DRAFT CLEANUP ACTION PLAN

SPOKANE RIVER UPRIVER DAM PCB SITE

SPOKANE, WA

Washington State Department of Ecology
Toxics Cleanup Program
Eastern Regional Office
Spokane, WA

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LIST OF ACRONYMS & ABBREVIATIONS

AET	Apparent Effects Threshold
ARARs	Applicable, Relevant and Appropriate Requirements
CAP	Cleanup Action Plan
DCAP	Draft Cleanup Action Plan
DW	Dry Weight
FCAP	Final Cleanup Action Plan
CFR	Code of Federal Register
EPA	Environmental Protection Agency
EqP	Equilibrium Partitioning
FS	Feasibility Study
LAET	Lowest Apparent Effects Threshold
MTCA	Model Toxics Control Act
PCBs	Polychlorinated Biphenyls
PLPs	Potentially Liable Parties
RCRA	Resource Conservation and Recovery Act
RCW	Revised Code of Washington
RI	Remedial Investigation
RM	River Mile
SMS	Sediment Management Standards
SPMD	Semi-Permeable Membrane Device
SQV	Sediment Quality Value
TOC	Total Organic Carbon

TSCA	Toxics Substance Control Act
WAC	Washington Administrative Code

1.0 INTRODUCTION

This Draft Cleanup Action Plan (DCAP) presents the Washington State Department of Ecology's (Ecology's) proposed cleanup action to address Polychlorinated Biphenyl (PCB) contaminated sediments that have accumulated behind the Upriver Dam on the Spokane River. The activities will be performed in compliance with the Washington Administrative Code (WAC), Washington's Sediment Management Standards (SMS) (Ecology, 1995; WAC 173-204), and the Model Toxics Control Act (MTCA) (Ecology, 2001; WAC 173-340). Ecology expects that remediation efforts will be performed pursuant to the terms of a forthcoming Consent Decree between Ecology and Avista Development Corporation. The work to be performed is consistent with the United States Environmental Protection Agency's (EPA's) September 12, 2002 Record of Decision (ROD) for heavy metal contamination in the Coeur d'Alene Basin and Spokane River (USEPA, 2002). Ecology recognizes that this DCAP does not provide complete remedies for the contaminants other than PCBs identified across the area of investigation. The cleanup actions proposed in this DCAP are designed to mitigate risks associated with sediments containing PCBs and also incidentally co-located contaminants. The Site lies within a larger area listed under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). Heavy metal contamination in the upper reaches of the river and proposed remedial activities are discussed in the ROD. The United States Protection Agency (EPA) is the lead agency responsible for the remediation of heavy metals, originating in the Coeur d'Alene Basin and deposited in the sediments behind the Upriver Dam and elsewhere.

A Cleanup Action Plan (CAP) is one of a series of documents used by Ecology in the cleanup process conducted under MTCA, in chapter 70.105D of the Revised Code of Washington (RCW), and implemented under WAC 173-340. This iteration of the Spokane River Upriver Dam PCB Site (the Site) Cleanup Action Plan is made available to the public for review and comment before it will be finalized and is referred to as the Draft Cleanup Action Plan (DCAP). After review and consideration of the comments received during the public comment period, Ecology shall issue a Final Cleanup Action Plan (FCAP).

The alternatives chosen for the Upriver Dam PCB Site (Site definition is provided in Section 2.1) are protective of human health and the environment. Selected cleanup actions chosen for the Site include actions that isolate PCBs from the water column and the biologically active surface layer of the sediment. PCB-contaminated sediments that are more accessible to the public will be removed and disposed of offsite in accordance with all state and federal regulations. Detailed descriptions of Ecology's selected cleanup actions are provided in Section 7.3. Forthcoming engineering designs and planning documents associated with the selected alternatives will provide for future monitoring of the Site in order to assure the long-term effectiveness of all remedial actions in accordance with WACs 173-340-400 and 173-340-410.

1.1 The Cleanup Process and the Cleanup Action Plan

This DCAP provides a general description of the proposed cleanup action (s) and sets forth functional requirements that the cleanup must meet for cleanup including: a general description of the proposed cleanup action developed in accordance with WAC 173-340-350 through 173-340-390; a summary of the rationale for selecting the proposed alternative; a brief summary of other cleanup action alternatives evaluated in the Feasibility Study; general cleanup standards considered in determining site-specific cleanup levels and points of compliance for each hazardous substance and media of concern; the schedule and plans for implementation including restoration time frames; institutional controls; applicable state and federal laws; a preliminary determination by Ecology that the proposed cleanup action will comply with WAC 173-340-360; and, where the cleanup action involves on-site containment, specification of the types, levels, and amounts of hazardous substances to remain on site and the measures that will be used to prevent exposure, migration, and contact with those substances. Finally, this DCAP provides a document through which public comment may be solicited regarding the selected cleanup actions proposed for the Upriver Dam PCB Site. A final determination of cleanup actions for the site, taking public comments into account, will be documented in Ecology's forthcoming Final Cleanup Action Plan (FCAP).

This draft decision document presents Ecology's selected cleanup action for the Spokane River Upriver Dam PCB Site. The selected cleanup action is chosen based upon information in the following documents:

Draft Final Focused Remedial Investigation Report, Upriver Dam PCB Sediments Site - February, 2005. The Draft Final Remedial Investigation (RI) Report is being made available for public review and comment concurrently with this DCAP.
Draft Feasibility Study Technical Screening Memorandum, Upriver Dam PCB Site – March 29, 2004.
Draft Final Focused Feasibility Study, Upriver Dam PCB Sediments Site - February 2005. The Draft Feasibility Study (FS) Report is being made available for public review and comment concurrently with this DCAP.

Portions of the text and the figures in this DCAP are borrowed from these documents.

1.2 Declaration

Ecology's selected cleanup action will comply with WAC 173-340-360. This selected remedy is protective of human health and the environment, and is consistent with the preference for permanent solutions to the maximum extent practicable requirement under chapter 70.105D.030(1)(b) RCW.

1.3 Applicability

This DCAP is applicable to the Upriver Dam PCB Site. Cleanup standards and cleanup actions have been developed as an overall remediation process being conducted under the MTCA for this Site specifically.

1.4 Administrative Record

The documents used to make decisions discussed in this DCAP are constituents of the administrative record for the Site. The entire administrative record for the Site is available for public review by appointment at Ecology's Eastern Regional Office, 4601 N. Monroe, Spokane, WA 99205-1295. Documents that were made available for public comment and review are also available at the Spokane Public Library – 906 West Main, Spokane, WA 99201; Spokane Valley Library – 12004 East Main, Spokane Valley, WA; and the Argonne County Library – 4322 North Argonne Road, Spokane, WA 99206.

2.0 BACKGROUND INFORMATION

2.1 Site Description

The Upriver Dam PCB Site (the Site) is located along the Spokane River in the County of Spokane, Washington, east-northeast of the City of Spokane. The Site consists of the aerial extent of sediments hydraulically influenced by the Upriver Dam at river mile (RM) 80. Upriver Dam facility is owned and operated by the City of Spokane. The Site extends upstream of the dam to approximately RM 85 near the Centennial Trail footbridge and Plante's Ferry Park. Elevated levels of PCBs have been found in isolated sediment deposits within the Site. A general map of the Site location is provided in Figure 1. The Spokane River is also part of a large Superfund site which extends into Northern Idaho and is covered by the EPA 2002 Record of Decision (ROD) for the Spokane River and the Coeur d'Alene Basin. The river has been listed under CERCLA due to elevated levels of heavy metals including: zinc, cadmium, lead and arsenic.

2.2 Site History

The Spokane River is a large river which drains more than 4,900 square miles of land in both Washington and Idaho. The Spokane River watershed includes areas in the Northern Rocky Mountain and Columbia River ecoregions. The river flows through an urbanized and industrialized basin and is downstream of the City of Coeur d'Alene, Idaho. Mining operations, industries, and municipal wastewater treatment plants located within the watershed have discharged PCBs, heavy metals and wood waste into the river system. The river transported these contaminants and sediments contaminated with these materials downstream where they have settled in the depositional area created by the Upriver Dam.

The Dam, first constructed in 1894, altered the natural flow of the river creating a low-energy impoundment area which serves as a depositional area for sediment traveling down the river. The river was originally a free-flowing system subject to seasonal variations in flow with high-water/ high-flow events that periodically redistributed sediment deposits to more downstream locations. The Dam has stabilized the system creating an impoundment area in which contaminated sediments have been deposited over time. Background investigations, discussed in section 2.4, have characterized contaminated sediment deposits in the upper reaches of the river. The EPA has identified a 17 acre area, upstream of the Upriver Dam, containing sediment deposits with elevated levels of heavy metals (EPA 2001). EPA's Coeur d'Alene Basin Remedial Investigation/Feasibility Study focused on heavy metal contamination in the Basin without specifically addressing PCB contaminated sediment deposits located upstream of the Spokane River Upriver Dam. Ecology, as the lead agency responsible for overseeing the cleanup of PCBs on the Spokane River, initiated the characterization of sediment deposits containing PCBs in the impoundment area.

This DCAP addresses the PCB-containing sediments found within the Site boundaries. A partial failure of the Dam occurred in May 1986. While water overtopped the spillway gates and caused considerable erosion of earthen-dam material downstream of the dam, there was no indication that significant erosion occurred upstream of the spillway gates in the impoundment area. Radioisotope profiling of sediment cores from the PCB-contaminated deposits suggest that these sediments in the impoundment are stable and there is no indication of substantial widespread scouring and remobilization. While PCB-contaminated sediments at the Site targeted for cleanup have been generally stable, the deposits act as a source, or potential source, of dissolved PCBs to the overlying water column.

In 2001, the Spokane Regional Health District issued a PCB fish consumption advisory for areas along the length of the site. Analysis of tissues from rainbow trout, mountain whitefish, and large scale suckers revealed that PCB levels in three species of fish inhabiting the river were substantially above levels considered safe for human consumption. It was determined that it was unsafe to eat any rainbow trout or mountain whitefish caught in the upper Spokane River between the Upriver Dam and the Washington/Idaho state line. The Spokane Regional Health District determined that meals of large-scale suckers should be limited to one meal per month and specific preparation methods should be employed to limit consumption of tissue known to accumulate PCBs. The PCB advisory was updated in 2003 to include tissue analyses from Long Lake (Lake Spokane).

