Appendix J

Evaluation of Dredging Feasibility

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Appendix J – Evaluation of Dredging Feasibility

J.1 Equipment Type

Several different dredging technologies are described and evaluated in Appendix B.3.1. Dredging technologies can be placed in one of four categories:

- mechanical;
- hydraulic;
- pneumatic; and
- specialized.

Several evaluation criteria were used for the technology screening analysis presented in Appendix B.3.1.3. The criteria that were used included:

- sediment resuspension;
- availability;
- site compatibility / technical feasibility;
- solids content;
- production rate; and
- past performance.

Based on these evaluation criteria, mechanical dredging using either an open or enclosed clamshell bucket, and hydraulic cutterhead dredging were retained for detailed analysis to support the development and evaluation of the Removal Action Alternatives. Further, the clamshell bucket dredge is a likely candidate if transport and offsite disposal of the material is selected (Alternatives A, B, or D), and the cutterhead dredge is a likely candidate if a CDF is developed at Slip 1 (Alternative C). The cutterhead dredge would not likely be used for the alternatives with offsite disposal because the removed sediment contains a high water content and dewatering and/or stabilizing the sediment would be required so that it would be acceptable for transport and offsite disposal at a landfill.

As a part of alternatives development, production rates play an important part in evaluating the compatibility of dredging with use in the Removal Action Area due to the potential disruption of tenant operations from dredging activities. Additionally, the degree of sediment resuspension is an important component in evaluating the feasibility of dredging in each of the alternatives developed. Water quality goals for the Removal Action Area and the Willamette River must be maintained during dredging. Therefore, this section evaluates the technologies selected in terms of the potential disruption due to production rates (Section J.2) and the ability to maintain water quality goals (Section J.3).

J.2 Dredge Production Rate

In-water construction in Slip 3 such as dredging and capping will cause disruption of the tenant's operations. The tenant at Pier 4 (Berths 410 and 411) will likely have to be relocated temporarily. The current lease agreement allows the Port to disrupt the tenant's operation for two weeks each year for maintenance dredging without incurring disruption costs. If the Port exceeds the two weeks per year, it is responsible for costs incurred for temporarily relocating the tenant to another Port facility or a different port. While the disruption cost represents an economic impact, another concern is that of losing the tenant altogether, which would represent a large economic loss to the Port. Therefore, the disruption duration needs to be as short as possible. The Port established a minimum production rate of 2,400 cy/day to limit tenant disruption and economic impact to acceptable levels. Therefore, the clamshell bucket dredge and the cutterhead dredge were evaluated to assess whether the technologies had the capability of meeting these requirements. As outlined in the previous section, both of these dredge types are compatible with the general conditions within the Removal Action Area and are the most widely available technologies in the Pacific Northwest at this time. As identified in Appendix B, other dredge types may be available and may be viable candidates as well for all or parts of the dredging. The technology types that are suitable for only limited portions of the dredging to allow dredging in certain conditions (e.g., diver assisted hydraulic dredging which allows dredging in limited access areas or on steeper slopes) do not need to be assessed for disruption impacts because if used, the use would be limited in duration. The disruption impact of other potentially viable dredge technologies (i.e., those technologies identified as "possible" on Table B-1B) would likely be within the range in disruption identified below for clamshell buckets and cutterhead dredge based on the information gathered during the screening evaluation.

J.2.1 Assumptions

The dredging feasibility assessment considers that dredging may cause tenant disruption. Dredging in Slip 3 will cause disruption since this is an active slip. At present there is little marine traffic in Slip 1, however, this situation may change in the future. The following assumptions were made for dredging:

- Slip 1 dredge volume = 99,000 cy;
- Slip 3 dredge volume = 105,000 cy;
- The contractor will be able to work 2 10-hour shifts, 7 days a week;
- The contractor will dredge 8 hours per shift

J.2.2 Mechanical Dredging using a Clamshell Bucket Dredge

Based on experience on other dredging projects, contractors should be able to achieve an average production rate of about 150 cy/hour, or 2,400 cy/day with a clamshell bucket dredge. Production rates that can be achieved by clamshell bucket dredges depend largely on cycle time, bucket size, load factor, and dredge efficiency. The following equation may be used to estimate production rates:

Production Rate = $(60/T_C) \cdot C_B \cdot F_L \cdot E_D$ [in cy/hour]

Where,

T_C = cycle time in minutes;

C_B = bucket capacity in cy;
F_L = load factor in percent; and
E_D = dredge efficiency in percent.

