Tables

Table 2-1 Summary of Principal Contaminants and Sources

Principal Site Contaminants	Principal Source(s)	Source Control Status
Mercury	Wastewater Discharges to Log Pond	**Controlled**
		- Discharges terminated in the 1970s
	Groundwater Discharges to Log Pond	**Controlled**
		- Monitoring indicates no continuing discharges affecting Log Pond sediments or water quality
	Log Pond Sediments	**Partially Controlled**
		- Area capped as part of interim action
		- Contingency actions to be included in final site cleanup to address erosion of the shoreline edges of the cap.
	Historic Dredge Disposal	**Controlled**
		- Rigorous dredge material characterization and management protocols now required by regulation and permit for all dredging projects
	Chlor-Alkali Plant Discharges to ASB	**Controlled**
		- Chlor-alkali plant was closed and demolished in 1999.
Phenolic Compounds	Historic Pulp Mill Discharges to Waterway	**Controlled**
		- NPDES Wastewater improvements implemented in the 1970s, including primary & secondary treatment, and termination of waterway discharges.
		- Early remedial efforts completed in the Whatcom Waterway included sediment removal actions in 1974
	Pulp Mill Discharges to ASB	**Controlled**
		- Pulp mill and associated chemical plant were closed in 2001.
	Wood Waste from Log Rafting	**Controlled**
		- Cargo shipments of logs and wood products have been reduced, and additional regulatory and permit-required pollution controls apply to log/wood handling activities.
	Historic Sewer Outfalls	**Controlled**
		- Sewage treatment and discharge improvements implemented in the 1960s and 1970s.
	Stormwater Discharges	**Controlled**
		- Ongoing stormwater system upgrades to reduce/eliminate CSO events.
		- No evidence of ongoing sediment impact in intermittent CSO area
		- Enhanced stormwater management practices, permitting and monitoring.

Notes:
This table summarizes primary sources of sediment contamination. Secondary sources of sediment contamination (i.e.,impacted sufrace sediment at the site) will be addressed by the cleanup of the Site.
Section 2 of the RI contains an overall history of the Whatcom Waterway site.
Section 6.1 of the RI includes a detailed discussion of site source control activities.

Table 2-2 Principal Site Investigations and Findings

Site Study Area	Study Topics	Investigations	Quick Reference to Relevant RI Report Sections
Whatcom Waterway and Other Areas Outside the ASB	Assess current site lithology, including the impacts of historic dredging and shoreline development activities	Site lithology characterized through review of historic records, review of historic sediment borings, and completion of extensive subsurface physical and chemical testing	Section 3.1 includes a discussion of site lithology, with accompanying geologic cross-sections developed from subsurface explorations.
	Delineate the nature & extent of impacts to surface sediments	Surface sediment testing performed using chemical testing and whole-sediment bioassays	Section 5.2 figures, tables and text summarize the results of chemical and bioassay testing.
	Assess the natural recovery processess occurring at the Site.	Natural recovery processes studied with cores and sediment traps, modeled quantitatively and then verified through chemical testing	Section 6.2 describes the natural recovery process evaluation conducted at the Site. Changes in surface sediment conditions over time are documented in Section 5.2.
	Evaluate the nature & extent of subsurface sediment impacts	Core sampling used to directly assess the nature and extent of subsurface sediment impacts	Subsurface sediment quality summarized in Section 5.3. Refer also to the cross-sections and the lithology discussion in Section 3.1.
	Assess potential dredge disposal properties of waterway sediments	Dredge disposal suitability testing performed in support of the Feasibility Study	Previous dredge material evaluations summarized in Section 7, and in Appendix H.
Log Pond	Delineate surface & subsurface impacted sediments	RI activities included surface and subsurface testing prior to implementation of Log Pond Interim Action	Surface and subsurface sediment quality data are summarized in Section 5.2 and 5.3.
	Monitor effectiveness of Interim Action and assess the need for contingent actions	Effectiveness of Interim Action has been assessed through implementation of Year-1, Year-2 and Year-5 monitoring events	The Year-5 Log Pond Monitoring report is attached as Appendix I. Proposed contingency actions are discussed in Appendix D of the Site Feasibility Study.
	Assess the potential application of *in situ* treatment technologies at the Site	Electro-chemical reductive technology (ECRT) pilot test performed in support of the Feasibility Study	Results of ECRT pilot testing are summarized in Section 7.
ASB	Assess current site lithology, including the impacts of historic dredging and shoreline development activities	Site lithology characterized through review of historic records, review of historic sediment borings, and completion of extensive subsurface physical and chemical testing	Section 3.1 includes a discussion of site lithology, with accompanying geologic cross-sections developed from subsurface explorations.
	Assess the volume and thickness of the ASB sludges	Bathymetric and invasive physical testing used to quantify the volume of the ASB sludges	Bathymetric data are summarized in Section 3.1 and accompanying figures. Physical testing data are summarized in Appendix C and Appendix D to the RI.
	Assess the chemical properties of ASB Sludges	Core sampling used to document concentrations of mercury, phenolic compounds and other contaminants in ASB sludges.	Chemical properties of the ASB sludges are summarized in Section 5.3 and the accompanying figures and tables, and in Appendix C.
	Evaluate the characteristics of the ASB berm materials	Berm sand quality assessed through direct chemical and physical testing, to assess potential for reuse of these materials.	Chemical properties of the berm sands are summarized in Section 5.3 and the accompanying figures and tables, and in Appendix D.
	Quantify the characteristics of the sands underlying the ASB	Chemical and physical testing performed for the sands underlying the ASB sludges	Chemical properties of the berm sands are summarized in Section 5.3 and the accompanying figures and tables, and in Appendix C.
	Assess the physical properties of the sludges relevant to Site remedial decisions	Physical properties of the sludges assessed through physical and geotechnical testing, and during dewatering tests performed in support of the Feasibility Study.	Geotechnical properties of ASB materials are included in Appendix C. Dewatering test results are summarized in Section 7, and in Appendix D.
Starr Rock	Define the historic dredge disposal area	Area of dredge disposal defined through review of historic records, site bathymetric monitoring, and surface sediment testing	Disposal site location identified in Figure 3-1. Sediment quality data are summarized in Section 5.2 and in associated figures and tables.