PCBs were produced between 1929 and 1977 in the United States. They were used in a wide variety of products, including capacitors, transformers, hydraulic fluids, plasticizers, adhesives, cutting oils, sealants, caulks and inks. Known sources of PCBs to the Upriver Dam area of the Spokane River include: the Spokane Industrial Park, whose historic discharge was located at approximately RM 87 and which was formerly owned and operated by Pentzer Development Corporation, a corporation of which Avista is a successor; the Kaiser Trentwood Works (Trentwood) located at approximately RM 86 and owned and operated by Kaiser; Liberty Lake Sewage Treatment Plant (RM 92); and the Inland Empire Paper Company paper plant at approximately RM 83. Two distinct fine-grain sediment deposits, containing co-located PCBs, have been located within the Site in areas owned by the City of Spokane, the Washington Department of Natural Resources (DNR), and the Washington Department of Parks & Recreation.

2.3 Administrative Background

In certified correspondence dated May 31, 2001, Ecology notified Liberty Lake Sewer & Water District of the preliminary finding of potential liability and requested comment on those findings. Similarly, on June 1, 2001, Ecology notified Kaiser and Avista of the preliminary finding of potential liability and requested comment on those findings. Inland Empire Paper was notified via certified correspondence of the preliminary finding of potential liability on December 17, 2001. On December 12, 2001, Ecology notified Kaiser, Avista, and Liberty Lake Sewer & Water District of their status as “potentially liable persons” (PLPs) under Chapter 70.105D.040 RCW for the release of hazardous substances at the Site. Similarly, on April 30, 2003 Inland Empire Paper was notifiedof their status as “potentially liable persons” under Chapter 70.105D.040 RCW for the release of hazardous substances at the Site.

In 2002, Ecology negotiated with Kaiser and Avista to complete a Remedial Investigation (RI)/Focused Feasibility Study (FS) as required under MTCA. The RI is to determine the nature and extent of contamination and the FS is to evaluate cleanup alternatives for the Site. Effective February 6, 2003, Ecology entered into a Consent Decree with Avista and Kaiser, while the Liberty Lake Sewer & Water District and Inland Empire Paper opted not to participate. The Consent Decree set forth requirements for completing a focused RI/FS of PCBs in sediments at the Site. The recommendations provided in this decision document are based on the results of the RI and FS that are currently available in draft-final format.

The documents used to make the decisions documented in this DCAP are part of the administrative record for the Site. To review the RI and the FS or to obtain copies at an established cost, contact Ms. Carol Bergin at (509) 329-3546. (See Section 1.4 Administrative Record)

2.4 Background Site Investigations

Numerous other physical and chemical analyses have previously been performed on sediments located in the Upriver Dam impoundment area. These investigations include:

- Ecology's 1993-94 Investigations (Ecology 1995)
- Kaiser's 1994 Investigations (Hart Crowser 1995)
- Ecology's 1999 Survey (Johnson 2000)
- Ecology's 2000 Sediment Toxicity Tests (Johnson and Norton 2001)
- EPA's 2001 Coeur d'Alene Basin Remedial Investigation/Feasibility Study (EPA 2001)
- Avista's and Kaiser's 2001 Investigation (Exponent and Anchor 2001)
- Avista's and Kaiser's 2005 Focused Remedial Investigation Report, Upriver Dam PCB Sediments Site (Anchor Environmental RI February 2005)
- Avista's and Kaiser's 2005 Focused Feasibility Study, Upriver Dam PCB Sediments Site (Anchor Environmental FS February 2005)

These Site investigation reports are available in the administrative record for the Site, as discussed in Section 1.3. Brief summaries of the site investigation data are provided in the sections below.

2.5 Site Physical Characteristics

2.5.1 Site Sediments

Sediment and sediment-bound contaminants within the Spokane River are transported downstream and deposited in impoundments along its length including the Upriver Dam impoundment area. The sediment sources to the upper Spokane River include remobilization of channel bed material, bank erosion, and tributary inputs. Although Lake Coeur d'Alene provides a low energy environment where much of the sediment derived from upstream watershed and former mining sources is deposited, some silts and clay remain suspended through the lake and enter the Spokane River. Fine-grain suspended sediments travel downstream, binding with contaminants including PCBs originating from both point and non-point sources, and settle in downstream depositional areas.

The upstream end of the Upriver Dam impoundment, at approximately RM 85 near Plante's Ferry Park, is approximately 17 miles downstream of the Post Falls Dam at RM 101.7. Even under seasonal low flow conditions, stream velocity between Post Falls and Plante's Ferry Park is generally high enough that sands and finer-grained materials do not appreciably settle in this area beyond small, localized deposits. However, below Plante's Ferry Park, within the Upriver Dam impoundment, river velocity slows considerably, particularly during seasonal low flow conditions and within the relatively wide and deep reach of the river immediately upstream of the Upriver Dam at RM 79.8. Settling of fine-grained sediments and organic matter occurs within such lower energy environments resulting in the accumulation of sediments and organic sediment-bound contaminants such as PCBs. Similarly, sediment deposits contaminated by mining-related metals from Idaho have been identified by the EPA in the 170-acre Upriver Dam impoundment.

2.5.2 Site Groundwater (Hydrogeology)

The Site is located within the Spokane Valley Rathdrum Prairie Aquifer, a major regional water supply source. The aquifer is unconfined and composed of coarse-grained glacial outwash deposits. Typical deposits include sand, gravel, and boulders, with minor amounts of silt and clay. Regional groundwater flow is generally to the west, following the river basin.

Groundwater flow directions in the vicinity of Upriver Dam are influenced by water impounded behind the dam. The pool behind the dam has an approximate elevation of 1,910 feet (mean sea level; MSL) while the river elevation below the dam is approximately 1,880 feet MSL. This results in localized surface water exfiltration from the reservoir to the aquifer. Regional groundwater flow patterns resume downstream from the dam, with groundwater flow generally following the river basin. Groundwater elevation data collected by Spokane County from nearby monitoring wells confirm this finding (Stan Miller personal communication 2003). The most complete data sets covering the spring runoff and fall low flow periods were used to develop the groundwater contours. Lower gradients and the regional westward flow with discharge to the river appear to be restored within approximately ½ to 1 mile west of the dam. The presence of visible seepage discharges on both sides of the river within ½ mile of the dam, particularly at locations immediately below the dam and powerhouse, provides additional evidence of localized return flows.

3.0 NATURE OF CONTAMINATION

3.1 Soils and Sediments

Sediment samples from potential depositional zones located between Upriver Dam (RM 80 and RM 81.5) and near an island locally known as "Donkey Island" (RM 83.25 to 83.75) were collected and analyzed to complete characterization of the nature and extent of PCB sediment contamination at the Site. Potential depositional zones were identified based upon field inspections, the results of the bathymetric survey, bottom profiling, and structure profiling. Sediment samples from a total of 22 locations were collected and analyzed for chemicals of potential concern (COPCs). In late May 2003, Bluewater Engineering performed a combined bathymetric and sediment texture profiling survey within target depositional areas of the Site.

The sediment classification survey identified a total of four potentially fine-grained sediment deposits within the Site having a continuous dimension in any direction of 50 feet or greater, or a minimum surface area of 250 square feet. These four areas are located along inner bends of the Spokane River channel or in off-channel embayments (e.g., near Donkey Island) where sediment deposition may be focused in such a fluvial system. Initial investigation of the four areas thought to potentially contain fine-grained sediments and associated PCBs enabled the exclusion of one of the areas based on bathymetric survey results and observation of photographic transects of the study areas.

The objective of the focused sediment sampling activities was to investigate other depositional areas immediately upstream of the Upriver Dam apron in order to determine if surface sediments in such depositional areas contained hazardous concentrations of PCBs. Based on the bathymetric survey and video transect of the four suspect deposits, sediment samples from three areas were analyzed for PCBs. In order to characterize the extent of PCB contamination, sediment cores were used to profile the PCBs in the largest deposit (Figure 2).

Sediment samples from the three remaining areas suspected of containing PCB contaminants were collected in June and July of 2003. Additional sampling efforts were conducted in July 2004 to further delineate the contaminated sediment deposits identified by earlier sampling events. Specifically, sediment samples were collected from the large deposit immediately upstream of the dam, the two backwater channels of Donkey Island, and a small deposit on the south side of the riverbed. Three deposits suspected of containing elevated PCBs were evaluated in the Site's RI. Sampling efforts enabled Ecology to select the deposits with elevated PCB levels. Two of the three deposits sampled contained PCB concentrations exceeding Ecology's selected cleanup levels discussed in Section 5.3.

These two contaminated deposits are discussed below and depicted in Figure 3.

Deposit 1 – approximately 3.7 acres in deep water (20 to 25 feet below normal pool level) zones near Upriver Dam (approximately RM 80.1 to 80.6), containing dry-weight (dw) surface sediment PCB concentrations up to 1,430 µg/Kg dw. Sub-surface sediments within the deposit contain PCBs at concentrations reaching 20 mg/Kg. The contaminated sediments have accumulated in a channel depression formed by the river prior to the construction of the Upriver Dam. Preliminary ownership determinations at Deposit 1 indicate that portions of the deposit or land adjacent to the deposit along the bank are owned by the City of Spokane, while the principal underwater sediments of concern are believed to be located within the bed and banks of the

Spokane River owned by the state of Washington, under the control of the Department of Natural Resources.

Deposit 2 – a smaller (0.2 acre) shallow water area on north bank side channels near Donkey Island (RM 83.4), containing surface sediment PCB concentrations up to 330 µg/Kg dw. The upland area is owned by the WA Dept. of Parks and Recreation. Some submerged portions, as bed and bank of the Spokane River, may be owned by the state of Washington, under the control of the Department of Natural Resources. Donkey Island is valuable riparian habitat that provides shelter for juvenile salmonids. The island is a highly heterogeneous environment consisting of areas that are only seasonally inundated as well as channels which have standing water throughout the year. The proximity of the two backwater channels to known spawning areas for trout and other species enhances the ecological importance of this area. The remedial action proposed in this DCAP accounts for the importance of this riparian habitat.

3.2 Surface Water

Water column PCB concentrations at the Site were characterized by direct collection of surface water samples, as well as Semi-Permeable Membrane Device (SPMD) deployments. SPMD technology is based on rate-controlled chemical partitioning from the water column to enclosed neutral lipid materials, and can be used to mathematically extrapolate modeled steady-state water concentrations of dissolved organic chemicals such as PCBs (Huckins et al. 1993 and 2002). The results of the direct sampling and SPMD estimates of seasonal surface-water PCB concentrations are summarized in the section below.

