HUDSON RIVER PCBs REASSESSMENT FS

APPENDIX H

HYDRAULIC DREDGING REPORT AND DEBRIS SURVEY

H.1 Hydraulic Dredging Report
H.2 Debris Survey

HUDSON RIVER PCBs REASSESSMENT FS

APPENDIX H

HYDRAULIC DREDGING REPORT AND DEBRIS SURVEY

H.1 Hydraulic Dredging Report

HYDRAULIC DREDGING CONCEPT DEVELOPMENT

For the Hudson River PCBs Site Reassessment Feasibility study

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SUMMARY

Cost elements are presented for the hydraulic dredging concept portion of the Hudson River Feasibility Study. Alternatives REM-3/10/Select and REM-0/0/3 are evaluated in this report. For each alternative examined it is judged that hydraulic dredging is infeasible for Section 3 (areas downstream of Lock 5) due to the long pumping distances involved to reach the northern processing site. A combination of hydraulic dredging loading scows with transport to a point closer to the northern processing site may be feasible but has not been examined in this report.

Alternative REM-3/10/Select provides for the removal of areas in the Thompson Island Pool greater than 3 g/m^2 and the removal of areas greater than 10 g/m^2 in the Lock 6 and Lock 5 Pools. Dredging will take place over a river distance of 12 miles. The total required dredging volumes are 1.6 million cy in the Thompson Island Pool and 0.05 and 0.46 million cy respectively in the Lock 6 and Lock 5 Pools for a total required dredging volume of 2.1 million cy. No additional volume for the practical minimum dredging depth of 2 ft since all polygons are greater than 2 ft in depth. Access dredging which might be required to reach shallow-water dredge zones is not required under this alternative. Tolerance dredging which would be excavated in order to assure removal to the required depth is also not required due to the conservative method used to estimate the required depth of dredging. The total cut volume that must be dredged, transported to the northern processing site for water and solids separation, solids dewatering and rail transport to a permitted (drop) landfill is equal to the required dredging volume.

Alternative REM-0/0/3 provides for the "full section" dredging of the Thompson Island and Lock 6 and Lock 5 Pools. Dredging will take place over a river distance of 12 miles. The total required dredging volumes are 2.0 million cy in the Thompson Island Pool and 0.33 million cy in the Lock 6 Pool and 0.78 million cy in the Lock 5 Pool for a total required dredging volume of 3.1 million cy. An additional volume of 90 thousand cy must be added to account for the practical minimum dredging depth of 2 ft. Access dredging which might be required to reach shallow-water dredge zones is not required under this alternative. Tolerance dredging which would be excavated in order to assure removal to the required depth is also not required due to the conservative method used to estimate the required depth of dredging. This results in a total cut volume of dredging of 3.2 million cy that must be transported to the processing site for water and solids separation, solids stabilization and rail transport to an industrial landfill.

The dredging system evaluated includes; a 12-in. Hydraulic Dredge pipeline and up to six Booster Pumps with a maximum pumping distance of approximately 53,000 ft. Solids and water processing and rail car loading takes place at the Northern Processing Site. The principal solids and water processing elements are; (a) Primary Solids Separation (Trash rack, screens and hydrocyclone separation), (b) Water Treatment (surge storage, coagulation, flocculation, sedimentation, dual media filtration and granular activated carbon filtration), (c) Solids dewatering, (d) Transport of Stabilized Solids by rail to industrial landfill(s). For Alternative REM-3/10/Select hydraulic dredging can be completed in three 6.5-month dredging seasons. For Alternative REM-0/0/3 hydraulic dredging will be carried out over the maximum five dredging seasons allowed.

This report defines costing elements only. Cost estimates for the concept systems are to be prepared by the U. S. Army, Corps of Engineers. Data in this report is the basis for a conceptual analysis only and is not be used for additional planning or design purposes without review. Additional detailed studies and investigations will be required to refine the technical details and the estimated costs of the processes described in this report.

1. INTRODUCTION

1.1 Description of the Project

The Hudson River Feasibility Study (HRFS) is the most recent of a number of feasibility and design studies carried out in recent years. The first analysis of the feasibility of removal of PCB-contaminated materials from the bed of the Hudson River above the Federal Lock and Dam at Troy, New York was prepared for the NY State, Department of Environmental Conservation in 1978 (MPI 1980a). Several additional studies and design efforts were completed prior to the current effort.

Cost elements are presented for the hydraulic dredging concept portion of the Hudson River Feasibility Study. Alternatives REM-3/10/Select and REM-0/0/3 are evaluated in this report. Reference maps depicting the alternative dredging areas discussed in this report are available in the Feasibility Study; REM 3/10/Select - Pl. 17; and REM 0/0/3 – Pl. 18. For each alternative examined it is judged that hydraulic dredging is unfeasible for Section 3 (areas below Lock 5) due to the long pumping distances involved to reach the northern processing site. A combination of hydraulic dredging loading scows with transport to a point closer to the northern processing site may be feasible but has not been examined.

Alternative REM-3/10/Select provides for the removal of areas in the Thompson Island Pool greater than 3 g/m^2 and the removal of areas greater than 10 g/m^2 in the Lock 6 and Lock 5 Pools. Dredging will take place over a river distance of 12 miles. The total required dredging volumes are 1.6 million cy in the Thompson Island Pool and 0.05 and 0.46 million cy respectively in the Lock 6 and Lock 5 Pools for a total required dredging volume of 2.1 million cy. No additional volume for the practical minimum dredging depth of 2 ft since all polygons are greater than 2 ft in depth. Access dredging which might be required to reach shallow-water dredge zones is not required under this alternative. Tolerance dredging which would be excavated in order to assure removal to the required depth is also not required due to the conservative method used to estimate the required depth of dredging. The total cut volume that must be dredged, transported to the northern processing site for water and solids separation, solids stabilization and rail transport to an permitted landfill is equal to the required dredging volume.

Alternative REM-0/0/3 provides for the "full section" dredging of the Thompson Island and Lock 6 and Lock 5 Pools. Dredging will take place over a river distance of 12 miles. The total required dredging volumes are 2.0 million cy in the Thompson Island Pool and 0.33 million cy in the Lock 6 Pool and 0.78 million cy in the Lock 5 Pool for a total required dredging volume of 3.1 million cy. An additional volume of 90 thousand cy must be added to account for the practical minimum dredging depth of 2 ft. Access dredging which might be required to reach shallow-water dredge zones is not required under this alternative. Tolerance dredging which would be excavated in order to assure removal to the required depth is also not required due to the conservative method used to estimate the required depth of dredging. This results in a total cut volume of dredging of 3.2

million cy that must be transported to the processing site for water and solids separation, solids dewatering and rail transport to an permitted landfill.

1.2 Geographical Locations

The hydraulic dredging and material processing areas are located along the Upper Hudson River between Fort Edward and Northumberland, New York a river distance of approximately 12 miles. The Dredge Zones have been identified and described by TAMS and supplied to GBA for determination of dredging requirements (TAMS 2000). Dredge slurry solids and water separation and rail car loading of processed solids will take place at the Northern Site. A second Rail Loading Site outside the river reach to be dredged is located at the southern part of the river. As part of the HRFS the Upper Hudson River has been divided into three sections as indicated in Table 1-1.

TABLE 1-1, HRFS RIVER SECTIONS

Section	Reach	RM us	RM ds	Length, st mi	Length, naut mi	Remarks *(1)*
1	Thompson Island Pool	194.5	188.5	6.0	5.4	Some non-navigable
2	Lock 6 Pool	188.5	186.2	2.3	2.0	Some non-navigable
2	Lock 5 Pool	186.2	182.6	3.6	3.1	Some non-navigable
3	Lock 4 Pool	182.6	168.2	14.4	12.5	Some non-navigable
3	Lock 3 Pool	168.2	166.0	2.2	1.9	Some non-navigable
3	Lock 2 Pool	166.0	163.5	2.5	2.2	
3	Lock 1 Pool	163.5				
3	Federal Dam Pool					Some non-navigable

RM us, ds - upstream and downstream river miles
st mi - statute miles
naut mi - nautical miles
(1) Some portions of the Canal are in land cut. This may require remobilization of the dredging system into non-navigable portions of the river in order to access Dredge Zones.

Details of the dredging and site locations used in the dredging production analysis are given in Section 3 and Appendix A.

1.3 Scope of Work

This report was prepared under the direction of Richard F. Thomas, PE, Vice President and with the review of J. Franklin Bryant, PE, Principal, both of Gahagan & Bryant Associates, Inc. This report defines costing elements only. Cost estimates for the concept systems presented are to be prepared by the U. S. Army, Corps of Engineers.

1.4 Disclaimer

Data in this report is the basis for a conceptual analysis only and is not be used for additional planning or design purposes without review. Additional detailed studies and investigations will be required to refine the technical details and the estimated costs of the processes described in this report.

2. DREDGE ZONES AND MATERIAL ANALYSIS

2.1 Dredge Zones

Characteristics of areas to be dredged (Dredge Zones) have been described and supplied to GBA by TAMS. The Dredge Zones identification (ID), location (River Mile), surface area, required depth of dredging, required dredging volume and typical depth of water for the two alternatives examined are contained in appendix A and the Feasibility Study; Plates 17 and 18. These characteristics are summarized in Table 2-1a and 2-1b.

TABLE 2-1A, CHARACTERISTICS OF DREDGING AREAS, ALTERNATIVE REM-3/10/SELECT*(1)*

Characteristic	Thompson Island Pool	Lock 6 Pool	Lock 5 Pool	Totals
River Miles (RM)	194.3 - 188.5	188.5 - 186.2	186.2 - 182.6	194.5 – 182.6
Distance, miles	6.0	2.3	3.6	11.9
Area to be dredged, 1,000 sq ft	12,316	482	2,822	15,619
Area to be dredged, acres	283	11	65	359
Required average removal depth, ft	2.9 - 4.4	3.0	3.1 - 5.1	2.9 - 5.1
Required removal volume, cy *(2)*	1,620,000	55,300	463,800	2,139,000
Minimum Dredging volume, cy *(2)*	0	0	0	0
Tolerance dredging, cy *(2)*	0	0	0	0
Access dredging, cy *(2)*	0	0	0	0
Total cut volume, cy *(2)*	1,620,000	55,300	463,800	2,139,000

Values rounded
(1) Section 3 is not dredged hydraulically. Mechanical dredging of Section 3 is to be evaluated by TAMS
(2) See Section 3 and Appendix A for definition of these terms.

TABLE 2-1B, CHARACTERISTICS OF DREDGING AREAS, ALTERNATIVE REM-0/0/3*(1)*

Characteristic	Thompson Island Pool	Lock 6 Pool	Lock 5 Pool	Totals
River Miles (RM)	194.5 - 188.5	188.5 - 186.2	186.2 - 182.6	194.5 - 182.6
Distance, miles	6.0	2.3	3.6	11.9
Area to be dredged, 1,000 sq ft	20,569	5,459	8,425	34,454
Area to be dredged, acres	472	125	193	791
Required average removal depth, ft	1.6 - 3.4	1.6 – 2.1	1.9 – 4.1	1.6 – 4.1
Required removal volume, cy *(2)*	2,018,000	328,000	780,500	3,127,000
Minimum Dredging volume, cy *(2)*	23,000	60,000	7,000	90,000
Tolerance dredging, cy *(2)*	0	0	0	0
Access dredging, cy *(2)*	0	0	0	0
Total cut volume, cy *(2)*	2,041,000	388,000	788,000	3,217,000

Values rounded
(1) Section 3 is not dredged hydraulically. Mechanical dredging of Section 3 is to be evaluated by TAMS
(2) See Section 3 and Appendix A for definition of these terms.

2.2 Materials Analysis

The grain-size distribution of the materials to be dredged are described in a memorandum prepared by TAMS (TAMS 1999). Materials are divided into coarse and fine-grained sizes in the two river reaches examined in this report; Thompson Island Pool and the Lock 6 and Lock 5 Pools. The average of these four distributions are shown in Figure 2-1.

These data show that about 80 percent of the coarse-grained materials have, on average, a particle size greater than 0.1 mm and are coarser than fine sand. Even in the fine-grained materials about 40 percent of the materials are coarser than fine sand.

These results may have significant implications for the project. The classification of the sand-sized materials as non-contaminated and therefore available for beneficial uses may be a possibility. In any event, the mechanical separation of coarse materials as proposed in this alternative (Section 3.4) will offer the possibility of reduced material stabilization, transport and containment costs.

