7.0 EVALUATION AND SELECTION OF CLEANUP ACTIONS

7.1 Evaluation Criteria, Remedial Expectations, and Selection of Cleanup Actions

MTCA describes the requirements for selecting cleanup actions. It specifies criteria for approving cleanup actions, the order of preference for cleanup technologies, policies for permanent solutions, the application of these criteria to particular situations, and the process for making these decisions. Ecology's selected cleanup actions for the Site (See Section 7.3) must be protective of human health and the environment. The selection of 62 µg/Kg as the sediment cleanup level, based on the Lowest Adverse Effects Threshold (LAET) concentration, will ensure that PCB mass-transfer from sediments to surface and/or groundwater is minimized and below criteria set by applicable, relevant and appropriate requirements (ARARS) for each media. Selected cleanup actions and standards will meet the 64 pg/L EPA recommended water quality criterion and 0.044 µg/L criterion for surface and groundwater, respectively. Ecology will utilize a combination of cleanup actions to reduce and/or eliminate the toxicological effects of PCBs at the Site. The selected remedies, discussed in Section 7.3, include those that isolate/contain PCBs from surface water and the upper biologically active layer of the sediment. Two distinct PCB-contaminated sediment deposits were identified in the Site's RI (Figure 3). Specifically, the 3.7 acre deep-water area (Deposit 1) was identified and characterized as having surface-sediment PCB concentrations in excess of 1,430 µg/Kg. Deposit 2, a smaller 0.2 acre pocket of sediment with PCBs as high as 330 µg/Kg, was also identified within a backwater channel of the Donkey Island complex.

As is set forth in MTCA and Ecology's Sediment Management Standards (WACs 173-340-370 & 440, and 173-204-580), Ecology has the following expectations during the evaluation of cleanup action alternatives:

- Emphasis on treatment technologies in areas of high concentrations, high mobility, or areas that lend themselves to treatment;
- At a minimum, destruction, detoxification, and/or removal of hazardous substances in areas containing small volumes of hazardous substances;
- Use of engineering controls;
- Minimization of migration of hazardous substances;
- Consolidation, to the maximum extent practicable, of hazardous substances that may remain onsite;
- Taking active measures to prevent/minimize releases to surface water;
- Natural attenuation, if appropriate;
- Provide for reasonable 10-year restoration timeframe, where practicable; and
- No significantly greater overall threat to human health and the environment than other alternatives.
- Establish restrictive covenants or an effective alternative where appropriate.

7.2 Cleanup Action Criteria

Acceptable cleanup actions must meet threshold criteria and other requirements specified in WAC 173-340-360. The criteria and process for Deposit 1 is discussed below. The selected cleanup action for Deposit 2 is removal (See Section 7.3), which satisfies these criteria. Therefore, the selected cleanup action for the PCB-contaminated sediment in this deposit is not

competitively analyzed fully in this discussion. A comparative discussion for Deposit 2 can be found in the FS report

7.2.1 Evaluation of Threshold Criteria

All cleanup actions must meet the following requirements pursuant to WAC 173-340-360(2)(a):

- Protection of Human Health and the Environment – The selected remedy shall reduce the risks posed to human health and the environment by eliminating, reducing, or controlling exposure to these receptors The selected cleanup action addresses removal and isolation of PCB-contaminated sediments, preventing the completion exposure pathways between humans, the environment, and the contaminants.
- Compliance with Cleanup Standards – The selected remedy must comply with MTCA standards pursuant to WAC 173-340-700 through -760 while meeting applicable substantive requirements and Ecology's Sediment Standards (WAC 173-204). It is anticipated the selected cleanup action will isolate or eliminate PCBs and co-located COPCs, which have been determined to be harmful to human health and the environment.
- Compliance with Applicable State and Federal Laws – The selected remedy shall meet applicable state and federal laws. Local laws, which may be more stringent than specified state and federal law, will govern where applicable.
- Compliance Monitoring – Performance of the selected remedial actions and long-term protectiveness of the cleanup will be confirmed by compliance monitoring. The general scope of long-term compliance monitoring activities is described below. Compliance monitoring shall be required for all cleanup actions, as assured by the completion of a detailed compliance monitoring plan during remedial design, pursuant to WAC 173-340-410(3). The plan shall provide for adequate monitoring to ensure the effectiveness of the selected cleanup actions (WAC 173-204-580)