3.2.1 Water Chemistry Results

Total PCB concentrations in surface water were measured at the Site in early September 2003 during low flow conditions of nearly 500 cubic feet per second (cfs), measured at the Spokane gage. The RI used two methods to calculate PCB concentrations in the water column. Chemistry results were reported as EPA-method blank-qualified and blank-corrected values. PCBs reached a maximum concentration of approximately 120 picograms per liter (pg/L) at Boulder Beach at RM 82. Based on EPA-method blank-qualified results, surface water PCB concentrations measured at the Site were below the current surface water quality standard of 170 pg/L, WAC 173-201A, though samples collected during September at Boulder Beach and at the Upriver Dam forebay (RM 79.8) exceeded EPA's 2002 recommended water quality criterion for total PCBs of 64 pg/L and the alternative blank-corrected method indicated that concentrations were greater than 170 pg/L. Under MTCA, the National Recommended Water Quality Criterion for PCBs of 64 pg/L must be considered since it is recognized as an applicable, relevant, and appropriate requirement (ARAR). A narrative discussion of the nature and extent of water column total PCB concentrations at the Site which ranged from 14 to roughly 120 pg/L is provided below.

In September 2003, the highest validated total PCB concentration (approximately 120 pg/L) was detected in the surface water sample collected from Boulder Beach (RM 82), located upstream of Deposit 1. The surface water sample collected further downstream in the Upriver Dam Forebay (RM 79.8) also contained a similar total PCB concentration (approximately 110 pg/L). Conversely, water samples collected at and above the upstream Site boundary at Plante's Ferry Park (RM 84.6) and Barker Road (RM 90.4), respectively, both contained lower total PCB concentrations (14 to 17 pg/L). Much of the apparent increase in total PCB concentrations between Plante's Ferry Park and Boulder Beach was attributable to PCB-11. Increases in bottom water concentrations of certain PCB homologue groups (e.g., tetrachlorobiphenyls) near the Dam Forebay were potentially attributable to sediment-associated releases from deposits near the dam (primarily between RM 80.1 and 80.6).

In December 2003, all validated PCB results were relatively low, compared with those during the September 2003 sampling. Total PCB concentrations in surface water samples collected during December ranged from 15 to 29 pg/L, based on EPA qualified results, and there were no noticeable trends in the data. Based on the available data, the apparent seasonal increase in total PCB concentrations observed during September 2003 is indicative of surface water releases of predominantly PCB-11 to the river system between Plante's Ferry Park and Boulder Beach apparently from treated wastewater discharged from the Inland Empire Paper outfall (Ecology 2002). The apparent increase in certain PCB homologue groups in deep-water samples collected between Boulder Beach and the Dam Forebay may be the result of a release of PCBs from Deposit 1. Based on chemical analysis performed on the sediment in each deposit, PCBs from Deposit 2 may also contribute to the PCBs measured in the surface water at the site. The increase in total PCB concentrations upstream of the contaminated sediments in the Dam impoundment area and localized increase in certain PCBs homologues behind the dam are illustrated in Figure 4.

3.2.2 Semi-permeable Membrane Device (SPMD) Results

SPMDs placed in the water-column support the interpretation that PCB 11 is entering the river upstream of the sediment deposits. The SPMD results from the devices placed one meter over the bottom sediment deposits also demonstrate a shift in PCB congeners which is consistent with the congener profile seen in the sediment in Deposit 1. The SPMDs were deployed at three stations along the Upriver Dam PCB site. Specifically, SPMDs were deployed at Plante's Ferry Park, Boulder Beach, and in the Dam Forebay during the summer low flow and fall precipitation sampling intervals.

A comparison of SPMD-based semi-quantitative dissolved PCB concentration estimates with corresponding total PCB concentrations from direct water sampling at the same stations and over the same time frame support the conclusion that total PCB concentrations in the waters of the Spokane River increase as the river flows through the Deposit 1 area under low-flow conditions. The increases in PCBs appear to be attributable to a combination of locally treated wastewater releases of PCB-11 between Plante's Ferry Park and Boulder Beach and releases of dissolved PCBs from the sediment deposits behind the Upriver Dam. The SPMD data further corroborate that, on a river reach scale, concentrations of both dissolved and total PCBs were below the 170 pg/L water quality standard but above the National Recommended Criterion of 64 pg/L under the seasonal low flow conditions sampled. The SPMD results also corroborated a number of other PCB fate and transport characteristics at the Site, including:

A common shift in predominant dissolved PCB congener homologue groups or individual congeners between Boulder Beach and the Upriver Dam.
An apparent increase in dissolved PCB concentrations at depth near Boulder Beach, likely due to a combination of wastewater sources and potential sediment releases.

3.3 Groundwater

All results indicate that the PCBs in groundwater are significantly below the MTCA Method B groundwater cleanup level of 500,000 picograms per liter [pg/L] based on the state and federal drinking water maximum contaminant level [MCL]), and below the Method B level for groundwater of 44,000 pg/L required to meet the maximum one in a million lifetime cancer risk. Average and maximum results were 23 and 70 pg/L, respectively, in the May samples. In September, average and maximum results were 63 and 116 pg/L, respectively. The associated blanks ranged from 10 to 226 pg/L.

As discussed in Section 4.2.3, down-gradient groundwater total PCB concentrations measured during the focused RI sampling were similar to area background surface water PCB concentrations measured upstream of fine-grained sediment deposits at Boulder Beach. Maximum groundwater PCB concentrations were also substantially (more than 4,000-fold) lower than drinking water-based groundwater cleanup levels. Thus, the groundwater results are consistent with river surface water conditions.

3.4 Contaminants and Media of Concern

The purpose of this discussion is to present a summary of identified Chemicals of Potential Concern (COPCs) within Upriver Dam sediments based on characterization data collected to date at the Site, consistent with Ecology’s goal of establishing cleanup levels at sediment concentrations that minimize adverse effects, as described in the Sediment Management Standards (SMS: WAC 173-204). Freshwater sediment screening levels used for COPC identification were based on the lowest apparent effects thresholds (LAETs), as updated in Ecology’s Freshwater Sediment Quality Value (SQV) development document (Michelson 2003) which includes sediment quality values for a wide range of metal and organic chemicals.

The frequency of exceedance of updated LAET-based screening levels in Upriver Dam sediments on a broad area-wide scale, based on the cumulative RI data collected at the Site, is summarized below. Of all chemicals analyzed in site sediments, metals exceeded the LAET values most frequently. However, as discussed in Section 2.0, the EPA is the lead agency responsible for remedial actions related to wide-spread elevated heavy metals that have been deposited within the watershed. PCBs were the next class of chemicals that most frequently exceeded guidance values set for freshwater sediments, exceeding the draft LAET values in 13 percent of all samples collected under the RI. Sediments exceeding adverse effects thresholds primarily occurred within the known fine-grained deposit located directly upstream of the Dam along the northern bank of the river (Deposit 1) and along a relatively small area in the backwater channels near Donkey Island (Deposit 2). Wood waste and associated degradation products such as retene were also detected in the fine-grained deposit at concentrations above updated LAETs. An initial ranking of COPCs in Upriver Dam sediments, based on the relative frequency of exceedances above the draft LAET screening guidance and presence at Deposits 1 and 2, are summarized in Table 1.

Chemicals of Concern (COC)s Exceedences in Sediments of the Spokane River PCB Site	
COCs	Frequency of LAET Guidance Value Exceedences
Zinc	69.6%
Cadmium	56.5%
Lead	30.4%
PCBs	13.0%
Arsenic	4.3%
Retene	4.3%
Total Organic Carbon (TOC)	4.3%

Table 1. Chemicals of Concern (COCs) and the relative frequency of exceedances identified at the Site

In 2000, sediment toxicity was evaluated at various locations along the Spokane River, including at Deposit 1, using a suite of acute and chronic sediment toxicity bioassays (Johnson and Norton 2001). Laboratory bioassays performed on the Site sediments show evidence of acute and chronic toxicity. The two samples collected in the vicinity of Upriver Dam, from the area designated as Deposit 1, exhibited sediment toxicity significantly greater than the reference samples.
Although a suite of contaminants in the Site's sediment are likely to have contributed to the bioassay failures, data indicate that the existing concentrations of PCBs at Deposit 1 are at levels that may independently cause bioassay failures. As discussed previously, surface sediments located primarily in the two fine-grained sediment deposits, Deposit 1 and 2, exceed draft LAET screening levels for potential PCB toxicity in freshwater environments (Michelsen 2003).

This DCAP is focused on remedial activities associated with PCB-containing sediment at the Site. However, in the context of developing appropriate cleanup levels and response actions that recognize all COPCs at the Site, Ecology also considered the relationship of potential risks and remedies relevant to other co-occurring hazardous substances. All planned remedial cleanup actions will effectively eliminate the risks posed by the PCBs found behind the Upriver Dam and, incidentally, will be consistent with actions that are effective at reducing risks to the other COPCs. PCBs in fish from the upper Spokane River, which includes the Upriver Dam PCB Site, have been documented at concentrations well above the National Toxics Rule (NTR) criterion. Tissue concentrations are high enough to warrant no-consumption advisories for fish caught at the Site (See Section 4.2). Cleanup Actions selected by Ecology must meet the criteria set forth by WAC 173-340-360 and must be protective of both human health and the environment.

4.0 RISKS TO HUMAN HEALTH & THE ENVIRONMENT

The following discussion of exposure pathways, exposure points, and receptors identifies possible means and locations where human or ecological receptors may come in contact with PCB-contaminated media now or in the future. The purpose of the exposure pathway/receptor evaluation is to:

- Assess potential risks and establish remedial actions needed at the Site.
- Provide a basis for establishing cleanup levels. That is, determining levels of constituents that can remain in the sediments and still be adequately protective of human health and the environment.

An exposure pathway is a link between a contaminant source and an exposed receptor (human, animal, plant, etc.). A complete exposure pathway must include all of the following:

Source and mechanism for release
Transport medium
Receptor at an exposure point
Route of uptake (ingestion, inhalation, dermal contact).

Ecology's recommended cleanup actions will protect people and ecological receptors under all probable exposure scenarios. Cleanup levels will be based on the most current standards that are being recommended for the protection of human health and the environment.

4.1 Ecological Receptors & Environmental Concerns Relative to PCBs

The primary potential ecological receptors of PCBs in surface water and sediment in the vicinity of Upriver Dam are: 1) species that live in the Spokane River bottom sediments that have contact with or ingest the river sediments and/or river water, 2) species that live in the river, and 3) species that ingest surface water and organisms from the river.

Potential environmental risks and receptors of concern identified to date for PCBs present in the Upriver Dam area have included the following:

Potential mobilization into the water column and impacts to water quality
Potential for localized toxicity (i.e., in areas exceeding sediment screening level concentrations) to sediment-dwelling (benthic) invertebrate organisms (Johnson 2001)
Potential contributions to fish body burdens of PCBs resulting in decreased fitness and fecundity
Potential risks to wildlife (e.g., birds and mink) and human health due to PCB uptake and bioaccumulation (Johnson 2001)

4.2 Human Receptors & Exposure Pathways

The pathways of human exposure to the PCBs found on the Site vary according to the specific location within the Site. There are two potential exposure pathways that were identified for people who frequent the Site: PCB exposure through ingestion and dermal contact. The human exposure pathway to PCBs associated with the Site is dietary, through fish consumption. A second potential dermal exposure pathway was also considered for people who might come in contact with PCBs in the water column and/or sediments at the Site. This pathway was determined to be insignificant and/or unlikely. The environmental concerns associated with PCBs and human-exposure scenarios are explained in more detail below.

