



PORTLAND HARBOR RI

APPENDIX G
BASELINE ECOLOGICAL RISK ASSESSMENT

ATTACHMENT 10
SELECTION OF WATER TRVs

DRAFT

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Prepared for
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1.0 SELECTION OF WATER TRVS

A review of water quality regulatory benchmarks and literature-based thresholds was conducted to develop water toxicity reference values (TRVs) for chemicals in water. The TRVs were used to evaluate potential risks to aquatic receptors (i.e., benthic invertebrates, fish, amphibians, and aquatic plants) exposed to chemical concentrations in water in the baseline ecological risk assessment (BERA). The process for developing water TRVs is presented in a technical memorandum (Windward 2005). TRVs were developed by the Lower Willamette Group and revised based on US Environmental Protection Agency (EPA) comments (EPA 2006a, 2008c). TRVs were developed for all surface water and transition zone water (TZW) chemicals of potential concern (COPCs). The following chemicals of interest (COIs) could not be screened as COPCs because no toxicity data were available (Table 1).

Table 1. COIs Without Associated TRVs

| COIs | |
|--|-----------------------------------|
| Metals | |
| Calcium | Titanium |
| Dioxins/Furans | |
| 1,2,3,4,6,7,8-Heptachlorodibenzo- <i>p</i> -dioxin | 1,2,3,7,8-Pentachlorodibenzofuran |
| 1,2,3,4,7,8,9-Heptachlorodibenzofuran | 2,3,4,7,8-Pentachlorodibenzofuran |
| 1,2,3,4,7,8-Hexachlorodibenzofuran | 2,3,7,8-Tetrachlorodibenzofuran |
| 1,2,3,6,7,8-Hexachlorodibenzofuran | |
| TPH | |
| Residual-range hydrocarbons | |
| Diesel-range hydrocarbons | Total petroleum hydrocarbons |

COI – chemical of interest

TRV – toxicity reference value

TPH – total petroleum hydrocarbons

For individual metals, if the criteria were developed using dissolved concentrations, then the dissolved sample result was compared to the dissolved criteria. The toxicity of some metals depends upon the hardness of the water; therefore, metals criteria were hardness-adjusted when appropriate.

The water TRVs for hardness-dependent metals were modified using the following EPA national recommended water quality criteria (EPA 2006c) formula for hardness:

$$\text{CCC (dissolved)} = \exp\{m_c [\ln(\text{hardness})] + b_c\} \quad \text{Equation 1}$$

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Where:

- CCC = criterion continuous concentration (an estimate of the highest concentration of a material in surface water to which an aquatic community can be exposed indefinitely without resulting in an unacceptable effect)
- m_c = constant that varies by metal
- b_c = constant that varies by metal

The selection hierarchy for TRVs is generally as follows:

1. Lowest of national ambient water quality criteria (AWQC) (EPA 2002, 2006c) or Oregon Department of Environmental Quality (ODEQ) state water quality standards (WQS) (either Table 20 values or proposed WQS in Tables 33A or 33B (ODEQ 2006)).
2. Tier II values from Suter and Tsao (1996)
3. Individual polycyclic aromatic hydrocarbon (PAH) chronic TRVs from EPA (2003)
4. Canadian water quality guidelines (CCME 2005)
5. The more protective of ODEQ acute guidance values or Tier II acute values divided by an acute-to-chronic ratio of 8.3¹
6. Effects data reported in the literature

The selected chronic water TRVs for both surface water and TZW COPCs are presented in Table 2. COPCs were identified in the BERA as those chemicals whose maximum detected concentration in surface water or TZW samples exceeded the water TRV.

¹ An acute-to-chronic ratio of 8.3 was used to calculate a chronic screening value from an acute screening value when no chronic data were available per agreement with EPA (EPA 2008b).