7.2.2 Other Requirements

Pursuant to WAC 173-340-360(2)(b), several criteria must also be considered when selecting from among the alternatives that fulfill the threshold requirements. All cleanup actions shall provide for reasonable restoration time frames with use of permanent solutions to the maximum extent possible, and consider public concerns.

1) Reasonable Restoration Time Frame: The selected cleanup actions must provide for a reasonable restoration time frame pursuant to WAC 173-204-580, where restoration occurs when cleanup levels are met at the point of compliance and potential risks are alleviated. All of the potential cleanup alternatives may, with varying degrees of uncertainty, result in compliance with even the most stringent potential PCB cleanup levels, though the different alternatives would achieve this condition under significantly varying time frames. The alternatives associated with the shortest restoration time include Alternatives 2, 3D and 3E capping options, which can be completed within 1-2 years of execution of a consent decree to implement the CAP. Alternatives 3B, 3C, and 4 could be implemented over intermediate time frames due to increased technical and regulatory requirements. Alternative 1 is associated with the longest restoration time frame, as cleanup standards may not be met for 5 to 40 years, depending on sedimentation rates during the recovery period. Although confirmatory testing would be required, completion of remedial actions associated with Alternatives 2, 3, and 4 could result in

compliance with Ecology's selected 62 µg/Kg sediment cleanup level. In summary, at varying degrees of certainty, Alternatives 2, 3, and 4 could provide for reasonable restoration times frames, while Alternative 1 would not be likely to meet time-frame requirements.

2) Permanent Solutions: WAC 173-340-360(2)(b)(i) and -360(3)(f)(ii) outline the requirements and procedures for determining whether a cleanup action uses permanent solutions to the maximum extent practicable. A permanent solution is one in which the cleanup standards can be met without further action being required. Evaluations of whether cleanup actions exhibit permanence are to focus on "the degree to which the alternative permanently reduces the toxicity, mobility or volume of hazardous substances, including the adequacy of the alternative in destroying the hazardous substances, the reduction or elimination of hazardous substance releases and sources of releases, the degree of irreversibility of waste treatment process, and the characteristics and quantity of treatment residuals generated." WAC 173-340-360(3)(f)(ii). An alternatives evaluation was performed by Kaiser and Avista to assist in the selection of the cleanup actions. The results of the evaluation are provided in Table 2 and a brief narrative discussion for each of the evaluation criteria is also provided below. The six criteria used to rank remedial alternatives included: (A) protectiveness, (B) permanence, (C) cost, (D) long-term effectiveness, (E) management of short-term risks, and (F) technical and administrative implementability. Table 2 also represents Ecology's evaluation of each of the criteria.

(A) Protectiveness – For Deposit 1, Ecology has determined that Alternatives 3D and 3E are the most protective of the remedial actions considered due to the degree of risk reduction and the time required to reduce the risks. The AquaBlok™ capping Alternatives 3B and 3C ranked below the carbon-based reactive cap barriers due to the time required to implement the Alternatives. While the long-term protectiveness of removing the contaminated deposits is high (Alternative 4), the time required to reduce the risks is longer than the time frames associated with the Alternative 3 solutions. Alternatives 1, 2 and 3A are the least protective of the evaluated actions, respectively.