4.2.1 Surface Water

The primary route of human exposure along the length of the Site and in other stretches of the river is through the ingestion of PCBs accumulated in fish. Elevated PCB exposure and risks exist to people who consume fish caught in the Spokane River. Consumption of fish inhabiting and/or feeding throughout the Site and upper river may have detrimental health effects on people and higher level predators. PCBs accumulate in fatty tissue of fish and other organisms that come in contact with them through surface water or through ingestion of other aquatic species accumulating PCBs via the benthic food web. In turn, these PCBs are passed to other organisms higher on the food chain. The end result is high levels of PCBs in the fish species frequently consumed by anglers and their families. PCBs can also be passed from mothers who eat PCB-contaminated fish to infants by breast feeding. Exposure to PCBs either through direct or secondary ingestion of contaminated fish can have both short-term and long-term health consequences.

Ecology and the WA Department of Health, in conjunction with the Spokane Regional Health District, issued a fish consumption advisory due to elevated fish tissue lead concentrations. Further testing of fish caught in the upper Spokane River confirmed the presence of elevated levels of PCBs in rainbow trout, mountain whitefish, and large scale suckers. The advisory was updated in 2001 to reflect the results of PCB tissue analysis of fish taken from, or in the vicinity of, the Site and the greater risks posed by PCBs. The public was advised to avoid eating any rainbow trout or mountain whitefish caught in the Spokane River above the Upriver Dam to the Idaho state line primarily due to PCBs. The advisory also recommended limitations on eating meals of large scale suckers. Pregnant women, as well as families with small children, were informed of the detrimental developmental effects associated with ingesting PCBs and heavy metals at levels found in the three species of fish. The toxicological affects of exposure are cumulative, and cancer risks increase with continued exposure to PCBs. PCBs can also have detrimental human health effects other than cancer including liver damage, skin irritation, neurotoxicity, immune and reproductive system suppression. Potential changes in fish tissue concentrations since 2001 is expected to be evaluated through additional future sampling.

4.2.2 Sediments

The primary potential pathway of exposure to human receptors of PCBs in sediments in the vicinity of Upriver Dam is the consumption of fish species that may have accumulated PCBs as a result of water column and/or benthic food web uptake. The potential for dermal exposure may potentially occur in the backwater area of Deposit 2, Donkey Island, due to the accessibility of the PCB-contaminated sediments in the shallow backwater areas of that area. The proximity of the contaminated area to the Centennial Trail also increases the likelihood of dermal exposure to the sediments and porewater in the Donkey Island channels. The potential toxicological consequences of dermal exposure to PCBs, through either contact with contaminated sediment or the surface water at the Site, are similar to those discussed above for ingestion of PCB-contaminated fish. Remedies proposed by this decision document reduce or eliminate the potential for dermal exposure to toxic concentrations. PCB-contaminated sediments will be removed in areas where containment and isolation is infeasible or less protective.

4.2.3 Groundwater

The primary potential pathway of exposure to human receptors of PCBs in groundwater in the vicinity of Upriver Dam is groundwater consumption. Groundwater beneath the Spokane River near Upriver Dam occurs in the Spokane Valley-Rathdrum Prairie "Sole Source" Aquifer that serves as the drinking water supply for at least 400,000 people in Spokane County. In the vicinity of the Upriver Dam impoundment, surface water generally flows from the impoundment into the groundwater; however, a regional westward groundwater flow with discharge to the river appears to be restored within approximately one-half to one mile downstream from the dam. As discussed in Section 3.3, maximum PCB concentrations in groundwater in the Upriver Dam area are well below the MTCA groundwater cleanup levels and are approximately three orders of magnitude below the current drinking water maximum contaminant levels. Further, the existing domestic and public water supply wells near the river do not draw water wholly derived from Upriver Dam, providing for additional mixing and attenuation. For these reasons, consumption of groundwater containing detectable PCBs from river water associated with the Upriver Dam impoundment is an insignificant exposure pathway.

5.0 Cleanup Standards

Ecology is the lead agency responsible for selecting site-specific cleanup levels, cleanup areas, and cleanup actions for the Spokane River. The standard Ecology Sediment Management Standards/Model Toxics Control Act (SMS/MTCA) framework was used to designate PCB removal and cleanup areas. Under MTCA, cleanup standards include three components: 1) cleanup levels; 2) points of compliance; and 3) applicable or relevant and appropriate requirements (ARARs). Potential cleanup levels and associated points of compliance were developed for the Site following MTCA Cleanup Regulations (WAC 173-340). MTCA Method B procedures employ a risk-based evaluation of potential human health and environmental exposures to Site contaminants. Cleanup levels must be protective of wildlife inhabiting the Site and must account for health risks associated with consuming fish and shellfish. Since PCBs bioconcentrate, cleanup levels must be set at a level that will not result in the accumulation of PCBs in fish tissue above levels known to cause a maximum one in a million lifetime cancer risk. As defined in the MTCA regulation, cleanup levels must also be at least as stringent as established state or federal standards or other laws (i.e., ARARs) developed for human health and environmental protection.

5.1 Applicable Federal, State, and Local Laws

Many environmental laws may apply to this cleanup action. In addition to meeting MTCA cleanup standard requirements, cleanup actions will also meet the environmental standards set forth in other applicable laws. Though a cleanup action performed under formal MTCA authorities (e.g., a Consent Decree) is exempt from the procedural requirements of certain state and local environmental laws, the action must nevertheless comply with the substantive requirements of such laws. Potentially applicable federal, state, and local laws that may impact the implementation of remedial actions at the Site are provided below in accordance with WAC 173-340-710. A more detailed summary of potentially applicable federal and state regulation has been provided in the Upriver Dam PCB Site Feasibility Study, 2005. Selected cleanup actions will meet the substantive requirements of all applicable local, state, and federal regulations. Site-specific requirements will be discussed and accounted for in the forthcoming Upriver Dam PCB Site Engineering Design Document.

5.1.1 Federal Requirements

Potential federal requirements are specified in several statutes, codified in the US Code USC), and regulations promulgated in the Code of Federal Regulations (CFR), as discussed in the following sections.

The Clean Water Act (CWA) (33 USC Section 1251 et seq.) requires the establishment of guidelines and standards to control the direct or indirect discharge of pollutants to waters of the United States. Cleanup levels at this Site will provide a level of protectiveness that meets or exceeds the EPA's Water Quality Criteria for PCBs published in accordance with Section 304 of the CWA (33 USC 1314).

Discharges of Pollutants into Navigable Waters are regulated under Sections 401 and 404 of the CWA (33 USC 1341 and 1344), 40 CFR Part 230 [Section 404(b)(1) guidelines], 33 CFR Parts 320 (general policies), 323 and 325 (permit requirements), and 328 (definition of waters of the United States). These requirements regulate the excavation of shoreline materials and the placement of fill material (including caps) below the ordinary high water elevation of waters of the United States.

5.1.2 Washington State and Local Requirements

MTCA (Chapter 70.105D RCW) authorized Ecology to adopt cleanup standards for remedial actions at sites where hazardous substances are present. The processes for identifying, investigating, and cleaning up these sites are defined and cleanup standards are set for groundwater, soil, surface water, and air in WAC 173-340. The levels for cleanup of contaminated sediments must meet cleanup levels or standards established for other potentially impacted media. Site-specific cleanup levels are determined on a case-by-case basis while meeting the intent of the Sediment Management Standards (WAC 173-204).

In addition to MTCA, potential state requirements are specified in several statutes, codified in the Revised Code of Washington (RCW), and regulations promulgated in the WAC.

Washington Sediment Management Standards (WAC 173-204). The SMS sets forth a marine sediment cleanup decision process for identifying contaminated sediment areas and determining appropriate cleanup responses. The SMS governs the identification and cleanup of contaminated sediment sites and establishes two sets of numerical chemical guidance against which surface sediment concentrations are evaluated. The more conservative sediment quality standard (SQS) provides a regulatory goal by identifying surface sediments that have no adverse affects on human health or biological resources.

State Environmental Policy Act (SEPA) (43.21C RCW; WAC 197-11). The SEPA is intended to ensure that state and local government officials consider environmental values when making decisions or taking an official action such as issuing a MTCA Cleanup Action Plan.

Washington Water Pollution Control Act (Chapter 90.48 RCW; WAC 173-201A). The Water Pollution Control Act provides for the protection of surface water and groundwater quality. WAC 173-201A establishes water quality standards for surface waters of the state.

Washington Shoreline Management Act (Chapter 90.58 RCW; WAC 173-14). The Shoreline Management Act and regulations promulgated there under establish requirements for substantial developments occurring within water areas of the state or within 200 feet of the shoreline.

Washington Hydraulics Code (Chapter 75.20 RCW; WAC 220 110). The Washington Hydraulics Code establishes requirements for performing work that would use, divert, obstruct, or change the natural flow or bed of any salt or fresh waters. Shoreline excavation, dredging, and/or capping actions would likely be required to meet the substantive requirements of a Hydraulic Project Approval (HPA) permit under this state regulation.

5.2 Cleanup Levels Considered

Developing cleanup levels involves several steps: determining what substances contribute to overall risks at the site (indicator hazardous substances or contaminants of concern); evaluating concentrations of single hazardous substances in single media (e.g., sediment) to select indicators; determining which method to use; determining the reasonable maximum exposure scenario; developing cleanup levels for individual substances in individual media, taking into account potential cross-media contamination; and, adjusting individual concentration levels downward to meet site total cancer risk and hazard index limits specified in MTCA. See, WAC 173-340-700.

Based on the RI data for the Upriver Dam impoundment area, the chemicals of potential concern within sediments investigated at the Site are PCBs, cadmium, lead, zinc, total organic carbon (TOC) and retene. As discussed in Section 3.4, the widespread heavy metal contamination at the Site is addressed under the EPA's ROD for the Spokane River. This DCAP is directed towards a subset of areas (Deposits 1 & 2) within the Site which have elevated levels of PCBs . However, in the context of developing appropriate cleanup levels and response actions that address PCBs at the Site, consideration was given to the potential risks and cleanup remedies applicable to the other hazardous substances found at the Site. The proposed cleanup actions will remediate the Site's PCB-contaminated sediments while also incidentally effectively reducing risks posed by the co-located COCs in Deposits 1 and 2.

Cleanup levels for the Site were developed pursuant to the MTCA Cleanup Regulation Method B procedures, taking into account the potential for cross-media transport. Method B employs a risk-based evaluation of potential human health and environmental exposures to site contaminants.

