TABLES

Table 1-1
Advantages/Disadvantages of Mechanical Excavation Versus Hydraulic Dredging

Mechanical Excavation		Hydraulic Dredging	
Pro	**Con**	**Pro**	**Con**
High productivity allows shorter excavation period Expedites timeframe for providing fish passage (due to earlier removal of Milltown Dam) Expedites timeframe for starting natural recovery of arsenic plume in alluvial aquifer (due to earlier reduction in hydraulic head driving arsenic from sediments into aquifer and more rapid removal of source sediments) Elimination of need for a local repository by allowing cost-competitive consolidation of the excavated sediment to Opportunity Ponds using rail haul	Soft soils require alternation for proper stability during excavation Potential for greater scour of reservoir sediments in SAA III (the existing channels) during the reservoir drawdown required to facilitate access for mechanical excavation equipment	Ability to work in soft soils	Requires significant water volume Potential to exacerbate alluvial aquifer arsenic plume in short term due to increasing hydraulic connection between dredge area and aquifer Limits use of local labor Difficulty in managing uptime utilization if debris is present Risks associated with pipeline/booster failure Downtime required for all operations in event of pipeline/booster failure Higher risks due to potential floods/ice flows Time required increases probability of impacts due to production and weather The development of a local repository close enough to allow slurry pipeline transport is required

Table 1-2 – Surface Water ARARs – Montana WQB-7 Standards (total recoverable – 100 mg/L hardness)

	Acute * Aquatic	Chronic * Aquatic	Human Health
Arsenic	340 µg/L	150 µg/L	10 µg/L (MCL/anticipated WQB-7)
Cadmium	2.1 µg/L	0.3 µg/L	5 µg/L
Copper	14 µg/L	9.3 µg/L	1,300 µg/L
Iron	1,000 µg/L	-	-
Lead	82 µg/L	3.2 µg/L	15 µg/L
Zinc	120 µg/L	120 µg/L	2,100 µg/L

* Federal Ambient Water Quality Criteria are also ARARs. They are identical to the Montana WQB-7 acute and chronic standards except they are for dissolved rather than total recoverable analyses.

Table 1-3 – Proposed Temporary Construction Related Water Quality Standards*

Cadmium-Acute AWQC	2 ug/L	Short-term (1 hour)
Copper-80% of the TRV (dissolved) (at hardness of 100 mg/L)	25 ug/L	Short-term (1 hour)
Zinc-Acute AWQC (dissolved)	117 ug/L	Short-term (1 hour)
Lead-Acute AWQC (dissolved) DWS (dissolved)	65 ug/L 15 ug/L	Short-term (1 hour) Long-term (30-day average)
Arsenic-Acute AWQC (dissolved) DWS (dissolved)	340 ug/L 10 ug/L	Short-term (1 hour) Long-term (30-day average)
Iron-AWQC (dissolved)	1,000 ug/L	Short-term (1 hour)
Total Suspended Solids (TSS)	550 mg/L 170 mg/L 86 mg/L	Short-term (day) Mid-term (week) Long-term (season)

*All hardness related AWQC values assume a hardness of 100 mg/L.
TRV = Toxicity Reference Value, used in proposed plan for the Clark Fork River Operable Unit.
AWQC = Federal Ambient Water Quality Criteria.
DWS = Federal Drinking Water Standard.

Table 3-1
Typical Downstream Sediment and Metals Load at CFR above Missoula Station

	TSS (tons/yr)	Net TSS deposit (+) or loss (-) in Milltown Reservoir (tons/yr)	Total Copper (tons/yr)	Dissolved Copper (tons/yr)
Average 1991-1995	55,485	12,901	24.5	5.97
Average 1991-1997	148,000	-6,000	54.2	9.2
1996 Ice Scour	317,000	-52,000	105	16.4
1997 High Flow	445,000	-55,000	129	18.8

Data References:

1. USGS, 1997, "Spatial and Temporal Trends of Trace Metals in Surface Water, Bed Sediment, and Biota of the Upper Clark Fork Basin, Montana, 1985-1995", Menlo Park, CA, November 1997.
2. USGS, 1998, "Estimated 1996-97 and Long-Term Average Annual Loads for Suspended Sediment and Trace Metals in Streamflow of the Upper Clark Fork Basin from Warm Springs to Missoula, Montana", Water-Resources Investigations Report 98-4137.

