12.0 Technical Issues

A key technical issue in preferred remedy implementation at the Milltown Reservoir Operable Unit is controlling sediment during dredging and removal to protect downstream water quality. The sediment control strategy described in this chapter considers OSWER Directive 9285.6-08, *Principles for Managing Contaminated Sediment Risks at Hazardous Waste Sites*. These guidelines are applicable if more than 10,000 cubic yards of sediment are to be dredged or capped. The preferred remedy intends to dredge approximately 3.46 million cubic yards (mcy) of sediment from behind Milltown Dam. The 11 principles of this directive are:

1. Control Sources Early
2. Involve the Community Early and Often
3. Coordinate with States, Local Governments, Tribes and Natural Resource Trustees
4. Develop and Refine a Conceptual Site Model that Considers Sediment Stability
5. Use an Iterative Approach in a Risk-based Framework
6. Carefully Evaluate the Assumptions and Uncertainties Associated with Site Characterization Data and Site Models
7. Select Site-Specific, Project-Specific, and Sediment-Specific Risk Management Approaches that will Achieve Risk-Based Goals
8. Ensure that Sediment Cleanup Levels are Clearly Tied to Risk Management Goals
9. Maximize the Effectiveness of Institutional Controls and Recognize their Limitations
10. Design Remedies to Minimize Short-Term Risks While Achieving Long-Term Protection
11. Monitor During and After Sediment Remediation to Assess and Document Remedy Effectiveness

Each of these principles and its strategy are discussed in this chapter.

12.1 Overall Sediment Management Strategy

As described in previous sections of this document, in-place metals-laden sediment, and sediment stirred up by mechanical or hydraulic scouring, represent the threat to human health and the aquatic ecology at this site. The historic significance of this threat and its potential longevity have prompted the selection of a remedy that focuses on the physical removal of the source sediment from the reservoir. The fundamental approach to sediment management during sediment removal at the Milltown Reservoir Sediments Operable Unit is to contain the sediment by isolating them from the flow of the Blackfoot and Clark Fork rivers, and preventing uncontrolled downstream release and transport during the remedial removal activities. The success of these efforts will be evaluated by continuous water quality monitoring below the project at the established USGS monitoring station above Missoula, Montana. Before any work begins, interlocking sheet piling will be installed around the sediment removal area to isolate the sediment from the active flows of the Clark Fork and the Blackfoot rivers. These walls will be maintained throughout the entire removal process and the subsequent import of clean borrow soils for floodplain reconstruction and construction of the new channel. Upon completing the new channel and re-routing the Clark Fork River, sheet piling will be removed or cut off at ground surface depending on its location and ability to help stabilize the new channel configuration.

12.2 Application of Sediment Management Principles

12.2.1 Control Sources Early

Previous sections of this Remedy Review Board document summarize the history of the Milltown Reservoir sediments. From the Remedial Investigation, we know that the primary contributors of the mine waste and tailings incorporated in the sediments are more than 100 years of mining activity in the upper Clark Fork and Blackfoot river basins. These wastes are incorporated into the active floodplain soils throughout both river basins and account for most of the arsenic and trace metals issues currently observed at the Milltown Site. Metals-laden sediment continues to be transported to the reservoir from residual upstream sources as stream channels erode in response to dynamic fluvial processes. According to the USGS (Water Resources Report 98-4137), the average annual suspended sediment load reaching Milltown Reservoir was approximately 111,000 tons/year.

Sediment has filled the reservoir to capacity and USGS concludes (Lambing 1998) that the reservoir is in a long-term dynamic equilibrium with the incoming sediment load.

The remedy proposed for the Milltown Reservoir will not affect the load as it continues to pass through to the reservoir and lower Clark Fork. Despite extensive remediation efforts in Butte, Anaconda, on Silver Bow Creek, Warm Springs Pond and planned remediation on the Upper Clark Fork in the Deer Lodge Valley, there will still be a significant load of contaminated sediment into Milltown Reservoir from the interim 60 miles of floodplain and river bed load. Although reduced, it is impossible to completely control this input which, for the most part, presently passes through the reservoir.