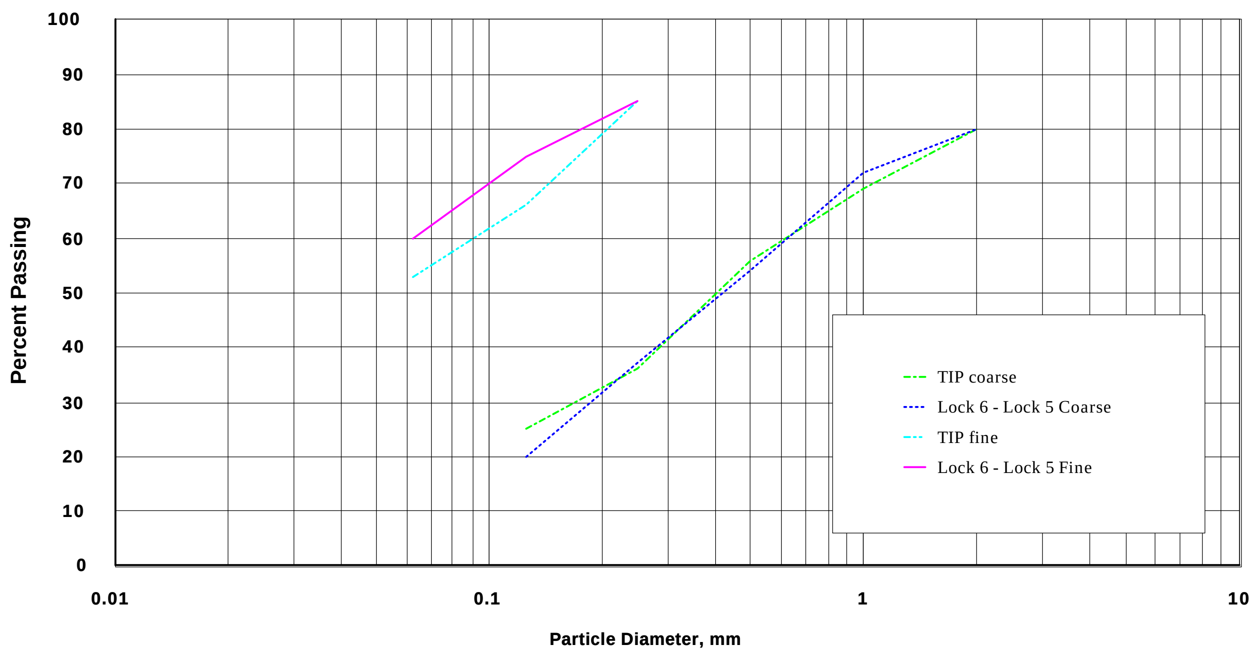


FIGURE 2-1, GRAIN SIZE DISTRIBUTIONS IN THOMPSON ISLAND, LOCK 6 AND LOCK 5 POOLS

The grain-size distribution of the materials to be dredged are described in a memorandum prepared by TAMS (TAMS 1999). Materials are divided into coarse and fine-grained sizes in two river reaches; Thompson Island Pool and the Lock 6 and Lock 5 Pools. The average values of these four distributions are shown in this figure. The pair of curves at the upper left are the fine-grained material size distributions for the two pool reaches. Those at the lower right are the coarse-grained distributions. These data show that the about 80 percent coarse-grained materials are, on the average, coarser than 0.1 mm or coarser than fine sand. Even in the fine-grained materials about 40 percent of the materials are coarser than fine sand.

These results may have significant implications for the project. The treatment of the sand-sized materials as non-contaminated and therefore available for beneficial uses may be a possibility. In any event, the mechanical separation of coarse materials as proposed in this alternative (Section 3.4) will offer the possibility of reduced material stabilization, transport and containment costs.

Results of a debris survey in the project area can found in Capital Feasibility Study Appendix H. The purpose of that investigation carried out in November 1999 was to identify debris within the river, its relative amount, and discuss the impact that the debris might have on remedial activities being studied for the river. The dredge proposed for this conceptual study, with proper operating care, can accommodate or work around the debris described.

3. DREDGING SYSTEM DESCRIPTION (DRG)

3.1 Introduction

The dredging system evaluated includes; a 12-in. Hydraulic Dredge and pipeline and up to six Booster Pumps as needed. Solids and water processing and rail loading takes place at the Northern Processing Site. A second rail loading site at The Southern Site is required to meet rail car loading requirements. Dewatered solids from the Northern Site will be barged to the Southern Rail Transfer Site. The principal solids and water processing elements at The Northern Site are; (a) Primary Solids Separation (trash rack, screens and hydrocyclone separation), (b) Water Treatment (surge storage, coagulation, flocculation, sedimentation, dual media filtration and granular activated carbon filtration). (c) Solids Dewatering (d) Processed Solids Transport by rail to permitted landfill(s). Dredging is to be carried out over a maximum of five dredging seasons. The dredging system described in this report can accomplish the required removal in three or possibly four dredging seasons. A further description of this system presented below. A schematic diagram of the overall hydraulic dredging concept is presented in Figure 3-1.

GBA judges that pumping approximately 54,000 ft with six booster pumps is at the practical limit under HRFS project conditions. We are aware of a dredging project pumping about ten miles but do not have specific information on the project. Advances in equipment reliability and instrumentation in recent years contribute to the feasibility of such a system. Careful planning and operational controls will be required in the work.

3.2 Dredging Seasons

In consideration of traffic and ice conditions on the Upper Hudson the New York Barge Canal is normally operated from early May to mid-November. Therefore, mobilization of floating equipment and dredging operations are limited to about 6.5 months each year. Dredging operations are limited to five dredging seasons in the development of the hydraulic dredging concept.

3.3 Dredge and Pipeline

It should be emphasized that although it is feasible to use essentially conventional hydraulic dredging equipment with some modifications, a project such as this cannot be approached as a traditional dredging project. It is imperative that careful field engineering and equipment and data management on a real-time basis be applied to insure that design expectations are being met and to make any necessary adjustments to maintain design and environmental requirements.

3.3.1 Dredge and Pipeline General Description

The hydraulic dredge and ancillary equipment are readily available from various dredging contractors. As noted, however, some equipment modifications are desirable and will need to be addressed in the detailed planning and design phases of project implementation. A general description of the equipment evaluated is presented in the following sections. All dimensions are approximate.

a. Dredge – 12-in. hydraulic cutterhead dredge with a 600 HP main pump and 200 HP auxiliaries. A typical dredge of this size has hull dimensions of 60 ft x 28 ft x 4 ft. Its overall length to the end of the cutterhead is about 100 ft. The draft of the dredge is about 2.5 to 3 ft. The dredge advances by alternately raising and lowering spuds located at the rear of the hull. Other dredge cutterhead configurations and swing procedures should be evaluated in the detailed planning and design phases of project implementation (see Section 3.4).

The dredge should not advance (make an upset) more than the length of the cutterhead being used. The actual length of the "upset" will depend on how the material reacts with the cutter being used and the depth of the bank being excavated. An upset (moving the spud on the center line ahead) is made by swinging the dredge off the center line to the starboard the desired number of degrees and then changing spuds (dropping the port spud and raising the starboard digging spud) and then swinging back to the port so that the starboard spud is again on the center line, and again changing spuds, dropping the starboard spud and raising the port spud.

The cutterhead for a typical 12-in. dredge will be about 40-in. in diameter by about 42-in. in length. Modification of the dredge ladder and suction intake arrangements is proposed in order to optimize conditions for a 2 ft cut or face of material, or other appropriate face, in order to minimize losses of material at the dredge cutterhead.

b. Skimmer/Debris Collector - This will be a standard vessel utilized to collect debris and floating materials which may accumulate on the surface and near surface of the river during dredging operations. Collected materials will be periodically transferred at collection points, and transported to the Northern Processing Site for processing. This vessel will be powered by a 200 HP engine and will be about 25 ft in length, 10 ft in beam and draw about 2 ft of water. It will operate in conjunction with any devices found feasible for deployment at the dredge.

c. Pipeline - The dredging system described utilizes a 16 in. High Density Polyethylene (HDPE) pipeline with a maximum length of about 53,000 ft. Three types of pipeline will be employed:

Pontoon Line - Typically 2,000 ft in length will be used immediately behind the dredge. This line provides flexibility for maneuvering the dredge along the various dredge cuts. The pipeline can be either HDPE or steel. If the steel pipeline is used, the connections between the joints could be either hoses or ball joints. Hoses are preferred.

Submerged Line - Will vary from a few hundred to about 50,000 ft in length. Additional pipe is added periodically as the dredge advances along the river. Submerged line presents minimum interference with river traffic.

Shoreline - Short sections of shoreline will be installed as necessary to carry the pipeline over land at locations such as the Thompson Island and Lock 6 dams.

d. Booster Pumps with 1,000 HP pump and 200 HP auxiliaries mounted on barges, or possibly on shore, will be added as necessary. Booster barge dimensions will be typically 45 ft x 30 ft x 5 ft with about a 3 ft draft. The distance between booster barges will be on the order of 10,000 ft. Shore Boosters may also be utilized. System characteristics are summarized in Table 3-1.

TABLE 3-1, DREDGING SYSTEM CHARACTERISTICS

Unit	Hull Dimensions, ft			Length	Draft, ft	Horsepower	
	Length	Beam	Depth	Overall, ft		Main	Auxiliary
12-in. Hydraulic Cutterhead Dredge	60	28	4	100	2.5-3	600	200
Skimmer/Debris Collector	25	10	---	---	2	200	---
16-in. Booster	45	30	5	---	3	1,000	200

Dredging system production rates are discussed in Section 4.

3.4 Dredging System Design Considerations

During the detailed planning and design phase of project implementation several aspects of dredging system design and operation should be considered. They are; (1) alternative cutterhead types, e.g. wheel, "goose neck" and auger types, (2) Swinging-ladder dredge that would avoid use of anchors, (3) evaluation of Dredge Zones located in non-navigable portions of the river which may preclude use of floating equipment or require remobilization of the dredge.

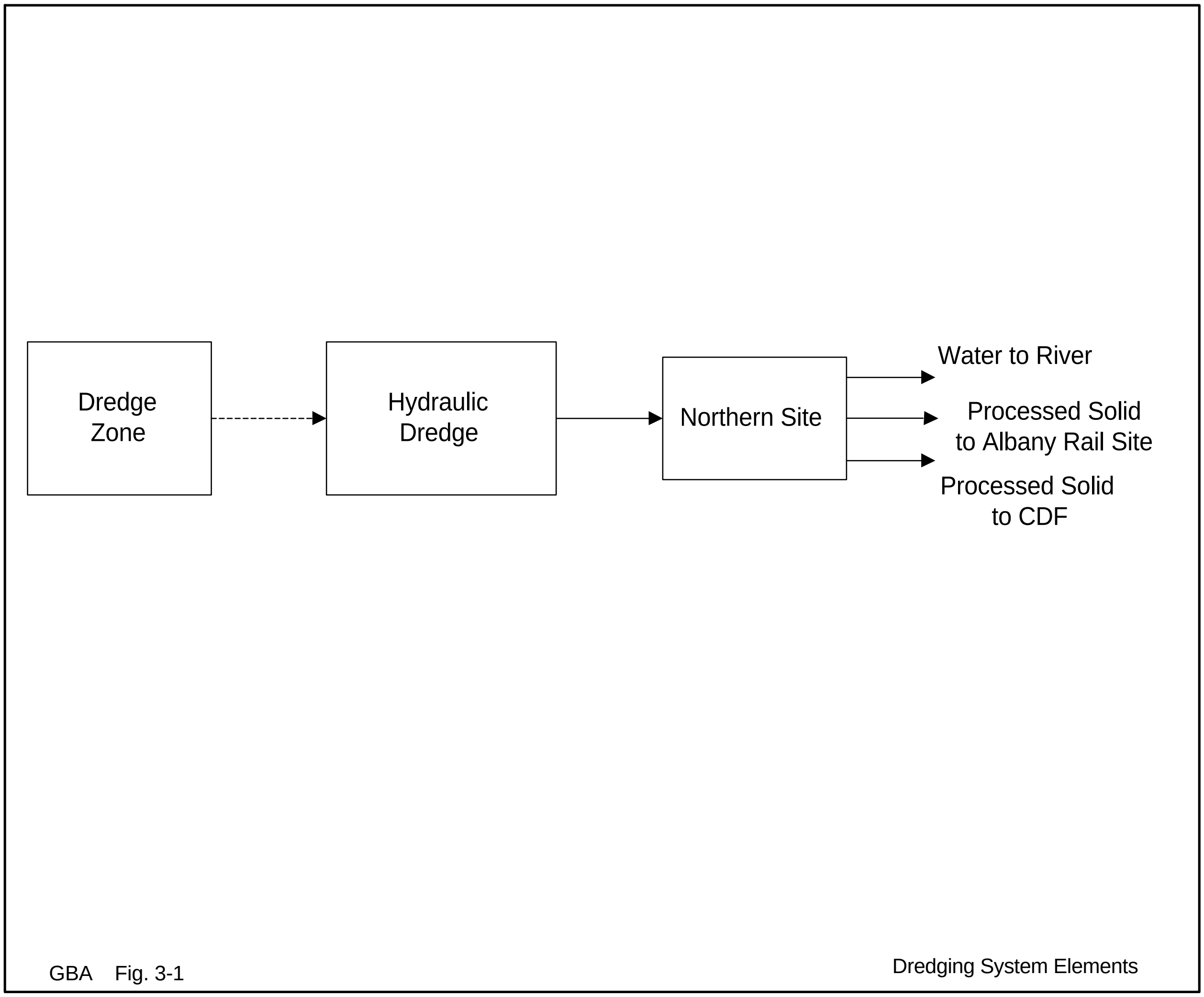


FIGURE 3-1, HYDRAULIC DREDGING SYSTEM (DRG) SCHEMATIC DIAGRAM

The dredging system evaluated includes; a 12-in. Hydraulic Dredge with a 16-in. Pipeline and up to six Booster Pumps as needed. Solids and water processing and rail loading takes place at the Northern Processing Site. A second rail loading site at The Southern Site is required to meet rail-car loading requirements. Processed solids from the Northern Site will be barged to the Southern Rail Transfer Site. The principal solids and water processing elements at The Northern Site are; (a) Primary Solids Separation (trash rack, screens and hydrocyclone separation), (b) Water Treatment (surge storage, coagulation, flocculation, sedimentation, dual media filtration and granular activated carbon filtration). (c) Solids Dewatering. (d) Processed Solids Transport by rail to permitted landfill(s). Dredging is to be carried out over a maximum of five dredging seasons.