Table 3-2
Average Total and Dissolved Copper Concentrations in Surface Water
Milltown Reservoir Operable Unit

	Average Total Copper (parts per billion)	Average Dissolved Copper (parts per billion)
Clark Fork River at Turah Bridge		
1991 - 1999	29.9	5
Blackfoot River near Bonner		
1991 - 1999	5	1.2
Clark Fork River above Missoula		
1991 - 1999	20.2	3.1

Data Reference:

USGS Statistical Report, 1999

Table 4-1: Estimated Volume of Sediment Scoured by Area under Scenario 1- No Action

Area	Tons	Cubic Yards
Clark Fork (Milltown Dam to Duck Bridge) Sands	-6,458	-5,491
Clark Fork (Milltown Dam to Duck Bridge) Fines	12,348	10,500
Blackfoot (Milltown Dam to I-90) Sands	-9,251	-7,866
Blackfoot (Milltown Dam to I-90) Fines	186	158
Blackfoot (I-90 to Stimson Dam) Sands	-7,222	-6,141
Blackfoot (I-90 to Stimson Dam) Fines	-817	-695
Upper Clark Fork (Duck Bridge to Turah) Sands	-22,511	-19,142
Upper Clark Fork (Duck Bridge to Turah) Fines	13,556	11,527
TOTAL	**-20,169**	**-17,151**

Note: Conversion factor from tons to cubic yards (1.176 tons/cy) based on the average dry density of sheetpile wall sediment core samples from RD Field Investigation Data Summary Report.

Table 4-2a: Estimated Volume of Sediment Scoured by Area during Modeled Period under Scenario 2 - EPA's Proposed Plan

Area	Tons	Cubic Yards (1)
Clark Fork (Milltown Dam to Duck Bridge) Sands	-3,142	-2,672
Clark Fork (Milltown Dam to Duck Bridge) Fines	34,317	29,181
Blackfoot (Milltown Dam to I-90) Sands	-10,069	-8,562
Blackfoot (Milltown Dam to I-90) Fines	280	238
Blackfoot (I-90 to Stimson Dam) Sands	-6,799	-5,781
Blackfoot (I-90 to Stimson Dam) Fines	-750	-638
Upper Clark Fork (Duck Bridge to Turah) Sands	-11,608	-9,871
Upper Clark Fork (Duck Bridge to Turah) Fines	46,070	39,175
TOTAL DURING MODELED PERIOD	**48,299**	**41,071**

Table 4-2b: Estimated Volume of Sediment Scoured by Area under Scenario 2 - EPA's Proposed Plan during Modeled Period Plus Estimated Post-Dam Removal Scour

Area	Tons	Cubic Yards (1)
Clark Fork (Milltown Dam to Duck Bridge) Sands	-3,142	-2,672
Clark Fork (Milltown Dam to Duck Bridge) Fines	34,317	29,181
Blackfoot (Milltown Dam to I-90) Sands	11,441	9,729
Blackfoot (Milltown Dam to I-90) Fines	79,204	67,350
Blackfoot (I-90 to Stimson Dam) Sands	117,343	99,781
Blackfoot (I-90 to Stimson Dam) Fines	35,462	30,155
Upper Clark Fork (Duck Bridge to Turah) Sands	40,690	34,600
Upper Clark Fork (Duck Bridge to Turah) Fines	51,950	44,175
TOTAL	**367,265**	**312,300**

Notes:

(1) Conversion factor from tons to cubic yards (1.176 tons/cy) based on the average dry density of sheetpile wall sediment core samples from RD Field Investigation Data Summary Report.

(2) If the Clark Fork River channel upstream of Duck Bridge was reconstructed at a lower bottom elevation prior to dam removal under Scenario 2, then it may be possible to reduce post-dam removal scour for this reach.