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Table 2. Selected Water TRVs

| Surface Water or TZW COPC | Unit | Water TRV | Source | Species Included in TRV Derivation |
|------------------------------|------|----------------------|---------|---|
| Metals | | | | |
| Aluminum | µg/L | 87 ^a | AWQC | Daphnids, fish species (fathead minnow, brook trout, striped bass) |
| Barium | µg/L | 4 ^a | Tier II | Daphnids, amphipods, snail |
| Beryllium | µg/L | 0.66 ^a | Tier II | Isopod, worms, salamanders, daphnids, fish species (goldfish, fathead minnow, flagfish, guppy) |
| Cadmium | µg/L | 0.09 ^b | AWQC | 21 aquatic species (including 7 invertebrates and 14 fishes in 16 genera) |
| Cobalt | µg/L | 23 | Tier II | <i>Daphnia</i> , isopod, amphipod, worms, snail, frog, fish species (fathead minnow, goldfish, common carp) |
| Copper | µg/L | 2.74 ^b | AWQC | Daphnids, five invertebrate species, fish species (fathead minnow, rainbow trout, bluegill, white sucker, bluntnose minnow, northern pike, rainbow trout, brown trout, brook trout, lake trout) |
| Iron | µg/L | 1,000 ^a | AWQC | Endpoints and organisms not specified in criteria document |
| Lead | µg/L | 0.54 ^b | AWQC | Multiple invertebrate species, fish species (rainbow trout, brook trout, lake trout, channel catfish, white sucker, bluegill) |
| Magnesium | µg/L | 82,000 ^a | AWQC | Based on daphnid endpoint but was considered within natural range |
| Manganese | µg/L | 120 ^a | Tier II | <i>Daphnia</i> , amphipod, fathead minnow |
| Nickel | µg/L | 16.1 ^b | AWQC | <i>Daphnia</i> , caddisfly, fish species (rainbow trout, fathead minnow) |
| Potassium | µg/L | 53,000 ^a | Tier II | Daphnids |
| Selenium | µg/L | 5 | AWQC | <i>Daphnia magna</i> and <i>pulex</i> , 2 fish species (rainbow trout, fathead minnows) |
| Sodium | µg/L | 680,000 ^a | Tier II | Based on daphnid endpoint but was considered within natural range |
| Vanadium | µg/L | 20 ^a | Tier II | Daphnids, fish species (fathead minnow, bonytail chub, flag fish, Chinook salmon, pikeminnow, brook trout, razor back sucker) |
| Zinc | µg/L | 36.5 ^b | AWQC | Two invertebrate species, six fish species |
| Butyltins | | | | |
| Butyltin ion | µg/L | 0.072 ^c | AWQC | <i>Daphnia magna</i> , fathead minnow |
| PAHs | | | | |
| 2-Methylnaphthalene | µg/L | 2.1 | Tier II | Fathead minnow |
| Acenaphthene | µg/L | 23 | Tier II | Fathead minnow, midge |
| Anthracene | µg/L | 0.73 | Tier II | Daphnids, bluegill |

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Table 2. Selected Water TRVs

