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April 20, 2000

Ms. Alison Hess
Mr. Douglas Tomchuk
USEPA – Region 2
290 Broadway -19th floor
New York, NY 10007-1866

Re: Feasibility Study for Hudson River PCBs Superfund Site: Use of Models

Dear Ms. Hess and Mr. Tomchuk:

I am writing to share with EPA the views of General Electric Company ("GE") on several important aspects of EPA's forthcoming Feasibility Study ("FS") for the Hudson River PCBs Superfund Site ("Site"). In this letter, I address issues that are relevant to EPA's use of its fate, transport and bioaccumulation models in its remedial analysis.

EPA is now addressing the issues of what remedies may be necessary and feasible for the Hudson River PCB site. The two fundamental questions that EPA has asked throughout the reassessment are:

1. "When will PCB levels in fish populations recover to levels meeting human health and ecological risk criteria under continued No Action?"
2. "Can remedies other than No Action significantly shorten the time required to achieve acceptable risk levels?"

Both EPA and GE have recognized that the best tools for answering these questions are the models, which allow the Agency to make realistic projections of the outcome of the remedial alternatives it is considering. There are a number of important constraints that EPA must recognize regarding the remedies, particularly dredging remedies, when using the models to make projections. The answers to the following questions set the boundaries within which the models can be used:

- What will be the upstream source's contribution of PCBs in the future?

- How will the timing and implementation of upstream source control measures impact the effectiveness of a sediment remedy?
- After issuance of the ROD, how quickly can a remedy begin?
- How long will it take to complete particular remedies?
- Following a remedy, what will be the residual concentration of PCBs at the sediment surface?
- How does controlling resuspension from dredging affect the length of time to implement a remedy and/or the residual concentration of PCBs at the sediment surface?

It is important to make the model projections and the assumptions they are based on as realistic as possible. EPA's assumptions about these model inputs should be necessarily constrained by site-specific data and remedial experience drawn from other sites. This letter provides an analysis of the key model inputs needed to accurately simulate various remedial actions in the river. Since much of this is based on experience from sites where dredging has already occurred, I enclose for placement into the administrative record for the site a copy of GE's Major Contaminated Sediment Sites Database (Release 2.0), which contains data from remedial efforts at major contaminated sediment sites in the United States. These data provide the factual information needed to support assumptions about the rate at which remedial actions progress and about their efficacy. The database can also be obtained from the GE Hudson River website (www.hudsonwatch.com).

I. <u>Reduction of PCB Concentrations in Fish is Constrained by the Upstream Source.</u>

Pending further reductions in the flow of PCBs into the river from the vicinity of GE's Hudson Falls Plant site, the PCB load passing Rogers Island will continue to average between 0.2 and 0.4 lbs/day[1]. Both EPA's and GE's models show that this load will prevent Thompson Island Pool fish PCB levels from declining below a range of 1 to 2 ppm.

GE is continuing to work diligently with NYSDEC to reduce the flow of PCBs into the river from the vicinity of GE's Hudson Falls Plant site. The presence of Dense Non-Aqueous Phase Liquids (DNAPL) in fractured bedrock below the riverbed makes the job extremely difficult. Accordingly, for purposes of model projections, EPA should assume

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[1] These loads yield average water column concentrations approximately equal to the range of 10 to 30 ng/L used in the EPA model projections

that future inputs of PCBs from the upstream source will remain at current levels. Assuming a lower input would require a factual analysis showing that the assumption is reliable and well founded. EPA must also recognize that, as both GE's and EPA's models show, the presence of the upstream source will limit the reductions attainable in sediment and fish PCB concentrations through any remedial action directed at the sediments. Without source control, it is apparent that other remedies can only have limited effect; consequently, source control must receive focus if there is an interest in obtaining less constrained long-term results.

II. The Timing of Remedy Implementation is Important in Assessing Remedial Effectiveness.

Two items related to the timing of a remedy are also important inputs into EPA's model projections. How quickly one can begin a remedy following the ROD and how quickly that remedy can be completed both constrain the ability to meet a remedial goal materially sooner than natural recovery. This is true, in part, because of the significant rate of natural recovery now and in the near future, as demonstrated in Figure 1. Figure 1 shows that PCB concentrations in the Thompson Island Pool surface sediments are predicted by both EPA and GE to continue to decline and will be reduced by half within the next six to seven years.

A. It will take several years to begin implementation of any large scale remedy

There typically is a sizeable lapse between issuance of a ROD and the start of remediation because of the time needed to (1) design the remedy, (2) select disposal methods and locations, (3) prepare bid packages, obtain bids, and select a contractor, (4) resolve property access issues, and (5) where appropriate, negotiate with PRPs. Tables 1 and 2 summarize 19 remedial dredging projects with depth-based and concentration-based remedial targets, respectively. The nine projects for which a state or federal Superfund dredging ROD was issued illustrate the time between the original ROD date and the implementation of dredging. Preparation time before dredging started ranged from two years to ten years (median five years). Also, EPA issued an Explanation of Significant Differences (ESD) or ROD amendment for five of these nine projects. Not only do such ESDs or amendments further delay implementation; they may also signify that the original RODs were based on incomplete information or unrealistic assumptions.

Based on these data, EPA must realistically allow, at a minimum, approximately five years following issuance of the ROD before any large-scale dredging or capping remedy can begin. Thus, if the ROD is issued in 2001, EPA should assume that a dredging or capping remedy could not be implemented before 2006.

B. <u>A large-scale remedial dredging project will take many years to complete.</u>

Data from real sites at which dredging has been implemented permit one to estimate the time to complete a remedial dredging project and should be used to develop realistic model inputs. GE has evaluated 19 major remedial dredging projects involved hydraulic dredges or mechanical buckets at a variety of physical settings (*i.e.*, marine, channel, bay, lake, single river hot spot). The average production rate for the 19 remedial dredging projects is extremely low in comparison to navigational dredging, ranging from 5 cubic yards per hour (cy/hr) (New Bedford Harbor and Pioneer Lake) to 140 cy/hr (Selby Slag, a nearshore marine setting).

Low production results from a variety of causes: (1) the presence of obstructions, such as rocks, vegetation, and debris; (2) operational controls imposed to minimize resuspension; (3) downtime during installation of sheetpiling or installation and relocation of silt curtains; (4) water treatment capacity limitations; and (5) the need for precision in sediment removal to minimize the volume removed, leading to repeated, potentially inefficient passes with the dredgehead to achieve a targeted depth horizon or cleanup level. Collection and analysis of verification samples to confirm attainment of the targeted cleanup concentration also leads to delays because the dredge typically has to make repeated passes over already dredged surfaces in an attempt to reduce the contaminant surface concentration. Resuspended contaminants that fall back onto the dredged surface often make this task progressively less productive.

Figures 2 and 3 present total dredged volume vs. total dredging time for the 19 dredging projects. Dredge standby and operating time combined for each project has been adjusted to provide a common basis for comparison (*i.e.*, equivalent to a 40-hour week). For each graph, a straight line through the origin (x = months = 0; y = volume = 0) was then fit to these plotted points, the slope of which represents average monthly removal rate.

For the nine projects that targeted a depth only, the average monthly removal rate, adjusted to a 40-hour week, was in the range of 7,500 cubic yards per month. For the other ten projects, all of which targeted a cleanup level and included verification sampling, the average monthly removal rate, adjusted to a 40 hour week, was in the range of 3,000 cubic yards per month. Thus, experience from these other sites indicates that it is reasonable to assume a production rate of between 3,000 to 7,500 cy/month, depending on the nature of the project.

Any remedial dredging project in the Hudson River is likely to be more difficult and slower to implement than anticipated. Thus, when simulating remedial dredging projects, EPA should consider the experience from other sites[2]. EPA should use a range of these rates to determine the sensitivity of the results to the amount of time a dredging project would take to complete. We believe that regardless of the rate assumed, EPA will conclude as we have that remedial dredging will not achieve a faster recovery than is naturally occurring.

III. Constraints in Remedial Dredging Technology Limit the Ability to Achieve Low PCB Concentrations in Surface Sediments.

Although dredging can remove significant volumes of sediment, it will typically leave a residual surface layer containing PCBs (sometimes at levels higher than existed before dredging). It has not been possible to achieve truly low PCB concentrations in surficial sediments.

This constraint has been recognized by the U.S. Army Corps of Engineers and is evident from past experience. The Corps has concluded that "[n]o existing dredge type is capable of dredging a thin surficial layer of contaminated material without leaving behind a portion of that layer and/or mixing a portion of the surficial layer with underlying clean sediment" (Palermo, 1991).

This conclusion is supported by available data from other sites. Figure 4 summarizes PCB sediment data from several completed dredging projects. Sediment removal projects at Grasse River, Ruck Pond, and Sheboygan River left sediment with PCB concentrations on the order of 50-75 ppm. Moreover, the data show that it is not feasible to achieve significant reductions when pre-dredging surface concentrations levels. At, Lake Järnsjön, the initial surface concentration was 1.5 ppm; dredging was only able to lower these levels to 1 ppm. When reviewed as a whole, the results show that the best dredging could accomplish was surface sediment PCB concentrations of

[2] With respect to the Hudson River, both GE and EPA have made more optimistic assumptions about dredging rates. In its "Evaluation of Removal Action Alternatives, Thompson Island Pool Early Action Assessment" (March 1999), EPA estimated of rate of 10,000 to 12,000 cubic yards per month. In QEA's model report (July 1999), we assumed an even more optimistic rate of between 14,000 and 33,000 cubic yards per month. Our assumption was intentionally optimistic, using multiple dredges and a large water management facility, so as to allow a comparison between natural recovery and even the most optimistic results one could hope to obtain from dredging. QEA's model report demonstrated, in fact, that even using these optimistic assumptions, dredging would not achieve lower PCB concentrations in sediments or fish materially faster than natural recovery. I also note that regardless of whether EPA's or GE's optimistic rates are used, a dredging project directed at removal of 660,000 cubic yards (all the hot spots in the Thompson Island Pool) would take between 9 and 11 years using EPA's rate, and 5 to 8 years using GE's rate, not including time for project planning.

approximately 5-10 ppm. As demonstrated in Figure 1, natural recovery would achieve surface concentrations in this range before dredging could even begin. Further, the model results indicate that fish PCB levels would be near or below the FDA action limit by this time.