(B) Permanence - Among the remedial solutions evaluated for permanence, Alternative 4 – Removal, Off-Site Disposal, and Residuals Capping – ranks the highest and Alternatives 3D and 3E capping options second highest. Alternative 4 includes off-site confinement at an engineered, lined, and monitored containment facility, and thereby permanently reduces the volume of hazardous substances at the Site, but limited residual contamination would remain in place. In Alternatives 3D and 3E, the reactive layer sequesters PCBs and impedes hazardous substance mobility into surface sediment porewater and surface water, and in this capacity results in a higher relative permanence ranking than sediment caps without reactive amendments. The degree of mobility control depends on the amount of sequestration material provided, such as the total organic carbon (TOC) content incorporated into the cap design. Thus, depending on the final TOC content of the AquaBlok™ cap design, Alternatives 3B and 3C both have a similar degree of permanence. Alternative 2 – Enhanced Natural Recovery – and capping option Alternative 3A have lower permanence rankings since such technologies rely solely on in situ isolation of contaminants without the benefits provided by reactive barrier capping systems.

(C) Cost – Pursuant to WAC 173-340-360(3)(f)(iii), costs considered in evaluating remedial alternatives include costs of design, materials, construction, capital long-term operation and maintenance, and agency oversight. The cost for each alternative varies according to the specific Deposit to which the alternative may be applied. Detailed cost analysis for each

alternative is provided in the Site Focused FS. In summary, for Deposit 1, the estimated cost is highest for Alternative 4, followed by Alternatives 3C, 3E, 3B, 3D, 3A, and 2.

(D) Long-Term Effectiveness – Pursuant to WAC 173-340-360(3)(f)(iv), long-term effectiveness includes the degree of certainty that the alternative will be successful, the reliability of the alternative during the restoration time frame, the magnitude of residual risk with the alternative in place, and the effectiveness of controls required to manage remaining hazardous substances. MTCA ranks the following types of cleanup action components in descending order of long-term effectiveness:

- Reuse and recycling (and waste minimization under SMS)
- Destruction or detoxification
- Immobilization or solidification
- Off-site disposal in an engineered, lined, and monitored facility
- On-site isolation or containment with attendant engineering controls
- Institutional controls and monitoring

To evaluate the long-term effectiveness of the alternatives, the layer in each alternative that would most effectively retard chemical migration was modeled in the FS. The results of the modeling provided for a relative ranking of the effectiveness of each alternative relative to potential long-term sediment porewater PCB migration. The modeling results ranked Alternatives 3B through 3E and Alternative 4 the highest in terms of long-term effectiveness. Alternative 1, 2, and 3A had the lowest long-term effectiveness rank.

(E) Management of Short-Term Risks – Pursuant to WAC 173-340-360(3)(f)(v), management of short-term risks is the degree to which human health and the environment are protected during construction and implementation of the alternative. Alternative 1 presents no additional short-term risks to human health and the environment because there is no construction or implementation planned with this alternative. Alternatives 2 and 3A to 3E also present minimal additional short-term risks to human health or the environment because the cap placement methods are not expected to result in water quality impacts beyond localized, minor turbidity increases. Elutriate and sediment transport testing of alternative coal materials used in Alternatives 3D and 3E would be required to ensure that water quality and adjacent sediments are protected during and after construction. Alternatives 3D and 3E, thus, would provide effective management of short-term risks resulting from implementation of the remedy.

Implementation of Alternative 4 could result in potential localized releases of a range of contaminants (PCBs, metals, wood waste, and other associated chemicals) to surface water during sediment excavation and/or dredging. Construction-related impacts to surface water quality could be mitigated to varying degrees by using appropriate best management practices and through the use of residual control measures. Relative to other alternatives, Alternative 4 applied to Deposit 1 PCB sediments provides less effective management of short-term risks. Traditional control measures, such as silt curtains, have often proven to be relatively ineffective when they have been applied in other similar riverine environments. In order to apply Alternative 4 to Deposit 1, more complicated and costly construction containment methods would likely be required to minimize short term risks associated with the removal of contaminated sediment. In contrast, Alternative 4 applied to Deposit 2 PCB sediments can be readily implemented while minimizing short-term risks because of the relatively small size and off-channel location of the contaminated sediment deposit.