Table 2-3 Exposure Pathways and Receptors

Receptor	Exposure Pathway	Basis for Evaluating Protectiveness
Benthic Organisms	Direct toxicity to benthic/epibenthic invertebrates	Screening for areas of potential impact using SMS numeric standards
		Verification using whole-sediment bioassays and SMS interpretive criteria
Human Health	Contaminant exposure through consumption of seafood containing bioaccumulated mercury and/or methylmercury	Development of a site-specific BSL as part of 2000 RI/FS activities to identify sediment concentrations that will prevent significant bioaccumulation impacts
		Conservative application of BSL in site decision-making to ensure a substantial additional degree of protectiveness
Ecological Health	Exposure of higher trophic level wildlife (e.g., whales) through consumption of benthic organisms	BSL assessed to verify its protectiveness of potential wildlife exposures
		Verification of BSL protectiveness through sediment bioaccumulation tests and seafood tissue monitoring
Other Considerations	Cross-media transfers (e.g., contaminant leaching) and subsequent exposure to human health or environmental receptors	Contaminant mobility studies conducted in support of Feasibility Study and Remedial Design efforts
	Direct contact of human health and ecological receptors at dredge disposal locations	Applicable regulatory standards for dredge disposal scenarios evaluated as part of Feasibility Study

Notes:

Section 4 of the RI Report contains a summary of exposure pathways and receptors, and a discussion of the screening levels used to evaluate the protectiveness of site conditions under these exposure conditions.

Table 4-1 Concise Summary of Remedial Alternatives & Technologies Applied

Alternative Number	Probable Cost ($million)	Institutional Controls	Monitored Natural Recovery	Containment	Removal & Disposal	Treatment	Reuse & Recycling
Alt. 1	$8	Yes	Yes	Yes	—	—	—
Alt. 2	$34	Yes	Yes	Yes	—	—	—
Alt. 3	$34	Yes	Yes	Yes	—	—	—
Alt. 4	$21	Yes	Yes	Yes	Yes	—	—
Alt. 5	$42	Yes	Yes	Yes	Yes	Yes	Yes
Alt. 6	$44	Yes	Yes	Yes	Yes	Yes	Yes
Alt. 7	$75	Yes	Yes	Yes	Yes	Yes	Yes
Alt. 8	$146	Yes	Yes	Yes	Yes	Yes	Yes