The load factor is the ratio of excavated volume per bucket over the total capacity of the bucket. The dredge efficiency takes into account the ability of the dredge operator to achieve a "clean" dredge cut in as few attempts as possible. Modern clamshell dredges are equipped with computers and monitors that help the operator in visualizing the location of the bucket relative to the sediment surface, which is a tool for increasing the dredge efficiency and accuracy.

In general, a reasonable cycle time is 2 minutes, 20 cy is a common bucket capacity, the load factor is commonly about 50 percent, and the dredge efficiency is typically about 50 percent leading to a typical production rate of 150 cy/hour as follows:

Production Rate = $(60/2) \cdot 20 \cdot 0.5 \cdot 0.5 = 150$ cy/hour.

Higher production rates could potentially be achieved by using a larger bucket. Buckets are available up to about 60 cy. However, the contractor should take other factors into account such as dredge depth when selecting the equipment to optimize the load factor and dredge efficiency. Therefore, dredging using a clamshell bucket dredge should be able to meet the Port's minimum required production rate.

J.2.3 Hydraulic Cutterhead Dredging

Based on experience on other dredging projects and production rates reported in the literature, large production rates can potentially be achieved using a hydraulic cutterhead dredge. Cutterhead dredges are widely available on the West Coast. Production rates greatly depend on pump size. The Sierra Club (2001) reports production rates for cutterhead dredges ranging from 33 to 3,270 cy/hour. Palermo et al. (in press) reports a dredge production rate of 120 cy/hour for 12-inch pumps. Therefore, larger pumps would likely be required to achieve production rates comparable to or higher than those of mechanical dredges. A production rate of 150 cy/hour could likely be achieved using a 14- to 16-inch pump. Larger production rates of 300 cy/hour and higher would likely be compatible with initial filling of a CDF (i.e., during dredging in Slip 3 under Alternative C). A production rate of 300 cy/hour would likely require a 20- to 22-inch pump. Cutterhead dredges of up to 30 inches are available on the West Coast. The Port owns a 30-inch cutterhead dredge and has realized production rates in excess of 2,000 cy/hour during navigational dredging. However, dredging production during environmental dredging will likely be less due to factors such as sediment resuspension, maneuverability, and solids content. Based on the information presented above, production rates meeting the Port's minimum requirements of 150 cy/hr can be achieved with the cutterhead dredge.

J.3 Water Quality

This section presents an evaluation of water quality during dredging using data presented in Appendix F. Certain summations were calculated to obtain total values for the elutriate data. Appendix E describes how total values were calculated. Section J.3.1 presents results and evaluations of dredge elutriate testing; Section J.3.2 presents results of mixing zone evaluations determining the dilution factor downstream of the dredge area.

Section J.3.3 presents conclusions on the feasibility of meeting water quality criteria during dredging within the different subareas of the Removal Action Area based on the DRET results and mixing zone evaluations.

J.3.1 Dredged Sediment Elutriate Characteristics

Dredging elutriate tests (DRETs) were performed to determine potential water quality impacts during dredging. The DRET is routinely used to evaluate potential water quality impacts during dredging with either a mechanical or a hydraulic dredge. Two DRETs were performed, one (T4-CM1-DRET) on a composite sediment sample from Berth 401 and Slip 1 and one (T4-CM2-DRET) on composite sediment sample from Wheeler Bay, Slip 3, and north of Berth 414. The DRET chemistry results compared to federal and Oregon state surface water criteria are presented in Tables J-1 and J-2, respectively. DRET data were compared to surface water quality criteria, including federal surface freshwater quality standards [40 Code of Federal Regulation 131.36] and Oregon state surface freshwater quality criteria (Oregon Administrative Rules 340-041-033). Federal freshwater surface criteria that data were compared to included:

- maximum criteria;
- continuous criteria; and
- consumption of water and organisms.

Oregon state surface freshwater criteria that data were compared to included:

- acute criteria;
- chronic criteria; and
- water and fish ingestion.