The Method B cleanup level for one medium must be protective of the beneficial uses of other affected media. For example, since sediment porewater could potentially contribute to surface water PCB flux at the Site, sediment cleanup levels need to consider surface water protection requirements. In turn, these surface water requirements and corresponding sediment concentrations must be stringent enough to prevent the excessive accumulation of PCBs in fish tissues and groundwater in order to be considered protective of human health. Sediment cleanup standards, groundwater criteria, and surface water protection considerations are discussed separately in the sections below.

5.2.1 Surface Water Protection Criteria

The MTCA Method B surface water cleanup level considers WAC 173-201A requirements, as well as federal Clean Water Act aquatic life and human health criteria, National Toxics Rule aquatic life and human health criteria (40 CFR 131.36), federal Drinking Water Standards and Health Advisories, and the State Primary Drinking Water Regulations (WAC 246-290). Human health risk calculations for reasonable maximum surface water exposures (including bioaccumulation and drinking water pathways) were performed using the standard MTCA Method B risk equations.

In accordance with MTCA requirements, Method B cleanup levels for the protection of surface waters, supporting fish or shellfish, were calculated for known or suspected carcinogens using MTCA Equation 730-2 (WAC 173-340-730) which accounts for cancer risks associated with dietary exposure to PCBs and the propensity of PCBs to concentrate in fish tissues. Using a bioconcentration factor of 31,200 L/Kg, and a cancer potency factor of 2 mg/Kg-day, a maximum surface water PCB concentration objective of 104 pg/l is estimated to lower the risk of fish consumption to an acceptable level.

Consistent with the summary provided in Ecology's current Cleanup Level and Risk Calculation (CLARC) tables, version 3.1, Method B surface water level ARAR for PCBs is based on WAC 173-201A and current National Toxics Rule ARAR for human health protection of 170 pg/L. Also note that EPA's 2002 ambient water quality standard for the protection of aquatic life from chronic PCB exposure (14,000 pg/L), as well as the drinking water maximum contaminant level (500,000 pg/L), are both considerably less stringent than the bioaccumulation-based Method B cleanup level.

While the current National Toxics Rule surface water quality criterion of 170 pg/L provides one basis for developing the Method B cleanup level, Ecology is using a second value that applies as the MTCA surface water quality cleanup level at the Upriver Dam PCB Site. That is, EPA (2002) recommends that the surface water quality criterion for PCBs be lowered to 64 pg/L, and this value may be used under MTCA as the Method B cleanup level (WAC 173-340-730[3][b][i][B]). For the purposes of this DCAP the more conservative of these values (i.e., 64 pg/L) was set as the cleanup level for the surface water and was the basis for evaluating prospective remedial action requirements at the Site.

5.2.2 Sediment Cleanup Levels Required to Protect Surface Water

Cleanup levels identified for one medium also need to be protective of other affected, or potentially affected, media. Thus, the selection of sediment cleanup levels needs to consider surface water protection requirements, among others. For the purpose of supporting a comparative evaluation of the protectiveness of alternative remedial actions within the Site (see Section 6), sediment porewater PCB concentrations at a depth of 10 cm below the mudline were estimated and compared with the 64 pg/L criterion recommended by the EPA. Since SMS recognizes the sediment/water interface at the mudline and the PCB-containing sediments continue gradually to be buried by cleaner sediments, the 0-10 cm depth represents a conservative point of release into the overlying water column. Three-phase equilibrium partitioning (EqP) was used to determine potential sediment cleanup levels (WAC 173-340-747, Equation 747-1). Two iterations of the 3-phase EqP model were run for the sediments in the Upriver Dam PCB Site. The model was run using both the generalized equilibrium coefficient [Koc] for total PCBs and a site-specific Koc value, which accounts for the proportion of individual PCB-congeners found on-site. Specifically, the 3-phase EqP model was utilized to determine a range of sediment cleanup levels that are protective of surface water and human health as demonstrated by meeting: (1) National Toxics Rule (NTR) criteria and; (2) Method B requirements for surface water PCB concentrations equated with a 1x10-6 maximum lifetime cancer risk associated with the consumption of contaminated fish and shellfish.

National Toxics Rule Criteria - Based on detailed core profiling data for PCBs and total organic carbon (TOC) available for the Site, the EqP model was run using a generalized equilibrium partitioning coefficient [Koc] for total PCBs of 822,422 liters per kilograms [L/Kg]. Using the generalized Koc value from the CLARC tables - version 3.1, the Method B EqP model and the National Toxics Rule criteria for human health protection of 170 pg/L, a protective sediment clean up level of 228 µg/Kg is calculated. Similarly, a protective surface sediment cleanup level of 86 µg/Kg is calculated based on the 64 pg/L recommended criteria ARAR for surface water protection.

In addition, a more site-specific evaluation of pore water contamination potential was also deemed appropriate by Ecology for the Site based on extensive chemical profiling of the sediment performed during the RI. A site-specific Koc of 457,088 L/Kg, based on the proportion of various PCB congeners found on-site, was used to calculate potential sediment cleanup levels for the Site. Based on the current National Toxics Rule ARAR for human health protection of 170 pg/L, the EqP model indicates a maximum advisable concentration of PCBs in surface sediment at 127 µg/Kg. A maximum sediment concentration of 48 µg/Kg is calculated to satisfy the recommended 64 pg/L surface water criteria, based on this modeling. Estimated porewater concentrations near the sediment surface (i.e., at a depth of 10 cm below the mudline at Deposit 1) currently range from approximately two to three orders of magnitude above the 64 pg/L criterion. Thus sediment deposits at the sediment surface and deeper are a likely source of PCBs to the overlying water column and an appropriately protective cleanup level based on the NTR criterion is between 48 µg/Kg and 228 µg/Kg.

MTCA Method B Surface Water Cleanup Level – Surface sediment (0-10cm) PCB cleanup concentrations to assure protection based on the Method B human health fish consumption assumptions were also calculated using both a generalized Method B Koc and Site-specific Koc values of 822,422 and 457,088 L/Kg, respectively. Using the standard three equilibrium partitioning model described by MTCA's Equation 747-1 and the generalized Koc value, maximum surface sediment concentrations of 140 µg/Kg are appropriate to maintain surface water PCB concentrations at a level where PCBs in fish tissue would not pose an unacceptable risk to human health (WAC 173-340-747). Similarly, the site-specific Koc indicates that maintaining surface sediment concentrations below 78 µg/Kg would reduce the risks associated with eating fish and/or shellfish exposed to PCBs at the surface water/sediment interface. Thus, Method B sediment/pore water calculations indicate that sediment levels ranging from 78 to 140 µg/Kg are protective of consumers of fish. This supports the use of the EPA recommended surface water criterion (64 pg/L) which is also designed to be protective of human health.

5.2.3 Sediment Cleanup Levels Required to Protect Groundwater

Ecology considered three criteria in the selection of sediment cleanup levels required for the protection of the Site's groundwater (Table 1). The selected sediment cleanup level must be protective of the most stringent criteria set by state and federal drinking water ARARs. Under MTCA Method B, groundwater PCB concentrations must be below 0.044 µg/L in order to maintain a 1x106 lifetime cancer risk (CLARC Version 3.1, Table 720-1). The state and federal drinking water maximum contaminant level of 0.5 µg/L exceeds MTCA risk requirements. Ecology's cleanup levels must ensure that affected groundwater remains below the 0.044 µg/L criterion as determined by Method B evaluation for carcinogens. Sediment deposits at the Site do not pose an appreciable risk to area groundwater based on the: site conceptual model, PCB concentrations in the sediments, observed PCB concentrations in groundwater, and the propensity for PCBs to bind to organic matter.

5.2.4 Sediment Cleanup Levels Required to Protect Aquatic Life

MTCA addresses sediment cleanup levels by reference to the Sediment Management Standards (SMS). Under the SMS, the primary endpoint for sediment quality evaluations is protection of the environment, specifically the benthic community within the biologically active zone (0 to 10 cm), from adverse effects associated with contaminants. Numeric freshwater sediment quality values (SQVs) for a range of chemicals are still under development by Ecology, though interim guidelines have been released based on probable or apparent effects thresholds (AETs) calculated using the available regional database of synoptic chemistry and toxicity test information (Michelsen 2003). While SMS cleanup levels have been promulgated for sediments in the marine environment, freshwater sediment cleanup levels are currently determined on a case-by-case basis (WAC 173-204-340).

Sediment quality screening values considered in this decision document included the following:

1. Potential for localized toxicity to benthic invertebrate organisms based on Ecology's most recent evaluation of SQVs for use in its freshwater sediment management programs, including updates of existing freshwater AETs and evaluations of other SQV measures that may provide improved reliability. Ecology is currently considering potential freshwater toxicity-based SQVs ranging from 62 µg/Kg dw (lowest AET) to 354 µg/Kg dw (second lowest AET). Although site-specific bioassays can be performed to provide a more direct assessment of sediment toxicity, at the Upriver Dam PCB Site this is complicated by the presence of co-occurring metal and wood waste contaminants.

2. Potential risks to wildlife and human health due to PCB uptake and bioaccumulation – Detailed bioaccumulation studies at other freshwater and marine PCB sites have evaluated average surface sediment concentrations across the characteristic home range of the resident biota. Representative applications of sediment bioaccumulation modeling at certain other sediment PCB cleanup sites have resulted in bioaccumulation-based SQVs ranging from approximately 320 to 1,000 µg/Kg dw (Anchor, 2004). For this DCAP, the more conservative guideline SQV presented above (i.e., 62 µg/Kg dw) was used as the basis for delineating remedial action areas at the Site. MTCA risk assessments, based on the EPA's recommended water quality criterion of 64 pg/L, validate the updated LAET levels of 62 µg/Kg for PCBs in sediments, as derived by Ecology for the protection of aquatic life (Michelsen, 2003).

5.3 Selection of Site-Specific Sediment Cleanup Level

For the Upriver Dam PCB cleanup, Ecology has determined that a cleanup level of 62 µg/Kg total PCBs in sediment will be protective of human health, the river ecological community, and is supported by interim benthic protection guidelines, analytical porewater partitioning calculations at the sediment /surface-water interface, as well as ground and surface water quality protection levels. This cleanup level has been applied to the selection of remedies for the Site.

The selected sediment cleanup level is based on the lowest AET suggested for use in freshwater sediments. The methodology for determining sediment AET levels is well established and has been utilized by the state of Washington and the EPA in determinations of SQVs. While this value is derived for protection of aquatic life inhabiting the upper layer (0 - 10 cm) of the sediment, the cleanup level of [62 µg/Kg dw] is also protective of human health. A summary of cleanup levels considered in the selection of sediment cleanup levels at the site is provided in Table 2.