Table 5-1 Detailed MTCA Evaluation of Alternatives

Alternative Number	**Alt. 5**	**Alt. 6**	**Alt. 7**	**Alt. 8**
Probable Cost ($Million)	$42	$44	$75	$146
Design Concept	Figure 4-5	Figure 4-6	Figure 4-7	Figure 4-8
Alternative Description				
Areas Outside the ASB	Outer Waterway: Dredging and capping adjacent to the Bellingham Shipping Terminal; Inner Waterway: Dredging and capping of planned multi-purpose channel configuration; Areas Outside of Waterway: Capping and Monitored Natural Recovery (MNR). Dredged sediments will be disposed and managed by upland disposal in a permitted off-site Subtitle D facility.	Outer Waterway: Dredging adjacent to the Bellingham Shipping Terminal; Inner Waterway: Dredging and capping of planned multi-purpose channel configuration; Areas Outside of Waterway: Capping and MNR. Dredged sediments will be disposed and managed by upland disposal in a permitted off-site Subtitle D facility.	Outer Waterway: Dredging adjacent to the Bellingham Shipping Terminal; Inner Waterway: Dredging and capping of historic 1960s industrial channel configuration; Areas Outside the Waterway: Capping and MNR. Dredged sediments will be disposed and managed by upland disposal in a permitted off-site Subtitle D facility.	Outer Waterway: Dredging adjacent to the Bellingham Shipping Terminal; Inner Waterway: Dredging and capping of historic 1960s industrial channel configuration; Areas Outside the Waterway: Dredging. Dredged sediments will be disposed and managed by upland disposal in a permitted off-site Subtitle D facility.
Volume of Sediment Dredged With PSDDA Disposal and Reuse (yd^3)	124,399	124,399	124,399	124,399
Volume of Sediment Dredged and Disposed with Upland Disposal (yd^3)	86,331	133,099	529,799	1,385,339
Capped Area (acres)	43	32	36	23
ASB	Sludges removed and berm opened. Sludges dewatered and managed by upland disposal in a permitted off-site Subtitle D facility.	Sludges removed and berm opened. Sludges dewatered and managed by upland disposal in a permitted off-site Subtitle D facility.	Sludges removed and berm opened. Sludges dewatered and managed by upland disposal in a permitted off-site Subtitle D facility.	Sludges removed and berm opened. Sludges dewatered and managed by upland disposal in a permitted off-site Subtitle D facility.
Volume of Sludge Dredged and Disposed with Upland Disposal (yd^3)	416,444	416,444	416,444	416,444