3.5 Northern Processing Site (NPS)

3.5.1 Introduction

A processing site is required to provide for dredged solids processing and railcar loading, treatment of slurry water and barge transport of dewatered solids to a second rail site for loading and haul to an industrial landfill(s). The principal solids and water processing elements at a transfer site are; (a) Primary Solids Separation (PSS) (screening and hydrocyclone separation), (b) Water Treatment Plant (WTP) (roughing and storage, coagulation, flocculation, sedimentation, dual media filtration and granular activated carbon filtration). (c) Secondary Dewatering, (d) Barge transport of stabilized solids to a second rail site (not evaluated in this report). A schematic diagram of the processing site is presented in Figure3-2. A conceptual layout of the site is presented in Figure 3-3. Rail car loading has been analyzed by TAMS and is not evaluated in this report.

Detailed design studies are required to optimize the integration of the solids and water processing systems described in this report.

3.5.2 Primary Solids Separation (PSS)

Consideration was give to conventional gravity settling of the dredge slurry to remove the coarse-grained fraction of the dredged material. It was determined however that the resultant ponds would require the use of some tens of acres of land that may not otherwise be available. The selected system utilizes a "separator" tower containing a set of trash racks and vibrating screens to remove debris down to about 20 mm. These materials will travel down vibrating chutes to a conveyor for stockpiling (Figure 3-4). The remaining slurry will travel vertically through a series of hydrocyclones to remove coarse, medium and fine sands. These sands will be carried on vibrating chutes to a stockpile. Each stockpile will have an underdrain to collect drainage water for treatment.

A separator tower has a slurry flow capacity of approximately 3 mgd. Typical dredge flows will be about 8 mgd. Four towers will provide for about 9 mgd with one tower for backup purposes. A tower will be about 75 ft in height with a 35 ft square cross section. The trash rack and screens will be mounted at the top with the three hydrocyclones mounted on the sides of the tower at approximately 16 ft intervals to provide adequate velocity head to the units. Solids collected from each of the screening and hydrocyclone units may be kept separate or mixed according to processing requirements.

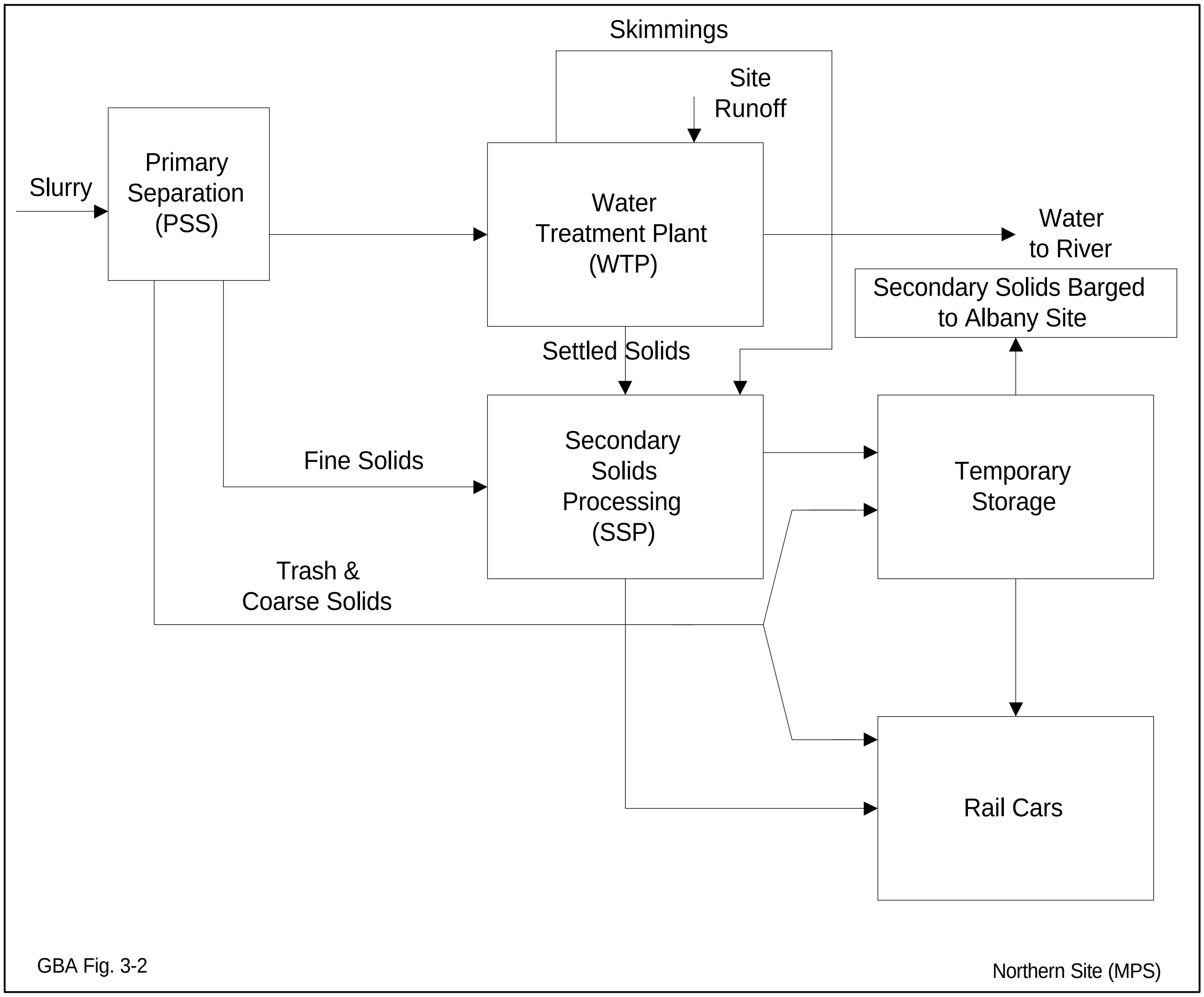


FIGURE 3-2, NORTHERN PROCESSING SITE (NPS) - SCHEMATIC DIAGRAM

The selected system utilizes a "separator" tower containing a set of trash racks and vibrating screens to remove debris down to about 20 mm. These saturated materials will travel down vibrating chutes to a conveyor for stockpiling. The remaining slurry will travel vertically through a series of hydrocyclones to remove coarse, medium and fine sands. These sands will be carried on vibrating chutes to a stockpile. Each stockpile will have an underdrain to collect drainage water for treatment.

After sand removal the remaining slurry is conducted to a set of circular tanks for flocculant addition and coagulation. Supernatant is delivered to the water treatment plant and settled solids can be further dewatered by filter press.

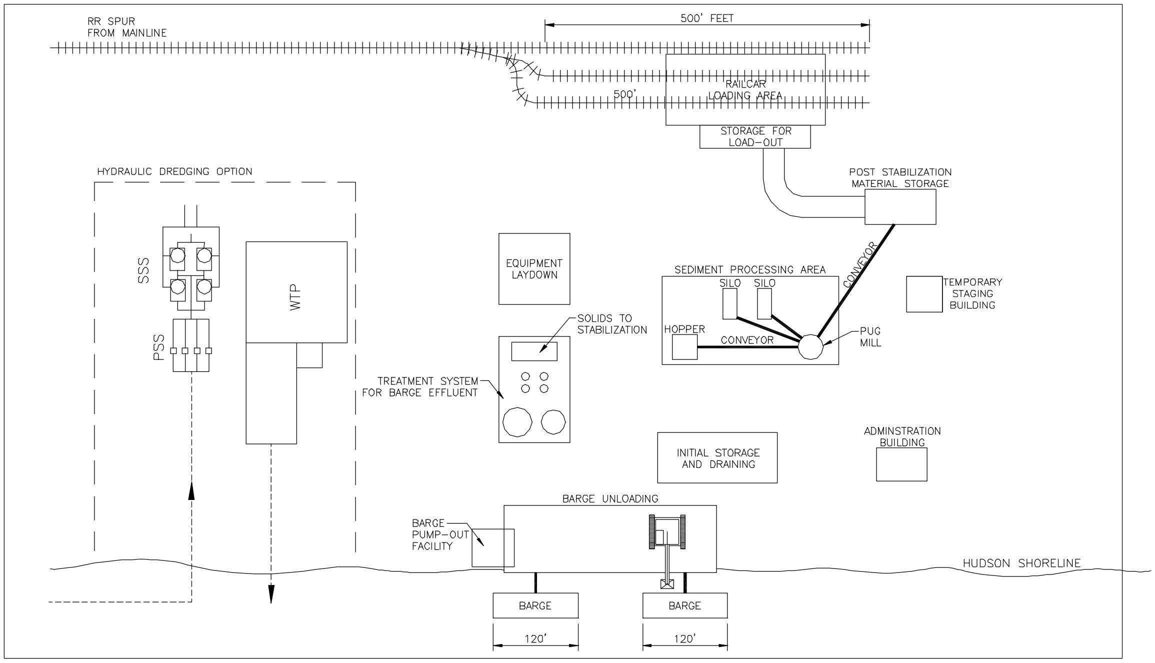


FIGURE 3-3, NORTHERN PROCESSING SITE (NPS) - CONCEPTUAL LAYOUT

A processing site is required to provide for dredged solids processing and railcar loading, treatment of slurry water and barge transport of stabilized solids to a second rail site for loading and haul to an industrial landfill(s). The principal solids and water processing elements at a transfer site are; (a) Primary Solids Separation (PSS) (screening and hydrocyclone separation), (b) Water Treatment Plant (WTP) (roughing and storage, coagulation, flocculation, sedimentation, dual media filtration and granular activated carbon filtration). (c) Secondary Solids Processing (SSP) through chemically enhanced mineralization, (d) Barge transport of stabilized solids to a second rail site (not evaluated in this report).