(F) Technical and administrative implementability – Pursuant to WAC 173-340-360(3)(f)(iv), technical and administrative implementability is the ability of an alternative to be implemented, including consideration of the following:

- Potential for landowner cooperation
- Whether the alternative is technically possible
- Availability of necessary facilities, services and materials
- Administrative and regulatory requirements
- Scheduling
- Size and complexity of the alternative
- Monitoring requirements
- Access for construction and monitoring
- Integration of existing operations with the remedial action

Based on these considerations, Alternatives 3A and 2 are, by definition, the easiest to implement Alternatives 3B and 3E consist of demonstrated technologies that have been proven to be relatively easy to implement. However, federal Clean Water Act permits and the potential need for accompanying Endangered Species Act consultation, along with pre-design engineering analyses and Ecology design approvals, would be required to implement this project. Although existing water uses in the Upriver Dam area would likely not be significantly affected by construction actions under these alternatives, coordination with river users would be required to implement this action. Compared with the other alternatives, Alternatives 3B through 3E are moderately implementable. Because Alternative 4 involves dredging contaminated sediments, meeting regulatory requirements would be more difficult. Thus, within Deposit 1, this alternative has a lower implementability relative to the other evaluated alternatives. Because the Donkey Island side channel can be more effectively isolated during construction, and also because of better land access for land-based construction equipment, Alternative 4 is moderately implementable within Deposit 2, relative to other alternatives.

3) Consideration of Public Comment: Pursuant to WAC 173-340-360(2)(b)(iii) and 173-340-600, the DCAP was made available for public review and comment from March 22 through May 6, 2005. A two-week extension of the 30-day comment period was granted by Ecology to facilitate greater public involvement. After evaluation of all comments received, Ecology concluded that the remedy defined in the DCAP addresses the various concerns raised and will be fully protective.

Summary of MTCA Remedial Alternative Evaluation

Alternative	Compliance with Cleanup Standards; Protection of Human Health and the Environment	Evaluation Criterion [1]							
		Reasonable Restoration Time Frame	Permanence	Maximum Future (500 yr) Porewater PCB Conc. 10 cm Below Mudline (pg/L; see text)	Long-Term Effective-ness	Short-Term Risk Management	Implement-ability	Cost-Deposit 1	Cost – Deposit 2
Alternative 1 – Monitored Natural Recovery	+	-	-	100,000	-	+	+	$806,000	$471,000
Alternative 2 – Enhanced Natural Recovery (Thin Sand Cap)	+	+	0	10,000	0	+	0	$959,000	$352,000
Alternative 3A – Thick Sand Cap	+	+	0	2	+	+	0	$1,226,000	$215,000
Alternative 3B – Thin AquaBlok™ Cap	+	+	0/+[4]	< 1	+	+	0	$1,643,000[5]	-
Alternative 3C – Thick AquaBlok™ Cap	+	+	0/+[4]	< 1	+	+	0	$2,626,000	-
Alternative 3D – Thin Coal and Sand Cap	+	+	+	< 1	+	+	0	$1,578,000[5]	-
Alternative 3E – Thick Coal and Sand Cap	+	+	+	< 1	+	+	0	$2,408,000	-
Alternative 4 – Dredging, Off-Site Disposal, and Residuals Cap	+	0[3]	+	< 1	+	-/0[3]	-/0[3]	$5,061,000	$360,000[2]

Legend:

- \- The alternative satisfies the criterion to a low degree.
- 0 The alternative satisfies the criterion to a moderate degree.
- \+ The alternative satisfies the criterion to a high degree.

Notes:

1. The threshold MTCA criteria, which must be satisfied for an alternative to be acceptable under MTCA, are not included in this table. All alternatives are judged to satisfy the threshold criteria.
2. Costs provided are feasibility study-level estimates of -30 to +20 percent. Actual costs will vary.
3. Short-term risk management and implementability characteristics are very site- and location-specific. Because of its relatively small size and off-channel location, Alternative 4 applied to Deposit 2 (Donkey Island side channel deposit) can be more readily implemented and effectively controlled (see text).
4. Permanence of the AquaBlok™ remedy is dependent in part on the final TOC content of the cap material, which may vary depending on final design.
5. The decision on whether Alternative 3B or 3D would be implemented in Deposit 1 will be based on a final performance evaluation of the coal component..