Table 5-1 Detailed MTCA Evaluation of Alternatives

Alternative Number	**Alt. 5**	**Alt. 6**	**Alt. 7**	**Alt. 8**
Probable Cost ($Million)	$42	$44	$75	$146
Design Concept	Figure 4-5	Figure 4-6	Figure 4-7	Figure 4-8
Basis for Alternative Ranking Under MTCA & SMS (Cont'd)				
1 Compliance with MTCA Threshold Criteria [1] *(WAC 173-340-360(2)(a))*				
Protection of Human Health & Environment	Yes -- Alternative will protect human health and the environment.	Yes -- Alternative will protect human health and the environment.	Yes -- Alternative will protect human health and the environment.	Yes -- Alternative will protect human health and the environment.
Compliance with Cleanup Standards	Yes -- Alternative is expected to comply with cleanup standards. Active remedial measures are used in all site areas not currently complying with cleanup levels.	Yes -- Alternative is expected to comply with cleanup standards. Active remedial measures are used in all site areas not currently complying with cleanup levels.	Yes -- Alternative is expected to comply with cleanup standards. Active remedial measures are used in all site areas not currently complying with cleanup levels.	Yes -- Alternative is expected to comply with cleanup standards. Active remedial measures are used in all site areas not currently complying with cleanup levels.
Compliance with Applicable State & Federal Laws	Yes -- Alternative complies with applicable laws.	Yes -- Alternative complies with applicable laws.	Yes -- Alternative complies with applicable laws.	Yes -- Alternative complies with applicable laws.
Provision for Compliance Monitoring	Yes -- Alternative includes provisions for compliance monitoring.	Yes -- Alternative includes provisions for compliance monitoring.	Yes -- Alternative includes provisions for compliance monitoring.	Yes -- Alternative includes provisions for compliance monitoring.
2 Restoration Time-Frame *(WAC 173-340-360(2)(b)(ii))*	Restoration time-frame is 5 to 6 years for design and construction.	Restoration time-frame is with 5 to 6 years for design and construction.	Restoration time-frame is 5 to 8 years for design and construction.	Restoration time-frame is 8 to 13 years for design and construction.
3 Evaluation of Permanence Using MTCA Disproportionate Cost Analysis *(WAC 173-340-360(2)(b)(i) & WAC 173-340-360(3)(f))*				
Overall Protectiveness	Alternative makes use of active remediation and off-site disposal. Establishment of consistent waterway depths and stable side-slopes reduces risk of recontamination and/or shoreline erosion.	Alternative makes greater use of active remediation and off-site disposal. Establishment of consistent waterway depths and stable side-slopes reduces risk of recontamination and/or shoreline erosion.	Alternative makes greater use of active remediation and off-site disposal. Alternative requires shoreline infrastructure improvements to prevent shoreline instability in Inner Waterway.	Alternative makes greatest use of active remediation and off-site disposal. Alternative requires shoreline infrastructure improvements to prevent shoreline instability in Inner Waterway.
Permanence	Alternative reduces the volume of impacted material by completely removing the ASB sludges and partially removing impacted subsurface sediments in the Waterway. Remaining impacted sediments are capped.	Alternative reduces the volume of impacted material by completely removing the ASB sludges and impacted subsurface sediment in the Outer Waterway adjacent to the Bellingham Shipping Terminal. Impacted subsurface sediments in the Inner Waterway are partially removed. Remaining impacted sediments are capped.	Alternative reduces the volume of impacted material by completely removing the ASB sludges and impacted subsurface sediment in the Outer Waterway adjacent to the Bellingham Shipping Terminal. A greater volume of impacted subsurface sediment is removed from the Inner Waterway. Remaining impacted sediments are capped.	Alternative reduces the volume of impacted material by completely removing, to greatest degree technically feasible, impacted surface and subsurface sediments throughout the Site. Remaining impacted sediments are capped.
Remedy Costs	$42 Million	$44 Million	$74 Million	$146 Million

Table 5-1 Detailed MTCA Evaluation of Alternatives

Alternative Number	**Alt. 5**	**Alt. 6**	**Alt. 7**	**Alt. 8**
Probable Cost ($Million)	$42	$44	$75	$146
Design Concept	Figure 4-5	Figure 4-6	Figure 4-7	Figure 4-8
Long-Term Effectiveness	Alternative makes least use of upland disposal and most use of containment. Dewatering treatment performed on ASB sludges. Clean ASB berm materials reused.	Alternative makes greater use of upland disposal. Dewatering treatment performed on ASB sludges. Clean ASB berm materials reused.	Alternative makes greater use of upland disposal. Dewatering treatment performed on ASB sludges. Clean ASB berm materials reused.	Alternative makes greatest use of upland disposal and the least use of containment. Dewatering treatment performed on ASB sludges. Clean ASB berm materials reused.
Short-Term Risk Management	Work in Waterway and harbor areas to be completed within two construction seasons. Most ASB remediation activities to take place prior to opening of ASB berm, reducing short-term risks to water quality.	Work in Waterway and harbor areas to be completed within two construction seasons. Most ASB remediation activities to take place prior to opening of ASB berm, reducing short-term risks to water quality.	Alternative requires three to four in-water construction seasons. Extensive off-site transportation of sediments and sludges required. Deep dredging within Inner Waterway will destabilize shorelines and must be coordinated with upgrades in shoreline infrastructure.	Alternative involves between five and seven construction seasons to complete in-water dredging and off-site sediment transport. Highest degree of water quality and safety risks of evaluated Alternatives. Deep dredging within Inner Waterway will destabilize shorelines and must be coordinated with upgrades in shoreline infrastructure.
Implementability	Construction activities are complex, but use only established technologies. Dredging plan for Inner Waterway consistent with land use, navigation, and habitat enhancement plans.	Construction activities are complex, but use only established technologies. Dredging plan for Inner Waterway consistent with land use, navigation, and habitat enhancement plans.	Alternative has greater complexity and short-term risks. Dredging plan for Inner Waterway conflicts with land use, navigation and habitat enhancement plans. Requires upgrades in waterfront infrastructure, that must be coordinated with Waterway dredging.	Alternative has greaterest complexity and short-term risks. Dredging plan for Inner Waterway conflicts with land use, navigation, and habitat enhancement plans. Requires upgrades in waterfront infrastructure, that must be coordinated with Waterway dredging.
Consideration of Public Concerns	Alternative is consistent with land use, navigation, and habitat enhancement plans. Alternative does not maximize removal and upland disposal.	Alternative is consistent with land use, navigation, and habitat enhancement plans. While a greater volume of impacted sediments are removed and disposed upland under this Alternative, more is needed.	Alternative conflicts with land use, navigation and habitat enhancement plans. While an even greater volume of impacted sediment is removed and disposed upland under this Alternative, more is needed.	Alternative conflicts with land use, navigation and habitat enhancement plans. Alternative maximizes removal and upland disposal.