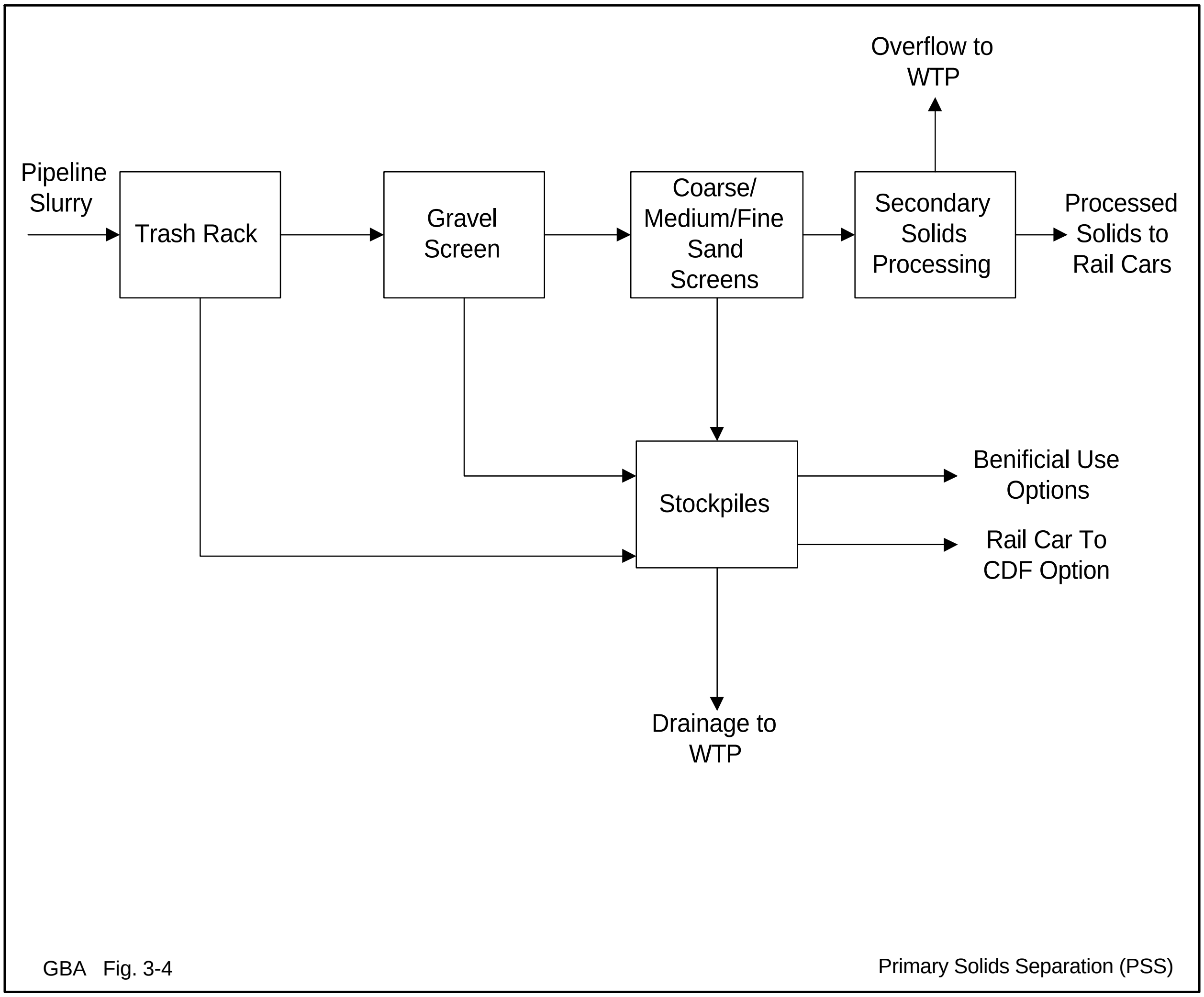


FIGURE 3-4, PRIMARY SOLIDS SEPARATION SCHEMATIC DIAGRAM

This system utilizes a "separator" tower containing a set of trash racks and vibrating screens to remove debris down to about 20 mm. These materials will travel down vibrating chutes to a conveyor for stockpiling. The remaining slurry will travel vertically through a series of hydrocyclones to remove coarse, medium and fine sands. These sands will be carried on vibrating chutes to a stockpile. Each stockpile will have an underdrain to collect drainage water for treatment.

3.4.3 Water Treatment Plant (WTP)

Laboratory-scale process studies were performed earlier for Hudson River bed materials (MPI 1980b). The WTP at the Northern Processing Site will treat all return flows from the dredges as well as on-site precipitation. Its capacity must be balanced with the capacity of the dredges to deliver water and sediment to the site.

The report describes a return water treatment plant having a capacity of 13 mgd and consisting of coagulation, flocculation and sedimentation. The influent suspended solids are expected to be on the order of 2,000 mg/L. Influent PCB should vary from the low hundreds to the thousands of micrograms per liter (µg/L) based on the PCB content of the river bed material.

A design overflow rate of 350 gpd per sq ft was selected for the final sedimentation unit. Effluent suspended solids less than 4 mg/L and turbidity less than 10 NTU were expected with proper chemical doses. The average PCB concentration in the discharge was expected to be in the 10 to 20 µg/L range. The maximum discharge concentration was projected at 100 µg/L, while a minimum of 4 µg/L was anticipated. The projected sludge suspended solids concentration was three percent by weight; with an estimated daily sludge volume on the order of 0.9 mgd.

The report evaluated additional treatment consisting of filtration and granular activated carbon adsorption. Such treatment was not recommended since a small quantity of PCB would be removed through filtration-adsorption treatment at a unit cost of estimated at 100 times greater than the average cost of PCB removal by dredging.

A summary of WTP characteristics is presented in Table 3-2. A schematic diagram showing WTP elements is contained in Figure 3-5.

TABLE 3-2, WATER TREATMENT PLANT CHARACTERISTICS

	MPI 1980	Northern Site
Influent		
Flow, mgd	13	10 *(1)*
SS, mg/L	2,000	2,000?
Coagulation		
Rapid mix detention time, sec	2	2
Polymer in-line rapid mixer		
Chemicals		
Cationic polymer	52 mg/L "Nalco 7132 *(2)*	
Flocculation		
Detention time, min	15	15
Slow mixers	two vertical turbines, variable speed	
Sedimentation		
Overflow rate OF, gpd/sq ft	350	350
Sludge solids concentration, %	3.0%	3.0%
Sludge volume, mgd	0.87	0.87 *(1)*
Sludge removal	Two portable dredges	
Effluent		
SS, mg/L	10 - 20 mg/L	10 - 20 mg/L
Turbidity, NTU	<= 10	<= 10

Source: adapted from MPI 1980b
(1) Plant sized to alternative requirements
(2) Chemical feed to be reevaluated in detailed planning and design

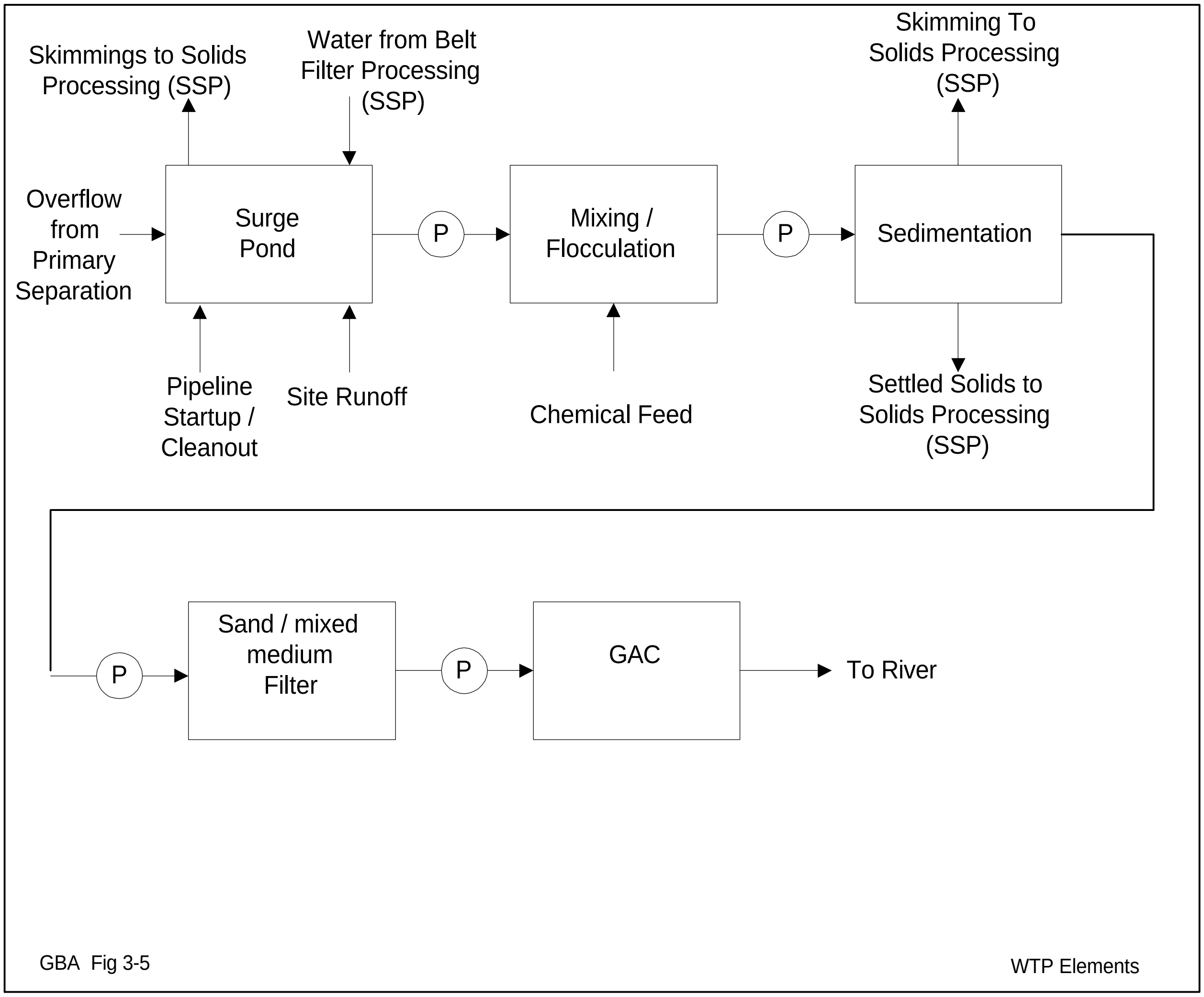


FIGURE 3-5, WATER TREATMENT PLANT (WTP) SCHEMATIC DIAGRAM

The Water Treatment Plant at the Northern Processing Site will treat all return flows from the dredges as well as on-site precipitation and water flows from the various site processes. Its capacity must be balanced with the capacity of the dredges to deliver water and sediment to the site.

3.4.4 Secondary Solids Processing (SSP)

After sand removal in the Primary Solids Separation tower the remaining slurry is conducted to a set of circular tanks for flocculant addition and coagulation. Supernatant is delivered to the water treatment plant and settled solids can be further dewatered and stabilized by filter press.

The final underflow from the separator tower will be delivered to a possibly proprietary process with a unit throughput of about 4 mgd. Four processing units will provide for backup capacity. Each SSP unit consists of a circular steel clarifier unit for polymer addition, flocculation and settling to remove particles down to the 7 to 14 Angstrom range. Settled solids are delivered to a dewatering grid and a belt filter press. Each process unit has a footprint of about 50 ft by 75 ft.

a. Beneficial Use

Beneficial use of the PCB-contaminated materials may prove to be an economical as well as an environmentally sound approach. A number of beneficial-use methods are now being developed, and in some cases, implemented. Section 412(c) of the Water Resources Development Act (WRDA) of 1990 authorized funds for the review, assessment and bench-scale demonstration of several treatment options for contaminated dredged material. Under this program the Port Authority of New York and New Jersey, US EPA and Corps of Engineers and other groups have sponsored and reported on methods for the stabilization or destruction of contaminants in dredged material with subsequent use in structural fills, concrete aggregate and other useful products. These processes include; Mechanical Stabilization to a Product and Contaminant Destruction to a Product. These approaches may warrant further examination as part of the detailed project planning and design.

3.4.5 Barge Transport (BSS)

Barge transport of processed solids will be required since the rail car loading capacity of the Northern processing site is inadequate. This issue has not been evaluated in this report. Barge Canal lock dimensions, which are a factor in barge transport, are 43.5 ft x 300 ft x 10 ft depth.

3.4.6 Railcar Loading (RSS)

Two rail access sites are available for the transport of processed materials. One site is located at the Northern end of the project area adjacent to the TI Pool. Northern Processing Site at the north end of the project area and one at the south end of the project area in the Albany vicinity approximately 40 miles from the Northern Site. The primary elements of rail car loading at the Northern Site are a) processed solids stockpile area, b) processed solids loading of rail cars, c) rail car storage capacity. Railcar loading requirements are affected by the length of the dredging season and the resulting solids throughput. Railcar loading has been analyzed by TAMS and is not evaluated in this report.

3.4.7 Solid Materials Handling (SMH)

The several unit processes discussed above will require the processing and transport of processed solids. The methods used may involve chemical feed units, solids dewatering equipment, end-loaders, hoppers, trucks, stockpiles and conveyor belts in various combinations. These units will be sized to meet the site throughput requirements.

4. DREDGING PRODUCTION

The time required to do the work is determined by the application of equipment production rates to the dredge areas and the cut volume of the areas to be dredged.

4.1 Types Of Production

The dredge areas were analyzed by both area (sq ft) and cut volume (cy) to evaluate dredge production, which is measured in three ways; a) Production Cut, b) Area Coverage Cut, and, c) Shoreline Cut. In each case the hydraulic dredge will make a "cleanup" swing to assure material removal.