The shaded cells above summarize the selected remedial alternatives for the Upriver Dam PCB Site, as discussed in Section 6.3.

Selected contingency remedy for Deposit 1.

Table 3. Summary of MTCA Remedial Alternative Evaluation

7.3 Selection of the Cleanup Action

Ecology's selected cleanup action is an integrated cleanup remedy that blends a number of remedial technologies including in-situ treatment, off-site disposal, in-situ engineered containment, and compliance monitoring. The following attributes support the selection of the combined remedial option as the selected cleanup action for the Site.

- Complies with MTCA, Sediment Management Standards and other applicable standards and laws.
- Achieves human health and environmental protection in a relatively rapid time frame, compared with the range of alternatives evaluated.
- Uses in-situ treatment technologies to sequester porewater PCBs below the biologically active layer, to the maximum extent practicable.
- Includes protective, engineered in-situ confinement of subsurface sediments that are not practicable to completely remove.
- Has minimal short-term construction risks.
- Uses multiple technologies (e.g., active cap) to provide maximum long-term effectiveness.
- Is implementable.
- Is cost effective, relative to the range of alternatives evaluated.
- Is consistent with the range of cleanup remedies evaluated and selected by EPA to address co-occurring metal contamination in the Upriver Dam area.

7.3.1 Selected Cleanup Action for Deposit 1

The selected cleanup action for the approximately 13,600 cubic yards (CY) of sediment exceeding the 62 µg/Kg cleanup level in Deposit 1 is Alternative 3D. As applied to Deposit 1, Alternative 3D consists of the following actions:

a) Selected Remedy - Placement of a clean cap system over Deposit 1, a portion of the Site with sediment PCB concentrations exceeding 62 µg/Kg dw and defined in Figure 3, thereby isolating the underlying PCB-contaminated sediments from the biologically active zone and water column and further stabilizing the sediments from potential worst-case hydrodynamic forces (i.e., erosion protection). An appropriately engineered isolation cap was determined appropriate for the sediments in Deposit 1 due to the effectiveness of the selected remedy in eliminating toxicity to sediment-dwelling species while limiting potential water quality impacts during remediation efforts. Ecology will require the incorporation of additional safety factors in the sediment cap engineering designs. Safety factors applied to Alternative 3D translates to the thickness of the containment layer in the cap system. While equilibrium partitioning models indicate that a 1-inch containment layer would be required to ensure that porewater PCB concentrations remain below the cleanup level for the next 500 years (Table 3), Ecology is requiring that a minimum 4-inch containment layer be placed over sediment in the deposit that exceeds the sediment cleanup level. The location of Deposit 1 serves to protect a containment system from disturbance and prevent incidental human contact with contaminated sediments.

Alternative 3D Cap Option	Cap Isolation Layer Carbon Loading (kg OC/m^2)	Maximum Future (500 Yr) Porewater PCB Concentration 10 cm Below Mudline (pg/L)
.5 inch Coal and 6 inches Sand	7	240
1 inch Coal and 6 inches Sand	14	< 0.000001
2 inches Coal and 6 inches Sand	28	< 0.000001
3 inches Coal and 6 inches Sand	43	< 0.000001
4 inches Coal and 6 inches Sand	57	< 0.000001
5 inches Coal and 6 inches Sand	71	< 0.000001
6 inches Coal and 6 inches Sand	85	< 0.000001

Table 4. Containment/Isolation layer depths considered by Ecology

The cap will consist of the following sequential layers:

- A nominal 6-inch lower layer of granular coal or carbon-based material as approved by Ecology not to be less than 4 inches at any location following placement.
- An intermediate nominal 6-inch layer of sand
- A surface nominal 3-inch cover layer of gravel armor