The inability of remedial dredging to achieve low surface sediment levels results from several constraints: (1) inefficient removal (*e.g.*, mechanical clamshell cratering, windrows/furrows left between hydraulic dredge swaths); (2) shallow waters, where barges and hydraulic dredging equipment cannot operate; (3) the presence of boulders and debris; (4) the inability to remove sediment along an irregular hardpan or bedrock bottom; (5) sediment sloughing from adjacent, undredged areas; and (6) mixing of sediment targeted for removal with underlying sediment. Further, in areas where sediment rests on bedrock, one cannot overcut into cleaner sediment, further limiting the ability to achieve low residual PCB concentrations. These limitations mean that PCBs will be left in the surficial sediment following dredging. Additionally, future sediment deposition in the remediated areas will tend to maintain or increase the surficial sediment PCB levels so long as PCBs continue to enter the river near Hudson Falls at their current rate.

IV. Resuspension of PCBs During Dredging will Constrain Both the Success of Dredging and the Speed at Which it can be Performed

Dredging PCB-containing sediment will inevitably stir up the sediment, thereby releasing particulate or dissolved PCBs to the water column. Although resuspension can be limited to some extent, it cannot be totally eliminated.

Resuspension has three effects: contaminant releases to the water column, redeposition of contaminated sediment, and reduced production rate. Obviously, releasing PCBs to the water column will, at least in the short term, increase the mobility and bioavailability of PCBs. To reduce PCB mobility, the removal area(s) are typically isolated with a perimeter silt curtain or other containment barrier. Although these systems can reduce the transport of suspended solids, their effectiveness in containing dissolved constituents is limited. Experience shows that some PCBs escape these containment systems. For example, the use of silt curtains at the Grasse River in New York failed to contain resuspended PCBs. See Smith, J.R. *Non-time-critical removal action pilot dredging in Grasse River* (November 8, 1999) (attached). In addition, silt curtains may not be feasible in the Hudson if flow rates make it impossible to secure the curtains to the riverbed.

Resuspended particulate PCBs inevitably resettle either in the removal area or downstream. Thus, surface sediments both within and outside the removal area can become more contaminated than before dredging. Efforts to reduce resuspension tend to reduce productivity; thereby increasing the time required to complete the removal.

EPA must recognize, therefore, that resuspension will limit the effectiveness of dredging and that efforts to reduce resuspension will lengthen the dredging project. EPA should simulate what impact a range of resuspension rates would have on the recovery of the river during a long term dredging project. This could be accomplished by making a range of assumptions of likely resuspension rates (*e.g.*, 0.5%. 1% and 5% of the material dredged would be resuspended).

* * *

Both EPA and GE have developed powerful tools – the fate, transport and bioaccumulation models – to use in the remedial analysis for the Hudson River site. These tools, however, will provide reliable and useful answers only if model inputs are realistic.

As always, we are available to discuss with EPA these and any other issues as the Agency prepares its FS.

Sincerely,

John Haggard /bg

John G. Haggard

JGH/bg

Attachment

cc: William Daigle, NYSDEC
Andy Carlson, NYSDOH
Douglas Fischer, U.S. EPA
William McCabe, U.S. EPA

TABLE 1
TIME FOR IMPLEMENTATION OF REMEDIAL DREDGING PROJECTS

Depth Targeted; No Verification Sampling During Dredging

PROJECT	ROD DATE[1]	DREDGING START	VOLUME REMOVED (cy)	CALENDAR TIME FOR DREDGING[2]
Lavaca Bay II	N/A	Winter 1998	10,000	Winter 1998 (3 weeks)
Outboard Marine (Waukegan Harbor)	1984 (1989)	Dec. 1991	38,300	Dec. 1991 - Feb. 25, 1992
Cherry Farm (Niagara River)	1991 (1993)	June 1998	50,000	Jun. - Nov. 1998
Black River	N/A	Dec. 1989	60,000	Dec. 1989 - Dec. 1990
Lavaca Bay I	N/A	Jan. 1999	80,000	Jan. 18 - Feb. 4, 1999
LTV Steel	N/A	June 1994	102,000	Jun. 1994 - Oct. 1996
Selby Slag	N/A	Sep. 1991	102,000	Sep. - Nov. 7, 1991
Cumberland Bay	1997	July 1999	146,000[3]	Jul. - Dec. 1999[3]
Bayou Bonfouca	1987 (1990)	April 1994	169,000	Apr. 1994 - Jun. 1995

1 Either Superfund or State ROD. ESD or Amendment date is in parentheses.

2 Includes winter shutdown time. Doesn't include mob/demob and site prep. time.

3 Two dredges, full time

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TABLE 2
TIME FOR IMPLEMENTATION OF REMEDIAL DREDGING PROJECTS

Verification Sampling Performed During Dredging

PROJECT	ROD DATE[1]	DREDGING START	VOLUME REMOVED (cy)	CALENDAR TIME FOR DREDGING[2]
Pioneer Lake	N/A	August 1996	6,600	Aug. 1996 - Sep. 1997
Formosa Plastics	N/A	1991	7,500	Six months, 1991 and four weeks 1992
Gould (Portland)	1988 (1997)	August 1998	11,000	Aug. - Nov. 1998
GM (Massena)	1990	May 1995	13,800	May 8 - Dec. 19, 1995
New Bedford Harbor[3]	1990 (1992/95/99)	April 1994	14,000	Apr. 26, 1994 - Sep. 6, 1995
Ford Outfall	N/A	June 1997	28,500	Jun. 25 - Sep. 26, 1997
Fox River (56/57)	N/A	August 1999	30,000	Aug. 30 - Dec. 15, 1999
Manistique R./Harbor[4]	N/A	May 1997[4]	47,000[4]	May 1997 - Oct. 1998
Marathon Battery	1986/1989	August 1993	77,000	Aug. 1993 - Apr. 1995
United Heckathorn	1994	August 1996	108,000	Aug. 7, 1996 - Apr. 16, 1997

1 Either Superfund or State ROD. ESD or Amendment date is in parentheses.

2 Includes winter shutdown time. Doesn't include mob/demob and site prep. time.

3 Interim measure

4 Only 1997 and 1998 evaluated. Project started in 1995 and will continue through 2000.

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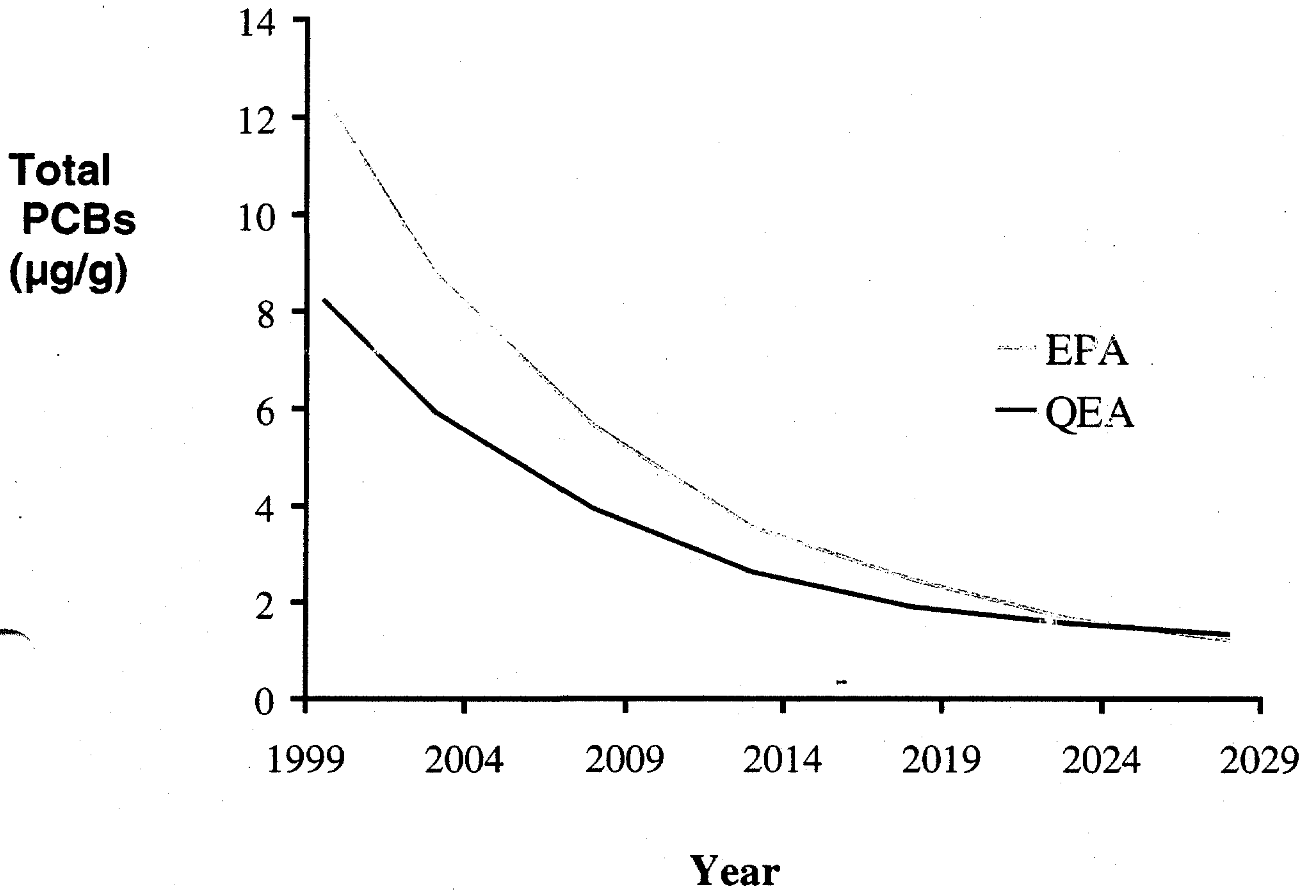

