a)(A), the Feasibility Study shall evaluate whether treatment is reasonably likely to restore or protect the beneficial use(s) within a reasonable time. This evaluation determines whether the "potential" hot spots identified during the Remedial Investigation are indeed "hot spots." The evaluation generally should include the following components:

1. Estimates of the "reasonable time" for <u>each</u> current and reasonably likely future beneficial use of water to be restored or protected. This evaluation should include:
   a) A summary of the information presented in the Remedial Investigation report pertaining to the evaluation of the "potential" hot spots.
   b) Number of people and types of ecological receptors affected by any significant adverse effects on the beneficial use(s) of the water.
   c) A description of any significant adverse affects the contamination may have on the beneficial use(s) of the water. For example, concentrations of silver in drinking water above the National Secondary Drinking Water Standard of 0.1 mg/L may produce argyria (a discoloration of the skin) and graying of the eyes and, for all practical matters, would make the water nonpotable.

d) Current and reasonably likely availability and adequacy of alternate water supplies which may be used as a substitute for the impacted water.
e) Recommended "reasonable time" for each of the beneficial use(s) to be restored and/or protected. The basis for this recommendation also should be provided.

2. The development of a range of remedial action alternatives, as specified in OAR 340-122-085(2), including treatment-based remedial action alternatives intended to restore or protect the beneficial use(s) of water within the recommended and Department approved "reasonable time". In conjunction with source removal or treatment, where applicable, the remedial alternatives developed should include, at a minimum, i) treatment of the aquifer or surface water body and ii) hydraulic controls intended to prevent further migration of contamination.

3. An evaluation of the protectiveness and feasibility of the remedial action alternatives, as specified in OAR 340-122-085(4). The feasibility of the alternatives is based upon a balancing of the following remedy selection factors, as provided in OAR 340-122-090(3) and (4): effectiveness; long-term reliability; implementability, implementation risk, and cost reasonableness.

4. The area of the "potential" hot spots over which the beneficial use(s) can be restored or protected within a reasonable time. This area should be identified as the "hot spot."

5. Any additional information or analyses the Department deems necessary.

Figure 2-1
Flow Chart for Identifying Hot Spots in Water

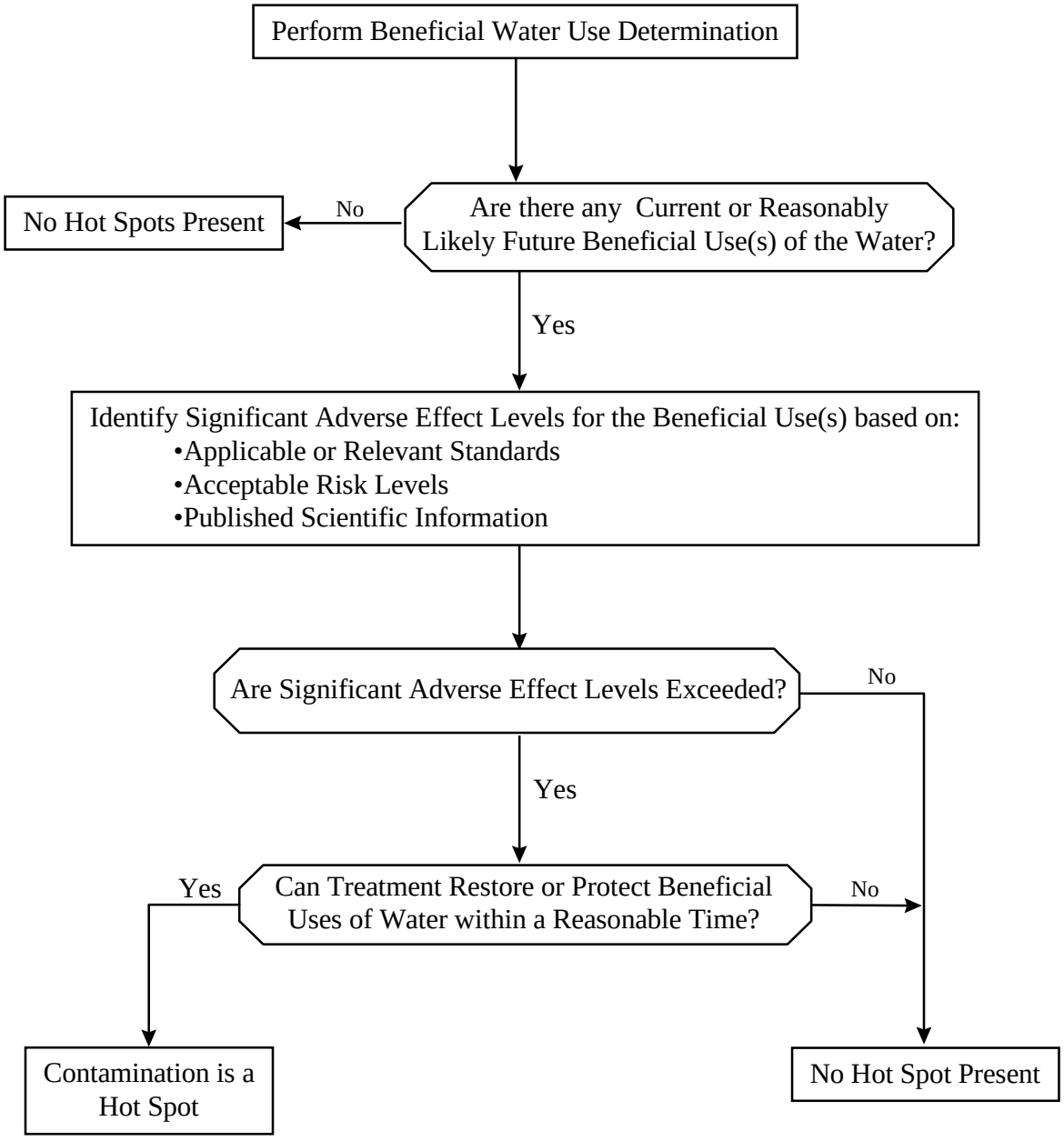
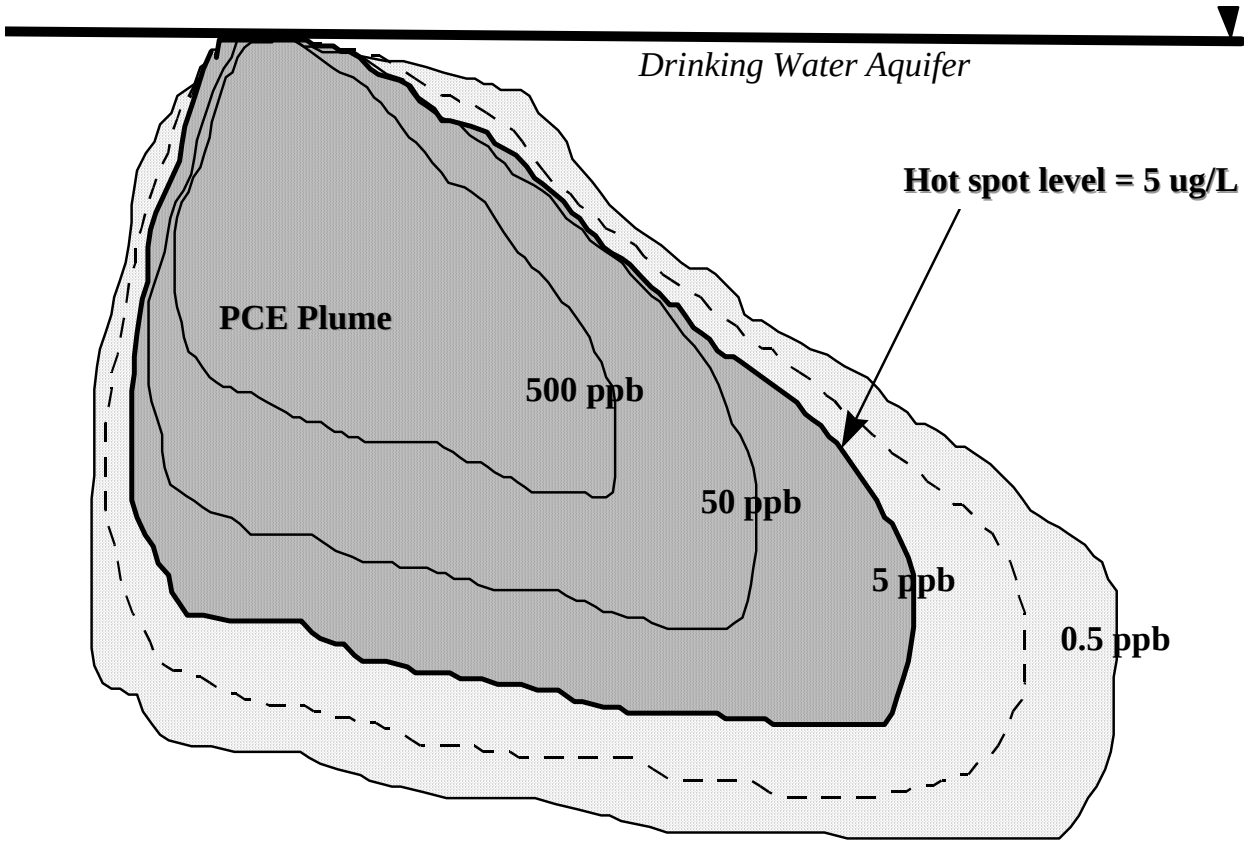


