EVALUATION OF RETAINED PROCESS OPTIONS FOR SEDIMENT [a]
Secondary Screening of Technologies and Process Options

General Response Action	Remedial Technology	Process Option	Description of Process Option	Effectiveness [b]	Implementability [c]	Cost [d]
No Action	None	None	No action would be taken and the operation of the existing water treatment plant (WTP) would cease. The contaminated area remains in its existing condition or worsen over time.	Not Applicable Consideration required by the NCP.	NA Consideration required by the NCP.	No Cost
No Further Action	None	None	No new action would be taken, the existing WTP would continue to operate and be repaired; however significant upgrades would not be made.	No actions have been taken to reduce exposure to sediments. However, some reduction in sediment migration will occur from existing surface water controls.	Existing WTP may be approaching end of its practical life.	Low Capital Medium O&M
Institutional Controls	Land Use Controls	Deed/Zoning Restrictions	Restrictions would be used to prevent use or transfer of property without notification of limitations on the use of the property.	Potentially effective in reducing human contact with contaminated sediments, but would not provide protection of the environment.	Legal requirements which are readily implemented.	Low Capital Low O&M
	Access Restrictions	Physical Restrictions (Fencing and Posted Warnings)	Warning signs would be used and fences installed to restrict access. Monitoring would be performed to ensure controls remain in place.	Effective in limiting direct exposure of humans to contaminated sediments.	Readily Implemented.	Low Capital Low O&M
	Community Awareness	Information and Educational Program	Community information and education programs would be undertaken to enhance awareness of potential hazards and remedies.	Potentially effective in reducing human exposure to contaminated sediments. Would not protect the environment.	Readily Implemented.	Low Capital Low O&M

EVALUATION OF RETAINED PROCESS OPTIONS FOR SEDIMENT [a]
Secondary Screening of Technologies and Process Options

General Response Action	Remedial Technology	Process Option	Description of Process Option	Effectiveness [b]	Implementability [c]	Cost [d]
Monitoring	None	Long-term monitoring of Contaminants of Concern (COCs)	Periodic monitoring of COCs in sediment, groundwater, and surface water to check for reduced loadings.	Effective in monitoring migration of COCs in sediment to groundwater and surface water, but does not does reduce exposure to contaminated materials.	Readily Implemented.	Low Capital Medium O&M
Containment	Barriers/Source Controls	Soil Cover	Contaminated sediments would remain in place and be covered with clean soil. Could be used for non-saturated or submerged sediments.	Effective in reducing transport of sediments and human exposure to contaminated sediments. Reduced effectiveness if used in high energy environments, such as drainages with fast moving water.	Readily implemented, but requires source of clean soil.	Medium Capital Low O&M
		Rock Armoring {NOT RETAINED}	Contaminated sediments would be covered with inert natural rock materials and/or riprap to reduce exposure and erosion.	Effective at preventing human contact, but only moderately effective at reducing mobility of sediments and exposure to ecological receptors.	Readily Implemented.	Medium Capital Low O&M
		Sedimentation Dams/Traps	Sedimentation dams and traps would be constructed to capture and contain contaminated sediment in drainages to control downstream transport. Only considered for drainages.	Effective at reducing mobility of sediments, but not effective in reducing exposure to humans and ecological receptors.	Readily Implemented.	Low Capital Medium O&M

EVALUATION OF RETAINED PROCESS OPTIONS FOR SEDIMENT [a]
Secondary Screening of Technologies and Process Options

General Response Action	Remedial Technology	Process Option	Description of Process Option	Effectiveness [b]	Implementability [c]	Cost [d]
Containment (continued)	Barriers/Source Controls (continued)	Channelization	Sediment transport would be reduced by installation of constructed channels. Existing drainages would be straightened, lined, and have energy dissipaters installed to isolate contaminated sediments from surface water. Only considered for drainages.	Effective at reducing human and animal contact with sediments. Also effective for reduced COC loadings from sediment to surface water. Likely disruptive to aquatic habitat and organisms.	Readily Implemented, but more complex to install than other source control methods.	Medium Capital Low O&M
		Diversion Ditches	Surface water run-on from areas up slope of contaminated materials would be diverted around and away from contaminated material.	Effective at decreasing surface water flow through areas with contaminated sediment and associated transport of COCs.	Readily Implemented.	Low Capital Medium O&M
		Biostabilization	Reduce exposure and erosion using vegetation and other natural materials such as rocks and wood debris. Not considered for Pit 3 and Pit 4.	Effective in reducing sediment transport and human contact with the contaminated surface.	Readily Implemented.	Medium Capital Medium O&M
		Burial	Contaminated sediments in the pits would be buried beneath mining waste materials or ore/protore to eliminate direct exposure as part of an engineered containment system. Only considered for sediments in Pit 3 and Pit 4.	Effective for reducing exposure to sediments. A containment system would be needed to prevent groundwater impacts from mining waste backfill.	Readily Implemented, but would likely require handling of surface water in the pit.	High Capital No O&M

EVALUATION OF RETAINED PROCESS OPTIONS FOR SEDIMENT [a]
Secondary Screening of Technologies and Process Options