Criteria Evaluated in the Selection of Sediment Cleanup Level for the Spokane River Upriver Dam PCB Site	Calculated or Established Concentration Limits for PCBs in Water	Sediment Concentrations to Meet Standards or Criteria
Criteria For Surface Water Protection		
National Toxics Rule (NTR) Criterion	170 pg/L	228 µg/Kg *
EPA 2002 recommended Water Quality Criterion	64 pg/L	86 µg/Kg *
MTCA Method B Evaluation for Carcinogens	104 pg/L	140 µg/Kg *
Ambient Water Quality for Protection of Aquatic Life		
Ecology's Acute Criterion	2.0 µg/L	1644.8 mg/Kg *
Ecology's Chronic Criterion	0.014 µg/L	11.5 mg/Kg *
Groundwater Protection Criteria		
MTCA Method B Evaluation for Carcinogens	0.044 µg/L	36 mg/Kg *
Maximum Contaminant Level (WAC 246-290-310)	0.5 µg/L	411 mg/Kg *
MTCA Method A Criterion	0.1 µg/L	82.2 mg/Kg *
Ecology's Guidelines For Protection of Sediment Species		
MTCA Sediment Quality Value (SQV)	62 µg/Kg – Ecology's Selected Cleanup Level	

Table 2. Criteria and guidelines used to set sediment PCB cleanup levels. (* EqP Estimated sediment cleanup standards)

Ecology believes the selected cleanup level of 62 µg/Kg will prevent fish from accumulating excessive PCBs from the Site's sediments. The value also is protective of both human health and aquatic life inhabiting the upper biologically active area of the sediments. As discussed above, a three-phase partitioning model was utilized to estimate sediment concentrations which would meet criteria MTCA objectives, and ARARS. The sediment cleanup level also is protective of national surface water quality recommendations [i.e., 64 pg/L] for the protection of human health. The 62 µg/Kg sediment cleanup level set by this decision document is as stringent as established state or federal standards or other laws (i.e., ARARs) developed for human health and environmental protection.

5.4 Point of Compliance

MTCA defines the point of compliance as the point or points where cleanup levels established in accordance with WAC 173-340-720 through 173-340-760 shall be attained. Once those cleanup levels have been attained the site is no longer considered a threat to human health and the environment.

The SMS default point of compliance for sediment and surface water cleanup levels is the 0 to 10 cm depth interval below the mudline. Radioisotope dating evaluations support that the biologically active zone in the contaminated sediments does not extend below the 10 cm interval, and in several cores is limited to the 0 to 4 cm interval. Existing sediment contamination at the Site (i.e., metals, PCBs, and possibly wood waste) may potentially limit the effective depth of biologic activity. Use of a default 0 to 10 cm point of compliance in the sediment cleanup level provides an additional level of protectiveness to address potential future improved conditions at the Site.

Pursuant to MTCA, the point of compliance for documenting protection of human health and the environment resulting from potential surface water exposures is at the sediment/water interface and throughout the water column of the Spokane River (WAC 173-340-730(6), (7)). Consistent with MTCA and the selected cleanup level, PCB concentrations at the sediment/water interface below 62 µg/Kg are not considered a threat to human health or the environment for this cleanup. Under MTCA, the point of compliance for the protection of human health and the environment resulting from potential surface water exposures must also consider the point of release of sediment porewater into the Spokane River (i.e., at the sediment-surface water interface or mudline). As stated previously, EqP modeling of PCBs between bulk sediment and porewater, along with diffusion of PCBs into the overlying surface water at the mudline, indicates that a surface (0 to 10 cm average) sediment cleanup level of 62 µg/Kg will maintain porewater concentrations at the mudline below the recommended criteria of 64 pg/L. Thus, the sediment cleanup level and associated point of compliance provides for appropriate surface and groundwater protection.

6.0 SUMMARY OF CLEANUP ACTION ALTERNATIVES

6.1 Remedial Action Objectives

The Site remedial action objectives are intended to protect human health and the environment by eliminating, reducing, or otherwise reducing risks posed through exposure pathway and migration route at Deposits 1 and 2. They are developed considering the characteristics of the contaminated sediment and the hazardous substances present, migration and exposure pathways, and potential receptor points.

Consistent with the conceptual model developed for the Site (Anchor 2004), along with Ecology guidance, this Draft Cleanup Action Plan (DCAP) considered four interrelated remedial action objectives for the Upriver Dam Site:

1. Control of benthic exposure to PCB-contaminated sediments located within the biologically active sediment zone (defined in the RI as 0 to 10 cm below mudline).
2. Minimization of benthic exposure to PCB-contaminated subsurface sediments (i.e., located more than 10 cm below mudline), considering sediment stability under potential future conditions.
3. Reduction of potential remobilization of PCB-contaminated sediments by hydraulic or other physical processes.
4. Reduction of potential transport (flux) of PCBs into the overlying water column and groundwater.

6.2 Cleanup Action Alternatives

The Focused Feasibility Study (FS) Report presented remedial technologies and process options that are potentially applicable to Deposit 1 and 2 Site sediments. The Report evaluated those technologies based on initial MTCA screening criteria including effectiveness, implementability and cost of application to the Site. It then combined the technologies to formulate the following four remedial action alternatives which span the range of potentially feasible response actions typically available for sediment sites.

Alternative 1 - Monitored natural recovery
Alternative 2 - Enhanced natural recovery
Alternative 3 - Engineered sediment capping
Alternative 4 - Removal, off-Site disposal and residuals capping

A brief summary of each of these alternatives is presented below and graphically illustrated in Figure 5 in Appendix A.

6.2.1 Alternative 1 – Monitored Natural Recovery

Monitored natural recovery (MNR) is a risk management alternative that relies upon natural environmental processes to permanently reduce exposure and risks associated with contaminated sediments. This alternative relies on sediment deposition (burial) and contaminant attenuation processes. Any necessary upstream source controls for PCBs would need to be implemented under existing wastewater discharge permits and future total maximum daily loading (TMDL) allocation-based limits. The effectiveness of MNR would be verified through long-term monitoring.

6.2.2 Alternative 2 – Enhanced Natural Recovery

This alternative relies on MNR processes but enhances the natural recovery rate with the placement of a nominal 6-inch (15 cm) layer of clean, fine to medium grained sand over sediments that exceed the cleanup level of 62 µg/Kg dw. Placement of this thin layer on the existing sediments would facilitate attainment of the cleanup level within the top 10cm biologically active zone. Compared with thicker sediment caps, application of thin-layer placement technologies is typically associated with less short-term environmental impact, as existing sediment-dwelling benthos populations are able to migrate through the 6-inch layer with relatively little mortality. As is true for MNR, any necessary upstream source controls for PCBs would be implemented under existing wastewater discharge permits and future TMDL allocation-based limits. The effectiveness of enhanced natural recovery would be verified through long-term monitoring, though fewer monitoring events would be required to verify attainment and maintenance of the cleanup level compared with the MNR alternative.

6.2.3 Alternative 3 – Engineered Sediment Capping

These alternatives involve the placement of various materials over areas of the Site that exceed the sediment cleanup level of 62 µg/Kg dw. Long-term monitoring, maintenance, and adaptive management of the cap surface, including repair, would be performed as part of this alternative to ensure the long-term integrity and performance of the cap system. Any necessary upstream source controls for PCBs would be implemented under existing wastewater discharge permits and future TMDL allocation-based limits.

Five alternative sediment cap designs were considered by Ecology. Each design includes a surface erosion-protection layer and an underlying isolation layer; some designs include a "reactive" layer. Each cap design:

- physically isolates PCB-contaminated sediments below the biologically active zone (10 cm thick benthic environment);
- further stabilizes subsurface PCB-contaminated sediments from potential worst-case hydrodynamic forces (i.e., erosion protection); and
- reduces the transport (flux) of dissolved PCBs into the overlying water column.

The five alternative reactive-barrier cap designs are as follows:

A) a nominal 12 inch layer of sand overlain by a 3 inch layer of appropriate gravel armor cover;

B) a 6 to 12 inch gas venting (sand) layer overlain by a nominal 6 inch layer of AquaBlok™, and covered by an additional 3 inch layer of gravel armor;

C) a 6 to 12 inch gas venting layer overlain by a nominal 18 inch layer of AquaBlok™, and covered by an additional 3 inch layer of gravel armor;

D) a nominal 6 inch layer of granular bituminous coal overlain by a 6 inch layer of sand and covered by an additional 3 inch layer of gravel armor; or

E) a nominal 18 inch layer of granular bituminous coal overlain by a 6 inch layer of sand and covered by an additional 3 inch layer of gravel armor.

Gravel armor composes the surface erosion-protection layer and would be designed to protect the cap from erosion during a 100-year flood event. Different materials and thicknesses were considered for the cap isolation layer in order to prevent future groundwater/porewater transport of PCBs into the surface sediment biologically active zone. Relative to substantially inert sand, more "reactive" materials were considered in some of the alternative cap isolation layer designs, providing for further adsorption and mobility controls (sequestering) of PCBs from sediment porewater. The "reactive" layer materials may be constructed of regionally available granular bituminous coal or AquaBlok™, a commercial product consisting of gravel, clay minerals, polymers and other additives.

6.2.4 Alternative 4 – Removal, Off-Site Disposal and Residuals Capping

This alternative involves the removal and off-Site disposal of sediments exceeding the sediment cleanup level of 62 µg/Kg dw. Estimated excavation/dredging depths range from 2 to 3.5 feet for Deposit 1. Some of the dredged sediment would require passive dewatering before disposal, with the runoff requiring treatment prior to discharge. In Deposit 1, the presence of woody debris, boulders and other potential obstructions would likely impede dredge efficiency, resulting in a thin layer of residual PCB-contaminated sediment that would remain in the dredge area. Accordingly, dredge residuals will likely require covering with a backfill/sand cap. The post-dredge cap would prevent exposure of the residual PCBs to the biologically active zone or water column and would also restore existing grades. Because of its backwater location (Figure 3), excavation of the Donkey Island, Deposit 2, sediments could be accomplished by first isolating this area from the Spokane River by placement of a small sand dam. The isolation dam would control water quality releases associated with excavation within this area. The effectiveness of the dredge/excavation and cap remedies at Deposits 1 and 2 would be verified through sediment and water quality monitoring. Any necessary upstream source controls for PCBs would need to be implemented under existing wastewater discharge permits and future TMDL allocation-based limits for PCBs that are currently under development by Ecology.

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 for the selection of cleanup actions:

- Emphasis on treatment technologies;
- Destruction, detoxification, and/or removal of hazardous substances;
- Use of engineering controls;
- Minimization of migration of hazardous substances;
- Consolidation, to the maximum extent practicable, of hazardous substances remaining onsite;
- Taking active measures to prevent/minimize releases to surface water;
- Natural attenuation, if appropriate;
- Provide for reasonable 10-year restoration timeframes; 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 COCs, 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 preferred 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.