Figure 1. Cohesive surface sediment PCB concentrations predicted under natural recovery by the EPA and GE models with an upstream source fixed at a concentration of 10 ng/L

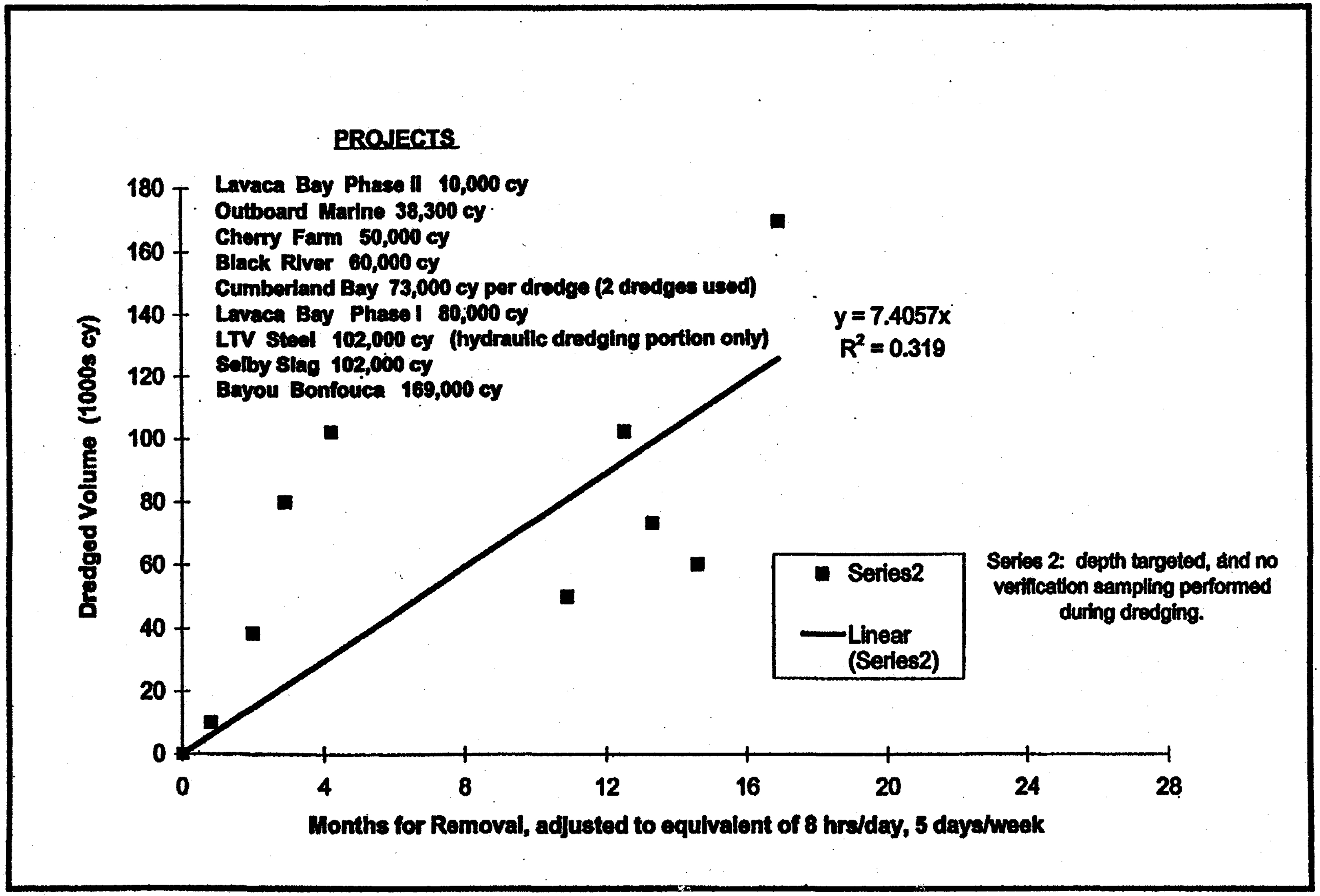

FIGURE 2. Sediment Volume Removed vs Time : Dredging Projects

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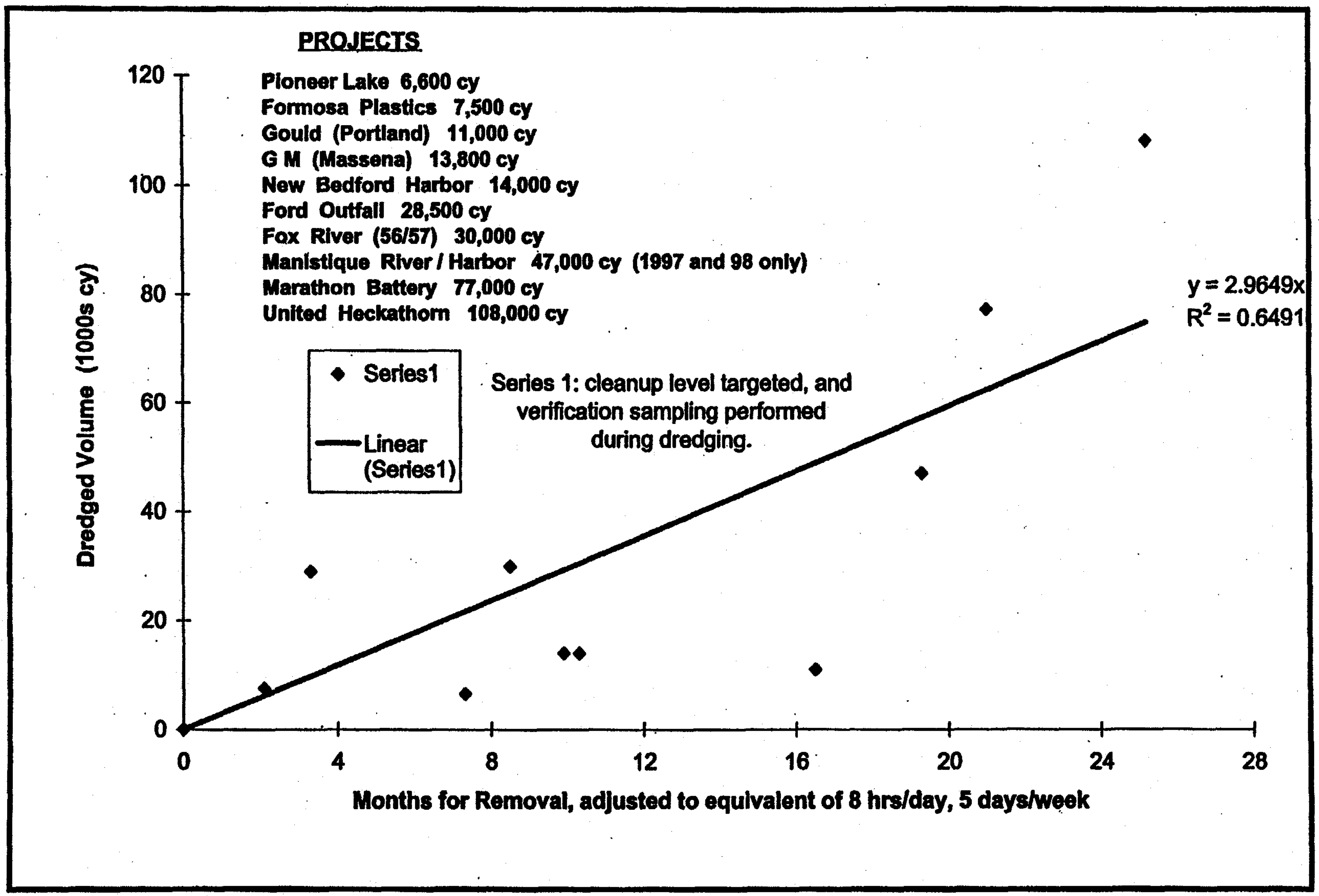

FIGURE 3. Sediment Volume Removed vs Time : Dredging Projects

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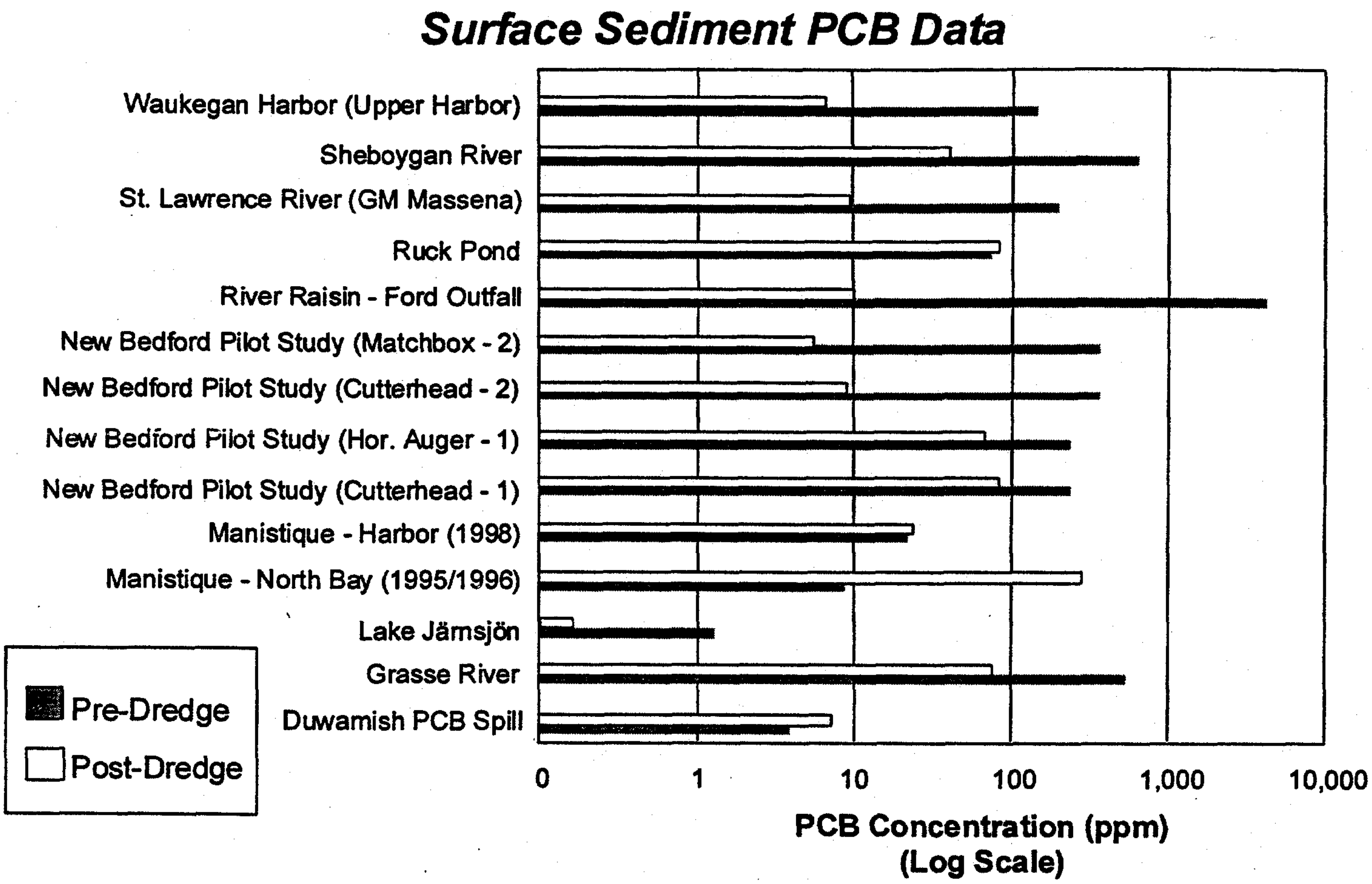