4.1.1 Production Cut

A production cut has a bank or face of material in front of the dredge that is larger than can be moved by one swing pass in each set of the dredge.

4.1.2 Area Coverage Cut

In an area cut dredge production is controlled by the speed at which the dredge can move over the dredged area and is, therefore less than full production. These areas have a bank or face of material in front of a dredge that is less than can be moved by one pass in each set of the dredge. This shallow face of cut results in lower dredged solids and thus higher water content in the dredge slurry.

4.1.3 Shoreline Cut

An approximately 40 ft width from the bank in each dredge area is defined as a shoreline cut. These areas will be cleared of branches, stumps and logs prior to hydraulic dredging. The average dredge production rate for Area Coverage Cut is used for estimated production after shoreline area clearing.

4.2 Production Rates

Optimum production rates are estimated on the basis of the operating characteristics of existing equipment similar to that described in Section 3. The optimum production rate of the hydraulic dredge pumping directly to the Northern Processing Site via pipeline is determined by considering the excavating and pumping characteristics of the material, the pumping capability of the dredge and boosters, and the length and hydraulic characteristics of the pipeline. These estimates are summarized in Table 4-1.

The production rate adopted for alternative analysis is based on a reduced rate that considers the area coverage rate for the dredge and utilizes the maximum of five dredging seasons planned for the project. As may be noted in Table 4-1 the dredge production rate adopted for alternative analysis has been reduced by about 20% to 50% of the optimum rate. This reduced adopted rate provides a conservative estimate of dredging time required and allows additional time for adjustments in dredging operations as the project progresses.

TABLE 4-1, HYDRAULIC PIPELINE DREDGE OPTIMUM AND ADOPTED PRODUCTION RATES WITH HDPE PIPELINE

Estimate No.	1	2	3	4	5	6
Dredge Size, in.	12	12	12	12	12	12
Pipeline dia, in.	16	16	16	16	16	16
Pool	TI	TI	Lock 6	Lock 6	Lock 5	Lock 5
Material	Silt-soft clay	sand-silt	silt-soft clay	sand-silt	silt-soft clay	sand-silt
Pipeline length, ft (1)	12,400	12,400	32,500	32,500	41,100	41,100
Number boosters	2	2	4	4	5	5
System lift, ft	91	91	96	96	107	107
Percent solids	20%	15%	20%	15%	20%	15%
unit wt, pcf	110	120	110	120	110	120
Slurry Specific Gravity	1.15	1.14	1.15	1.14	1.15	1.14
Slurry Solids Content by Weight, %	21	20	21	20	21	20
Discharge velocity, fps	14.5	13.8	12.2	11.6	12.0	11.5
Optimum production, cy/hr	540	386	455	324	447	321
Adopted Production, cy/hr	**275**	**275**	**266**	**266**	**266**	**266**
Dredge Operating hrs	17	17	15	15	14	14
Slurry Flow, cfs	20.2	19.3	17.0	16.2	16.8	16.1
Slurry Flow, gpm	9,087	8,648	7,646	7,270	7,520	7,207
Slurry Flow, mgd per 24 hr	9.3	8.8	6.9	6.5	6.3	6.1
Pipeline Startup and cleanout						
Length	28,440	28,440	36,960	36,960	55,968	55,968
Startup Time @ Discharge vel., minutes	33	34	50	53	78	81
Cleanout Time @ 2 x startup time	65	69	101	106	155	162
Pipeline startup flows, million gals	0.3	0.3	0.4	0.4	0.6	0.6
Pipeline cleanout flows, million gals	0.6	0.6	0.8	0.8	1.2	1.2
Total non-production flow, million gals	0.9	0.9	1.2	1.2	1.8	1.8
Maximum operating hours	19	19	16	16	15	15
WTP Flow, 7-day avg, mgd	8.7	8.3	6.9	6.6	6.9	6.7

(1) Average pipeline length weighted by cut volume in pool
(2) Boosters required for weighted pipeline length. Fewer or more boosters may be required for a specific Dredge Zone

Dredging industry practice is to measure pipeline solids as percent of the cut or in-situ volume in the slurry. This developed from the normal practice of payment based on cubic yards removed from the cut. The GBA hydraulic dredge production estimates are based on empirical and theoretical data and on operational experience. As an example, the 20% solids by cut volume for Estimate No.

1 pumping silt and soft clay (TI Pool, one booster, Table 4-1) results in a slurry specific gravity of 1.15. Percent solids content by weight or by volume is about equal under these conditions.

A key factor in the production rates is the number of hours the equipment works per day. The average daily operating times are dependent upon the degree of exposure to unfavorable weather conditions as well as mechanical and operational delays. Delays due to weather are assumed to be minimal. The major delays will be in the clearing of the pump and cutter and the coordination of the booster pumps. The maximum daily operating times for the selected hydraulic dredge is estimated to be 19 hours per day. A reduction of one hour per day is made for each booster pump in use. The dredge is estimated to work 6 days per week or 26 days per month. Lost time due to moving between dredge areas must be evaluated although this is a minor factor in this alternative.

The appropriate balance among pump and pipeline capacities, the dredge swing, cutterhead speed (RPM), width of cut and dredge advance will be optimized as part of detailed design of the project.

4.3 Production Analysis

Dredge production characteristics for each alternative and for each Dredge Zone are presented in Appendix C. Results of the analyses are summarized in Table 4-2.

TABLE 4-2, SUMMARY OF HYDRAULIC DREDGING PRODUCTION ANALYSES

	Season 1	Season 2	Season 3	Season 4	Season 5	Totals
REM-3/10/Select						
Cut Volume, cy	677,000	801,000	661,000	---	---	2,139,000
Dredge Months	5.2	6.5	6.6	---	---	18.3
Booster Months	4.9	11.9	28.5	---	---	41.3
Average Monthly Production, cy	130,000	123,000	100,000			117,000
REM-0/0/3						
Cut Volume, cy	519,000	849,000	707,000	680,000	462,000	3,217,000
Dredge Months	4.1	6.7	6.0	6.7	5.0	28.5
Booster Months	3.4	9.4	14.7	26.4	26.0	80.0
Average Monthly Production, cy	127,000	127,000	118,000	102,000	92,000	113,000

Notes: 1. Hydraulic dredging is performed only in Sections 1 and 2. Mechanical dredging of Section 3 is to be evaluated by TAMS
2. Other combinations of work by season are possible with comparable overall results
3. Specific values given above will vary with final design characteristics.

5. COST ESTIMATE ELEMENTS OUTLINE

Rational of the Cost Estimating Process

Assumptions

Site Construction and Decommissioning

Dredging and Materials Handling
- Monthly Costs
  - Operating Costs
  - Ownership Costs
- Special Costs
- Mobilization and Demobilization

Cost Elements [tabulation of equipment, sites and rates]

1. Northern Processing Site (NPS)
   - 1.1 Construction
     - Right of Way
     - Demolition
     - Power, telephone
     - Grading
     - Paving
     - Storm Drainage
     - Site Office
     - Security
     - Road Access
     - Rail Access
   - 1.2 Site Operations
   - 1.3 Site Decommissioning

2. Dredging System (DRG)
   - 2.1 12-in. Hydraulic Dredge
   - 2.2 16-in. Booster Barge
   - 2.3 Tender Tug
   - 2.4 Skimmer/Debris Collector
   - 2.5 Survey Boat
   - 2.6 25-Ton Derrick Barge
   - 2.7 Fuel Barge
   - 2.8 Deck Barge
   - 2.9 Boom System

3. Water Treatment Plant (WTP)
    - 3.1 Construction
    - 3.2 WTP Operations
    - 3.3 WTP Decommissioning

3. Primary Solids Separation (PSS)
    - 4.1 Construction
    - 4.2 PSS Operations
    - 4.3 PSS Decommissioning

4. Secondary Solids Processing (SSP)
    - 4.1 Construction
    - 4.2 SSP Operations
    - 4.3 SSP Decommissioning

5. Materials Handling (SMH)
    - 5.1 Construction
    - 5.2 SMH Operations
    - 5.3 SMH Decommissioning

7. Process Control System (PRO)
    - 7.1 DRG - position, velocity, density, dredge and booster performance
    - 7.2 PSS -
    - 7.3 WTP - water levels, flow, pumps, mixers, chemical feed
    - 7.4 SSP -
    - 7.5 RSH -
    - 7.6 SMH -
    - 7.7 LAB -

8. Environmental Monitoring

6. REFERENCES

EPA 1999 - "Physical Separation (Soil washing) for Volume Reduction of Contaminated Soils and Sediments: Processes and Equipment," T. J. Olin, et al, EPA -905-R-99-006, Great Lakes National Program Office, Chicago, IL.

MPI 1980a - "Draft Environmental Impact statement, New York state Environmental Quality Review, PCB Hot Spot Dredging Program, Upper Hudson River, New York," prepared for the NY State, Department of Environmental Conservation, Malcolm Pirnie, Inc., September 1980.

MPI 1980b - "Design Report, PCB Hot Spot Dredging Program Containment Site," prepared for the NY State, Department of Environmental Conservation, Malcolm Pirnie, Inc., September 1980.

TAMS 1999 - "Hudson River Sediment Characterization," Memorandum dated October 25, 1999.

TAMS 2000 - "Removal Alternatives, Volume, Area, Depth Dredged," October 6, 2000

APPENDIX A, PRODUCTION ANALYSIS

Hudson River PCBs Reassessment FS
HYDRAULIC DREDGING CONCEPT DEVELOPMENT, Alternatives REM-3/10/Select & REM-0/0/3

HYDRAULIC DREDGING PRODUCTION ANALYSIS

Alternative REM-3/10/Select Areas

	River Section 1											River Section 2								
	Thompson Island Pool Dredging Zones (1)											Lock No. 6 Pool Dredging Zones			Lock No. 5 Pool Dredging Zones				Combined
	T-1	T-2	T-3	T-4	T-5	T-6	T-7	T-8	T-9	T-10	T-11	L6-1	L6-2	L6-3	L5-1	L5-2	L5-3	L5-4	Totals
Pertinent Information:																			
1 Pool Elevation	119	119	119	119	119	119	119	119	119	119	119	114	114	114	103	103	103	103	
2 Non-navigable Section (2)																			
3 Processing Site	North	North	North	North	North	North	North	North	North	North	North	North	North	North	North	North	North	North	
Distances (River Miles):																			
4 Dredge Zone Centroid	194.0	193.5	193.0	192.5	192.0	191.5	191.0	190.5	190.0	189.5	188.9	188.1	187.1	186.8	185.8	184.8	183.9	183.6	
5 Processing Site	193.5	193.5	193.5	193.5	193.5	193.5	193.5	193.5	193.5	193.5	193.5	193.5	193.5	193.5	193.5	193.5	193.5	193.5	
Pumping Distance (Feet):																			
6 Total Pumping Distance	2,851	0	2,640	5,280	7,920	10,560	13,200	15,840	18,480	21,120	24,394	28,406	33,792	35,376	40,656	46,200	50,952	52,166	
7 Dredge Pumping Distance	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	
8 One Booster Pumping Distance	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	
9 Number of Boosters Required	1	0	1	1	1	1	2	2	2	2	3	3	4	4	4	5	5	6	
Areas (1000 Square Feet):																			
10 Areas of Dredging Zones	719	337	1,725	1,448	1,279	967	1,290	1,031	1,582	842	1,096	117	153	212	1,294	204	827	496	359
Dredging Depths (Feet):																			acres
11 Typical Water Depth (3)																			
12 Required Depth of Removal (4)	2.9	3.2	3.2	3.2	3.4	4.0	3.3	3.4	3.5	4.4	3.4	3.0	3.0	3.0	4.8	4.0	3.1	5.1	
13 Minimum Depth Allowance (5)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
14 Tolerance Allowance Depth (6)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Dredging Volumes, cy																			
15 Required Volume	79,931	41,659	210,852	176,816	167,318	148,944	163,635	134,642	211,915	141,938	142,188	13,478	17,536	24,317	237,772	31,202	98,364	96,512	2,139,019
16 Minimum Depth Volume	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17 Required + Min Depth Volumes	79,931	41,659	210,852	176,816	167,318	148,944	163,635	134,642	211,915	141,938	142,188	13,478	17,536	24,317	237,772	31,202	98,364	96,512	2,139,019
18 Tolerance Allowance Volume	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19 Access Volume (7)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20 Total Cut Volume	79,931	41,659	210,852	176,816	167,318	148,944	163,635	134,642	211,915	141,938	142,188	13,478	17,536	24,317	237,772	31,202	98,364	96,512	2,139,019
Total Cumulative Volumes 1000 cy																			
21 Season 1	80	122	332	509	677														677
22 Season 2						149	313	447	659	801									801
23 Season 3											142	156	173	198	435	466	565	661	661
24 Season 4																			
25 Season 5																			
Dredging Production cy/hr																			
26 Production Type (8)	Prod	Prod	Prod	Prod	Prod	Prod	Prod	Prod	Prod	Prod	Prod	Prod	Prod	Prod	Prod	Prod	Prod	Prod	
27 Coverage Rate, sq ft/hr	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500	
28 Full Production Rate (9)	275	275	275	275	275	275	275	275	275	275	275	266	266	266	266	266	266	266	
29 Actual Production Rate	275	275	275	275	275	275	275	275	275	275	275	266	266	266	266	266	266	266	
Time Required , hr																			
30 Dredge Hours Required	291	151	767	643	608	542	595	490	771	516	517	51	66	92	896	118	370	364	
31 Dredge Operating Hours/Day (10)	18	19	18	18	18	18	17	17	17	17	16	16	15	15	15	14	14	13	
32 Move to next Dredge Zone												8	8	8	8	8	8	8	
Total Time (Days):																			
33 Total Dredge Days	16.1	8.0	42.6	35.7	33.8	30.1	35.0	28.8	45.3	30.4	32.3	3.5	4.7	6.4	60.0	8.7	26.8	28.3	477
34 Total Booster Days	16.1	0.0	42.6	35.7	33.8	30.1	70.0	57.6	90.7	60.7	96.9	10.5	18.9	25.8	240.2	43.6	134.0	169.8	1,177
Total Time (Months):																			
35 Total Dredge Months	0.6	0.3	1.6	1.4	1.3	1.2	1.3	1.1	1.7	1.2	1.2	0.1	0.2	0.2	2.3	0.3	1.0	1.1	18.3
36 Total Booster Months	0.6	0.0	1.6	1.4	1.3	1.2	2.7	2.2	3.5	2.3	3.7	0.4	0.7	1.0	9.2	1.7	5.2	6.5	45.3
37 Cummulative Dredge Months per Season	0.6	0.9	2.6	3.9	5.2	1.2	2.5	3.6	5.4	6.5	1.2	1.4	1.6	1.8	4.1	4.5	5.5	6.6	
38 Cummulative Booster Months per Season	0.6	0.6	2.3	3.6	4.9	1.2	3.8	6.1	9.6	11.9	3.7	4.1	4.9	5.9	15.1	16.8	21.9	28.5	