| Surface Water or TZW COPC | Unit | Water TRV | Source | Species Included in TRV Derivation |
|---------------------------|------|------------------|-------------------------|--|
| Benzo(a)anthracene | µg/L | 0.027 | Tier II | <i>Daphnia magna</i> |
| Benzo(a)pyrene | µg/L | 0.014 | Tier II | <i>Daphnia pulex</i> |
| Benzo(b)fluoranthene | µg/L | 0.6774 | EPA (2003) ^d | <i>Daphnia</i> , midge, fish species (fathead minnow, rainbow trout) |
| Benzo(g,h,i)perylene | µg/L | 0.4391 | EPA (2003) ^d | <i>Daphnia</i> , midge, fish species (fathead minnow, rainbow trout) |
| Benzo(k)fluoranthene | µg/L | 0.6415 | EPA (2003) ^d | <i>Daphnia</i> , midge, fish species (fathead minnow, rainbow trout) |
| Chrysene | µg/L | 2.042 | EPA (2003) ^d | <i>Daphnia</i> , midge, fish species (fathead minnow, rainbow trout) |
| Dibenzo(a,h)anthracene | µg/L | 0.2825 | EPA (2003) ^d | <i>Daphnia</i> , midge, fish species (fathead minnow, rainbow trout) |
| Fluoranthene | µg/L | 6.16 | Tier II | <i>Daphnia</i> , fathead minnow |
| Fluorene | µg/L | 3.9 | Tier II | Species and endpoint not provided. |
| Indeno(1,2,3-cd)pyrene | µg/L | 0.275 | EPA (2003) ^d | <i>Daphnia</i> , midge, fish species (fathead minnow, rainbow trout) |
| Naphthalene | µg/L | 12 | Tier II | <i>Daphnia magna</i> and <i>D. pulex</i> , fish species (rainbow trout, fathead minnow) |
| Phenanthrene | µg/L | 6.3 | Tier II | <i>Daphnia</i> |
| Pyrene | µg/L | 10.11 | EPA (2003) ^d | <i>Daphnia</i> , midge, fish species (fathead minnow, rainbow trout) |
| Phthalates | | 3 | | |
| BEHP | µg/L | 3 | Tier II | Midge, <i>Daphnia</i> , fish species (scud, three-spined stickleback, channel catfish, American flag fish, bluegill, coho salmon, rainbow trout, fathead minnow); northern leopard frog |
| VOCs | | | | |
| 1,1-Dichloroethene | µg/L | 25 | Tier II | Fathead minnow, daphnids |
| 1,2,4-Trimethylbenzene | µg/L | 7.3 ^e | Tier II | Fish species (guppy, fathead minnow) |
| 1,3,5-Trimethylbenzene | µg/L | 7.3 ^e | Tier II | Fish species (guppy, fathead minnow) |
| Benzene | µg/L | 130 | Tier II | Daphnids, fish species (goldfish, slimy sculpin, three spined stickleback, channel catfish, bluegill, pink salmon, coho salmon, rainbow trout, sockeye salmon, Chinook salmon, fathead minnow, guppy, dolly varden trout, Arctic grayling) |
| Carbon disulfide | µg/L | 0.92 | Tier II | <i>Daphnia</i> , fish species (fathead minnow, mosquitofish) |
| Chlorobenzene | µg/L | 64 | ODEQ | <i>Daphnia</i> , bluegill |
| Chloroethane | µg/L | 47 ^s | Tier II | Guppy |
| Chloroform | µg/L | 28 | Tier II | Daphnids, fish species (rainbow trout, channel catfish, bluegill, largemouth bass, fathead minnow) |

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Table 2. Selected Water TRVs

| Surface Water or TZW COPC | Unit | Water TRV | Source | Species Included in TRV Derivation |
|--------------------------------|------|--------------------|--------------------------------|---|
| cis-1,2-Dichloroethene | µg/L | 590 | Tier II | <i>Daphnia</i> , bluegill |
| Ethylbenzene | µg/L | 7.3 | Tier II | Fish species (guppy, fathead minnow) |
| Isopropylbenzene | µg/L | 7.3 ^e | Tier II | Fish species (guppy, fathead minnow) |
| m,p-Xylene | µg/L | 66.67 | EPA (2006b) | <i>Daphnia</i> , fish species (rainbow trout, fathead minnow, guppy) |
| o-Xylene | µg/L | 13 ^h | Tier II | Fish species (common carp, bluegill, fathead minnow) |
| Styrene | µg/L | 4 | MacDonald Environmental (1999) | NA |
| Toluene | µg/L | 9.8 | Tier II | <i>Daphnia</i> , fathead minnow |
| Total xylenes | µg/L | 13 ^h | Tier II | fish species (common carp, bluegill, fathead minnow) |
| Trichloroethene | µg/L | 47 | Tier II | <i>Daphnia</i> ; fish species (flagfish, fathead minnow) |
| SVOCs | | | | |
| 1,2-Dichlorobenzene | µg/L | 14 | Tier II | Species and endpoint not given |
| 1,4-Dichlorobenzene | µg/L | 15 | Tier II | Species and endpoint not given |
| Dibenzofuran | µg/L | 3.7 | Tier II | <i>Daphnia</i> , fathead minnow |
| PCBs | | | | |
| Total PCBs | µg/L | 0.014 | AWQC | Based on protection of mink via ingestion of contaminated prey. |
| Pesticides | | | | |
| 4,4'-DDT | µg/L | 0.001 | AWQC (EPA 2006c) | Based on protection of brown pelican via ingestion of contaminated prey. |
| Total DDx | µg/L | 0.001 ⁱ | AWQC (EPA 2006c) | Based on 4,4'-DDT criterion. Based on protection of brown pelican via ingestion of contaminated prey. |
| TPH | | | | |
| Gasoline-range hydrocarbons | µg/L | NV ^j | NA | NA |
| Aliphatic hydrocarbons C4-C6 | µg/L | 128 ^j | EPA (2008a) | NA |
| Aliphatic hydrocarbons C6-C8 | µg/L | 54 ^j | EPA (2008a) | NA |
| Aliphatic hydrocarbons C8-C10 | µg/L | 9.5 ^j | EPA (2008a) | NA |
| Aliphatic hydrocarbons C10-C12 | µg/L | 2.6 ^j | EPA (2008a) | NA |
| Aromatic hydrocarbons C8-C10 | µg/L | 212 ^j | EPA (2008a) | NA |