If sediments were removed and the dam not removed this continued input would re-accumulate and it would be necessary to have periodic dredging in the future. **The proposed remedy, however, will influence the potential for the reservoir sediments to act as a source for the release of spikes of copper laden sediments and prevent degradation of downstream water quality**. Ice scour (as occurred in 1996), extreme hydrologic events, and rapid drawdown of the reservoir pool level, trigger the release of in-place sediments from the reservoir, which can impact downstream aquatic life. The removal of the source sediment from the reservoir and restoration of the river to free flowing effectively mitigates the existing condition. Previous sections in the Remedy Review Board package explain how the combination of the high levels of contaminants in Sediment Accumulation Area 1 (SAA-1), with reducing geochemical conditions in the sediment, and an artificially elevated hydraulic head in the reservoir, all combine to contribute to the arsenic groundwater plume in the Milltown/Bonner area. The removal of

SAA-1 and the dam will preclude accumulation of incoming sediments and remove the hydraulic head driving arsenic into the local aquifer. Then the upstream contamination cannot contribute to further groundwater degradation in the Milltown area. As a result EPA estimates the aquifer could be clean in as little as a decade.

12.2.2 Involve the Community Early and Often

Community Involvement is an integral part of an effective Superfund cleanup program. EPA strives to provide opportunities early and often for stakeholders to have meaningful input into Site-related decisions. Therefore, the Milltown Reservoir Sediments Remedial Investigation and Feasibility Study process has been, and continues to be, highly interactive with the local communities. Open technical meetings, public meetings, regular fact sheets, a comprehensive web page, and an active Technical Assistance Grant group provide the public with the information and the means by which they can personally engage in the project. The community's use of the reservoir and the potential impact of the contaminants of concern resulting from that use were discussed in the original Human Health and Ecological Risk Assessment (EPA 1993a and b) and the Focused Feasibility Study Addendum to the Ecological Risk Assessment (EPA 2000). The role of the community in all aspects of this project was described in Chapter 2, Section 2.2, *Stakeholder Involvement History*. Remedy selection proposals were carefully assessed in light of the thoughts of the Milltown, Bonner, and Missoula residents. Restoring the Clark Fork and Blackfoot Rivers will provide many benefits to the community, it also means that the reservoir will ultimately be gone. This fact has generated favorable and unfavorable comments and concerns about fishing, boating, and waterfowl hunting. However, it is important to note that the overwhelming majority (94%) of public comments received support EPA's proposed remedy (dam and sediment removal).

12.2.3 Coordinate with States, Local Governments, Tribes, and Natural Resource Trustees

Similarly to EPA's efforts to involve the community, EPA has also encouraged other stakeholder to participate in this project. Heavily involved partners include the state agencies of Montana Department of Environmental Quality and Montana Fish, Wildlife, and Parks; the Confederated Salish and Kootenai Tribes; the U.S. Fish and Wildlife Service (USFWS) as a trustee; and the Missoula[1] City and County officials. This cooperation has been ongoing throughout the remedial investigation, feasibility study, and the remedy selection process at the Milltown Operable Unit, as described in Chapter 2, Section 2.2, *Stakeholder Involvement History*. The respective positions on the remedial alternatives are described in section 9.8. The state's primary concern with the contaminated sediments involves the arsenic plume that has degraded local groundwater supplies, and the potential for impaired fisheries downstream of the reservoir from uncontrolled releases influenced by extreme climatic conditions and dam operator error. The State will endorse the proposed remedy. USFWS' concern also revolves around the aquatic system, particularly the fate of bull trout (threatened species under the Endangered

[1] The communities of Bonner and Milltown (as well as West Riverside, Piltzville, etc.) are unincorporated and as such, have no elected town officials and are represented by the County.

Species Act). In spite of the loss of wetlands associated with the site, the USFWS is expected to endorse the remedy to gain a free flowing river that does not impede the movement of fish. The Confederated Salish and Kootenai Tribes have strongly endorsed EPA's proposed remedy because of its long-term view and protection of future generations ("permanence") and the improvements to the native trout fishery. Missoula City and County officials have both passed resolutions calling for dam and sediment removal.

12.2.4 Develop and Refine a Conceptual Site Model that Considers Sediment Stability

The geochemistry and stability of the sediments has been studied extensively throughout the Remedial Investigation process. Exhibit 14, *Conceptual Hydrogeologic Model: Cross-Section of Hydrogeological System and Geochemical Processes in Milltown Reservoir*, illustrates the fate and transport of the arsenic through the existing sediments and groundwater system. Exhibits 9, 10, and 11 illustrate the mechanics associated with sediment deposition and release within the surface water system of the reservoir. Both these models are well developed and supported by existing site specific data developed during the Remedial Investigation (data include contaminant sources, mechanisms, pathways, and receptors).