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[4]

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 recommended 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

3) Consideration of Public Comment: Pursuant to WAC 173-340-360(2)(b)(iii) and 173-340-600, the DCAP will be made available for public review and comment. The degree to which each alternative considers public concerns will be evaluated after public comments are received. Public participation processes are described in more detail in Ecology's Public Participation Plan for the Upriver Dam PCB Site.

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, safety factor of 4, isolation cap was determined appropriate for the sediments in Deposit 1 due to the effectiveness of the proposed remedy to eliminate toxicity to sediment-dwelling species while limiting potential water quality impacts during remediation efforts. The safety factor 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's safety factor requires 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 bituminous coal 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., 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 suggest that appropriate performance cannot be achieved by Alternative 3D, Alternative 3B will be selected 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 surface 3-inch cover layer of gravel armor.

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.

8.0 ADDITIONAL REQUIREMENTS

8.1 Permit Requirements

Chapter 70.105D RCW exempts remedial actions conducted under a consent decree, order, or agreed order from the procedural requirements of Chapters 70.94, 70.95, 70.105, 77.55, 90.48, and 90.58 RCW and of any laws requiring or authorizing local government permits or approvals. However, Ecology shall require and determine compliance with the substantive provisions of such permits or approvals. In addition, any permits required under federal law to perform the cleanup must be obtained.

8.2 Work Plan

A Work Plan that describes the cleanup actions and planning shall be prepared following the acceptance of the Final Cleanup Action Plan (FCAP) pursuant to WAC 173-340-400(4). The Work Plan will include an Engineering Design Report per WAC 173-340-400(4)(a), Construction Plans and Specifications per WAC 173-340-400(4)(b), an Operation, Maintenance, and Monitoring Plan (OMMP; see below) per WAC 173-340-400(4)(c), an Institutional Controls Plan, and a schedule of activities required to complete the selected cleanup actions.

8.3 Operation, Maintenance, and Monitoring Plan

The OMMP will be prepared to assure performance and compliance in accordance with WAC 173-340-410 for all cleanup actions and shall include:

- A Sampling and Analysis Plan which shall specify procedures that ensure that sample collection, handling, and analysis will result in data of sufficient quality to evaluate the effectiveness of remedial actions at the Site. The Sampling and Analysis Plan shall be prepared by the implementers of the remedial action and shall include the elements defined in WAC 173-340-820.
- Data analysis and evaluation procedures used to demonstrate and confirm compliance with and justification for these procedures.
- Other information as required by Ecology.

8.4 Worker Health and Safety Plan

A Health and Safety Plan will be prepared pursuant to WAC 173-340-810(2). The plan will address all applicable federal or state worker safety requirements.

9.0 IMPLEMENTATION SCHEDULE

A projected schedule for implementation of the selected cleanup actions is generally summarized in Table 4. Submittal of the following documents for Ecology's review and approval will be required within 60 days of the effective date of the CAP Consent Decree:

a) A Remedial Design Work Plan that includes plans for:
   i) An Engineering Design Report;
   ii) Construction Plans and Specifications (including as-built drawings upon completion);
   iii) An Operation, Maintenance, and Monitoring Plan (OMMP; including a Sampling and Analysis Plan that also addresses compliance and performance) and,
   iv) Institutional Controls Plan.

b) A Health and Safety Plan.

A public comment period may be provided for some of the materials listed above. It may be appropriate to combine the information in these various documents into one report to avoid unnecessary duplication. Where the information is contained in other documents it may also be appropriate to incorporate those documents by reference.

Ecology anticipates that a work plan schedule shall establish a plan for planning and construction in 2005 and 2006. Deposits 1 and 2 may follow separate implementation schedules, but both are expected to be completed by the end of 2006. The party implementing the remedy will be required to acquire all necessary permits and access agreements. The party implementing the selected remedy will also be required to notify Ecology in a timely manner of progress or any extenuating circumstances that will affect the implementation schedule. An implementation schedule is provided in Table 4. The OMMP will also include procedures for establishing a contingency plan in the event that the selected remedy fails to meet cleanup requirements established in this DCAP.

GENERALIZED SCHEDULE OF IMPLEMENTATION		
Task	Deposit of Concern	Completion Date
Submittal of Remedial Design (RD) Work Plan	Deposits 1 and 2	Within 60 days of receipt of Ecology's execution of decree implementing the CAP
Construction of Remedies	Deposits 1 and 2	Completion by end of 2006
Submit Final Cleanup Action Report, including results of confirmational sampling.	Deposits 1 and 2	Within three months of the completion of construction associated with cleanup actions.

Table 5. General Schedule of implementation of tasks associated with the Spokane River Upriver Dam PCB Site.

A final cleanup action report will be required by Ecology soon after the completion of construction activities related to the selected cleanup actions and include as-builts and other appropriate completion information, including any potential institutional controls implemented.

10.0 REFERENCES CITED

Anchor Environmental, L.L.C. February 2005. Focused Remedial Investigation Report, Upriver Dam PCB Sediments Site. Prepared for Avista Development, Inc. and Kaiser Aluminum & Chemical Corporation. December 2004.

Anchor Environmental, L.L.C. February 2005. Focused Feasibility Study, Upriver Dam PCB Sediments Site. Prepared for Avista Development, Inc. and Kaiser Aluminum & Chemical Corporation. December 2004.

Mackay, Donald, Shiu, W.Y., and Ma, K.C., 1993, Illustrated handbook of physical-chemical properties and environmental fate for organic chemicals-Volume III, Volatile organic chemicals: Ann Arbor, Michigan, Lewis Publishers, 916 p.

Exponent and Anchor, 2001. Sediment characterization of sediment in the Spokane River upstream of the Upriver Dam. Prepared by Exponent, Bellevue, WA, and Anchor Environmental L.L.C., Seattle, WA.

Golding, Steven. 2002. Spokane Area Point Source PCB Survey May 2001. Washington State Department of Ecology Environmental Assessment Program. Olympia, WA. Publication No. 02-03-009

Hart Crowser, 1995. Supplemental 1994 Spokane River PCB Investigations, Kaiser Aluminum and Chemical Corporation, Trentwood Works, Spokane, Washington. Report prepared by Hart Crowser, Inc., Seattle, WA. February 2, 1995.

Johnson, A., 2001. An Ecological Hazard Assessment for PCBs in the Spokane River. April 2001. Pub. No. 01-03-015. Washington Department of Ecology, Olympia, WA 56 pp.

Johnson, A., and D. Norton, 2001. Chemical Analysis and Toxicity Testing of Spokane River Sediments Collected in October 2000. Pub. No. 01-03-019. Washington Department of Ecology, Olympia, WA. 30 pp.

Michelsen, T. 2003. Phase II Report: Development and Recommendation of SQVs for Freshwater Sediments in Washington State. Prepared for Washington Department of Ecology Toxics Cleanup Program Sediment Management Unit. Avocet Consulting. Kenmore, WA

U.S. EPA, 2001. Coeur d’Alene Basin Remedial Investigation/Feasibility Study. Report prepared for U.S. Environmental Protection Agency by URS, Seattle, WA. October 2001.

U.S. EPA. 2002. National Recommended Water Quality Criteria: 2002. EPA-822-R-02-047. Office of Water, U.S. Environmental Protection Agency, Washington, D.C.

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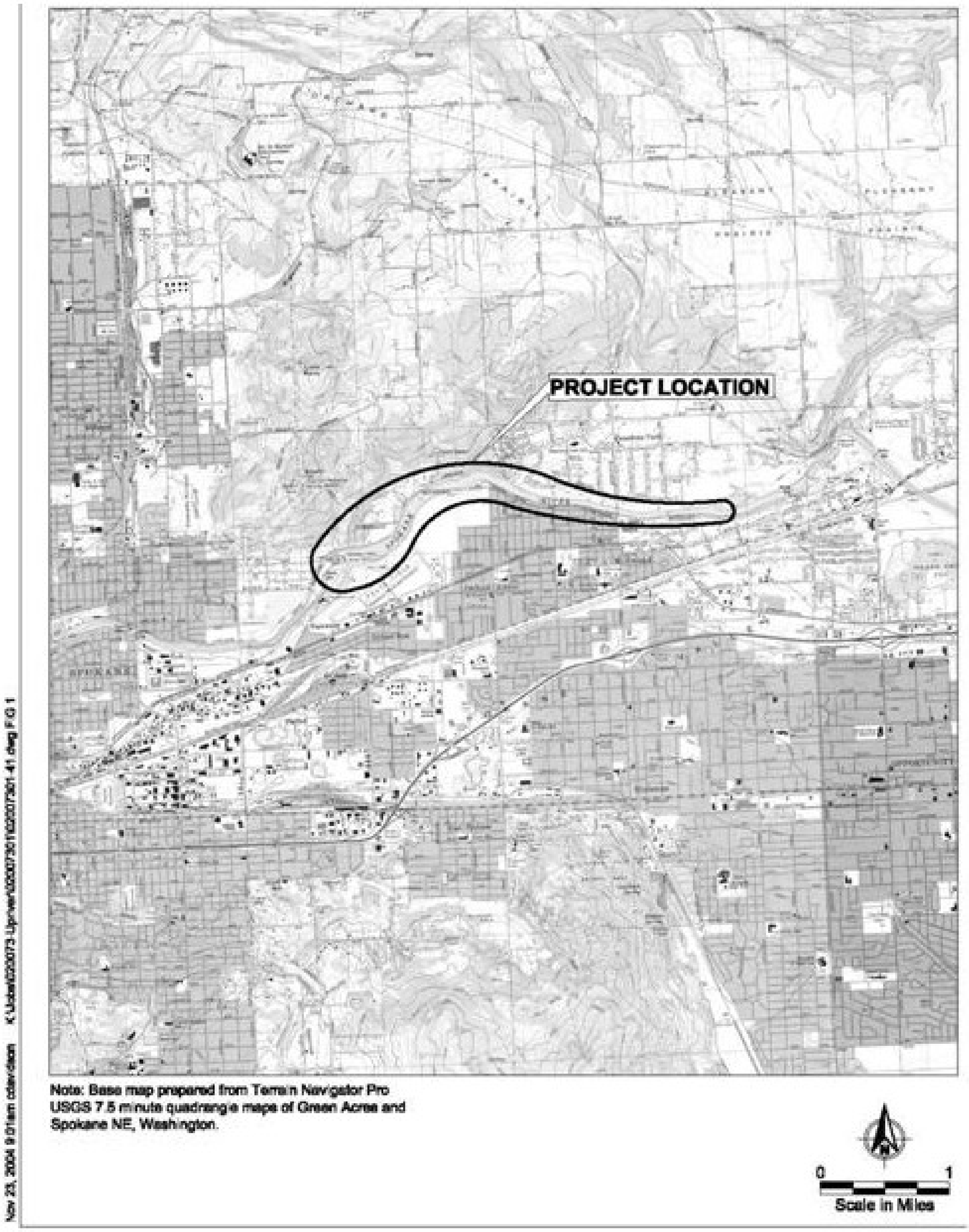