General Response Action	Remedial Technology	Process Option	Description of Process Option	Effectiveness [b]	Implementability [c]	Cost [d]
Excavation, Transport, Disposal	Removal [e]	Mechanical Excavation/Dredging	Sediments would be removed from the contaminated areas using mechanical excavation methods.	Effective at removing sediments and reducing exposure to humans and ecological receptors. Possible adverse impacts to riparian and aquatic habitat. High probability of downstream transport of sediments if used in drainages.	Readily Implemented.	Medium Capital No O&M
		Suction Dredging	Contaminated sediments would be removed using suction dredging methods, which essentially consist of an underwater vacuum cleaner. Retained for potential use in drainages.	Effective at removing sediments and reducing exposure to humans and ecological receptors. Possible adverse impacts to riparian and aquatic habitat. Minimizes downstream transport of sediment compared to mechanical dredging.	Readily Implemented. Most appropriate for use in streams and drainages.	Medium Capital No O&M
	Off-Site Disposal	See evaluation for Surface and Stockpiled Material (Table 2-5)				
	On-Site Disposal	See evaluation for Surface and Stockpiled Material (Table 2-5)				

EVALUATION OF RETAINED PROCESS OPTIONS FOR SEDIMENT [a]
Secondary Screening of Technologies and Process Options

General Response Action	Remedial Technology	Process Option	Description of Process Option	Effectiveness [b]	Implementability [c]	Cost [d]
Treatment	Ex-Situ Physical/Chemical	Ex-situ Solidification/ Stabilization (S/S)	COCs are physically bound or enclosed within a stabilized mass in a process performed on site. In general, the process consists of injecting a chemical compound (stabilizing agent) to bind COCs chemically to the sediment thereby reducing mobility. There are many distinct types of S/S processes.	Effective in reducing the mobility of metals and radionuclides, although COCs would still be present. May result in increased waste volume. Would require treatability testing.	Readily Implemented. Materials available and technology well established.	Very High Capital Low O&M
		Neutralization	Contaminated sediments would be chemically neutralized to reduce the potential for acid mine drainage (AMD) through the addition/mixing of lime, waste lime from sugar beet processing, phosphate, or other neutralizing agents.	Potentially effective at neutralizing pH, solubility, and mobility of inorganics in sediments. Would require treatability testing.	Readily Implemented. Technology well established but difficult to supplement neutralization in the future should it become necessary.	Medium Capital Low O&M
		Soil Washing {NOT RETAINED}	COCs sorbed onto fine particles are separated from bulk soil in an aqueous-based system on the basis of particle size. The wash water may be augmented with a reagent to help remove COCs. Process concentrates COCs into a smaller volume of material that typically requires additional treatment.	Moderately effective in removing inorganic COCs from the material surface. Effectiveness with radionuclides is not well known. Would require treatability testing. Supernatant would require further treatment.	Readily Implemented. Technology and equipment is commercially available	High Capital Low O&M

EVALUATION OF RETAINED PROCESS OPTIONS FOR SEDIMENT [a]
Secondary Screening of Technologies and Process Options

General Response Action	Remedial Technology	Process Option	Description of Process Option	Effectiveness [b]	Implementability [c]	Cost [d]
Treatment (continued)	In-Situ Physical/Chemical	In-situ Stabilization/ Solidification	Contaminated sediments would be treated with a reactive chemical to stabilize or reduce bioavailability of COCs. The chemical would render the COCs insoluble or bind them chemically to the sediment. Not retained for sediment in the drainages.	Effective at reducing mobility of metals and radionuclides with complete and uniform mixing, but COCs would still be present. May result in increased waste volume. Would require treatability testing.	Readily Implemented.	High Capital Low O&M
	Biological	Ex-Situ Anaerobic {NOT RETAINED}	Biological reactions are utilized for chemical reduction of the COCs to low solubility forms in an oxygen-free environment.	Effectiveness would need to be determined through bench-scale testing.	Not proven or developed to full scale.	Medium Capital Low O&M
		Phytoremediation {NOT RETAINED}	Direct use of plants and their associated rhizospheric microorganisms to remove, degrade, or contain COCs. Only considered for non-saturated sediments.	Potentially effective at reducing loadings of COCs in sediment.	Difficult to get vegetation capable of treatment established in sediment.	Low Capital Medium O&M

EVALUATION OF RETAINED PROCESS OPTIONS FOR SEDIMENT [a]

Secondary Screening of Technologies and Process Options

{NOT RETAINED} with shading denotes remedial technology process option that will not be carried forward for additional evaluation.

[a] Sediment includes those present open pits, ponds, and affected drainages.
[b] Effectiveness rates the technical effectiveness of the process to achieve the remedial action objectives for the medium of concern.
[c] Implementability is based on technical and administrative factors that affect the ability to implement the process.
[d] Costs are based on professional judgment and are relative to process options presented under a specific remedial technology type.
[e] Process options for water treatment are presented in Table 2-8 should it be necessary to remove water to access sediment.

Notes: 1) Multiple response actions and remedial technologies may be combined to develop effective alternatives for sediment.

2) Process options retained for additional evaluation may not be applicable to all locations of the site or material types present at the site.

3) Based on the NCP, consolidation/containment remedial technologies are preferred for contaminated material with large volumes and low concentration levels. Smaller volumes of material with higher concentrations are more suited for treatment.

4) If needed, treatability testing could be performed during the remedial design phase.