Notes: Values are Rounded

(1) Dredge zone characteristics in Sections 1 and 2 were estimated by GBA using dredge-zone polygons supplied by TAMS.
(2) Is access limited to a portion of the Dredge Zones because of shallow water.
(3) Typical water deoth as determined by TAMS.
(4) Required dredging depth determined by TAMS.
(5) Removal of a minimum of 2 ft of material.
(6) Because of methods used to determine required dredging depth no additional allowance (0.5 ft) is provided.
(7) Examination of River bathymetry indicates no additional dredging is required for dredge access to the Dredge Zone.
(8) GBA estimate of production or coverage dredging.
(9) GBA estimate of overall average production rate for pumping sand and silt.
(10) GBA estimate of average productive work hours per day.

Hudson River PCBs Reassessment FS
HYDRAULIC DREDGING CONCEPT DEVELOPMENT, Alternatives REM-3/10/Select & REM-0/0/3

HYDRAULIC DREDGING PRODUCTION ANALYSIS

Alternative REM-0/0/3	River Section 1													River Section 2											
	Thompson Island Pool Dredging Zones (1)													Lock No. 6 Pool Dredging Zones					Lock No. 5 Pool Dredging Zones						Combined
	T-1	T-2	T-3	T-4	T-5	T-6	T-7	T-8	T-9	T-10	T-11	T-12	T-13	L6-1	L6-2	L6-3	L6-4	L6-5	L5-1	L5-2	L5-3	L5-4	L5-5	L5-6	Totals
Pertinent Information:																									
1 Pool Elevation	119	119	119	119	119	119	119	119	119	119	119	119	119	114	114	114	114	114	103	103	103	103	103	103	
2 Non-navigable Section (2)																									
3 Processing Site	North	North	North	North	North	North	North	North	North	North	North	North	North	North	North	North	North	North	North	North	North	North	North	North	
Distances (River Miles):																									
4 Dredge Zone Centroid	194.5	194.0	193.5	193.0	192.5	192.0	191.5	191.0	190.5	190.0	189.5	189.0	188.6	188.4	188.0	187.5	187.0	186.5	186.0	185.5	185.0	184.5	184.0	183.5	
5 Processing Site	193.5	193.5	193.5	193.5	193.5	193.5	193.5	193.5	193.5	193.5	193.5	193.5	193.5	193.5	193.5	193.5	193.5	193.5	193.5	193.5	193.5	193.5	193.5	193.5	
Pumping Distance (Feet):																									
6 Total Pumping Distance	5,280	2,640	0	2,640	5,280	7,920	10,560	13,200	15,840	18,480	21,120	23,760	25,872	26,928	29,040	31,680	34,320	36,960	39,600	42,240	44,880	47,520	50,160	52,800	
7 Dredge Pumping Distance	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	
8 One Booster Pumping Distance	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	
9 Number of Boosters Required	1	1	0	1	1	1	1	2	2	2	2	3	3	3	3	3	4	4	4	5	5	5	5	6	
Areas (1000 Square Feet):																									
10 Areas of Dredging Zones	1,501	1,776	1,232	1,787	1,462	1,906	1,591	1,574	1,206	2,196	1,401	2,139	797	479	1,092	1,986	1,601	301	1,155	1,773	1,095	1,645	1,830	927	791
Dredging Depths (Feet):																									acres
11 Typical Water Depth (3)																									
12 Required Depth of Removal (4)	1.6	2.0	2.1	3.1	3.2	2.9	3.1	3.4	3.1	3.0	3.4	2.7	2.4	1.6	1.7	1.6	1.9	2.1	4.1	2.5	1.9	2.0	2.5	3.3	
13 Minimum Depth Allowance (5)	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.3	0.5	0.1	0.0	0.0	0.0	0.1	0.0	0.0	0.0	
14 Tolerance Allowance Depth (6)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Dredging Volumes, cy																									
15 Required Volume	84,369	124,302	90,915	196,959	162,897	191,172	175,101	186,926	132,936	232,735	166,003	206,282	67,886	26,245	64,279	108,569	106,847	22,010	167,892	158,057	72,261	113,734	160,120	108,483	3,126,980
16 Minimum Depth Volume	22,239	658	0	0	0	0	0	0	0	0	0	0	0	7,799	13,350	33,098	5,931	0	0	0	4,866	2,437	0	0	90,378
17 Required + Min Depth Volumes	106,608	124,960	90,915	196,959	162,897	191,172	175,101	186,926	132,936	232,735	166,003	206,282	67,886	34,044	77,629	141,667	112,778	22,010	167,892	158,057	77,127	116,171	160,120	108,483	3,217,358
18 Tolerance Allowance Volume	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19 Access Volume (7)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20 Total Cut Volume	106,608	124,960	90,915	196,959	162,897	191,172	175,101	186,926	132,936	232,735	166,003	206,282	67,886	34,044	77,629	141,667	112,778	22,010	167,892	158,057	77,127	116,171	160,120	108,483	3,217,358
Total Cumulative Volumes 1000 cy																									
21 Season 1	107	232	322	519																					519
22 Season 2					163	354	529	716	849																849
23 Season 3										233	399	605	673	707											707
24 Season 4															78	219	332	354	522	680					680
25 Season 5																					77	193	353	462	
Dredging Production cy/hr																									
26 Production Type (8)	Cover	Cover	Cover	Prod	Prod	Prod	Prod	Prod	Prod	Prod	Prod	Prod	Prod	Cover	Cover	Cover	Cover	Prod	Prod	Prod	Cover	Cover	Prod	Prod	
27 Coverage Rate, sq ft/hr	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500	
28 Full Production Rate (9)	275	275	275	275	275	275	275	275	275	275	275	275	275	266	266	266	266	266	266	266	266	266	266	266	
29 Actual Production Rate	259	259	272	275	275	275	275	275	275	275	275	275	275	259	259	259	259	266	266	266	259	259	266	266	
Time Required , hr																									
30 Dredge Hours Required	411	482	334	716	592	695	637	680	483	846	604	750	247	131	299	546	435	83	632	595	297	448	603	409	
31 Dredge Operating Hours/Day (10)	18	18	19	18	18	18	18	17	17	17	17	16	16	16	16	16	15	15	15	14	14	14	14	13	
32 Move to next Dredge Zone														8	8	8	8	8	8	8	8	8	8	8	
Total Time (Days):																									
33 Total Dredge Days	22.8	26.8	17.6	39.8	32.9	38.6	35.4	40.0	28.4	49.8	35.5	46.9	15.4	8.5	19.0	34.5	29.3	5.9	42.5	42.9	21.6	32.3	43.4	31.8	742
34 Total Booster Days	22.8	26.8	0.0	39.8	32.9	38.6	35.4	80.0	56.9	99.6	71.0	140.6	46.3	25.6	57.1	103.5	117.3	23.4	170.0	214.3	107.9	161.7	217.1	190.6	2,079
Total Time (Months):																									
35 Total Dredge Months	0.9	1.0	0.7	1.5	1.3	1.5	1.4	1.5	1.1	1.9	1.4	1.8	0.6	0.3	0.7	1.3	1.1	0.2	1.6	1.6	0.8	1.2	1.7	1.2	28.5
36 Total Booster Months	0.9	1.0	0.0	1.5	1.3	1.5	1.4	3.1	2.2	3.8	2.7	5.4	1.8	1.0	2.2	4.0	4.5	0.9	6.5	8.2	4.2	6.2	8.3	7.3	80.0
37 Cummulative Dredge Months per Season	0.9	1.9	2.6	4.1	1.3	2.8	4.1	5.6	6.7	1.9	3.3	5.1	5.7	6.0	0.7	2.1	3.2	3.4	5.0	6.7	0.8	2.1	3.7	5.0	
38 Cummulative Booster Months per Season	0.9	1.9	1.9	3.4	1.3	2.8	4.1	7.2	9.4	3.8	6.6	12.0	13.8	14.7	2.2	6.2	10.7	11.6	18.1	26.4	4.2	10.4	18.7	26.0	

Notes: Values are Rounded

(1) Dredge zone characteristics in Sections 1 and 2 were estimated by GBA using dredge-zone polygons supplied by TAMS.
(2) Is access limited to a portion of the Dredge Zones because of shallow water.
(3) Typical water deoth as determined by TAMS.
(4) Required dredging depth determined by TAMS.
(5) Removal of a minimum of 2 ft of material.
(6) Because of methods used to determine required dredging depth no additional allowance (0.5 ft) is provided.
(7) Examination of River bathymetry indicates no additional dredging is required for dredge access to the Dredge Zone.
(8) GBA estimate of production or coverage dredging.
(9) GBA estimate of overall average production rate for pumping sand and silt.
(10) GBA estimate of average productive work hours per day.

Notes: (1) Dredge zone characteristics in Thompson Island Pool were estimated by GBA using dredge-zone polygons supplied by TAMS
(2) Is access limited to a portion of the Dredge Zone because of shallow water
(3) Typical water depth as determined by TAMS
(4) Required dredging depth determined by TAMS for this alternative
(5) Removal of a minimum of 2 ft of material
(6) Because of the methods used to determine required dredging depth no additional allowance (0.5 ft) is provided for this alternative.
(7) Examination of river bathymetry indicates no additional dredging is required for dredge access to the Dredge Zone for this alternative.
(8) GBA estimate of production or coverage dredging.
(9) GBA estimate of overall average production rate for pumping sand and silt.
(10) GBA estimate of average productive work hours per day.

Dredge operates three shifts and averages 19 hours of production less one hour for each booster in use
Dredge operates six days per week
Dredging season is 6.5 months per year or 169 dredging days per season

Factors:		
	19-(1 hr/booster)	Operating Hours per Day
	6	Work Days per Week
	6.5	Dredging Months per Season
	169	Dredging Days per Season

HUDSON RIVER PCBS REASSESSMENT FS

APPENDIX H

HYDRAULIC DREDGING REPORT AND DEBRIS SURVEY

H.2 Debris Survey

HUDSON RIVER DEBRIS

Introduction

This report summarizes results of a debris survey conducted by Superior Special Services and TAMS Consultants, Inc. during the first week of November 1999 in the Upper Hudson. The purpose of the survey was to identify the extent and nature of debris that may be encountered along the river bed should an active remedy such as removal or capping be selected by USEPA.