Table 4-3: Estimated Volume of Sediment Scoured by Area under Scenario 3 - Dry Sediment Removal without Bypass Channel

Area	Tons	Cubic Yards
Clark Fork (Milltown Dam to Duck Bridge) Sands	470,635	400,200
Clark Fork (Milltown Dam to Duck Bridge) Fines	430,362	365,954
Blackfoot (Milltown Dam to I-90) Sands	2,405	2,045
Blackfoot (Milltown Dam to I-90) Fines	53,461	45,460
Blackfoot (I-90 to Stimson Dam) Sands	121,245	103,099
Blackfoot (I-90 to Stimson Dam) Fines	34,581	29,406
Upper Clark Fork (Duck Bridge to Turah) Sands	80,046	68,066
Upper Clark Fork (Duck Bridge to Turah) Fines	50,579	43,009
TOTAL	**1,243,314**	**1,057,240**

Note: Conversion factor from tons to cubic yards (1.176 tons/cy) based on the average dry density of sheetpile wall sediment core samples from RD Field Investigation Data Summary Report.

Table 4-4: Estimated Volume of Sediment Scoured by Area under Scenario 4a - Dry Sediment Removal with Full Bypass Channel

Area	Tons	Cubic Yards
Clark Fork (Milltown Dam to Duck Bridge) Sands	80,606	68,543
Clark Fork (Milltown Dam to Duck Bridge) Fines	56,644	48,167
Bypass Channel Sands	2,683	2,281
Bypass Channel Fines	1,542	1,311
Blackfoot (Milltown Dam to I-90) Sands	11,441	9,729
Blackfoot (Milltown Dam to I-90) Fines	79,204	67,350
Blackfoot (I-90 to Stimson Dam) Sands	117,343	99,781
Blackfoot (I-90 to Stimson Dam) Fines	35,462	30,155
Upper Clark Fork (Duck Bridge to Turah) Sands	40,690	34,600
Upper Clark Fork (Duck Bridge to Turah) Fines	51,950	44,175
TOTAL	**477,565**	**406,093**

Note: Conversion factor from tons to cubic yards (1.176 tons/cy) based on the average dry density of sheetpile wall sediment core samples from RD Field Investigation Data Summary Report.

Table 4-5: Estimated Volume of Sediment Scoured by Area under Scenario 4b- Dry Sediment Removal with Full Bypass Channel, 25-Yr Flow Event in Water Year 2007

Area	Tons	Cubic Yards
Clark Fork (Milltown Dam to Duck Bridge) Sands	81,028	68,901
Clark Fork (Milltown Dam to Duck Bridge) Fines	56,645	48,168
Bypass Channel Sands	785	668
Bypass Channel Fines	1,542	1,311
Blackfoot (Milltown Dam to I-90) Sands	10,773	9,161
Blackfoot (Milltown Dam to I-90) Fines	80,686	68,611
Blackfoot (I-90 to Stimson Dam) Sands	114,968	97,762
Blackfoot (I-90 to Stimson Dam) Fines	35,339	30,050
Upper Clark Fork (Duck Bridge to Turah) Sands	23	20
Upper Clark Fork (Duck Bridge to Turah) Fines	51,829	44,072
TOTAL	**433,618**	**368,723**

Note: Conversion factor from tons to cubic yards (1.176 tons/cy) based on the average dry density of sheetpile wall sediment core samples from RD Field Investigation Data Summary Report.

Table 4-6: Estimated Volume of Sediment Scoured by Area under Scenario 4c - Dry Sediment Removal with Full Bypass Channel, Low Flow in Water Year 2007

Area	Tons	Cubic Yards
Clark Fork (Milltown Dam to Duck Bridge) Sands	80,582	68,522
Clark Fork (Milltown Dam to Duck Bridge) Fines	56,644	48,167
Bypass Channel Sands	3,173	2,698
Bypass Channel Fines	1,542	1,311
Blackfoot (Milltown Dam to I-90) Sands	11,839	10,067
Blackfoot (Milltown Dam to I-90) Fines	76,965	65,446
Blackfoot (I-90 to Stimson Dam) Sands	115,542	98,250
Blackfoot (I-90 to Stimson Dam) Fines	35,416	30,116
Upper Clark Fork (Duck Bridge to Turah) Sands	44,770	38,070
Upper Clark Fork (Duck Bridge to Turah) Fines	51,886	44,121
TOTAL	**478,359**	**406,768**

Note: Conversion factor from tons to cubic yards (1.176 tons/cy) based on the average dry density of sheetpile wall sediment core samples from RD Field Investigation Data Summary Report.