These criteria were used to evaluate potential water quality impacts during dredging. The use of these criteria does not imply that they should or would be used as water quality criteria during dredging for the Removal Action Area. A number of water quality criteria (including those for mercury and some PAHs, pesticides, and PCBs) are below the practical quantitation limits that can be achieved by an analytical laboratory. This results in the detection limit being higher than the water quality criterion. These compounds were not modeled specifically but are expected to behave similarly to other compounds in that class of constituents. One mixing zone evaluation (in Section J.3.2) indicates that all water quality criteria would be met at the mixing zone boundary. The data are considered adequate to evaluate the feasibility of dredging.

DRET data are sometimes discussed as exceedance ratios, terminology that is used in this report. An exceedance ratio is the concentration of a constituent in a DRET sample result divided by the water criteria. An exceedance ratio of greater than 1 indicates a concentration greater than the criteria.

<u>T4-CM1-DRET Results</u>

Arsenic was detected at an exceedance ratio of 50 for the federal consumption of water and organisms and Oregon state water and fish ingestion criteria. The concentration of arsenic was below the other federal and Oregon state criteria. The Willamette River water that was used in the DRET test (Table F-2 in Appendix F), contained a concentration of arsenic with an exceedance ratio of 17. Approximately 30% of the arsenic in the

DRET result appears to be existing arsenic concentration in the river. The concentration of copper was above the federal maximum and continuous criteria (exceedance ratios of 1.1 and 1.5, respectively) and Oregon state acute and chronic criteria (exceedance ratios 1.4 and 1.9, respectively). The concentration of lead was above the federal continuous criterion and the Oregon state chronic criterion, with exceedance ratios of 3 and 3, respectively. Of the remaining seven metals that were analyzed for, the metals were either detected at concentrations below the federal and Oregon state water criteria or were not detected.

The concentrations of individual polycyclic aromatic hydrocarbon (PAH) compounds were below the federal and Oregon state water criteria. The concentration of total PAHs had an exceedance ratio of 27 for the Oregon state water and fish ingestion. However, this criterion is based on the federal carcinogenic PAH criterion and all carcinogenic PAH were not detected in the sample. Pyrene was the only PAH detected in the T4-CM1-DRET elutriate sample. The remaining 23 PAHs for which the sample was analyzed were not detected. The six phthalates for which the elutriate sample was analyzed were not detected.

The six DDT compounds and nine PCBs for which the elutriate sample was analyzed were not detected.

Diesel-range total petroleum hydrocarbons (TPH) was not detected in the T4-CM1-DRET elutriate sample. Residual-range TPH was detected in the elutriate sample. There are no federal or Oregon state water criteria for residual-range organics.

Total suspended solids (TSS) and total sulfide were not detected in the T4-CM1-DRET elutriate sample. Ammonia was detected in the T4-CM1-DRET elutriate at a concentration below the federal and Oregon state water criteria.

T4-CM2-DRET Results

Arsenic was detected at an exceedance ratio of 44 for the federal consumption of water and organisms and Oregon state water and fish ingestion criteria. The concentration of arsenic was below the other federal and Oregon state criteria. The Willamette River water that was used in the DRET test contained a concentration of arsenic with an exceedance ratio of 22 (Table F-2 in Appendix F). Approximately 50% of the arsenic in the DRET result appears to be existing arsenic concentration in the river. The concentration of copper was above the federal continuous criterion (exceedance ratio of 1.2) and the Oregon state acute and chronic criteria (exceedance ratio of 1.2 and 1.6, respectively). The concentration of lead was above the federal continuous criterion and the Oregon state chronic criterion, with exceedance ratios of 3.4 and 3.4, respectively. Of the remaining seven metals that were analyzed for, the metals were either detected at concentrations below the federal and Oregon state water criteria or were not detected.

The concentration of individual PAH compounds were below the federal and Oregon state water criteria. The concentration of total PAHs had an exceedance ratio of 263 for the Oregon state water and fish ingestion. However, this criterion is based on the federal carcinogenic PAH criterion and all carcinogenic PAH results were not detected. Seven PAHs (acenaphthylene, acenaphthene, 2,3,5-trimethylnaphthalene, fluorene, phenanthrene, fluoranthene, and pyrene) of the 24 PAHs for which the sample was analyzed were detected in the T4-CM2-DRET elutriate sample. The six phthalates for which the elutriate sample was analyzed were not detected.

The six DDT compounds and nine PCBs for which the elutriate sample was analyzed were not detected.

Diesel-range TPH and residual-range TPH were not detected in the T4-CM2-DRET elutriate sample.