Figure 4. Pre- and Post Dredging Sediment PCB Concentrations

Presentation made to:

National Research Council's Committee on Remediation of PCB-Contaminated Sediments Meeting

November 8, 1999
Albany, New York

by:

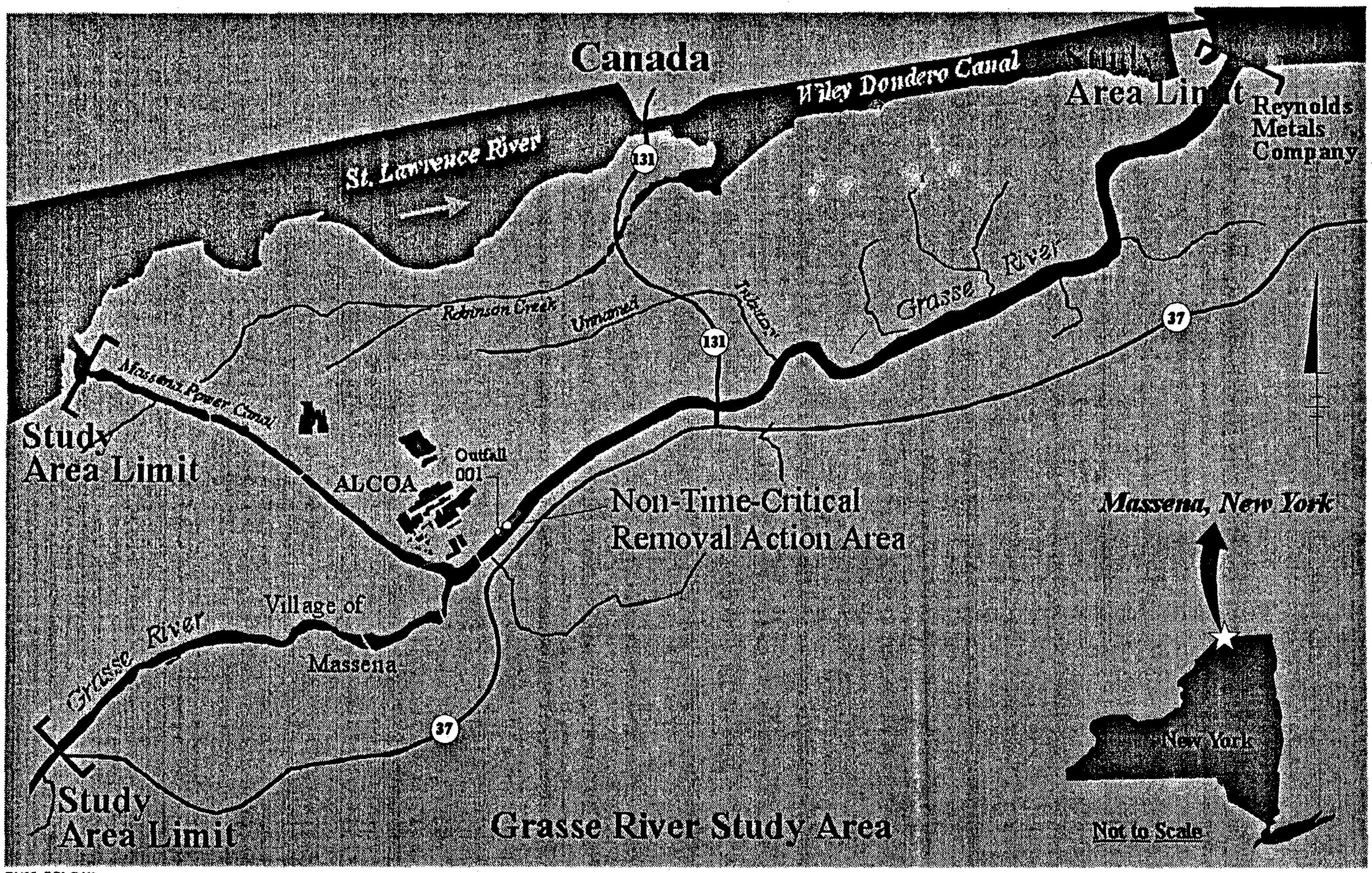
John R. Smith
Alcoa Inc.

Non-Time-Critical Removal Action (NTCRA) Pilot Dredging in Grasse River

By:

John R. Smith
Alcoa Inc.
Pittsburgh, PA

Site Location Map



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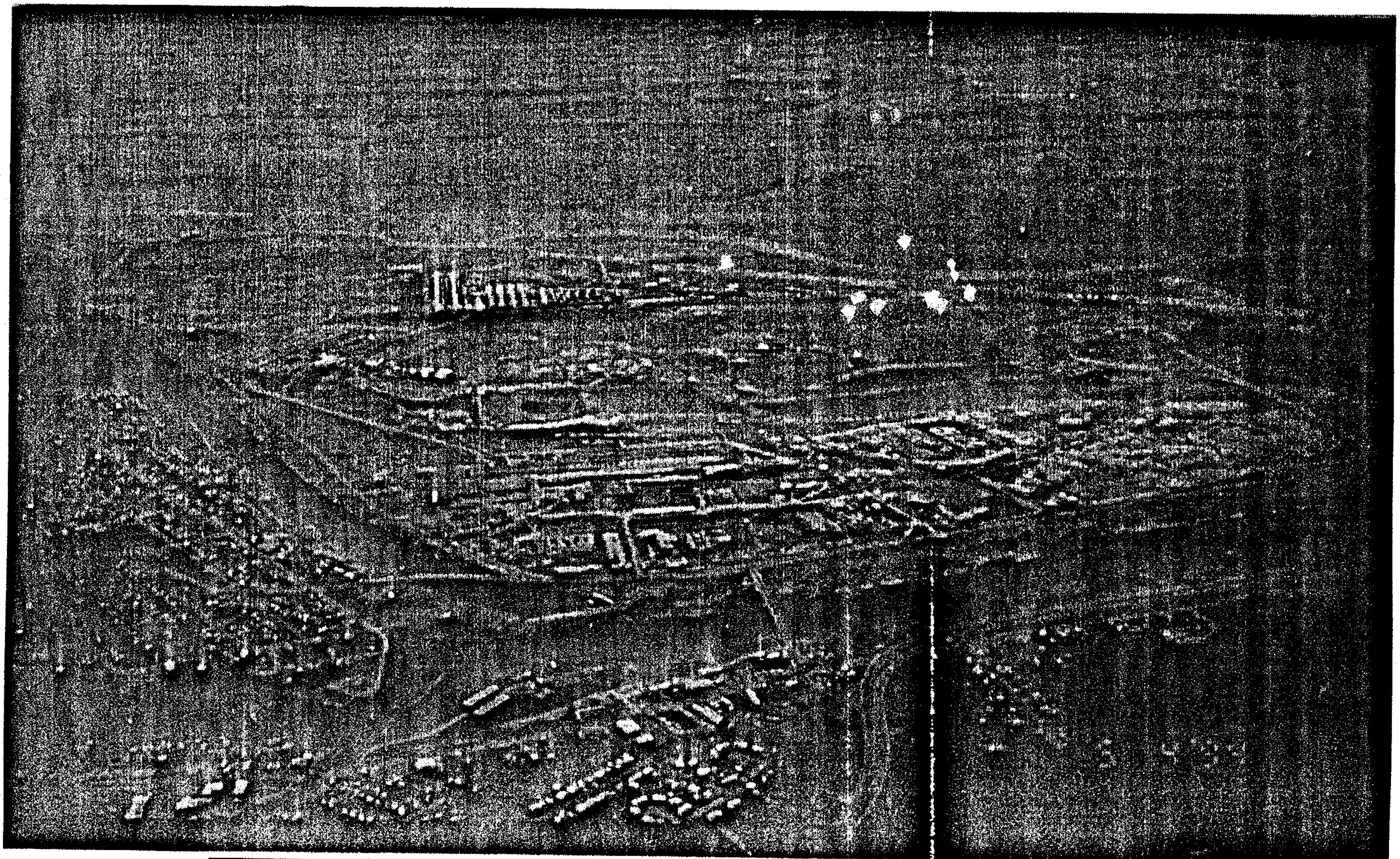
Site Location Aerial Photo