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Table 2. Selected Water TRVs

| Surface Water or TZW COPC | Unit | Water TRV | Source | Species Included in TRV Derivation |
|------------------------------|------|--------------------|------------------------------------|---|
| Other Chemicals | | | | |
| Perchlorate | µg/L | 9,300 ^k | Dean et al. (2004) per EPA (2008c) | Midge, cladoceran, fathead minnow |
| Cyanide | µg/L | 0.0052 | AWQC | Fish species (bluegill, brook trout, fathead minnow) and two invertebrate species |

- ^a TRV was based on total criteria; TRV was compared to total concentration.
- ^b TRV was based on dissolved criteria; TRV was compared to dissolved concentration.
- ^c TRV was based on criterion for tributyltin.
- ^d TRV was based on PAH mixtures.
- ^e TRV was based on criterion for ethylbenzene.
- ^f Based on a draft ambient aquatic life water quality criteria published in October 2008 (GLEC 2008).
- ^g TRV was based on criterion for 1,1-dichloroethane.
- ^h TRV was based on criterion for xylene.
- ⁱ TRV was based on criterion for 4,4'-DDT.
- ^j EPA provided TRVs for five of the chemical groups that are blended to form gasoline (EPA 2008a). Average fractions of these components in gasoline were used to convert the total gasoline-range hydrocarbon concentration into gasoline fraction concentrations for comparison with the TRVs. Any one gasoline fraction exceeding its TRV was grounds for identifying gasoline as a COPC.
- ^k An acute to chronic ratio of 8.3 was used to calculate a chronic screening value from an acute screening value when no chronic data were available per agreement with EPA (EPA 2008b).
- AWQC – ambient water quality criteria
 BEHP – bis(2-ethylhexyl) phthalate
 COPC – chemical of potential concern
 DDD – dichlorodiphenyldichloroethane
 DDE – dichlorodiphenyldichloroethylene
 DDT – dichlorodiphenyltrichloroethane
 EPA – US Environmental Protection Agency
 LCV – lowest chronic value
 NA – not available
 NV – no value
 ODEQ – Oregon Department of Environmental Quality
- PAH – polycyclic aromatic hydrocarbon
 PCB – polychlorinated biphenyl
 SL – screening level
 SVOC – semivolatile organic compound
 TBT – tributyltin
 Total DDx - sum of all six DDT isomers (2,4'-DDD; 4,4'-DDD; 2,4'-DDE; 4,4'-DDE; 2,4'-DDT; and 4,4'-DDT)
 TPH – total petroleum hydrocarbons
 TZW – transition zone water
 VOC – volatile organic compound

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