1.0 Instrumentation

To obtain data that would be needed to evaluate the presence of debris (trees, rocks, cars, metal debris, junk) in the river, and to obtain a visual understanding of river bottom conditions, a Coast Guard compliant survey boat was equipped with the instrumentation listed below. The survey boat and instrumentation are shown on Figures 1 and 2:

Dual Frequency Side-Scan Sonar
Multi-Beam Sonar Survey System
Sub-Bottom Profiling Sonar System
Remotely Operated Vehicle (ROV) with sonar, lights and video
Computer Monitors
Television, for ROV video viewing
Gyroscopes
Motion Reference Unit
All linked to three Differential Global Positioning Systems (DGPS)

2.0 Field Surveys

2.1 Pre-Survey Reconnaissance

On October 29, 1999 TAMS personnel conducted a pre-survey reconnaissance of the Upper Hudson River beginning with the Thompson Island Pool (TIP) and ending near the Federal Dam at Troy, New York. The purpose was to develop a general plan for the overall program and to identify potential problems that might be encountered. Among the matters that were resolved at this time were access to the non-navigable river section south of the TI Pool as well as access to the vicinity of several hot spots that also occur in off-channel areas. Finally, the reconnaissance also helped in determining the availability of boat launch and fueling facilities during the upcoming survey.

2.2 Debris Survey

The actual debris survey was conducted from November 1, 1999 through November 7, 1999 by Superior Special Services, Inc., with a TAMS representative directing the boat crew. The three-person Superior crew consisted of a boat captain and equipment operator, an instrumentation specialist, and an equipment tender and multibeam sonar specialist. Two of the crew members were also certified divers. The specific goal of the program was to assess five to seven different locations along the 40-mile section of the river and various data sets at potential remedial locations. Once in the river the capabilities of the instrumentation were tested and it was determined that the field team would attempt to obtain as much useful data as possible within the allotted time.

The survey began in the Thompson Island Pool (TIP) lasting for a period of two days at this location. The remainder of the time was spent primarily obtaining information from the historically identified Hot Spots downstream of TIP. While it was initially intended that five to seven locations would be assessed, with diver confirmation, the field team was able to access each of the historic Hot Spots identified on project maps (these have been designated by NYSDEC as HS 5 through HS 40) using the available instrumentation. Verification of images, from the sonar and sub-bottom profiler, was performed, as much as possible, by means of visual observations from the boat (in shallow areas) and through use of the ROV. The advantage of using the ROV was that it enabled continuous video taping of the area being evaluated. River velocities were also collected manually, at investigated locations by means of a current meter.

Side-scan sonar images were obtained in either 20-meter or 50-meter wide swaths. In most instances complete side-scan sonar coverage for a particular Hot Spot was not attempted since the goal of the survey was to assess these areas for the general presence of debris. Therefore, vessel passes over the Hot Spots were performed, at the direction of the TAMS representative, to obtain an over-view of bottom conditions covering as extensive an area as possible.

Sub-bottom profile data was usually collected on a single line transect over the Hot Spots in an attempt to confirm the presence of sediment deposits. Vegetated areas were typically avoided since signal interference occurs in these areas. Other interference occurred in areas where gas bubbles were trapped within the sediment. These areas were initially included in the sub-bottom sonar transects and discontinued when interferences were encountered. The sub-bottom profiling data is considered adequate to identify some debris at or near the surface of the sediments.

A multi-beam sonar composite image was collected at Hot Spot 14 within the TIP on the first day of the field survey. This trial was done to determine the time required to collect a data set and to establish the overall utility of the information being collected. An area one-half the size of Hot Spot 14 was scanned and selected results were plotted after data reduction was performed at the conclusion of the day's work. The multi-beam sonar was operated for approximately 45 minutes as the boat made multiple passes to collect an image covering 95 percent of the selected area. Based on this trial it was determined that the time and data storage requirements needed to collect this information were too great to continue this particular part of the program. However, the usefulness of multi-beam sonar imaging as an effective tool in determining pre- and post-dredge conditions were clearly demonstrated. After reducing the data at Hot Spot 14, it was easily converted into a bathymetric plot.

An estimate of the data collected for the week included 500 side-scan sonar images, one multi-beam sonar image of HS 14, 1+ JAZ drives of sub-bottom profile data, and almost 5-hours of ROV video tape. The approximate total of data collected was in excess of 2 gigabytes of information.

3.0 Results - Preliminary Evaluation of the Survey

This preliminary evaluation is based on initial observations made on the survey vessel while viewing the side-scan sonar, sub-bottom, and video images that were being both displayed and recorded. A further evaluation of selected images is presented in a following section.

3.1 Debris: Junk

Prior to initiating the survey it was not known if or to what extent man-made debris existed within the river. These items (e.g., cars, shopping carts, bales of wire, sunken boats and barges, boat motors, wooden docks, utility poles, farm equipment, concrete blocks, and other metallic or wooden debris) were thought to possibly exist in the river at areas of convenient access, such as at bridge crossings, near marinas, or from easily accessible roads or fields. It was assumed that these items would be have been either deliberately disposed or accidentally washed into the river during high flow events, while some items may have been blown into the river by the wind.

Man-made junk and debris was rarely seen in the river. Several side-scan sonar images contained car tires mounted on rims and some video footage showed a plastic bucket and a few bottles in shallow locations but rarely anything of significance. No cars, shopping carts, or similar metallic debris were detected.

At one location a swamped wooden boat was visually observed from the survey boat; it was also detected in a reflected side-scan image. Two or three sections of woven cable (each one a few hundred feet in length or more) were also identified lying along the river bottom. These are probably steel woven cable sections that may have been used to tow barges or act as protective barriers upstream of dams or dredge deposit mound areas.

3.2 Debris: Trees / Rocks / Boards and Slats

a. Trees

Logs and branches were discovered randomly throughout the 40-mile study area. Many of the logs and branches were located near islands. The operator at the Fort Miller Hydro plant stated that the facility usually removes two or three 40-foot trees per year from the bar-screen at the intake to the plant. This facility is within the un-charted section of the river between the Fort Miller Hydro plant and the Thompson Island dams.

b. Rocks

Rocks and rock outcrops are fairly well mapped throughout the Upper Hudson River. This field survey confirmed the location of many of the dredge/spoil deposit areas already mapped through earlier efforts associated with the Hudson River reassessment project. Side-scan sonar and the ROV video system also confirmed the presence of spoil areas north of the Route 4 Bridge near Northumberland and Schuylerville. Rock mounds and cobbles are typically found near the identified spoil areas. Thin sediment depositions may cover some rocky areas, but these reflective materials appear to be associated with underlying bedrock and do not appear to be loose rocks and cobbles.

c. Boards and Slats

Man-made wood debris consisting mainly of wooden slats was also observed. These slats were located in abundance just north of the Route 4 Bridge crossing, approximately 1¼ mile upstream of Lock 5. Video documentation is available regarding this find. Based on the initial discovery it is assumed that hundreds or more of these slats may be found at this location. Sediments appear to partially cover many of the slats as observed via the ROV system.

Other wood debris was discovered that appeared to be sections of docks or other waterfront structures. Larger pieces of lumber were not located in any significant amounts. The primary location where larger planks were found was in proximity to private boat docks. On occasion, planks and other scrap wood were found near areas where trees or branches had also accumulated; these usually are shallow and slow moving sections of the river.

4.0 Other Observations

While it was not the objective of this program to assess physical conditions within the river, other than the presence of debris, the following general observations were made.

4.1 Scour

At a few of the previously identified Hot Spot locations little or no sediment was observed. Using the ROV system, lack of sediment was observed initially at Hot Spot 26. Also, at Hot Spot 39 only minimal amounts of sediment appeared to be present. HS 38 consisted primarily of spoil mounds with some deposits of sediment in the spaces between the mounds. Side-scan sonar data indicates that most of the sediments originally documented in the northern half of Hot Spot 6 now appear to be coarse sediment and rock. Transport of this material during high flow conditions may be occurring at this and other locations along the Upper Hudson River.

4.2 Deposition

Just upstream of the Fort Miller Hydro facility thick deposits of sediments were observed by means of the sub-bottom profiler. Within the past year this location has almost completely silted along half of the Hydro facility's bar-screen zone. Using the ROV to conduct a visual inspection of the area in front of the bar screens revealed about a 13 foot high pile of wood debris (logs/branches/boards/ leaves and other green vegetation) had accumulated along parts of the bar screen structure, above the sediments mudline.

Sediment appears to have deposited down-stream of the southern tip of Rogers Island in the TIP, and the navigational channel east of Rogers Island appears to be getting shallower. Deposition appears to have also occurred in the TIP across the river from the southern half of Hot Spot 10 (along the right bank). Sediment deposits near the southern tip of Billings Island appear to be increasing in thickness.

4.3 Fish

Only four fish were seen during the five hours of video filming. Typically the ROV does not cause fish flight. Fishermen at the Schuylerville Marina also confirmed that fishing was poor this past year.

5.0 Data Evaluation

5.1 Method

A sample side-scan sonar bitmap image is provided as Image 1. These images were collected in sequential order on the date noted in the file name. Therefore, side-scan sonar image 06NOV044.MST was collected on November 6, 1999 and is the forty-fourth image for that day. The colors selected for the color image are helpful in interpreting the composition of the reflected image. Basically, the brighter (yellow) the image, the greater the return signal response. Therefore, harder materials show up lighter in color whereas soft sediments show up darker (approaching black) in color on the images. The primary sonar frequency used for consistent image comparison was 600 kHz. Several 150 kHz frequency images were collected for purposes of comparison.

Image 1 is an image that shows the reflected river bottom when viewed from the left looking toward the right. The three major yellow images are rock piles, which were confirmed through visual identification using the ROV system. The dark areas to the right of the three rock piles are in the "shadow" of the elevated piles. There also appears to be an elongated sediment mound, which is oriented approximately between the rock piles. The black area to the right of this mound is also a result of shadowing. The black area along the left edge is the segment directly beneath the side-scan sonar devise, which it is unable to "see". Dark areas can also represent depressions similar to shadows within a crater's edge on the moon, or may be shadowed areas behind rocks, tree logs or other elevated debris.

Similar interpretations were performed on most of the side-scan sonar images. Those images not used typically represented images which were a duplicate image of other collected data or were images which contained significant image "stretching". Stretching of the image occurs when the track of the boat is not sufficiently straight thereby elongating the image. Major directional changes made by the boat rendered some of the stretched images unusable since the data would not be accurately interpreted.

5.2 Side-Scan Sonar Data Interpretations

5.2.1 Junk

Based on observations made at the time of the survey and, as well, on a later interpretation of the collected data files, it does not appear that debris is a problem. Side-scan sonar and ROV images, which were collected primarily from areas within 200 feet of the shore, identified a few tires on rims, a bucket, some bottles and one swamped boat (easily visible along the shoreline). None of these items are of particular concern to impacting an active remedy such as capping or removal of contaminated sediments.

5.2.2 Trees

The vast majority of wood debris encountered consisted of tree branches, tree trunks or whole trees that may have been washed into the river during storms or high water conditions. Many cut logs were also discovered, some fireplace length and others that appear to be cut at one end with the branches removed. Employees at the Fort Miller Hydro facility reported that entire trees are removed at their bar-screens three or four times a year. They also remove other wood debris such as branches and boards on a regular basis. Within the river, however, wood debris is typically found at well defined locations, such as at river bends, in shallow or slow moving sections of the river, or perched atop dams. These areas are identified on the debris survey map.

Wood debris may present an obstacle to implementing a remedy. Therefore, identification and removal of large wood debris should be performed prior to initiating a remedial activity at any particular location. It is expected that smaller pieces of wood debris will not impact removal; operations by either mechanical or hydraulic dredging systems (see image 3).

5.2.3 Rocks

Significant quantities of rock debris were identified within specific areas during the debris survey. Previous mapping indicated the presence of rock mounds at dredge piles sites (identified as “spoil area” on the navigational charts). The presence of theses rock piles was confirmed during this survey, particularly by means of the ROV system. The observed rock mounds consisted of cobble-sized stone to objects two to three feet along one side and 12 to 18 inches thick. The side-scan sonar system also confirmed the presence of rock piles, or mounds, which appear to be associated with historic Champlain Canal dredging activities (see image 2).

In other locations, significant areas of exposed bedrock are present. One drawback of the side-scan sonar technology is that it is possible for the bottom of the river to obscure the true conditions. For example, coarse-grained sediments may have formed a crust overlaying softer sediments. These materials reflect back an image only of coarse hard materials. The underlying sediments are obscured. In most cases sub-bottom profiling instrumentation cannot penetrate these materials either. The alternative method to establish conditions at these locations is to physically probe the bottom; this was done at a number of locations.