TSS and total sulfide were not detected in the T4-CM12-DRET elutriate sample. Ammonia was detected in the sample at a concentration below the federal and Oregon state water criteria.

J.3.2 Mixing Zone Evaluation

The DRET results were preliminarily evaluated using the RIVPLUM5 mixing zone model (Ecology, 2002). Further evaluation of the DRET results may occur during design. The Washington State Department of Ecology spreadsheet, RIVPLUM5, was used to determine a dilution factor to apply to the results (Ecology, 2002).

The spreadsheet RIVPLUM5 calculates the dilution factor using the theory of Taylor (1954) by the method described in Fischer et al (1979). The analysis considers two-dimensional plume spread (longitudinal and transverse directions) and does not consider vertical mixing (it is assumed to be instantaneous). This is likely a valid assumption for a mechanical dredge. The model calculates the dilution factor at a specified distance downstream from the source. For the DRET analysis, 300 feet downstream of the dredge was used, a typical downstream mixing zone point that USEPA frequently uses for northwest dredging projects. The calculation of dilution factors uses boundary effect of shore lines by the method of superposition. The RIVPLUM5 model is based on the assumption that (Ecology, 2002):

- The discharge is a single point source;
- The discharge is completely and rapidly mixed vertically; and
- The velocity at all points in the channel is equal to the mean cross-section velocity.

Input values for the RIVPLUM5 model were based on Slip 3's channel morphology, results from the hydrodynamic field work, and estimated inputs from the dredge. Table J-3 presents inputs and results for the RIVPLUM5 model.

The RIVPLUM5 model calculated a dilution factor of approximately 2000 at a distance of 300 feet downstream from the dredge. This dilution factor indicates that all water quality criteria would be met at a mixing zone distance of 300 feet downstream of the dredge.

J.3.3 Conclusions from DRET testing and Mixing Zone Evaluations

Based on the DRET results and mixing zone evaluations, dredging is considered feasible in Slip 1 and Slip 3 with either a mechanical or a hydraulic dredge. The mixing zone evaluation indicates water quality criteria would be met at a 300-foot mixing zone point downstream of the dredge and that no additional actions would be required to protect water quality during dredging.

J.4 Conclusions from Dredging Feasibility Evaluation

The results of the production rate assessment support that the Port's minimum production rate of 150 cy/hour can be achieved by available dredging technologies compatible with conditions in the Removal Action Area.

Additionally, evaluation of DRET results and mixing zone evaluations support that dredging is feasible. Therefore, dredging is generally considered feasible in Slip 1 and in Slip 3. Dredging is not considered feasible in Wheeler Bay and the North of Berth 414 subareas because removal of detected contaminants would require dredging to great depths and is considered impractical (refer to Section 7 of the EE/CA report). A mechanical dredge is a likely candidate if offsite disposal of the dredge sediment is selected (Alternatives A, B, or D) and a hydraulic cutterhead dredge is a likely candidate if a CDF is developed at Slip 1 (Alternative C). These dredges would not likely be used for the alternatives with offsite disposal because the removed sediment contains extremely high water content. It would be inefficient to dewater and/or stabilize the sediment to meet acceptance criteria for the offsite disposal at a landfill. If CDF disposal is selected, a hydraulic cutterhead dredge could be used to fluidize the dredge sediment and deliver it to the CDF in a slurry form. Dredge sediment could be transported from the dredge to the CDF by pipeline if a hydraulic dredge is used.

A CDF alternative may also require some mechanical dredging to address certain engineering constraints, such as steep slopes, debris, and other underwater obstructions. Sediment generated from the mechanical dredging can be delivered to a CDF using barges, or pipeline transport may also be utilized for mechanical dredge if the dredge sediment is fluidized by adding water to form a slurry.

Other technologies including monitored natural recovery and capping are considered appropriate in Wheeler Bay, North of Berth 414, and at Berth 401 and were selected for these subareas as outlined in Section 7.

J.5 References

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Taylor, G.I., 1954. *The dispersion of matter in turbulent flow through a pipe*, Proceedings of Royal Society of London Series, A223, 446-468, Scientific Paper 2, 466-488.