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Administrative Background

1989	USEPA issues §106 Administrative Order to ALCOA
1991, 1993-94	ALCOA implements two phases of River and Sediment Investigation (RSI) for sediment, water, and biota. ALCOA proposes removal of PCB-containing sediment located adjacent to Outfall 001
April 1994	ALCOA submits Engineering Evaluation/Cost Analysis (EE/CA) to address sediment removal as a non-time-critical removal action (NTCRA)
April-May 1995	NTCRA Final Implementation Plan and Monitoring Plan are submitted to Agencies
May-October 1995	USEPA approval and NTCRA implementation
1996-1999	Supplemental Remedial Studies (SRS)
December 1999	Analysis of Alternatives Report submittal

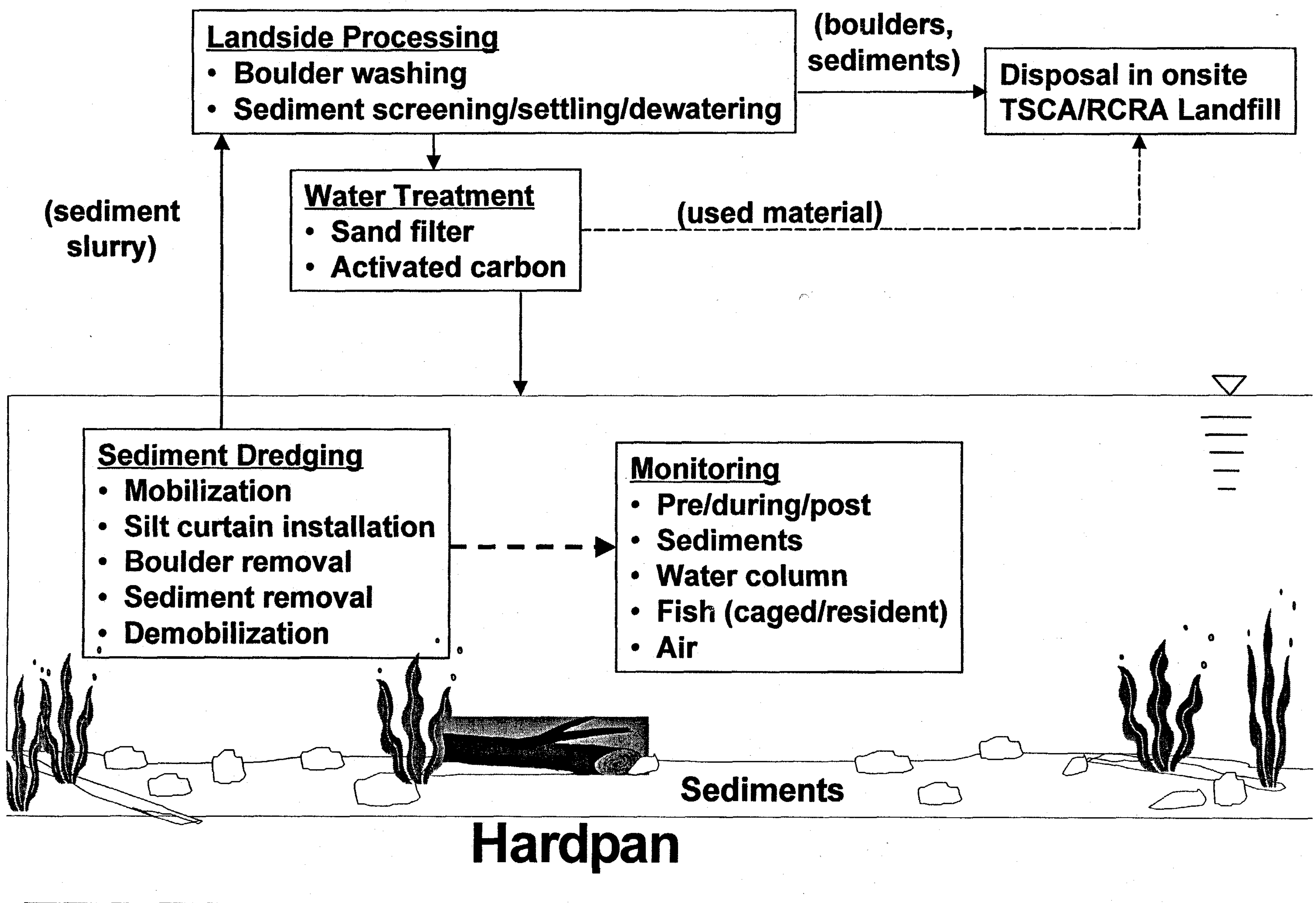
Characteristics of Removal Area

- Approximately 150 meters long by 30 meters wide (500 feet by 100 feet)
- Steeply sloped banks
- Average water depth of ~4 meters (13 feet)
- Estimated 2700 cubic meters of sediment/boulders/debris
- Up to 1 meter of sediment present, with 0.6 meter average thickness
- Sediments sit on glacial "hardpan" till
- PCB levels ranged from 12 to 11,000 ppm
- Sediment comprised of 70% sands
- Relatively low water velocity, backwater of St. Lawrence

Objectives of NTCRA

- Streamline remediation process for a portion of the Grasse River Study Area
- Reduce potential long-term risk to human health and the environment by eliminating most upstream PCB source
- Provide valuable site-specific data for use in Analysis of Alternatives Report for the Grasse River Study Area

Schematic of NTCRA Operations



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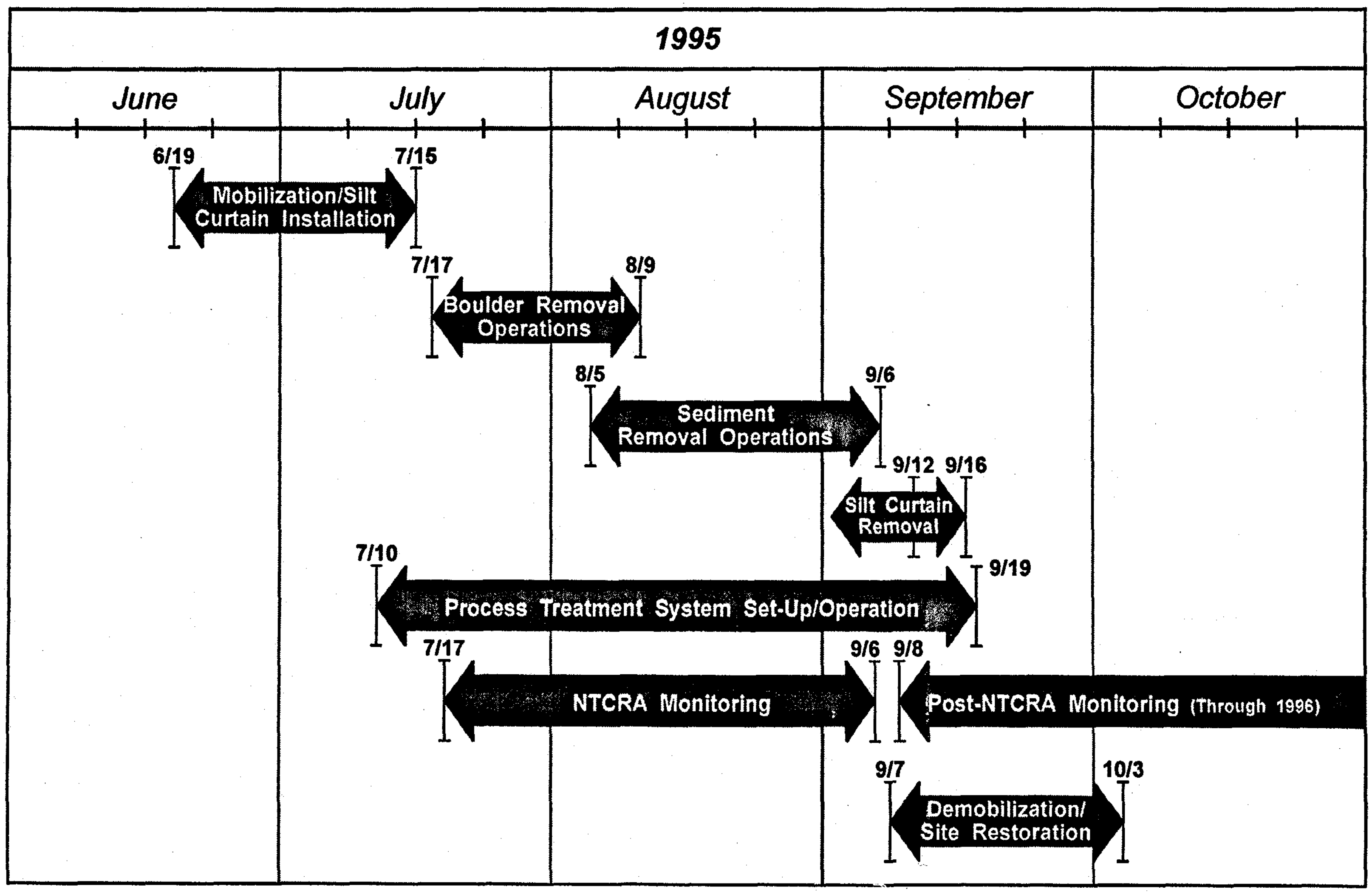
NTCRA Timeline