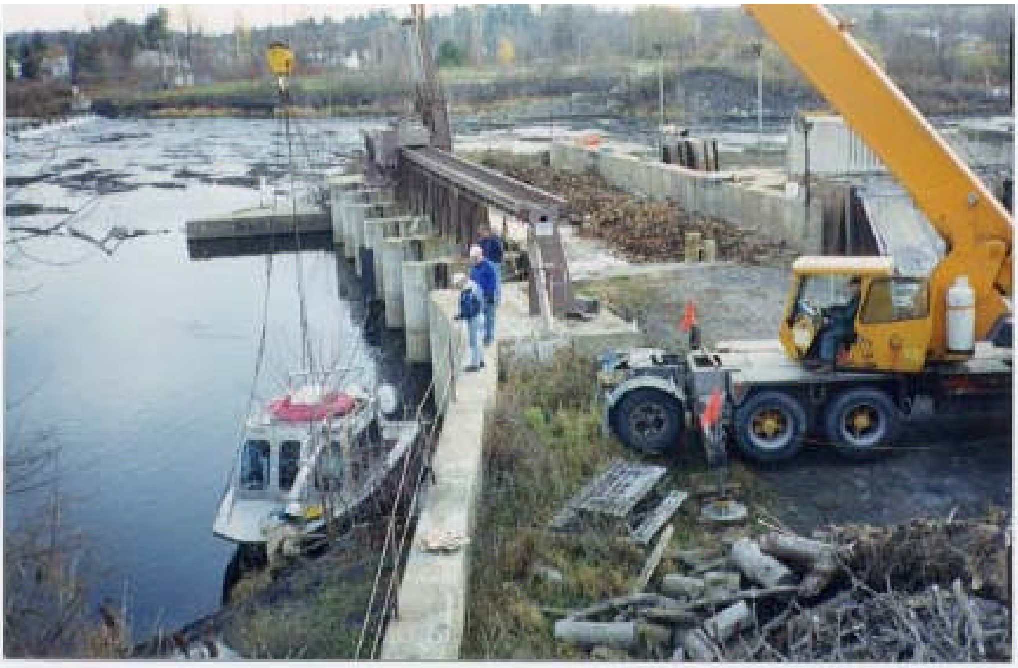
Scattered rocks and boulders that have been identified throughout the river can be removed prior to initiating remedial work in much the same manner that large pieces of wood debris would be removed. A more significant obstacle to remedial work is the presence of consolidated rock at the bottom of the river. The presence of rocky formation was detected both during this survey and earlier investigations that are recorded on FS Plate 2. It will be necessary to confirm the extent of such rocky formations prior to initiating a remedy. Then it is expected that most such areas will have to be avoided since removal work in these locations will either be inhibited or precluded.

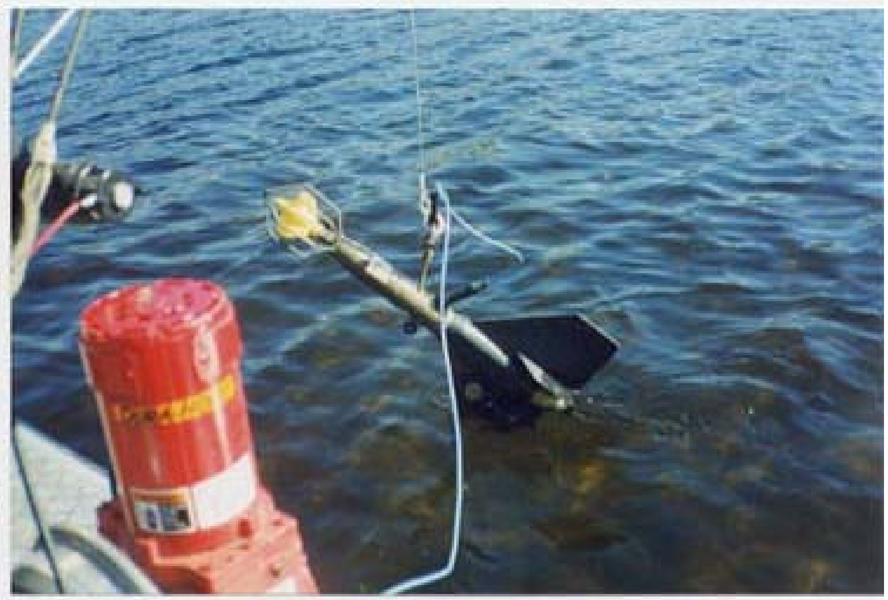
5.2.4 Boards and Slats

Man-made wood debris can be handled in the same manner as natural wood materials such as tree trunks and branches. This material will not impede planned remedial work.

6.0 Conclusions

The debris survey conducted during the first week of November 1999 demonstrated that instrumentation is available to detect most near surface material that would interfere with the implementation of an active remedy for the Upper Hudson. Another finding of the survey program is that manmade and plant debris is not likely to be a significant problem during remedial. The largest of these materials, along with cobble piles observed at several locations, can be removed prior to the initiation of work in any particular area. The presence of consolidated rock along the river bottom will preclude removal operations in some areas. The full extent of such rocky formations will also need to be established as part of the design phase of an active remedy.





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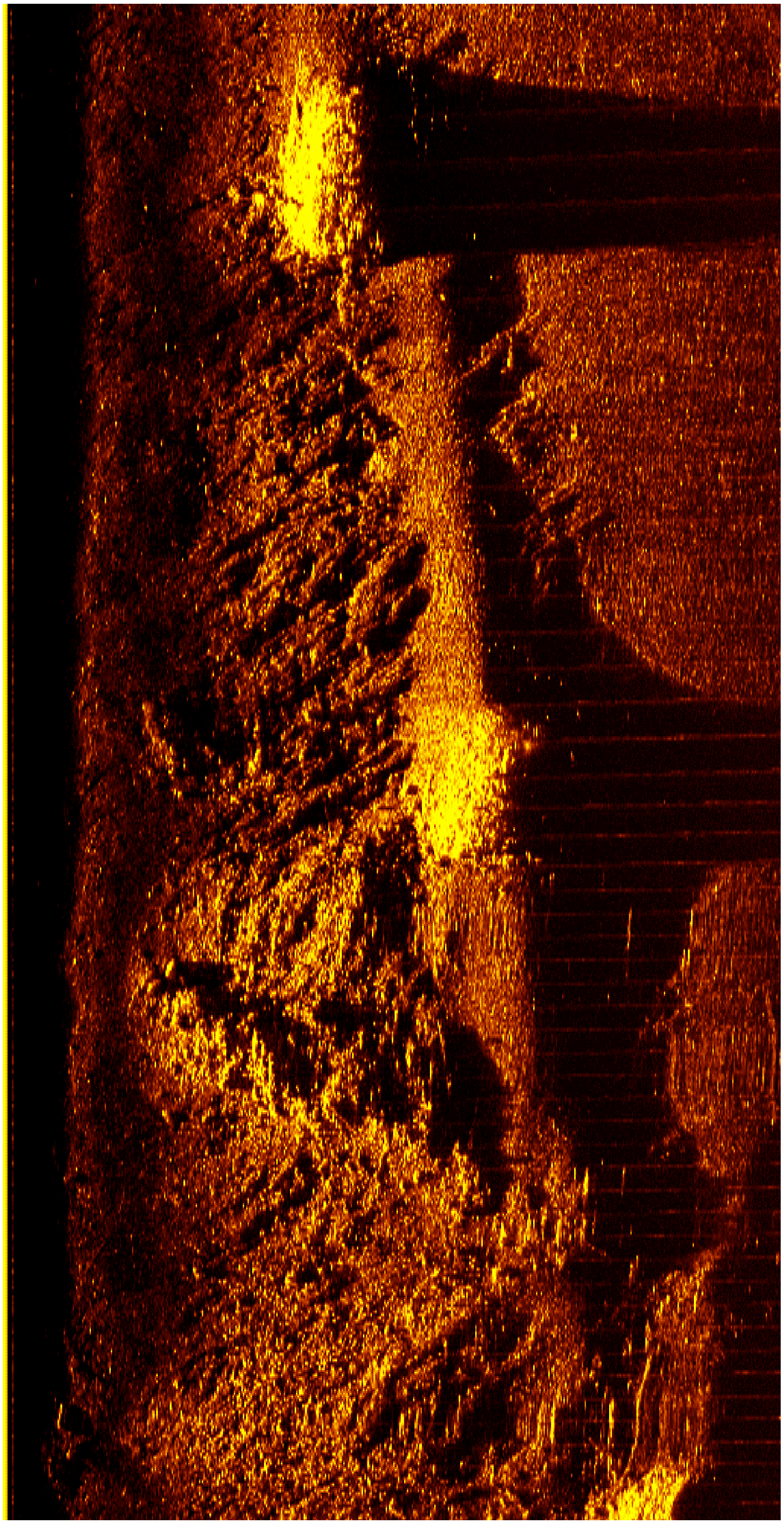

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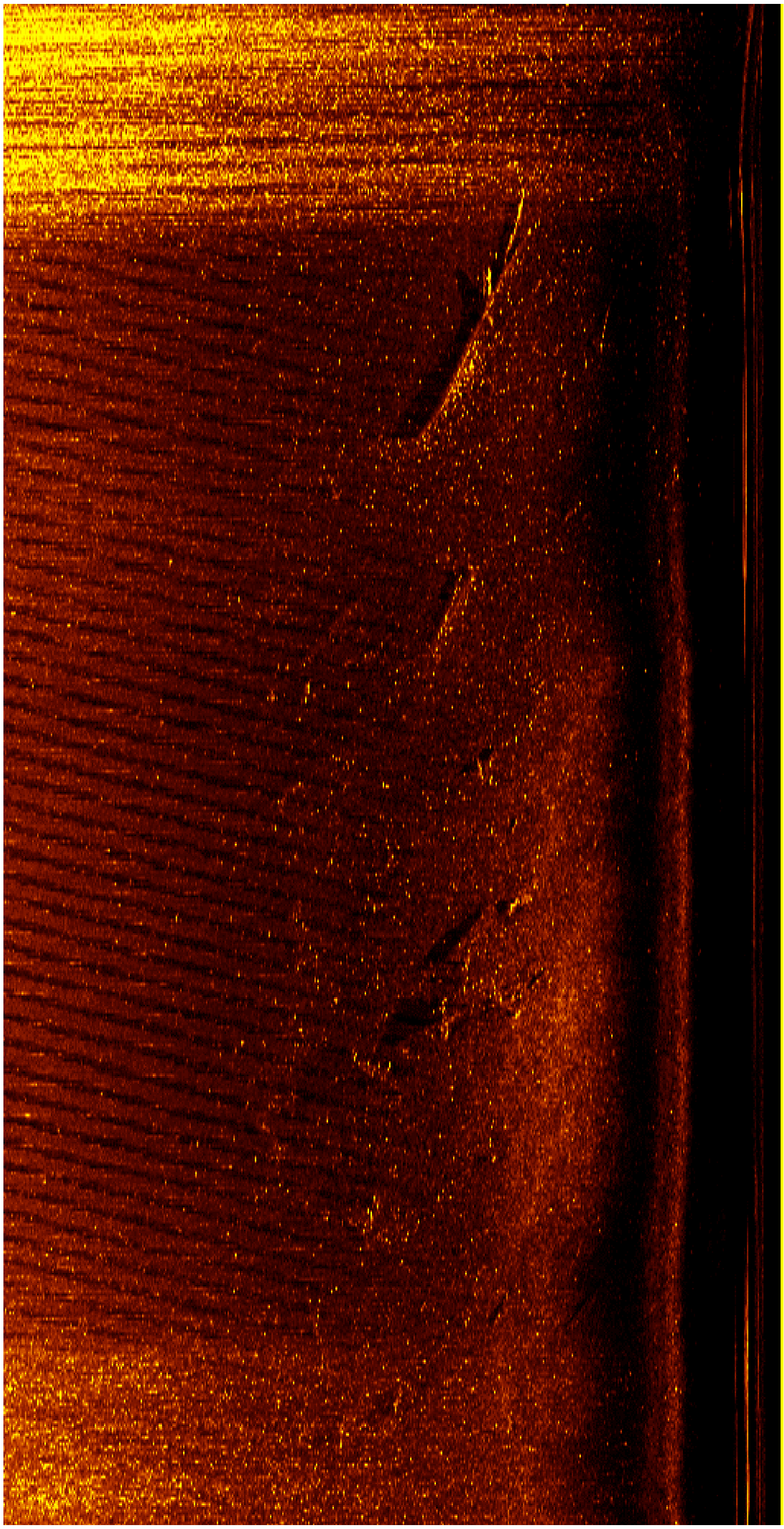

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