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Table J-1
DRET Elutriate Chemistry Results Compared to Federal Surface Water Quality Criteria

Sample ID: / Lab ID: / Date Sampled:	Maximum Criteria	Continuous Criteria	Consumption of Water and Organisms Criteria	T4-CM1-Dret K2402978-004 04/20/2004	T4-CM2-Dret K2403382-001 05/05/2004
Metals (ug/L)					
Arsenic	360	190	0.018	0.9	0.8
Cadmium	0.82	0.37	NA	0.02 U	0.04 U
Chromium	180	57	NA	1.11	1.77
Copper	4.6	3.5	NA	**5.08**	**4.25**
Lead	14	0.54	NA	**1.63**	**1.86**
Mercury	2.1	0.012	0.14	0.2 U	0.2 U
Nickel	440	49	610	1.3	1.65
Selenium	20	5	NA	0.7 U	0.4 B
Silver	0.32	NA	NA	0.03 U	0.03
Zinc	35	32	NA	5.62	6.7
Semivolatile Organics (ug/L)					
Naphthalene	NA	NA	NA	0.40 U	0.39 U
2-Methylnaphthalene	NL	NL	NL	0.40 U	0.39 U
1-Methylnaphthalene	NL	NL	NL	0.40 U	0.39 U
Biphenyl	NL	NL	NL	0.40 U	0.39 U
2,6-Dimethylnaphthalene	NL	NL	NL	0.40 U	0.39 U
Acenaphthylene	NA	NA	NA	0.40 U	0.099 J
Acenaphthene	NA	NA	NA	0.40 U	0.19 J
2,3,5-Trimethylnaphthalene	NL	NL	NL	0.40 U	0.027 J
Fluorene	NA	NA	1300	0.40 U	0.096 J
Phenanthrene	NA	NA	NA	0.40 U	0.13 J
Anthracene	NA	NA	9600	0.40 U	0.39 U
1-Methylphenanthrene	NL	NL	NL	0.40 U	0.39 U
Fluoranthene	NA	NA	300	0.40 U	0.092 J
Pyrene	NA	NA	960	0.075 J	0.13 J
Benz(a)anthracene	NA	NA	0.0028	0.40 U	0.39 U
Chrysene	NA	NA	0.0028	0.40 U	0.39 U
Benzo(b)fluoranthene	NA	NA	0.0028	0.40 U	0.39 U
Benzo(k)fluoranthene	NA	NA	0.0028	0.40 U	0.39 U
Benzo(e)pyrene	NL	NL	NL	0.40 U	0.39 U
Benzo(a)pyrene	NA	NA	0.0028	0.40 U	0.39 U
Perylene	NL	NL	NL	0.40 U	0.39 U
Indeno(1,2,3-cd)pyrene	NA	NA	0.0028	0.40 U	0.39 U
Dibenz(a,h)anthracene	NA	NA	0.0028	0.40 U	0.39 U
Benzo(g,h,i)perylene	NA	NA	NA	0.40 U	0.39 U
Dimethyl phthalate	NA	NA	313000	9.9 U	9.6 UJ
Diethyl phthalate	NA	NA	23000	9.9 U	9.6 U
Di-n-butyl phthalate	NA	NA	2700	9.9 U	9.6 U
Butylbenzyl phthalate	NA	NA	NA	9.9 U	9.6 U
Bis(2-ethylhexyl) phthalate	NA	NA	1.8	9.9 U	9.6 U
Di-n-octyl phthalate	NA	NA	NA	9.9 U	9.6 U
Total PAHs (a,b)	NL	NL	NL	0.075 J	0.737 J
Pesticides (ug/L)					
4,4'-DDE	NA	NA	0.00059	0.099 U	0.097 U
4,4'-DDD	NA	NA	0.00083	0.099 U	0.097 U
4,4'-DDT	1.1	0.001	0.00059	0.099 U	0.097 U
2,4'-DDE	NL	NL	NL	0.099 U	0.097 U
2,4'-DDD	NL	NL	NL	0.099 U	0.097 U
2,4'-DDT	NL	NL	NL	0.099 U	0.097 U
Total DDD (a,c)	NL	NL	NL	0.099 U	0.097 U

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Table J-1
DRET Elutriate Chemistry Results Compared to Federal Surface Water Quality Criteria