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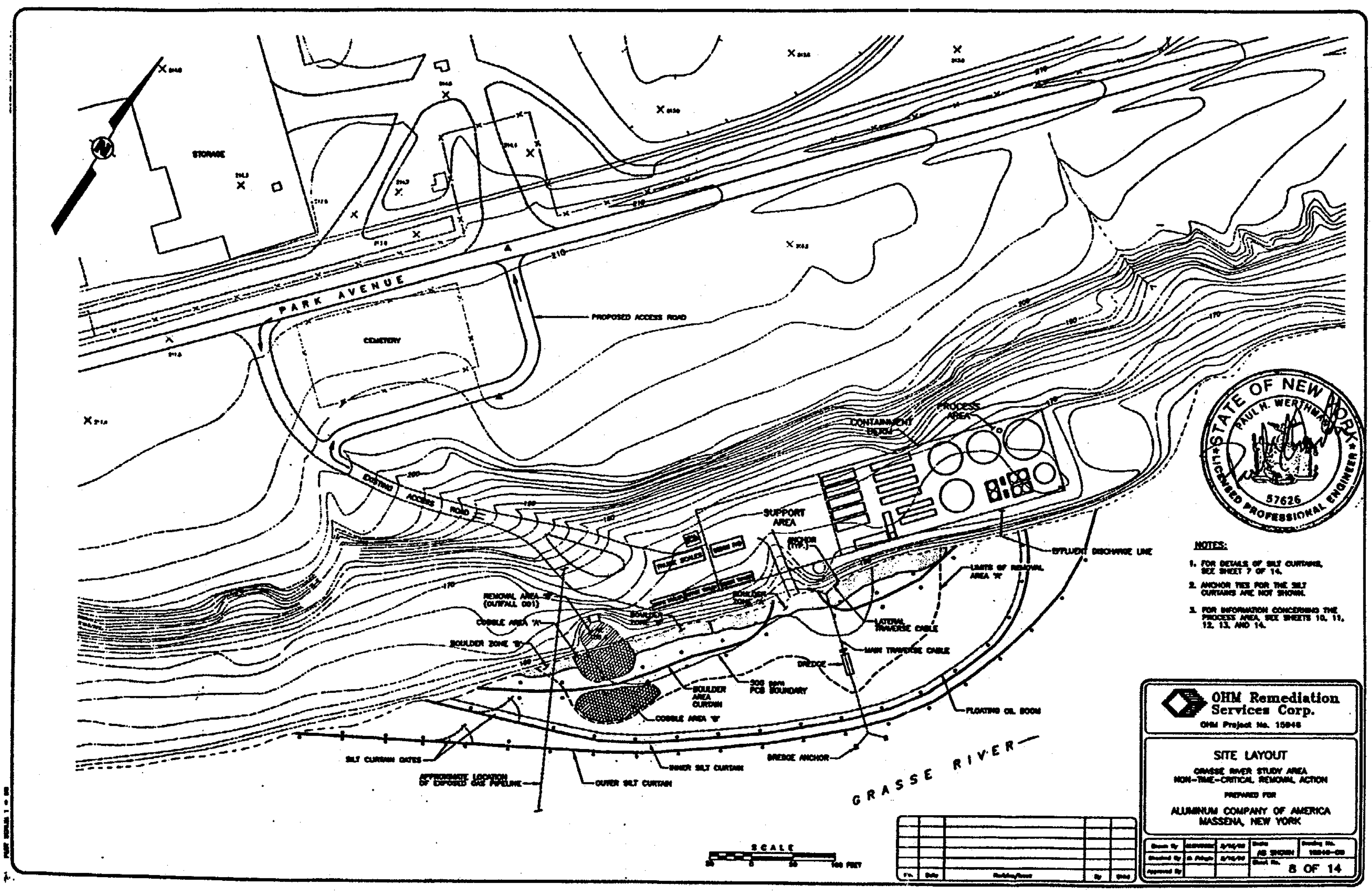
Site Layout



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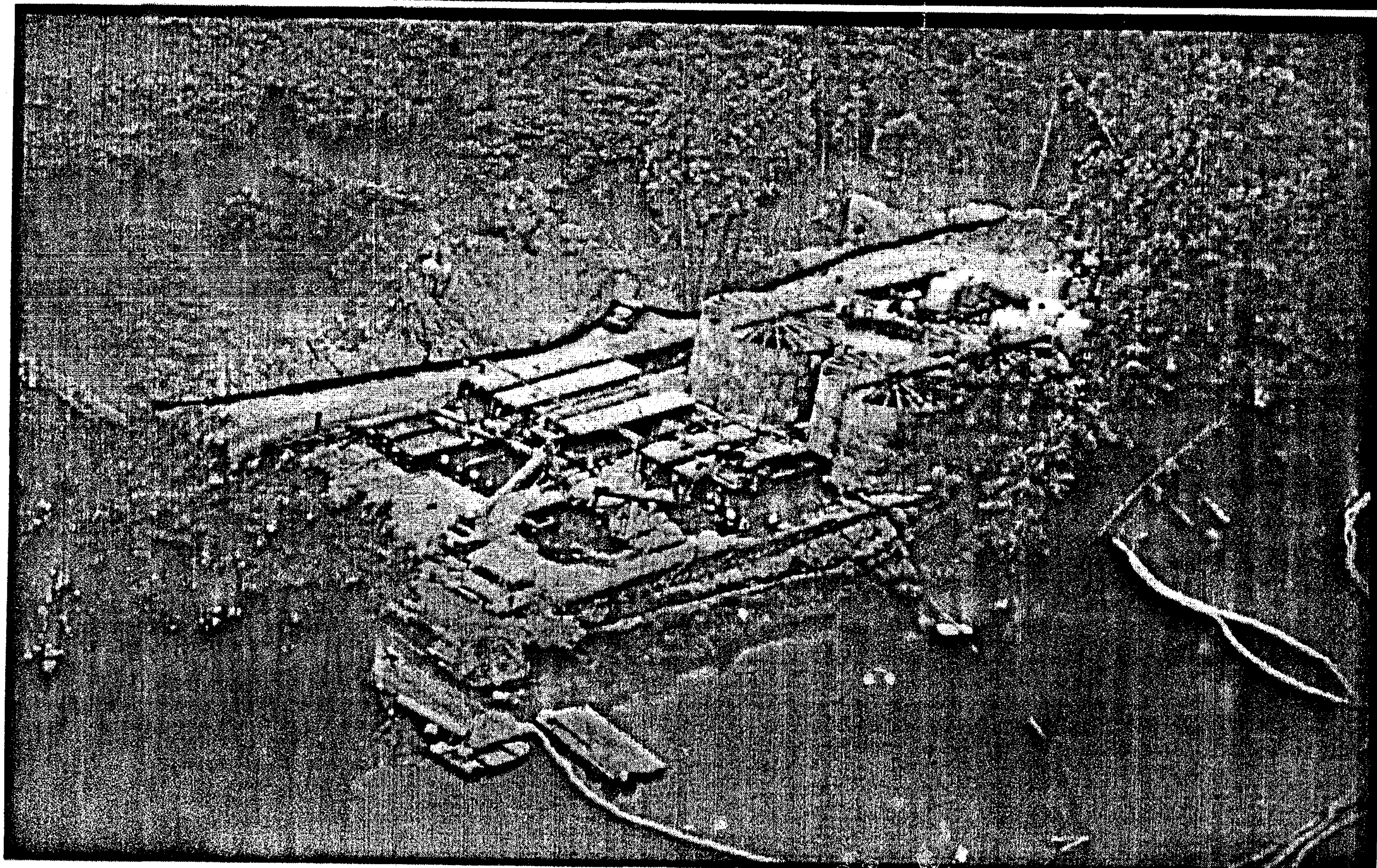
NTCRA Mobilization



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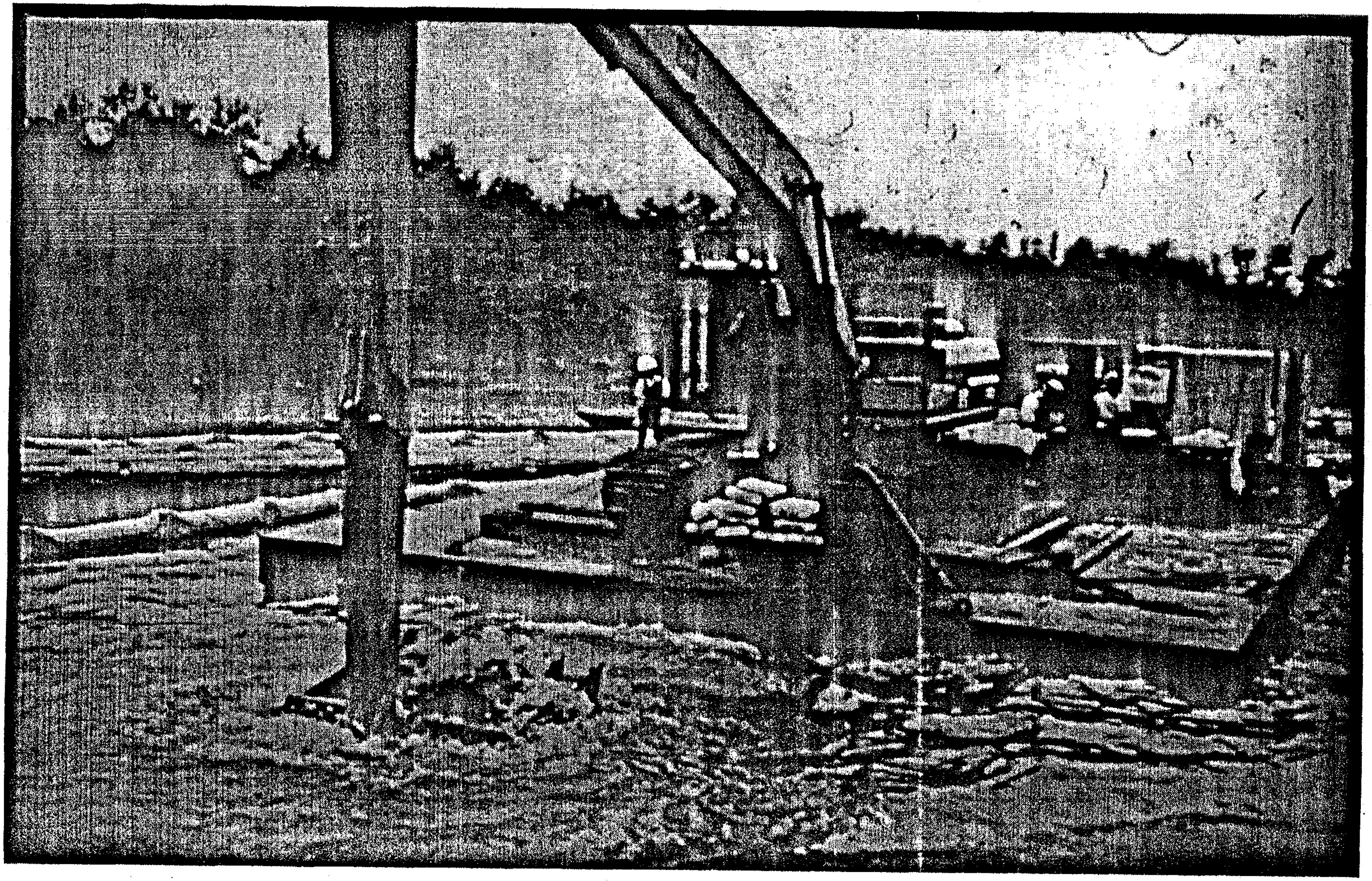
Boulder Removal