12.2.5 Use an Iterative Approach in a Risk-Based Framework

An iterative assessment of remedial data was followed throughout the Remedial Investigation with development of the site conceptual model for groundwater and surface water. New data was continually integrated with, and compared to, existing data. A Risk Assessment Addendum was prepared after the 1996 ice scouring event to further evaluate the impacts of ice scour/drawdowns have on downstream aquatic life. Extensive groundwater and surface water monitoring continues and will continue throughout remedy implementation. It is planned that an iterative risk assessment approach, utilizing data from ongoing monitoring, will be used throughout all future construction activities to both protect human health and the environment and to achieve the most cost effective remedy possible. Construction related acute water quality standards and in-situ biomonitoring will provide the basis for evaluating the best management practices (BMPs) employed to prevent impacts to local water quality. Contingency plans and changes to BMPs for the construction activities will be used to assure that risk is minimized. For example, if the sheet piling is not as effective as intended in containing sediment, then additional measures, such as a silt curtain outside the sheet piling in the reservoir, could be used. The remedy itself was subject to iterative risk based evaluations as short and long-term impacts (effectiveness) of various remedial alternatives were evaluated for both surface and groundwater considerations. Involvement of the U.S. Army Corps of Engineers (USACE) has been critical in assessing short-term implications of various remedial activities, such as modeling the impacts of dredging sediments on local water quality. Dredge water treatment needs are presently be evaluated by the USACE.

12.2.6 Carefully Evaluate the Assumptions and Uncertainties Associated with Site Characterization Data and Site Models

The Remedial Investigation/Feasibility Study groundwater and geochemistry conceptual models received intense scrutiny and review from the scientific and regulatory community. University of Montana professors have critiqued the site characterization from data and models through the process, and their input was incorporated where appropriate. These models are well-validated on site specific data.

A conceptual model for predicting the impacts to surface water quality by dredging the reservoir sediments was performed by the USACE (February 2002). This model (a Monte Carlo simulation) assessed the range of effects of dredging with and without BMPs on total suspended solids, arsenic, and trace metals as related to water quality standards. The broad variability associated with the type of dredge, number of dredges, dredge production rates, flow conditions, depth of operation, and volume/frequency of non-sediment debris represent some of the uncertainties associated with this model. The conclusions were founded on predicted exceedances generated by the model and compared to Montana's WQB-7 standards. The uncertainty associated with the results of this model was discussed in depth with the USACE as the proposed remedy was evaluated. These discussions contributed to the recognition that the source sediments should be isolated from the active river channels prior to initiation of removal activities. USACE involvement and evaluation will continue throughout the project.

12.2.7 Select Site-Specific, Project-Specific, and Sediment-Specific Risk Management Approaches that will Achieve Risk-Based Goals

Previous discussions in this document presented the viable remedial alternatives considered. The viability of many remedial actions, including capping in place, are negated given the location of the sediment, its contribution to the arsenic plume, and the potential for disturbance by ice scour or other extreme hydraulic events. The risks associated with the site are tied directly to the source sediment, the geochemical setting, and the artificially elevated hydraulic head driving the arsenic into the aquifer. We can significantly mitigate the risk of perpetuating or replicating existing conditions by: removing the source (contaminated sediments) to a designed repository; removing the mechanism (the dam) that allows new source sediment to accumulate; and removing the increased hydraulic head created by the reservoir pool. These will achieve the risk based goals described for the proposed remedy.

12.2.8 Ensure that Sediment Cleanup Levels are Clearly Tied to Risk Management Goals

Section 6, *Summary of Site Risks,* summarizes the risks posed by the reservoir sediments to human health and the environment. Section 7.0, *Remedial Action Objectives (RAOs) and Remediation Goals (RGs),* describe the objectives of the remedial actions proposed for the site. The volume of sediment proposed by the remedy for removal from SAA-I represents a mantle of contaminated sediment deposited over the pre-1907 floodplain and channel configuration (pre-dam) through the Milltown valley. Only that sediment which is clearly linked to groundwater contamination or ice scour events will be removed – the rest will be managed in place. The target (sediment clean-up levels) of this remedial action is sediment removal to pre-dam ground and armored channel elevations established by data from the previous Remedial Investigations. This removal should facilitate future compliance with ground and surface water standards through this reach of the rivers. Ongoing aquatic monitoring programs involving the benthic invertebrate and fish populations and groundwater monitoring will help evaluate the success of the remedial action in mitigating residual risk.