Sample ID: Lab ID: Date Sampled:	Maximum Criteria	Continuous Criteria	Consumption of Water and Organisms Criteria	T4-CM1-Dret K2402978-004 04/20/2004	T4-CM2-Dret K2403382-001 05/05/2004
Total DDE (a,d)	NL	NL	NL	0.099 U	0.097 U
Total DDT (a,e)	NL	NL	NL	0.099 U	0.097 U
ΣDDTs (a,f)	NL	NL	NL	0.099 U	0.097 U
PCBs (ug/L)					
Aroclor 1016	NA	0.014	NA	0.099 U	0.097 U
Aroclor 1221	NA	0.014	NA	0.099 U	0.097 U
Aroclor 1232	NA	0.014	NA	0.099 U	0.097 U
Aroclor 1242	NA	0.014	NA	0.099 U	0.097 U
Aroclor 1248	NA	0.014	NA	0.099 U	0.097 U
Aroclor 1254	NA	0.014	NA	0.099 U	0.097 U
Aroclor 1260	NA	0.014	NA	0.099 U	0.097 U
Aroclor 1262	NL	NL	NL	0.099 U	0.097 U
Aroclor 1268	NL	NL	NL	0.099 U	0.097 U
Total PCBs (a,g)	NA	NA	0.00017	0.099 U	0.097 U
Petroleum Hydrocarbons (ug/L)					
Diesel Range Organics (DRO)	NA	NA	NA	250 U	250 U
Residual Range Organics (RRO)	NA	NA	NA	57 J	500 U
Conventionals (mg/L)					
Total suspended solids	NA	NA	NA	5 U	5 U
Ammonia as Nitrogen	17	2.2	NA	0.57	0.68
Total Sulfide	NA	NA	NA	0.05 U	0.05 U

Table J-1
DRET Elutriate Chemistry Results Compared to Federal Surface Water Quality Criteria

U = Analyte was not detected above the reported sample quantitation limit.
J = Analyte was positively identified; the associated numerical value is the approximate concentration of

UJ = Analyte was not detected above the reported sample quantitation limit. The reported quantitation limit is approximate.
B = Analyte was positvely identified; the associated numerical value is the approximate concentration of the analyte in the sample. The approximate concentration is less than the method report limit but greater than the method detection limit.
T in sample ID indicates a total sample.
D in sample ID indicates a dissolved sample.
NA = No criterion available.
NL = Compound not listed.
Box exceeds maximum criteria.
Bold box exceeds continuous criteria.
Shaded exceeds consumption of water and organisms criteria.

a. Total concentrations are calculated using the detected concentrations of individual constituents. Non-detects are treated as zeros. If all the individual constituents are non-detect, the total concentration is reported as non-detect using the highest detection limit.
b. Swartz, 1999, which MacDonald et al., 2000a references as the source of the PAH screening levels, describes the total PAH criteria as the sum of the following polycyclic aromatic compounds: naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, anthracene, fluoranthene, pyrene, benz(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, and benzo(a)pyrene.
c. The total DDD criteria represent the sum of the following compounds: 2,4'-DDD and 4,4'-DDD.
d. The total DDE criteria represent the sum of the following compounds: 2,4'-DDE and 4,4'-DDE.
e. The total DDT criteria represent the sum of the following compounds: 2,4'-DDT and 4,4'-DDT.
f. ΣDDTs criteria represent the sum of the following compounds: total DDD, total DDE, and total DDT. See footnotes c, d, and e for the definitions of total DDD, total DDE, and total DDT, respectively.
g. MacDonald et al., 2000b, which MacDonald et al., 2000a references as the source of the PCB screening levels, does not describe which individual Aroclors make up the total PCB criteria. It was assumed that total PCBs consisted of all the Aroclors that were analyzed for (Aroclor 1016, Aroclor 1221, Aroclor 1232, Aroclor 1242, Aroclor 1248, Aroclor 1254, Aroclor 1260, Aroclor 1262, and Aroclor 1268).