Subject to final design, the coal layer will likely be constructed in Deposit 1 using precision hydraulic or mechanical placement of approximately 6 to 8 inches of coal, verified in the field with detailed construction monitoring observations (e.g., piston core profiling or sediment profile imaging [SPI] on a nominal 50-foot grid pattern) to ensure that a minimum 4 inches of coal material is placed at all SPI stations. The coal layer would then be overlain with a nominal 6 inches of sand, and covered with 3 inches of gravel armor.

b) Contingency Remedy - In the event that more detailed remedial design analyses indicate that appropriate performance cannot be achieved by Alternative 3D, modifications of Alternative 3D (e.g., considering alternate organic carbon materials) or Alternative 3B will be used as the cleanup action for Deposit 1. As applied to Deposit 1, Alternative 3B would consist of the same actions as Alternative 3D except that the cap will consist of the following sequential layers:

i) A 6- to 12-inch gas venting (sand) layer, as needed.
ii) An overlying nominal 6-inch layer of AquaBlok™ augmented with organic carbon.
iii) A nominal surface 3-inch cover layer of gravel armor.

Engineering planning will evaluate any limited adjustments to this contingent remedy that Ecology judges appropriate prior to final design and construction if this option is necessary.

Alternatives 3C and 3E examined thicker layers of AquaBlok™ and coal materials in Deposit 1 relative to Alternatives 3B and 3D. However, Ecology believes that costs associated with implementing either Alternative 3C or 3E would classify as disproportionate relative to the incremental degree of increased environmental protection relative to the thinner cap sections provided in Alternatives 3B and 3D.

Long-term monitoring and adaptive management of the cap surface will be required to verify the effectiveness of the cap and repair any cap damage or flaws. Compliance monitoring and contingency responses (as needed) will be implemented in accordance with WAC 173-340-410, Compliance Monitoring Requirements. Detailed requirements will be described in the Operations, Maintenance, and Monitoring Plan (OMMP) to be prepared as a part of remedial design. The objective of the OMMP is to confirm the long-term effectiveness of cleanup actions at the Site. The OMMP will contain discussions on the trigger for contingency response actions and the rationale for potentially reducing monitoring over time.

Long-term monitoring will be appropriately focused toward routine maintenance objectives and verification that the cleanup action is achieving its intended goals. The following broad categories of compliance monitoring will be included at the Site:

- Construction Phase - Monitoring will be conducted during construction of the remedial action to guide construction activities.
- Physical Integrity (Performance and Confirmation Monitoring) – Following completion of construction, long-term physical monitoring of the cap surface will be performed to verify that the cap is sound and not substantially eroded over time by natural and anthropogenic forces.
- Sediment Quality (Confirmation Monitoring) – Following completion of construction, performance monitoring of surface sediments will be conducted. Chemical (PCB) monitoring will be performed to verify that these areas achieve and maintain the 62 µg/Kg dw sediment cleanup level. Bioassays, coring, and/or other appropriate methods also will be applied to assure the dissolved-phase PCBs are contained and the cap system is performing as designed.

7.3.2 Selected Cleanup Action for Deposit 2

The selected cleanup action for Deposit 2, a 0.2 acre backwater channel area on Donkey Island containing approximately 300 CY of sediment with PCB concentrations exceeding 62 µg/Kg, is Alternative 4. As applied to Deposit 2, Alternative 4 will result in the following actions:

a) Excavating the top two feet of sediment, thereby removing roughly 95 percent of the sediment PCB mass from this area.
b) Backfilling the area with approximately two feet of clean sand.
c) Transportation of excavated material, including residual water, to a regional landfill facility for disposal.

In addition to the removal of the contaminated sediments, Ecology will require the restoration of the area to its approximate pre-excavation condition in order to preserve the valuable shoreline and river riparian/backwater habitat surrounding Deposit 2. Additional sediment sampling will be required to confirm the nature and extent of contamination at this location prior to proceeding with removals. Cleanup actions planned for the Donkey Island complex will be based on the results of additional sampling to be conducted prior to the preparation of remedial engineering designs. If comprehensive sampling reveals that previous data were anomalous and PCB levels in the sediments are below the PCB cleanup level, remedial actions may not be required.