Figure 2-2
Process for Identifying Hot Spots in Water

Example - *Beneficial use of groundwater is drinking water*
Contaminant of concern is perchloroethylene (PCE)
The significant adverse effect level for PCE is 5 ug/L, the national primary drinking water standard maximum contaminant level (MCL)
The Feasibility Study indicates that drinking water use can be restored or protected within a reasonable time by Reactive Permeable Barriers (RPBs)

Conclusion, the groundwater plume is a hot spot where concentrations of PCE exceed 5 ug/L



3.0 MEDIA OTHER THAN WATER

The Environmental Cleanup Rules define hot spots in media other than water as:

> *OAR 340-122-115(31)(b): For media other than groundwater or surface water (e.g., contaminated soil, debris, sediments, and sludges; drummed waste; 'pools' of dense, non-aqueous phase liquids submerged beneath groundwater or in fractured bedrock; and non-aqueous phase liquids floating on groundwater), if hazardous substances present a risk to human health or the environment exceeding the acceptable risk level, the extent to which the hazardous substances:*
>
> *(A) Are present in concentrations exceeding risk-based concentrations corresponding to:*
>
> *(i) 100 times the acceptable risk level for human exposure to each individual carcinogen;*
>
> *(ii) 10 times the acceptable risk level for human exposure to each individual non-carcinogen;*
>
> *(iii) 10 times the acceptable risk level for individual ecological receptors or populations of ecological receptors to each individual hazardous substance;*
>
> *(B) Are reasonably likely to migrate to such an extent that the conditions specified in subsection (a)[7] or paragraphs (b)(A) or (b)(C) would be created; or*
>
> *(C) Are not reliably containable, as determined in the feasibility study.*

Assessing a site for hot spots in media other than water will first require an evaluation of the site's baseline risk. If the baseline risk at the site[8] exceeds the acceptable risk level, it will be necessary to determine if any areas of contamination at the site constitute hot spots of contamination resulting from contamination that is "highly concentrated," "highly mobile," or "not reliably containable."[9] This process is illustrated in Figure 3-1 and discussed below in more detail.

Since the baseline risk assessment typically is not finished until the site characterization and Remedial Investigation is complete, it may be desirable to anticipate if the baseline risk exceeds the acceptable risk level so that hot spots can be tentatively identified concurrent with site characterization. Guidance on conducting the baseline risk assessment can be found in the Department's *Guidance on Ecological Risk Assessment Level 3 - Baseline* and the EPA document titled *Risk Assessment Guidance for Superfund Volume 1 Human Health Evaluation Manual (Part A)*, US EPA, 1989, EPA/540/1-89/002.

3.1 Soil

Soil is the most common environmental medium susceptible to contamination with hazardous substances. OAR 340-122-115(51) defines soil as "*a mixture of organic and inorganic solids, air, water, and biota which exists on the earth's surface above bedrock, including materials of anthropogenic source such as slag and sludge*." For the purpose of characterizing hot spots, "soil" is distinguished from debris, sediments and sludges, which will be described separately.

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[7] This references OAR 340-122-115(31)(a).

[8] The Environmental Cleanup Rules define facility or site as any area where a hazardous substance has been deposited, stored, disposed of, or placed, or otherwise come to be located and where a release has occurred or where there is a threat of a release. For the complete definition of "facility" or "site" see OAR 340-122-115(26).

[9] Throughout this guidance the terms "highly concentrated" and "highly mobile" are used as shorthand for the criteria provided in OAR 340-122-115(31)(b) subsections (A) and (B), respectively. See ORS 465.315(2)(b) for the origin of these terms.

3.1.1 Highly Concentrated Hot Spots in Soil

The assessment of "highly concentrated" soil hot spots is performed by comparing the concentration of each individual site contaminant to its "highly concentrated" hot spot level. This process is illustrated in Figure 3-2. The "highly concentrated" hot spot levels are "risk-based concentrations" corresponding to a given multiplier of the acceptable risk level, as discussed below. The EPA has developed numerous documents providing guidance on the calculation of risk-based concentrations (RBCs), also referred to as preliminary remediation goals (PRGs). The following documents provide the equations and other useful information for calculating RBCs:

- *Soil Screening Guidance: Technical Background Document*, US EPA, 1996, EPA/540-R-95/128

- *Risk Assessment Guidance for Superfund: Volume 1 - Human Health Evaluation Manual (Part B, Development of Risk-based Preliminary Remediation Goals*, US EPA, December 1991, Publication 9285.07-01B.

In addition, several EPA Regions have developed guidance documents listing precalculated RBCs and PRGs. The PRG tables developed by EPA Region IX can be downloaded from their Internet site at http://www.epa.gov./region09/waste/sfund/prg/index.html.

Risk-based concentrations are a function of three variables: the target risk level, the various exposure factors applicable to a given exposure pathway and the contaminant's toxicity. In calculating "highly concentrated" hot spot levels, the target risk level is a given multiplier, as discussed below, of the acceptable risk levels defined in OAR 340-122-115(1). The specific equations for calculating RBCs are based on the carcinogenicity and non-carcinogenicity of the contaminant and the various exposure pathways (e.g., ingestion of soil, dermal contact and inhalation of vapors or air born particulates), and the possible exposed receptors (e.g., children, adults or ecological receptors).