Table J-2
DRET Elutriate Chemistry Results Compared to Oregon State Surface Water Quality Criteria

Sample ID: / Lab ID: / Date Sampled:	Acute Critera	Chronic Criteria	Water and Fish Ingestion Criteria	T4-CM1-Dret K2402978-004 04/20/2004		T4-CM2-Dret K2403382-001 05/05/2004	
Metals (ug/L)							
Arsenic	340	150	0.018	0.9		0.8	
Cadmium	0.52	0.094	10	0.02	U	0.04	U
Chromium	180	24	170,000	1.11		1.77	
Copper	3.6	2.7	1,300	**5.08**		**4.25**	
Lead	14	0.54	50	**1.63**		**1.86**	
Mercury	2.4	0.012	0.144	0.2	U	0.2	U
Nickel	150	16	610	1.3		1.65	
Selenium	260	5	170	0.7	U	0.4	B
Silver	0.30	0.1	50	0.03	U	0.03	
Zinc	36	36	7400	5.62		6.7	
Semivolatile Organics (ug/L)							
Naphthalene	2300	620	NA	0.40	U	0.39	U
2-Methylnaphthalene	NL	NL	NL	0.40	U	0.39	U
1-Methylnaphthalene	NL	NL	NL	0.40	U	0.39	U
Biphenyl	NL	NL	NL	0.40	U	0.39	U
2,6-Dimethylnaphthalene	NL	NL	NL	0.40	U	0.39	U
Acenaphthylene	NA	NA	NA	0.40	U	0.099	J
Acenaphthene	1,700	520	670	0.40	U	0.19	J
2,3,5-Trimethylnaphthalene	NL	NL	NL	0.40	U	0.027	J
Fluorene	NA	NA	1,100	0.40	U	0.096	J
Phenanthrene	NA	NA	NA	0.40	U	0.13	J
Anthracene	NA	NA	8,300	0.40	U	0.39	U
1-Methylphenanthrene	NL	NL	NL	0.40	U	0.39	U
Fluoranthene	3,980	NA	130	0.40	U	0.092	J
Pyrene	NA	NA	830	0.075	J	0.13	J
Benz(a)anthracene	NA	NA	0.0038	0.40	U	0.39	U
Chrysene	NA	NA	0.0038	0.40	U	0.39	U
Benzo(b)fluoranthene	NA	NA	0.0038	0.40	U	0.39	U
Benzo(k)fluoranthene	NA	NA	0.0038	0.40	U	0.39	U
Benzo(e)pyrene	NL	NL	NL	0.40	U	0.39	U
Benzo(a)pyrene	NA	NA	0.0038	0.40	U	0.39	U
Perylene	NL	NL	NL	0.40	U	0.39	U
Indeno(1,2,3-cd)pyrene	NA	NA	0.0038	0.40	U	0.39	U
Dibenz(a,h)anthracene	NA	NA	0.0038	0.40	U	0.39	U
Benzo(g,h,i)perylene	NA	NA	NA	0.40	U	0.39	U
Dimethyl phthalate	NA	NA	270,000	9.9	U	9.6	UJ
Diethyl phthalate	NA	NA	17,000	9.9	U	9.6	U
Di-n-butyl phthalate	NA	NA	2,000	9.9	U	9.6	U
Butylbenzyl phthalate	NA	NA	1,500	9.9	U	9.6	U
Bis(2-ethylhexyl) phthalate	NA	NA	1.2	9.9	U	9.6	U
Di-n-octyl phthalate	NA	NA	NA	9.9	U	9.6	U
Total PAHs (a,b)	NA	NA	0.0028	0.075	J	0.737	J
Pesticides (ug/L)							
4,4'-DDE	1,050	NA	0.00022	0.099	U	0.097	U
4,4'-DDD	0.06	NA	0.00031	0.099	U	0.097	U
4,4'-DDT	1.1	0.001	0.00022	0.099	U	0.097	U
2,4'-DDE	NL	NL	NL	0.099	U	0.097	U
2,4'-DDD	NL	NL	NL	0.099	U	0.097	U
2,4'-DDT	NL	NL	NL	0.099	U	0.097	U
Total DDD (a,c)	NL	NL	NL	0.099	U	0.097	U

Table J-2
DRET Elutriate Chemistry Results Compared to Oregon State Surface Water Quality Criteria