12.2.9 Maximize the Effectiveness of Institutional Controls and Recognize their Limitations

Limited institutional controls (ICs) are presently in place at the project site. Boating restrictions are employed on Milltown Reservoir to reduce bank erosion. Other control measures include procedures and requirements specific to the long-term maintenance, operation, and safety of the dam. Many of the dam-related ICs are mandated by FERC stipulations to their operating license and agreement. More extensive ICs, such as water well bans, are actively opposed by the county and the State.

If the sediment and dam are removed, extensive ICs associated with the contaminated aquifer—such as alternate water supply maintenance, groundwater use restrictions, long-term monitoring, and long-term dam maintenance—will become unnecessary, except on a short term basis. The Combined Feasibility Study indicates that the groundwater system will recover possibly within several decades of the sediment/dam removal project completion. All long-term dam maintenance requirements will be eliminated. If sediment/dam removal is not done, these ICs must be instituted in perpetuity.

Other, non-dam related ICs are incorporated into the proposed remedy, including limiting access to the solid waste repository. The effectiveness of the controls will be monitored by county-administrated land use actions and future requests for land development. The status of the groundwater plume and its predicted natural attenuation will be monitored biannually.

12.2.10 Design Remedies to Minimize Short-Term Risks While Achieving Long-Term Protection

The proposed remedy uses both mechanical excavation of "dry" sediments and the dredging of saturated sediments. Section 10 of this document describes those remedial actions and the short-term protections recommended during implementation (for example, isolation by sheet piling, and treatment of dredge water). Even with these short-term protections there is still a potential for negative impacts on aquatic life downstream of the project site during construction. However, the USACE re-suspension analysis indicates that the mass loading of contaminants released during construction is not large enough to pose any long-term negative impacts. The location of the downstream repository and slurry pipeline are in areas of limited access that should contribute to the reduction of short-term impacts as the facilities are constructed and used.

After implementation of the proposed remedy, it is expected that the pipeline will be dismantled and the repository capped, re-vegetated, and monitored. The recovery of the dredged area and habitat is dependent on climatic factors and the quality of borrow materials used to backfill the excavation, as well as the success of the re-vegetation, and channel stabilization plans. Specific time estimates for recovery will accompany the detailed design of the proposed remedy.

The area is used recreationally by local residents. All recreational use of the project area will be precluded during implementation of the remedy. The local community will bear the brunt of construction activities, increased traffic, etc. EPA plans to minimize these impacts by relying on slurry lines and rail haul, rather than trucking using public roads, for the transportation of sediments to the repositories. The local area should receive an economic boost as construction activities provide local employment opportunities.

The long-term protections offered by the proposed remedy are related to both human health and aquatic life. Because of the expected aquifer recovery from sediment/dam removal, the need for the alternate water supply and groundwater control district institutional controls will eventually be eliminated. Removal of the sediment and dam will also eliminate the potential for release of contaminants during ice scouring or catastrophic dam failure.

12.2.11 Monitor During and After Sediment Remediation to Assess and Document Remedy Effectiveness

Groundwater and surface water quality monitoring programs continue to evaluate the impacts of the source sediments on the Milltown area as the Superfund process progresses through the selection of a remedy. During implementation of the proposed remedy, it is anticipated that the surface water quality monitoring program will incorporate continuous turbidity, pH, flow, and temperature monitoring, daily total recoverable and dissolved metals, and total suspended solids monitoring. In addition, in-situ biomonitoring (caged fish) will be conducted to assess the direct immediate impact on the downstream fishery. The purpose of these continuous and daily programs will be to monitor the impacts of the dredging activities downstream. If adverse water quality is noted, specific actions can be implemented to further quantify the impacts (by sampling for additional parameters) or to modify the remedial activities, if practical, and reduce or eliminate the impacts. A vital part of the proposed remedy is to minimize any impacts to downstream water quality. Yearly macroinvertebrate, periphyton, and fishery population assessments will also be conducted during the implementation of the remedy to assess the year to year impact of construction activities on the aquatic system. This information would be used to modify the construction activities, if practical, in the future. In a similar fashion to the surface water monitoring, a groundwater quality monitoring program using wells adjacent to the remedial activity will be monitored on a basis frequent enough to detect and evaluate potential impacts. Biological

monitoring of benthic invertebrate and fish populations will also continue on a long-term basis. It is anticipated that a long-term water quality monitoring strategy will be employed for the reservoir area and the downstream repository after implementation of the remedy. Long-term monitoring information is typically used by EPA to assess and quantify the success of specific remedies as part of their 5-year review process.