In calculating "highly concentrated" hot spot levels, these risk-based concentration equations are employed to normalize the contaminant concentration to its toxicity and the site-specific exposure factors representing the exposure scenarios at the site. The "highly concentrated" hot spot levels should not be mistaken as representing site risk since they do not consider the cumulative exposure from multiple contaminants or the contaminant distribution throughout the site.

3.1.1.1 Human Exposures

The assessment of "highly concentrated" soil hot spots for human exposures is required only in instances when the baseline risk at the facility exceeds the acceptable risk level[10] for human exposures. In such cases, the "highly concentrated" hot spot levels are calculated for those exposure pathways resulting in unacceptable risk.

The calculation of "highly concentrated" hot spot levels for human exposures is based on a 100-fold multiplier of the acceptable risk levels for carcinogens and a 10-fold multiplier of the acceptable risk level for non-carcinogens. For carcinogens, "highly concentrated" hot spot calculations use either the

[10] Acceptable risk levels are defined in OAR 340-122-115(1).

deterministic acceptable risk level defined in OAR 340-122-115(2)(a) or the probabilistic acceptable risk level defined in OAR 340-122-115(2)(b). For non-carcinogens, "highly concentrated" hot spot calculations use either the deterministic acceptable risk level defined in OAR 340-122-115(4)(a) or the probabilistic acceptable risk level defined in OAR 340-122-115(4)(b).

When using the deterministic acceptable risk definitions, the "highly concentrated" hot spot levels correspond to a lifetime excess cancer risk of **$1x10^{-4}$** for carcinogens and a hazard quotient[11] of **10** for non-carcinogens. When using the probabilistic acceptable risk definitions, the "highly concentrated" hot spot levels for carcinogens correspond to a lifetime excess cancer risk of **$1x10^{-4}$ at the 90th percentile** and less than **$1x10^{-3}$ at the 95th percentile**. For non-carcinogens, the "highly concentrated" hot spot levels correspond to a hazard quotient of **10 at the 90th percentile** and less than **100 at the 95th percentile**.

The Department expects the calculation of "highly concentrated" hot spot levels to be performed by an experienced toxicologist or risk assessor. Due to the complex nature of applying the probabilistic acceptable risk definitions, the Department should be contacted and a workplan approved prior to performing the hot spot assessment.[12] Guidance on the use of probabilistic techniques can be found in the Department's *Guidance for Use of Probabilistic Analysis in Human Health Risk Assessments.*

In order to facilitate the identification of hot spots, the Department plans to develop generic levels for "highly concentrated" hot spots in soil based on human exposures. It is anticipated that the generic "highly concentrated" hot spot levels will be applicable to residential and industrial land use scenarios and will be based on EPA's Reasonable Maximum Exposure Scenario (RME)[13]. Exposure routes for the generic "highly concentrated" hot spot levels likely will include incidental ingestion of soil, inhalation of contaminant vapors or soil particulates and dermal contact with soil. As mentioned in Section 1.5, use of the generic hot spot levels is optional. The calculation of site-specific "highly concentrated" hot spot levels may be more appropriate for different exposure scenarios and/or provide less conservative levels (e.g., for recreational land use or if based on the probabilistic acceptable risk level definitions).

3.1.1.2 Ecological Receptors

The assessment of "highly concentrated" soil hot spots for ecological receptors is required only in instances when the baseline risk at the facility exceeds the acceptable risk level for ecological receptors. In an attempt to facilitate the assessment of ecological risks, the Department has developed guidance describing four levels of effort for assessing ecological risks [see the Department's *Guidance for Ecological Risk Assessment*]. If any of these four levels indicate that ecological risks are either not present at the site (Levels I or II) or do not exceed the acceptable risk levels (Levels III or IV), then it is not necessary to assess "highly concentrated" hot spots for ecological receptors.

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[11] Although the Environmental Cleanup Rules use hazard indices for defining the acceptable risk level, hazard quotients must be used in deriving "highly concentrated" hot spots levels for individual non-carcinogens since a hazard index is only applicable to cumulative effects of multiple contaminants. The hazard index is defined as a number equal to the sum of the hazard quotients attributable to systemic toxicants with similar toxic endpoints.

[12] See OAR 340-122-084(5)(b).

[13] See Risk Assessment Guidance for Superfund Volume 1 Human Health Evaluation Manual (Part A), EPA/540/1-89/002, For a description the RME scenario.

The calculation of "highly concentrated" hot spot levels for ecological receptors is based on a 10-fold multiplier of the acceptable risk levels for individual ecological receptors as well as for populations of ecological receptors. For individual ecological receptors (i.e., species listed as threatened or endangered), "highly concentrated" hot spot calculations use either the deterministic acceptable risk level defined in OAR 340-122-115(5)(a) or the probabilistic acceptable risk level defined in OAR 340-122-115(5)(b). For populations of ecological receptor (i.e., non-threatened and endangered species), "highly concentrated" hot spot calculations use the acceptable risk level definition specified in OAR 340-122-115(6).

When using the deterministic acceptable risk definition for T&E species, the "highly concentrated" hot spot levels correspond to a toxicity quotient of **10**. When using the probabilistic acceptable risk definition for T&E species, the "highly concentrated" hot spot levels correspond to a hazard quotient of **10 at the 90th percentile** and less than **100 at the 95th percentile**. For non-T&E species, the "highly concentrated" hot spot level corresponds to a **10 percent chance, or less, that more than 20 percent of the total local population will be exposed to a toxicity quotient of 10**.

The Department has developed ecological Screening Benchmark Values (SBVs) for use in assessment ecological risk. For additional information on SBVs and a listing of SBVs for a variety of ecological receptors, see the Department's *Guidance for Ecological Risk Assessment - Level II Screening Benchmark Values*. These SBVs may be converted into generic "highly concentrated" hot spot levels by the following procedure:

- For T&E species, the "highly concentrated" hot spot level is 10 times the SBV;
- For non-T&E species, the "highly concentrated" hot spot level is 50 times the SBV.

3.1.2 Highly Mobile Hot Spots in Soil

Mobility refers to the transport or migration of hazardous substances from their present location. Typical routes of migration include:

- Infiltration or leaching through subsurface soils and into groundwater;
- Stormwater runoff into surface waters; and
- Wind-blown deposition on surface soils, water, foliage and structures.

Of these three migration routes, leaching to groundwater is often the most problematic and of greatest concern. However, stormwater runoff into surface water may be significant at sites with contaminated surface soils, especially soils located close to surface water bodies or storm drains which discharge to surface water. Although less prevalent, at some sites migration via wind-blown deposition may be a significant migration route.