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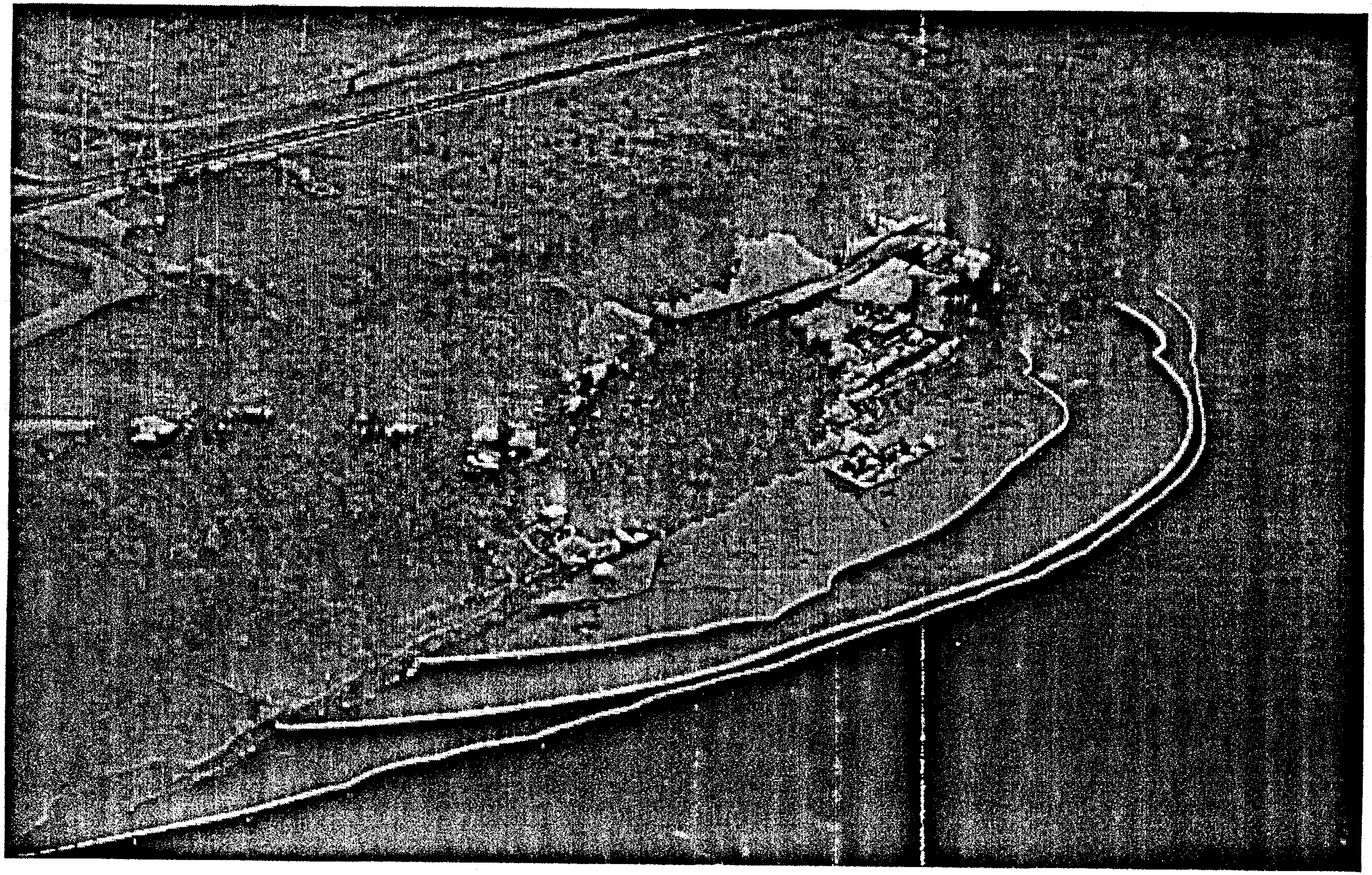
Aerial View of NTCRA Operations



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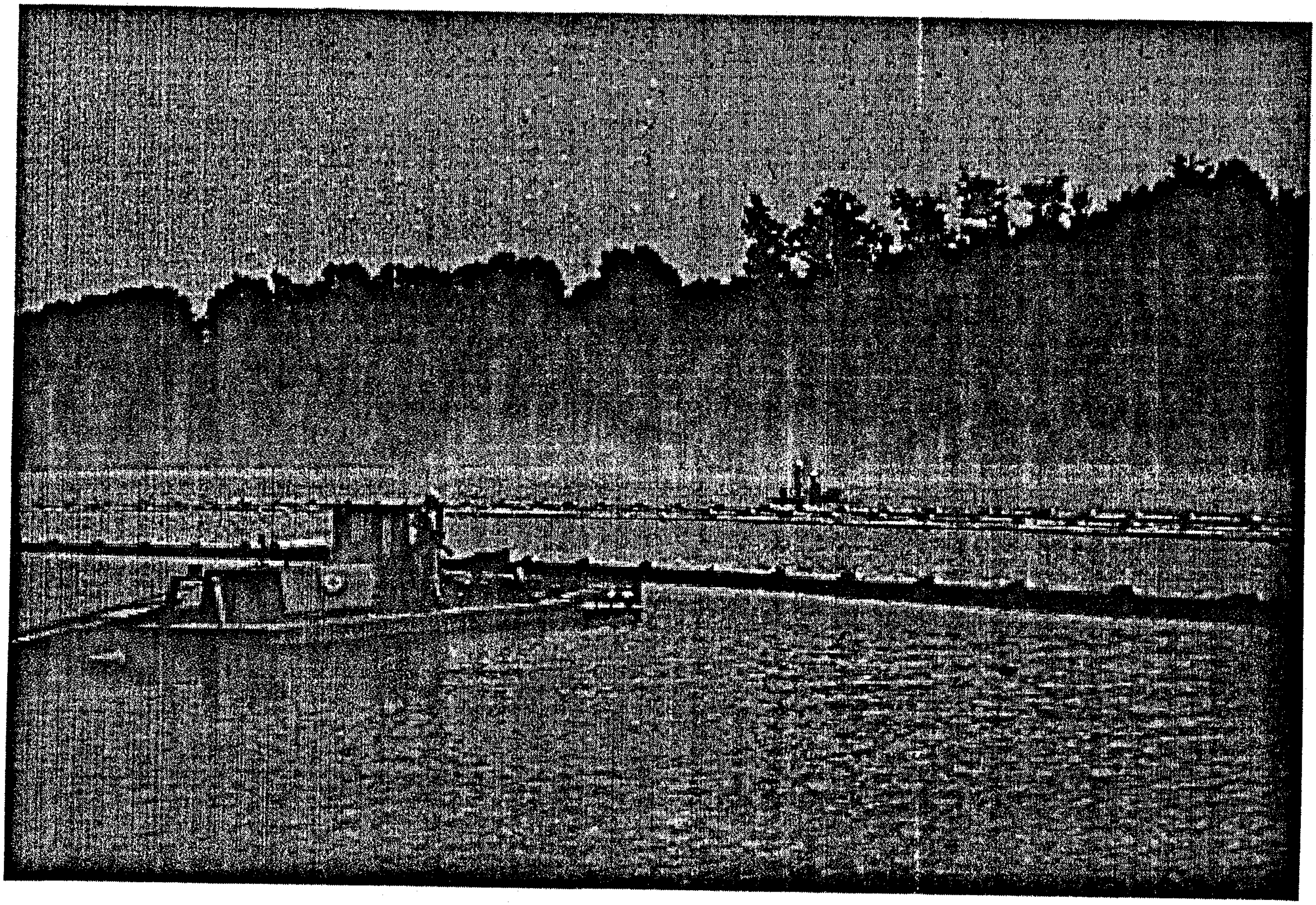
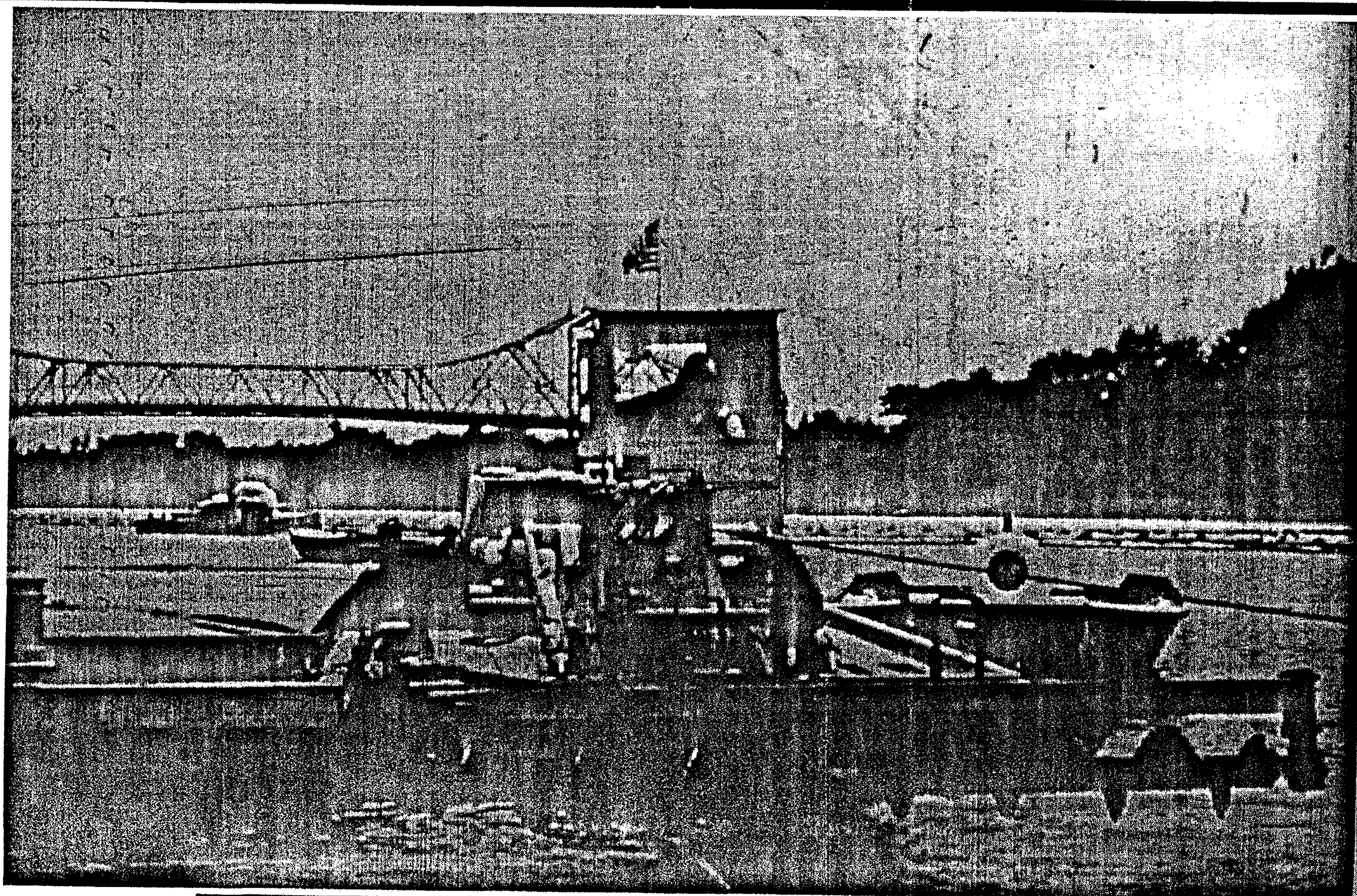
Dredging Operations