Figure 1

Vicinity Map
Upriver Dam
Spokane, Washington

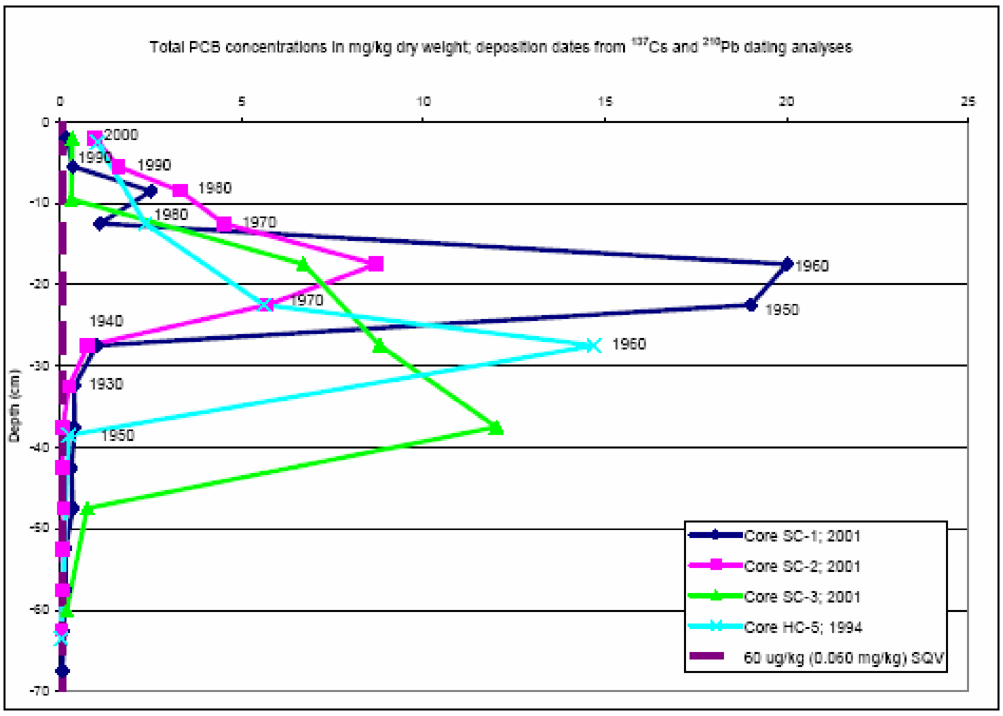

Figure 2. Depth Variation of PCBs in Deposit 1 Sediments Above Upriver Dam

RIVER MILE 80.0 TO 81.5
DAM APRON
BWE-9
UPRIVER DAM AND SPILLWAY
SPOKANE RIVER
BWE-10
DONKEY ISLAND AREA
Scale in Feet
Notes:
1) Aerial photo provided by Avista dated June 2002.
2) Bathymetry based on survey data provided by Blue Water Engineering dated May 20-22, 2003.
3) Horizontal Datum: State Plane NAD83 Washington, North
4) Vertical Datum: NAVD88
Sample Locations
Core Station Location
Surface Sediment Station Location
Deposit 1
Deposit 2

Figure 3

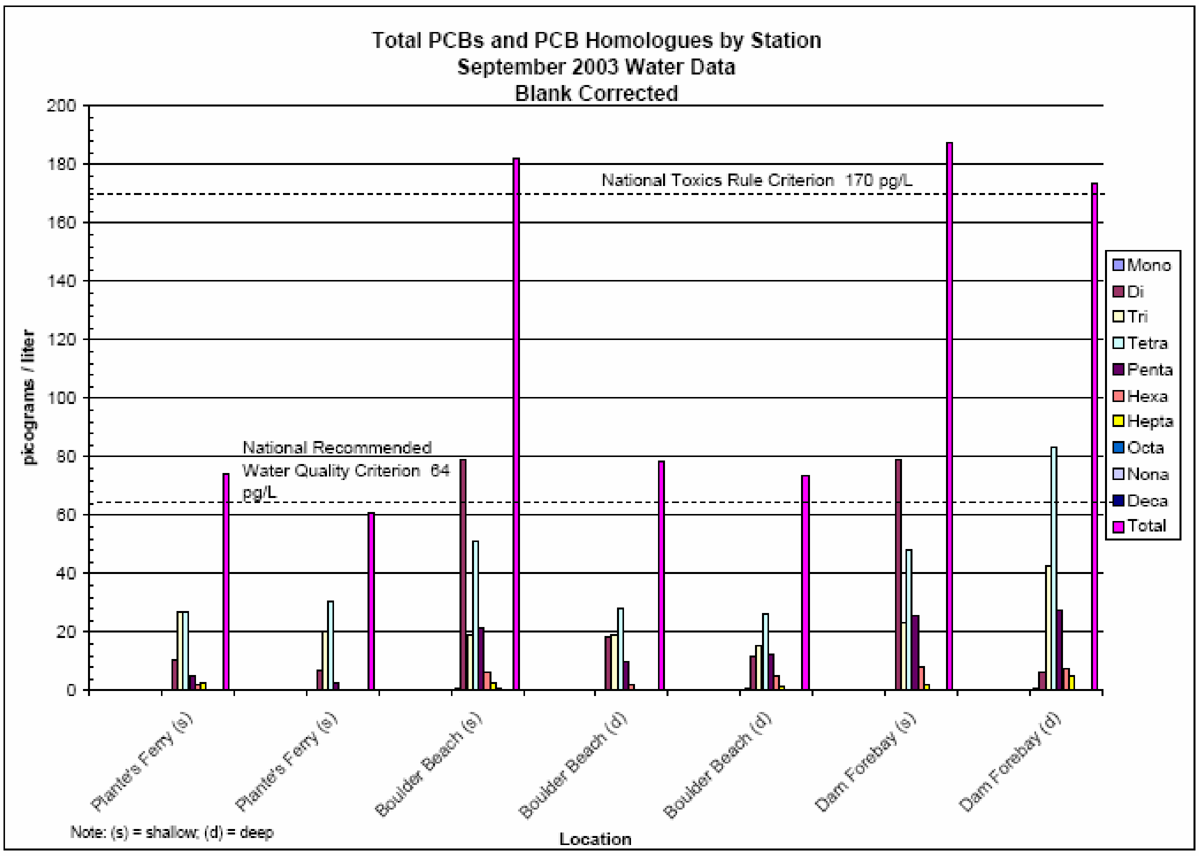

Figure 4. Total PCBs in Surface Water Sampled in September 2003

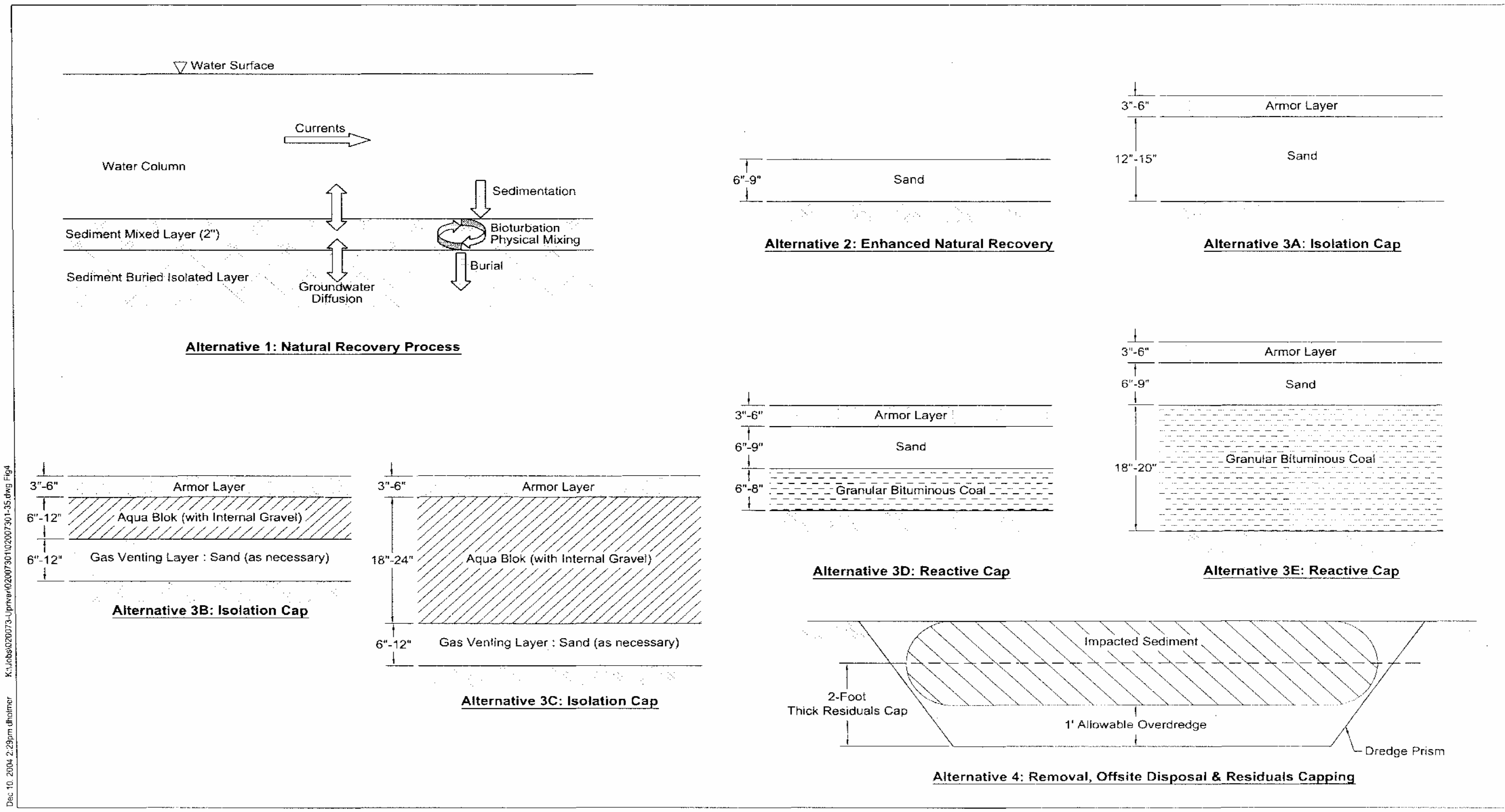

Figure 5. Remedial Alternatives Evaluated for the Site