The assessment of "highly mobile" hot spots is required only in instances when it is reasonably likely that significant migration routes exist at a site. For example, based on partitioning equations, extraction analyses, site monitoring data, computerized fate and transport modeling, or other relevant information, it

might be reasonable to conclude that leaching to groundwater is unlikely.[14] Furthermore, it may not be necessary to derive "highly mobile" hot spot levels if such levels would clearly exceed (i.e., be less conservative than) any "highly concentrated" hot spot levels derived for the site. In such cases, the expense and effort to calculate site-specific "highly mobile" hot spot levels would not effect the size of the hot spot which would be controlled by the lower (more stringent) "highly concentrated" levels. Any proposal to use "highly concentrated" hot spot levels in lieu of site-specific "highly mobile" hot spot levels must be based on sound professional judgment supported by site-specific information and approved by the Department.

The identification of "highly mobile" hot spots is performed by following a three step process. This process is illustrated in Figure 3-3. In the first step, the current and reasonably likely future beneficial use(s) of the water is determined. In the second step, a "reference value" is determined for the receiving medium. In the third step, the "reference value" is used to derive or back-calculate the "highly mobile" hot spot level of the contaminated medium. The "highly mobile" hot spot level is the concentration of the contaminant that will result in an exceedance of the "reference value" if migration occurs.

For the leaching to groundwater migration route, the groundwater "reference value" is the significant adverse effect level for the beneficial use(s) of the groundwater, or waters to which the hazardous substance would be reasonably likely to migrate. The hierarchical approach for determining significant adverse effect levels is described in Section 2.1 of this guidance. For example, if the beneficial use of the groundwater is drinking water, the groundwater "reference value" would be the National Primary Drinking Water Maximum Contaminant Level (MCL), if one exists.

The "point of reference" is another important parameter in identifying "highly mobile" hot spots when the receiving media is water. The "point of reference" is the location **where** an exceedance of the "reference value" would result in a significant adverse effect on the beneficial use(s) of the water. Although the "point of reference" is based on site-specific factors, several generalities can be made.

When the receiving media is groundwater, the "point of reference" should be the closest or most susceptible aquifer that has an identified beneficial use. If hydrogeological conditions would preclude the location of extraction wells within the more susceptible portions of the aquifer, such as the upper zone closest to the contaminated soil, the "point of reference" should be the most susceptible portion of the aquifer that the intake or screened portion of an extraction well may reasonably likely be located.

Note that the assessment of "highly mobile" hot spots is dependent upon the aerial extent (i.e., volume or mass) of the contamination. For example, the potential for contaminated soil to leach into groundwater and result in a significant adverse effect on the beneficial use(s) of the water will dramatically decrease for very small masses of contamination.

The Department plans to develop generic hot spot levels for "highly mobile" hot spots in soil based on the leaching to groundwater migration pathway. It is anticipated that these generic levels will be derived for a groundwater beneficial use which includes residential drinking water. Consistent with the definition of

[14] Guidance on leaching tests and mathematical modeling can be found in the Department's *Soil Cleanup Manual, Appendix B Guidelines for Mathematical Modeling*.

significant adverse effect on beneficial uses of water[15], the following hierarchical approach likely will be used in deriving the groundwater reference concentrations:

- The lowest of National Primary Drinking Water Standard MCLs and Secondary Drinking Water Standards and
- In the absence of the National Drinking Water Standards, the risk-based concentration indicative of the acceptable risk level for residential use of drinking water.

3.1.3 Not Reliably Containable Hot Spots in Soil

As required by the Environmental Cleanup Rules, the feasibility study must determine the extent to which hazardous substances cannot be reliably contained for the purpose of identifying "not reliably containable" hot spots in soil.[16] This assessment should be performed during the evaluation of "long-term reliability" which is one of the five remedy selection balancing factors that must evaluated in the Feasibility Study for each remedial action alternative. Guidance on the development and evaluation of remedial action alternatives is provided in the Department's *Guidance for Conducting Feasibility Studies*.

Factors to be considered when evaluating the reliability of containment include whether contaminated soils are in direct contact with groundwater or surface water; located in areas prone to floods or landslides or subject to vandalism; prone to leaching to groundwater; and prone to create surface run-off.

In most cases, the Department anticipates that any contamination that is "not reliably containable" will likely result in either "highly mobile" or "highly concentrated" hot spots. Thus, this criterion should seldom effect the outcome of the hot spot determination.

3.2 Drummed Waste and Contaminated Debris

Drummed waste and contaminated debris are examples of "media other than water" which must be evaluated in the hot spot assessment. In addition to the remedial action objectives identified during the Remedial Investigation or Feasibility Study, drummed waste and contaminated debris must be managed and disposed of in accordance with federal and state laws regarding hazardous and solid waste. The Department's Hazardous Waste Technical Assistance Program can provide advice on the identification, storage, handling and disposal of solid and hazardous wastes.

In order to facilitate the proper disposal of drummed waste and contaminated debris, in many cases the Department recommends that these wastes be expeditiously removed from the site. However, for excessively large volumes, a removal action may not be practical. Therefore, in such cases, it will be necessary to identify which wastes or debris constitute hot spots and evaluate the feasibility of treating such wastes.

3.3 Sediments

[15] See OAR 340-122-115(50).
[16] See OAR 340-122-115(31)(b)(C) and OAR 340-122-085(6).

Sediments are another medium listed in the Environmental Cleanup Rules as an example of "media other than water." Sediments can be defined as geological material submerged below the mean high water level which support biological activity. These materials often accumulate heavy metals and hydrophobic organics. For the purpose of characterizing sediment hot spots, the definition of sediments also includes the associated pore water.

Sediment hot spots can result from contamination that is "highly concentrated," "highly mobile" or "not reliably containable." Following is a brief description of how these types of hot spots are derived for contaminated sediments.

- "Highly concentrated" hot spots can be present in sediments if contaminant concentrations exceed human health or ecological risk-based concentrations, as discussed in Section 3.2.1. Typically, the pathways for human exposure to contaminated sediments include incidental ingestion of sediments and dermal contact (which may be associated with recreational activities). An additional human exposure pathway to contaminated sediments, although indirect, may exist from the consumption of contaminated fish and shellfish. The pathways for ecological exposure to contaminated sediments may include respiration (i.e., uptake of contaminants over the water/gill interface), incidental ingestion of suspended or bottom sediments while foraging, and dermal contact.

- "Highly mobile" hot spots can be present in sediments if contaminants are likely to leach out of the sediments and move into the surface water at concentrations that would cause a significant adverse impact on the use of the surface water. For sediments, the "point of reference" is the sediment pore water since this is the location at which aquatic plants and benthic organisms would be most susceptible. The "highly mobile" hot spot level for sediments can be estimated from standard equilibrium partitioning models after the "reference value" of the surface water has been determined. See Appendix C for applicable standards for use in identifying significant adverse effects on beneficial use(s) derived from surface water.

- Although "not reliably containable" hot spots can be present in sediments, containment often has been proven to be a protective and feasible remedy for contaminated sediments. When implemented correctly, containment results in minimal disturbance and resuspension of the contaminated sediments which significantly reduces the implementation risk. As required by the Environmental Cleanup Rules, the extent to which contaminated sediments can be reliably contained must be determined as part of the feasibility study. This assessment is done as part of the detailed analysis of the remedial action alternative's "long-term reliability" which is one of the five remedy selection balancing factors.

Due to the unique characteristics of sediments, the Department does not have immediate plans to develope generic hot spot levels for sediments. For sites in which sediments have been impacted, a toxicologist, hydrogeologist and/or engineer should be consulted in order to assess the potential for hot spots.