Notes:

Refer to Section 4 for a detailed description of each alternative.

1: All evaluated alternatives comply with the MTCA threshold criteria, as required by regulation.

Table 5-2 Summary of MTCA Alternatives Evaluation and Ranking

Alternative Number		Alt. 5	Alt. 6	Alt. 7	Alt. 8
Probable Cost ($Million)		$42	$44	$75	$146
Overall Alternative Ranking		**6.2**	**6.9**	**6.8**	**6.9**
Alternative Description					
Areas Outside the ASB					
Outer Waterway		Removal and disposal. Capping at BST	Removal and disposal	Removal and disposal	Removal and disposal
Inner Waterway		Removal, upland disposal and capping of planned multi-purpose channel	Removal, upland disposal and capping of planned multi-purpose channel	Removal, upland disposal and capping of historic industrial channel	Removal, upland disposal and capping of historic industrial channel
Areas Outside Waterway		Capping and MNR	Capping and MNR	Capping and MNR	Removal and upland disposal
ASB		Removal and upland disposal	Removal and upland disposal	Removal and upland disposal	Removal and upland disposal
Basis for Alternative Ranking Under MTCA & SMS					
1	**Compliance with MTCA Threshold Criteria**[1] *(WAC 173-340-360(2)(a))*	Yes	Yes	Yes	Yes
2	**Restoration Time-Frame** *(WAC 173-340-360(2)(b)(ii))*	5 to 6 yrs	5 to 6 yrs	5 to 8 yrs	8 to 13 yrs
3	**Relative Benefits Ranking for Disproportionate Cost Analysis** *(WAC 173-340-360(2)(b)(i) & WAC 173-340-360(3)(f))*	**Ecology Weighting Factor**			
	Overall Protectiveness	**30%**	**5** Waterway addressed Sludges Removed Slopes Stabilized	**6** Waterway addressed Sludges Removed Slopes Stabilized	**7** Waterway addressed Sludges Removed Additional Removal	**8** Waterway addressed Sludges Removed Most Removal
	Permanence	**20%**	**5** Medium Permanence	**6** Medium Permanence	**7** More Permanence	**8** Most Permanent
	Long-Term Effectiveness	**20%**	**7** More Upland Disp. Also Capping & Monitored Natural Recovery	**8** More Upland Disp. Also Capping & Monitored Natural Recovery	**9** More Upland Disp. Also Capping & Monitored Natural Recovery	**9** Most Upland Disp. Also Capping & Monitored Natural Recovery
	Short-Term Risk Management	**10%**	**8** Lower In-Water Work Slopes Stabilized	**7** Lower In-Water Work Slopes Stabilized	**6** More In-Water Work Slope Stability Concerns	**4** Most In-Water Work Slope Stability Concerns
	Implementability	**10%**	**8** Most Implementable	**8** Most Implementable	**4** Shoreline Infrastructure	**3** Shoreline Infrastructure Overall Difficulty
	Consideration of Public Concerns	**10%** (excluding above factors)	**7** Removal (+) Still too Much Hg (-) Consistent with use plans (+)	**8** More Removal (+) Still too Much Hg (-) Consistent with use plans (+)	**5** More Removal (+) Habitat Destruction (-) Conflicts with use plans (-)	**4** Most Removal (+) Habitat Destruction (-) Conflicts with use plans (-)

Notes:

Refer to Section 4 for additional description of the remedial alternatives, and to Table 5-1 for a description of the factors considered in evaluation of these alternatives under MTCA and SMS.

1: All evaluated alternatives comply with the MTCA threshold criteria, as required by regulation.