Table 5-1
Estimated Copper and Arsenic Concentrations on TSS Entering Thompson Falls Reservoir

Major Contributions to the Clark Fork River	Predicted Suspended Sediment Load over 4 Years (tons)	Average Copper Concentration on TSS (mg/kg)	Average Arsenic Concentration on TSS (mg/kg)
Blackfoot River near Bonner	211,662	116	30
Clark Fork River at Turah	235,536	586	191
Milltown Reservoir Scour (Averaged Over 4 Years)	477,565	232	34
Bitterroot River near Missoula	1,262,136	0	0
Flathead River at Perma	514,940	0	0
Weighted Average Estimates for Thompson Falls Reservoir Input	**2,701,839**	**101**	**25**

Notes:

1. Suspended sediment load for Blackfoot River near Bonner, Clark Fork River at Turah, and Milltown Reservoir Scour based on HEC-6 Scenario 4a results, Bitterroot and Flathead Rivers load based on USGS average measured tons/day of suspended sediment.

2. Concentration data source: USGS 1991-1999 Statistics for Blackfoot River near Bonner and Clark Fork River at Turah stations provided by John Lambing, USGS; Milltown Reservoir Scour concentrations for SAA III sediments from MRSOU RI Report (ARCO 1995); Bitterroot and Flathead Rivers copper and arsenic concentrations on TSS assumed to be neglible. Note, metals concentrations for Milltown Reservoir scour conservatively assumed based on sediment concentrations from the RI for all of SAA III which are skewed by the elevated metals in the Clark Fork limb; however, the majority of scour will come from the Blackfoot limb.

3. Average concentration on TSS = 1000 * average total concentration/average TSS concentration.

4. Estimated Thompson Falls Reservoir input concentrations conservative because the minor contributions and potential for depostion of Milltown Reservoir sediments in intervening reaches are ignored.

5. For comparison, the approximate average total copper and arsenic in existing Thompson Falls Reservoir sediments are estimated to be 88 mg/kg and 8.9 mg/kg, respectively. Total concentration extrapolated from acetic acid extractable concentrations based on relationship factors of 1.9 and 3.7 for total to acetic acid extractable average concentrations for copper and arsenic, respectively, found in Milltown Reservoir sediment samples (Johns and Moore, 1985).

Table 5-2
Predicted Dissolved Metals Concentrations Based on the Full Bypass Scenario Predicted Peak TSS of 1854 mg/L

Method	Predicted Dissolved Arsenic at Above Missoula Station (ug/L)	Predicted Dissolved Copper at Above Missoula Station (ug/L)
Mixed Data Regression	16.7	19.6
USGS Regression	11.7	23.2
Drawdown Data	21.6	-33.2
EPA October 2003 Area III Kd	14.2	17.2
Corps Water Column Kd	2.2	3.1
ENSR Area III Kd	10.0	14.6
Average	12.7	7.4
Max	21.6	23.2

Notes:

1. Shaded values used for comparison to temporary construction-related water quality standards because they were based on a defensible data set and were generally conservative.

2. For comparison, measured peak concentrations at the CFR above Missoula Station during the 1996 ice scour event were a dissolved copper concentration of 30 ug/l (MCCHD) or 11 ug/l (USGS), and a dissolved arsenic concentration of 12 ug/l (MCCHD) or 9 ug/l (USGS); peak concentrations during 1997 high flow at the CFR above Missoula Station were a dissolved copper concentration of 7.8 ug/l (USGS) and a dissolved arsenic concentration of 7 ug/l (USGS).