3.4 Sludges

Sludges are often present at cleanup sites in contained or semi-contained areas such as sumps or waste lagoons. Sludges also may be associated with site soils which usually result from disposal of sludge on or

in the soil. For contained or semi-contained sludges not representative of a typical soil matrix (i.e., oily sludges located in utility vaults), the Department recommends that the material be disposed of subject to the removal action rules *[see OAR 340-122-070]* and in accordance with state and federal regulations pertaining to hazardous and solid waste.

In contrast, where sludges are composed primarily of the soil and are representative of a typical soil matrix, the hot spot assessment should be completed as described in Section 3.1. The assessment of whether or not these sludges constitute a hot spot will be influenced by the physical properties of the material. Many of these types of sludges are "highly concentrated," "highly mobile" and "not reliably containable" by virtue of their origin and physical condition. A Department toxicologist, hydrogeologist and/or engineer should be consulted in order to help determine which parameters are appropriate for assessing the potential for hot spots in this medium.

3.5 Non-Aqueous Phase Liquids

Non-Aqueous Phase Liquids (NAPLs), whether present as "pools" or as areas of residual or somewhat interconnected pockets or zones of free product, are examples of "media other than water" which must be evaluated in the hot spot assessment. It generally can be assumed that NAPLs will produce "highly concentrated," "highly mobile" and "not reliably containable" hot spots, assuming that the baseline risk exceeds the acceptable risk level (i.e., a primary criteria for defining a hot spot in media other than water). In addition, the dissolved phase contamination resulting from NAPLs may result in a significant adverse effect on beneficial use(s) of water which may constitute a hot spot in surface water or groundwater.

Following is a brief discussion of how NAPLs may satisfy the hot spot criteria for media other than water.

- NAPLs are by definition present in very high concentrations. NAPLs are typically undissolved, free-phase chemicals and may approach concentrations of 1,000,000 ppm. For sites in which NAPLs present complete exposure pathways, all but the least toxic contaminants will typically exceed the "highly concentrate" hot spot levels.

- NAPLs can be "highly mobile." If NAPLs are in direct contact with groundwater or surface water, their long-term dissolution may continue to contaminate the water at concentrations approaching the saturation point. At many sites containing NAPLs in contact with groundwater, dissolved phase groundwater concentrations exceed potentially applicable or relevant drinking water standards as well as acceptable risk levels. Whether in soil or groundwater, mobility is especially significant with DNAPLs since their density has the potential to drive them deeper into an aquifer. As such, NAPLs, DNAPLs in particular, can result in significant adverse effects on many beneficial uses of water.

- NAPLs are likely to be "not reliably containable." In addition to potential migration of NAPLs, an impacted aquifer can act to transport dissolved phase contamination to exposure points or into surface water bodies or other connected aquifers. In many instances, controlling the migration of NAPLs, or the related dissolved phase contamination, through containment technologies has proven difficult. As such, NAPLs may not be reliably containable.

Site-specific information will be necessary to determine if NAPLs constitute a hot spot. Examples of such information include: current and reasonably likely future beneficial use(s) of the groundwater,

aquifer characteristics and contaminant fate and transport. In addition, the reliability of containment and effectiveness of source and groundwater treatment would need to be determined as part of a feasibility study.

3.6 Components of the Hot Spot Report for Media Other Than Water

The evaluation of hot spots in media other than water includes an assessment of the baseline risk posed by the hazardous substances, the potential for the hazardous substances to be "highly concentrated" and "highly mobile" as well as the potential for the hazardous substances to be "not reliably containable." The information used in the evaluation of hot spots in media other than water should be collected, analyzed, and presented in a concise and logical manner.

As required by OAR 340-122-080(7), the Remedial Investigation shall identify hot spots of contamination for media other than water, with the exception of "not reliably containable" hot spots. (These will be identified during the Feasibility Study, as discussed below.) The evaluation generally should include the following components:

1. Identification of the baseline risk and significant exposure pathways. If the baseline risk assessment has been completed in conjunction with the Remedial Investigation, the hot spot evaluation should specify the quantified baseline risk and identify the exposure pathways primarily responsible for any unacceptable risk. If the baseline risk assessment has not been completed by the time the Remedial Investigation report is submitted to the Department, the hot spot evaluation should anticipate if the baseline risk exceeds the acceptable risk level and tentatively identify the exposure pathways primarily responsible for any unacceptable risk.

2. Identification of all environmental media which have been contaminated by releases of hazardous substances or constitute the release. These media may include soil, drummed waste and contaminated debris, sediments, sludges NAPLs, groundwater and surface water.

3. Nature and extent of hazardous substances in the contaminated media.

4. Calculated "highly concentrated" and "highly mobile" hot spot levels for any and all hazardous substances in the contaminated media. If migration to groundwater or surface water is reasonably likely, it will be necessary to identify their current and reasonably likely future beneficial use(s) and the significant adverse effect levels for hazardous substances threatening those beneficial use(s).

5. Areas over which hazardous substances currently or in the future may likely exceed the "highly concentrated" and "highly mobile" hot spot levels. These areas should be identified as "hot spots."

6. Any additional information or analyses that the Department deems necessary.

As required by OAR 340-122-085(6), the Feasibility Study shall evaluate the extent to which the hazardous substances are "not reliably containable." This evaluation is performed in conjunction with the

evaluation of the remedy selection balancing factor "long-term reliability" [17] and generally should include the following components:

1. A description of the remedial action alternatives under evaluation.

2. An assessment of the long-term reliability of any remedial alternative utilizing engineering and institutional controls, taking into consideration the characteristics of the hazardous substances to be managed and the effectiveness and enforceability over time of these controls in preventing migration of contaminants and in managing risks associated with potential exposure.