Sample ID: Lab ID: Date Sampled:	Acute Critera	Chronic Criteria	Water and Fish Ingestion Criteria	T4-CM1-Dret K2402978-004 04/20/2004	T4-CM2-Dret K2403382-001 05/05/2004
Total DDE (a,d)	NA	NA	NA	0.099 U	0.097 U
Total DDT (a,e)	1.1	0.001	0.000024	0.099 U	0.097 U
ΣDDTs (a,f)	1.1	0.001	NA	0.099 U	0.097 U
PCBs (ug/L)					
Aroclor 1016	NL	NL	NL	0.099 U	0.097 U
Aroclor 1221	NL	NL	NL	0.099 U	0.097 U
Aroclor 1232	NL	NL	NL	0.099 U	0.097 U
Aroclor 1242	NL	NL	NL	0.099 U	0.097 U
Aroclor 1248	NL	NL	NL	0.099 U	0.097 U
Aroclor 1254	NL	NL	NL	0.099 U	0.097 U
Aroclor 1260	NL	NL	NL	0.099 U	0.097 U
Aroclor 1262	NL	NL	NL	0.099 U	0.097 U
Aroclor 1268	NL	NL	NL	0.099 U	0.097 U
Total PCBs (a,g)	2	0.014	0.000064	0.099 U	0.097 U
Petroleum Hydrocarbons (ug/L)					
Diesel Range Organics (DRO)	NL	NL	NL	250 U	250 U
Residual Range Organics (RRO)	NL	NL	NL	57 J	500 U
Conventionals (mg/L)					
Total suspended solids	NL	NL	NL	5 U	5 U
Ammonia as Nitrogen	20	5.4	NA	0.57	0.68
Total Sulfide	NA	2	NA	0.05 U	0.05 U

Table J-2
DRET Elutriate Chemistry Results Compared to Oregon State Surface Water Quality Criteria

U = Analyte was not detected above the reported sample quantitation limit.
J = Analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
UJ = Analyte was not detected above the reported sample quantitation limit. The reported quantitation limit is approximate.
B = Analyte was positvely identified; the associated numerical value is the approximate concentration of the analyte in the sample. The approximate concentration is less than the method report limit but greater than the method detection limit.
T in sample ID indicates a total sample.
D in sample ID indicates a dissolved sample.
NA = No criterion available.
NL = Compound not listed.
Box exceeds acute criteria.
Bold box exceeds chronic criteria.
Shaded exceeds water and fish ingestion criteria.
a. Total concentrations are calculated using the detected concentrations of individual constituents. Non-detects are treated as zeros. If all the individual constituents are non-detect, the total concentration is reported as non-detect using the highest detection limit.
b. Swartz, 1999, which MacDonald et al., 2000a references as the source of the PAH screening levels, describes the total PAH criteria as the sum of the following polycyclic aromatic compounds: naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, anthracene, fluoranthene, pyrene, benz(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, and benzo(a)pyrene.
c. The total DDD criteria represent the sum of the following compounds: 2,4'-DDD and 4,4'-DDD.
d. The total DDE criteria represent the sum of the following compounds: 2,4'-DDE and 4,4'-DDE.
e. The total DDT criteria represent the sum of the following compounds: 2,4'-DDT and 4,4'-DDT.
f. ΣDDTs criteria represent the sum of the following compounds: total DDD, total DDE, and total DDT. See footnotes c, d, and e for the definitions of total DDD, total DDE, and total DDT, respectively.
g. MacDonald et al., 2000b, which MacDonald et al., 2000a references as the source of the PCB screening levels, does not describe which individual Aroclors make up the total PCB criteria. It was assumed that total PCBs consisted of all the Aroclors that were analyzed for (Aroclor 1016, Aroclor 1221, Aroclor 1232, Aroclor 1242, Aroclor 1248, Aroclor 1254, Aroclor 1260, Aroclor 1262, and Aroclor 1268).

Table J-3
RIVPLUM5 Model Inputs and Results

INPUT	
1. Effluent Discharge Rate (cfs):	0.58
2. Receiving Water Characteristics Downstream From Waste Input	
Stream Depth (ft):	35
Stream Velocity (fps):	0.064
Channel Width (ft):	500
Stream Slope (ft/ft) or Manning roughness "n":	0.15
3. Discharge Distance From Nearest Shoreline (ft):	100
4. Location of Point of Interest to Estimate Dilution	
Distance Downstream to Point of Interest (ft):	300
Distance From Nearest Shoreline (ft):	100
5. Transverse Mixing Coefficient Constant (usually 0.6):	0.6
6. Original Fischer Method (enter 0) or Effective Origin Modification (enter 1)	0
OUTPUT	
Approximate Downstream Distance to Complete Mix (ft):	15
Theoretical Dilution Factor at Complete Mix:	1,931
Calculated Flux-Average Dilution Factor Across Entire Plume Width:	1,931
Calculated Dilution Factor at Point of Interest:	2,178