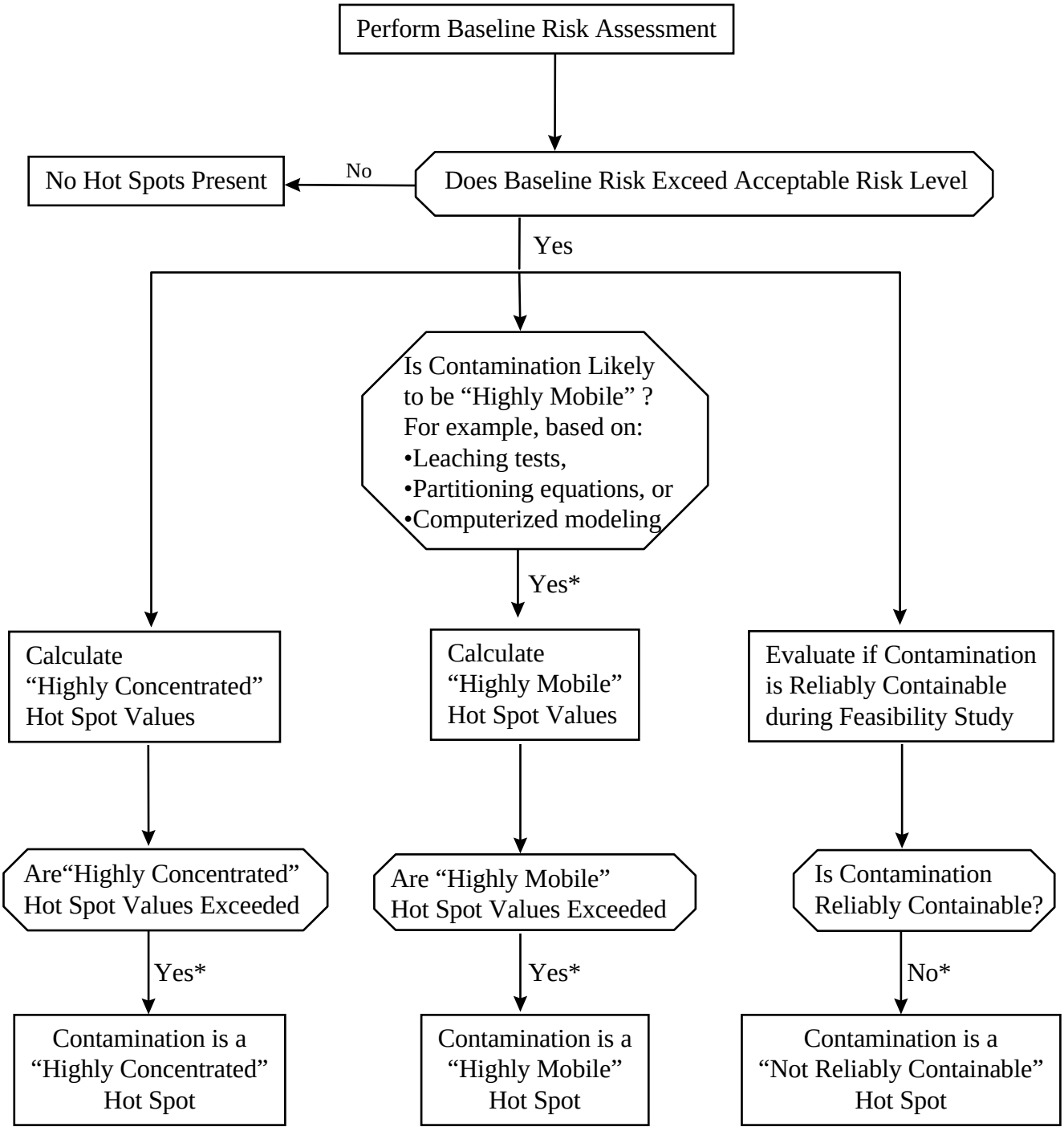
3. A qualitative assessment of the nature and degree of certainties or uncertainties.

4. A description of areas over which contamination cannot be reliably contained. These areas should be identified as "hot spots."

5. Any other information relevant to long-term reliability.

[17] See OAR 340-122-090(3)(b).

Figure 3-1
Flow Chart for Identifying Hot Spots in Media Other than Water



*Otherwise, the contamination is not a hot spot based on this component of the hot spot definition.

Figure 3-2
Process for Identifying "Highly Concentrated" Hot Spot in Soil

Example - *The contaminant of concern is perchloroethylene (PCE)*
Exposure pathways are ingestion of soil, dermal contact and inhalation of vapors by industrial workers
The "highly concentrated" hot spot level is 1,700 mg/kg, the risk-based concentration corresponding to a lifetime excess cancer risk of $1x10^{-4}$
The baseline risk assessment indicates (or is anticipated to indicate) that baseline risk at the facility exceeds the acceptable risk levels

Conclusion, the PCE contamination is a "highly concentrated" hot spot anywhere concentrations of PCE exceed 1,700 mg/kg

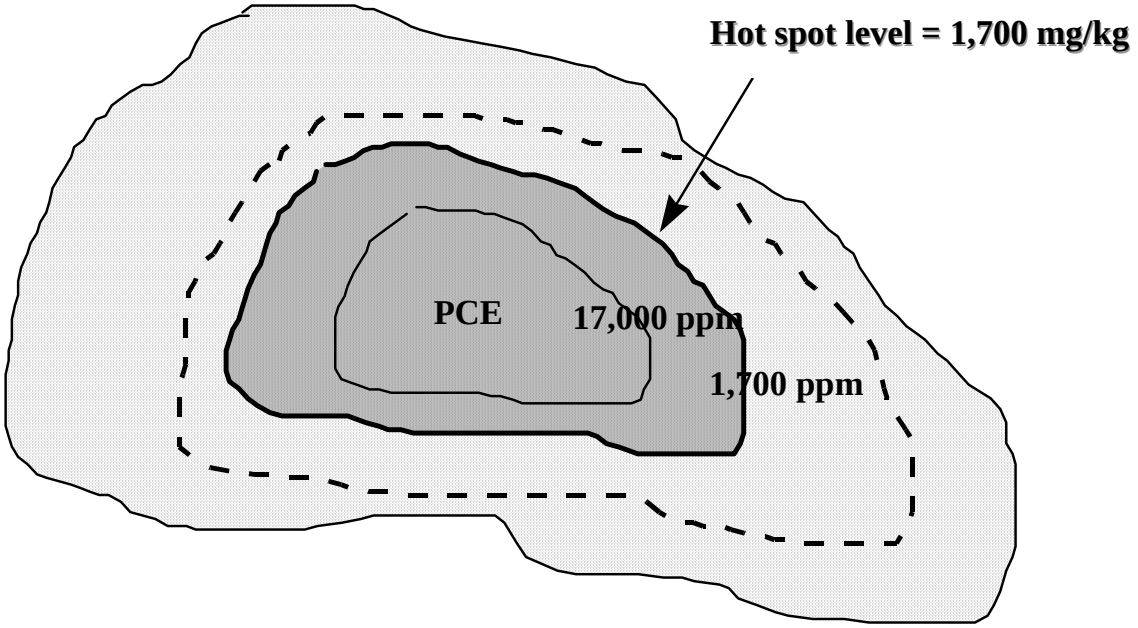
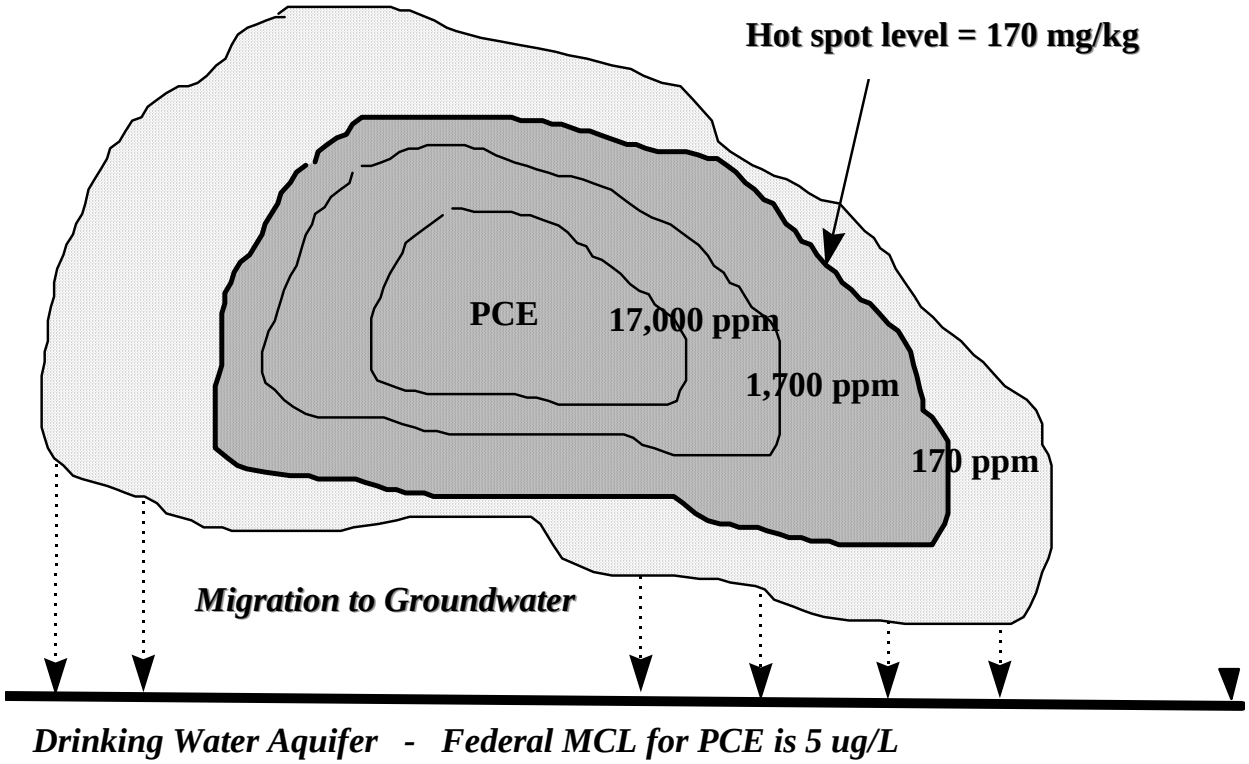


Figure 3-3
Process for Identifying "Highly Mobile" Hot Spots in Soil

Example - *The significant migration route is leaching to groundwater*
Beneficial use of groundwater is drinking
Contaminant of Concern is perchloroethylene (PCE)
Reference value for groundwater is the Federal MCL of 5 ug/L
It is estimated that PCE concentrations in soil in excess of 170 mg/kg would be necessary to result in groundwater concentration of 5 ug/L or more.

Conclusion, the PCE contamination is a "highly mobile" hot spot anywhere concentrations of PCE exceed 170 mg/kg



APPENDIX A: DEQ Guidance Relevant to Identification of Hot Spots

Guidance for Conducting Feasibility Studies

Guidance for Consideration of Land Use

Guidance for Beneficial Water Use Determinations

Policy on Toxicity Equivalency Factors

Guidance for Use of Probabilistic Analysis in Human Health Risk Assessments

Guidance for Ecological Risk Assessment

APPENDIX B: Suggested Format for Determining if Site Contamination Presents a Significant Adverse Effect on the Beneficial Uses of Water

(The examples used in this table are intended only for illustrative purposes)

Beneficial Uses of Water	Current or Reasonably Likely	Contaminants of Potential Concern	Significant Adverse Effect Level			Representative Site Concentration (ug/L)	Is there a Significant Adverse Effect?
			Applicable or Relevant Standards, Criteria or Guidance (ug/L)	Acceptable Risk Levels * (ug/L)	Published Peer Reviewed Scientific Information		
Groundwater							
Drinking Water (Industrial)	Current	PCE	5 *[1]*	---	---	200	**Yes**
Landscape Irrigation (Industrial)	Current	PCE	None	60 *[2]*	---	200	**Yes**
Surface Water							
Ecological Life	Current	PCE	840 *[3]*	---	---	10	No
Recreational (fish consumption)	Current	PCE	8.85 *[4]*	---	---	10	**Yes**
Recreational (swimming)	Current	PCE	None	490 *[5]*	---	10	No

* Acceptable risk levels or corresponding risk-based concentration are presented for only those contaminants of potential concern which do not have applicable or relevant standards, criteria or guidance.

Abbreviations

PCE = Perchloroethylene

Citations

[1] = National Primary Drinking Water Standard Maximum Contaminant Level.
[2] = Based on inhalation of vapor for workers, but may also include phytotoxicity.
[3] = OAR 340-41, Table 20: Protection of aquatic life, chronic criteria for fresh water.
[4] = OAR 340-41, Table 20: Protection of human health from fish consumption.
[5] = Based on incidental ingestion of surface water and dermal exposure for children playing in stream.

APPENDIX C: Potential Standards For Use In Identifying Significant Adverse Effects On Beneficial Uses Of Water

The following is a brief description of the more well-established standards, criteria or guidance which may be applicable or relevant in evaluating significant adverse effects on current or reasonably likely future beneficial use(s) of water from releases of hazardous substances. See OAR 340-122-115(50)(a) and section 2.1 of this guidance document for a description of why applicable and relevant water quality standards, criteria and guidance are important in the process of identifying significant adverse effects on beneficial uses of water. As a precautionary note, project managers should exercise professional judgment in determining which of these standards and criteria, if any, should be applied to a specific site. These standards, criteria or guidance have been classified based on the type of beneficial water use to which they apply. For those beneficial water uses in which applicable or relevant standards, criteria or guidance are not available, significant adverse effect levels must be derived from acceptable risk levels or, in the absence of such levels, published peer-reviewed scientific information.

DRINKING WATER

The following standards, to the extent they relate to hazardous substances under ORS 465.200(15), are considered to be applicable or relevant in assessing significant adverse effects on beneficial uses of water consisting of drinking water. This beneficial use may be derived from either groundwater or surface water.

Pursuant to the Safe Drinking Water Act, the U.S. Environmental Protection Agency (EPA) has promulgated primary and secondary drinking water standards applicable to public water systems. Enforcement authority of the Safe Drinking Water Act is typically granted to states which must adopt drinking water standards at least as stringent as the national standards. In Oregon, enforcement of drinking water standards is the responsibility of the Oregon Health Division.[18]

National Primary Drinking Water Standard Maximum Contaminant Levels: The National Primary Drinking Water Standards are specified in 40 CFR 141 and include Maximum Contaminant Levels (MCLs). MCLs were established by EPA taking into account human health effects, available treatment technologies and the costs of treatment. MCLs are the **maximum** levels at which contaminant concentrations in water supplies must be reliably and consistently below. The Oregon Health Division enforces MCLs but has not elected to set standards more stringent than MCLs. In addition to regulating the quality of public water systems, the Oregon Health Division uses MCLs as a non-enforceable benchmark of acceptable water quality for all sources of drinking water including private water supplies.

National Secondary Drinking Water Standards: National Secondary Drinking Water Standards are specified in 40 CFR 143. These standards were established as guidelines by EPA to regulate contaminants affecting the aesthetic quality and potability of drinking water relative to public acceptance. Although the Oregon Health Division does not enforce the Secondary Drinking Water Standards, these

[18] For a concise description of the Safe Drinking Water Act and listing of Primary and Secondary Drinking Water Standards, see EPA 810-F-94-002.

standards are strictly adhered to by municipalities and other public water providers in order to provide potable water that is aesthetically acceptable.

AQUATIC LIFE, RECREATIONAL USE, AESTHETIC QUALITY AND DRINKING WATER

The following standards, to the extent they relate to hazardous substances under ORS 465.200(15), are considered to be applicable or relevant in assessing significant adverse effects on beneficial uses of water consisting of aquatic life, recreational use (i.e., fishing), aesthetic quality and drinking. These beneficial uses may be derived from surface water or indirectly from groundwater which discharges to surface water.

State-Wide Water Quality Standards: Pursuant to the Clean Water Act, EPA has developed guidelines to be used by states in determining appropriate criteria for water bodies within the state. The state-wide water quality standards for Oregon are specified in OAR 340-41. These standards, which include both "numerical standards" and "narrative standards," are aimed at minimizing a wide range of impacts to water quality, not all of which are related to releases of hazardous substances. Following are those standards typically associated with releases of hazardous substances:[19]

Numerical Standards

- Standards relating to toxic impacts are specified in OAR 340-041 Table 20. These numerical standards are based on Federal Ambient Water Quality Criteria aimed at protecting aquatic life and human health.

  For the protection of aquatic life, Table 20 provides "acute" and "chronic" criteria for freshwater as well as marine water. The **chronic criteria** are the applicable standards for the beneficial use of water supporting aquatic life.

  For the protection of human health, Table 20 provides criteria for "fish ingestion only" and "water and fish ingestion." [20] The criteria for "fish ingestion only" are applicable for the beneficial use of water consisting of commercial or recreational fishing. If the beneficial uses of water include both fishing and drinking water, the criteria for "water and fish ingestion" are the applicable standards.

Narrative Standards

- The creation of tastes or odors or toxic or other conditions that are deleterious to fish or other aquatic life or affect the potability of drinking water or the palatability of fish or shellfish.

- The formation of appreciable bottom or sludge deposits or the formation of any organic or inorganic deposits deleterious to fish or other aquatic life or injurious to public health, recreation, or industry.

[19] Standards not typically associated with hazardous substances include dissolved oxygen, temperature, turbidity, pH, bacteria, dissolved gases, fungi and total dissolved solids.

[20] Table 20 also provides criteria for the protection of human health based on "drinking water M.C.L." However, as described above for drinking water, the Department considers MCLs **and** National Secondary Drinking Water Standards to be applicable.

- Objectionable discoloration, scum, oily sleek, or floating solids, or coating of aquatic life with oil films.

- Aesthetic conditions offensive to the human senses of sight, taste, smell, or touch.

- Radioisotope concentrations shall not exceed maximum permissible concentrations (MPCs) in drinking water, edible fishes or shellfishes, wildlife, irrigated crops, livestock and dairy products, or pose an external radiation hazard.

Water Quality Limited Waterbodies and TMDLs: These are **potentially** applicable or relevant in assessing significant adverse effects on the beneficial uses of water listed above. **The Department will evaluate the applicability or relevancy of these standards on a case by case basis.**

Section 303(d) of the Clean Water Act requires States to identify waters for which existing pollution controls are inadequate to attain applicable water quality standards. For these waters, TMDLs must be established for the pollutants that are limiting water quality. By definition, a TMDL is the sum of the individual waste load allocations for point source discharges, load allocations for non-point sources and natural background for a given segment of water.

Currently, 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8 -TCDD) is the only hazardous substance for which a TMDL has been established. The criteria for establishing this TMDL is contained in the document titled *Total Maximum Daily Loading (TMDL) to Limit Discharges of 2,3,7,8-TCDD (Dioxin) to the Columbia River Basin*, U.S. EPA, Region 10, February, 1991. The TMDL for 2,3,7,8-TCDD applies to the entire length of the Columbia River (river mile 0 to 306) and the mouth of the Willamette River to river mile 187.

The current listing of water quality limited waterbodies for which TMDLs have not yet been established is contained in the document titled *DEQ's 1994/1996 303(d) List of Water Quality Limited Waterbodies & Oregon's Criteria Used for Listing Waterbodies*, DEQ, July 1996. However, this listing will be updated in 1998. The proposed 303(d) listings for 1998 are provided in the document titled *Public Comment Draft, Oregon's 1998 Section 303(3) List of Water Quality Limited Waterbodies.*

Table C-1 identifies the waterbodies which are currently designated as "water quality limited" due to the presence of hazardous substances (i.e. toxics). If TMDLs are established for these water quality limiting hazardous substances, significant limitations or restriction will be placed on their discharges.

Table C-1
Water Quality Limited Waterbodies Due to the Presence of Toxics

BASIN	PARAMETER
Columbia River	
Mouth to Bonneville Dam	PCBs, DDE, DDT
Klamath River	
Keno Dam to California Border	ammonia
Malheur River	
Mouth to Hog Creek (Namorf)	DDT and Dieldrin
Owyhee	
Antelope Reservoir	Mercury
Jordan Creek - Mouth to Headwaters	Mercury
Owyhee Reservoir	Mercury
Owyhee River - Mouth to Black Willow Creek	DDT and Dieldrin
Rogue River	
Grave Creek to Applegate River	Mercury
South Coast	
Catching Slough - Tidal portions of the slough	Tributyltin
Coos Bay - Upper - Coos Bay to Jordan Cove Area	Tributyltin
North Slough - Tidal portions of the slough	Tributyltin
Willamette	
Cottage Grove Reservoir	Mercury
Columbia Slough	DDE, DDT, PCBs, 2,3,7,8-TCDD, Lead
Pringle Creek - Mouth to Headwaters	Dieldrin
Pudding River - Mouth to Little Pudding River	DDT

INDUSTRIAL WATER USE RESULTING IN DISCHARGE TO SURFACE WATER

The following standards, to the extent they relate to hazardous substances under ORS 465.200(15), are considered to be **potentially** applicable or relevant in assessing significant adverse effects on beneficial uses of water consisting of industrial use which results in discharges to surface water. This beneficial use may be derived from either surface water or groundwater. **The Department will evaluate the applicability or relevancy of these standards on a case by case basis.**

National Pollution Discharge Elimination System Effluent Limitations: The Clean Water Act, through the issuance of National Pollution Discharge Elimination System (NPDES) permits, has established discharge limits for point source discharges to surface water. These discharge limits must meet OAR 340-41 water quality standards including the numerical and narrative standards described above. NPDES effluent limitations also must be consistent with waste load allocations where a Total Maximum Daily Load (TMDL) has been established for a water quality limited waterbody. In assessing the applicability or relevancy of these standards, the ability of wastewater treatment systems to treat the hazardous substances within the wastewater effluents should be considered.

Notes:

1) The preceding list of applicable standards, criteria and guidance is provided as an informational tool. The list represents known and generally applicable standards, criteria and guidance, but the list may not be exhaustive or complete. As appropriate, DEQ or other interested parties may identify additional potentially applicable standards, criteria and guidance.
2) Certain local, state or federal standards, requirements or guidance not identified in the preceding list may apply to individual sites as regulatory requirements. These other potentially applicable requirements include but are not limited to: free product removal criteria under Subpart F of the Resource Conservation and Recovery Act at 40 CFR 280.64; free product removal requirements of the Oregon Underground Storage Tank Cleanup Rules at OAR 340-122-235; oil and hazardous material spill management requirements including ORS 465B.305; requirements for removal of hazardous substances consistent with OAR 340-122-070.
3) When two or more standards are applicable or relevant for the same beneficial use, the more stringent standard should be used in assessing significant adverse effects on the beneficial use.