Horizontal Auger Dredge



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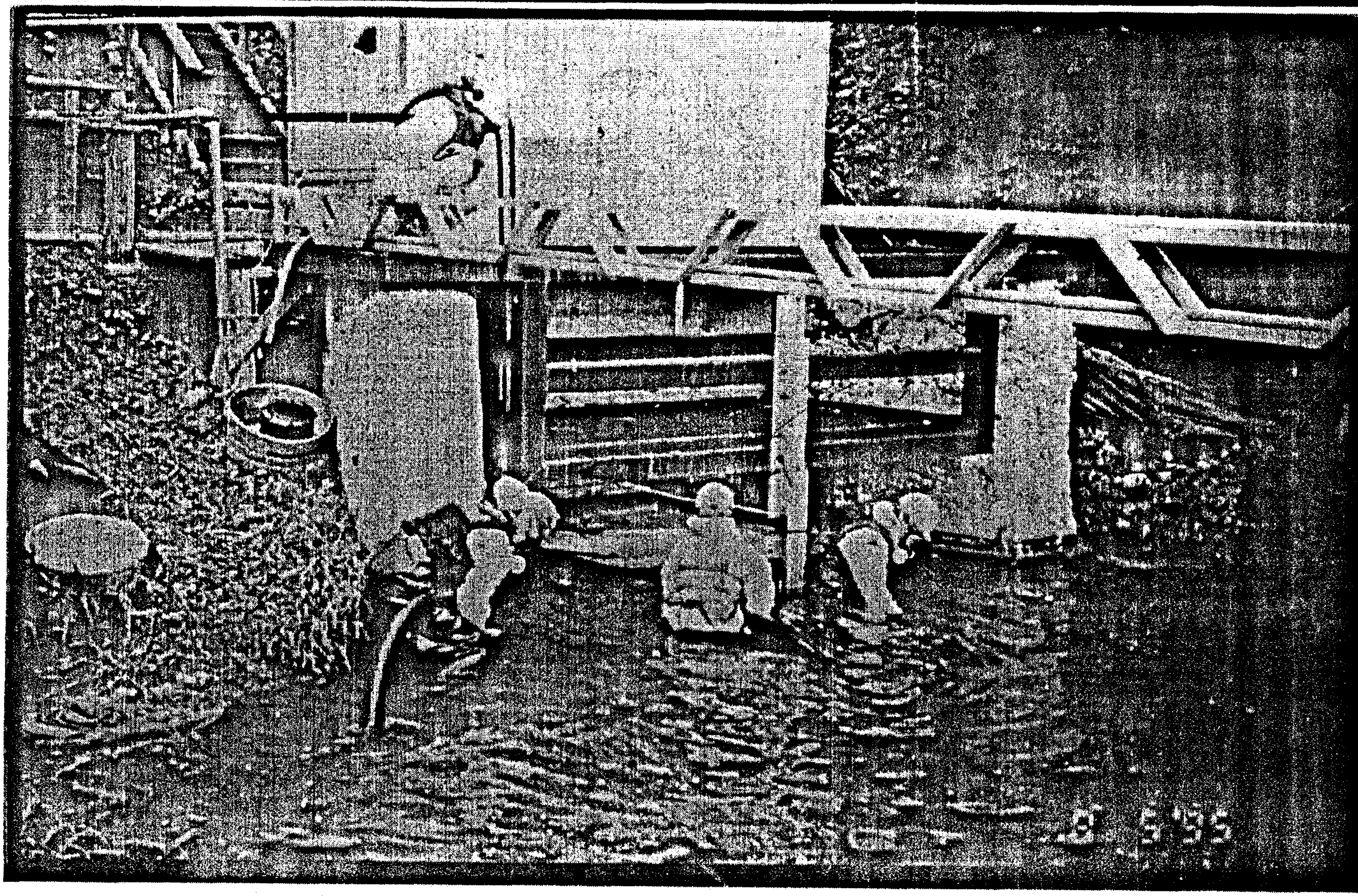
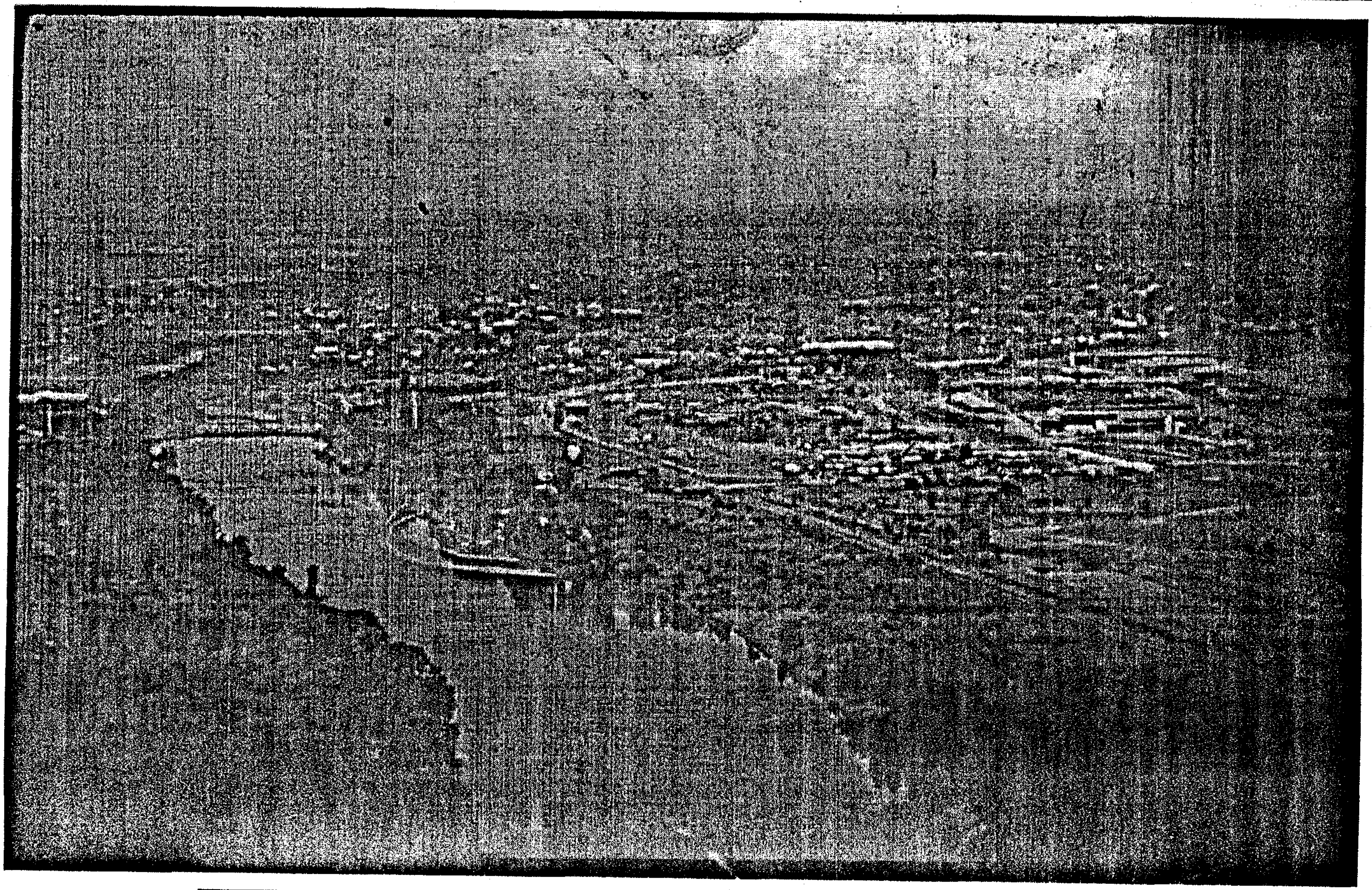
Manual Suction Dredging at Outfall 001



Downstream Aerial View of NTCRA



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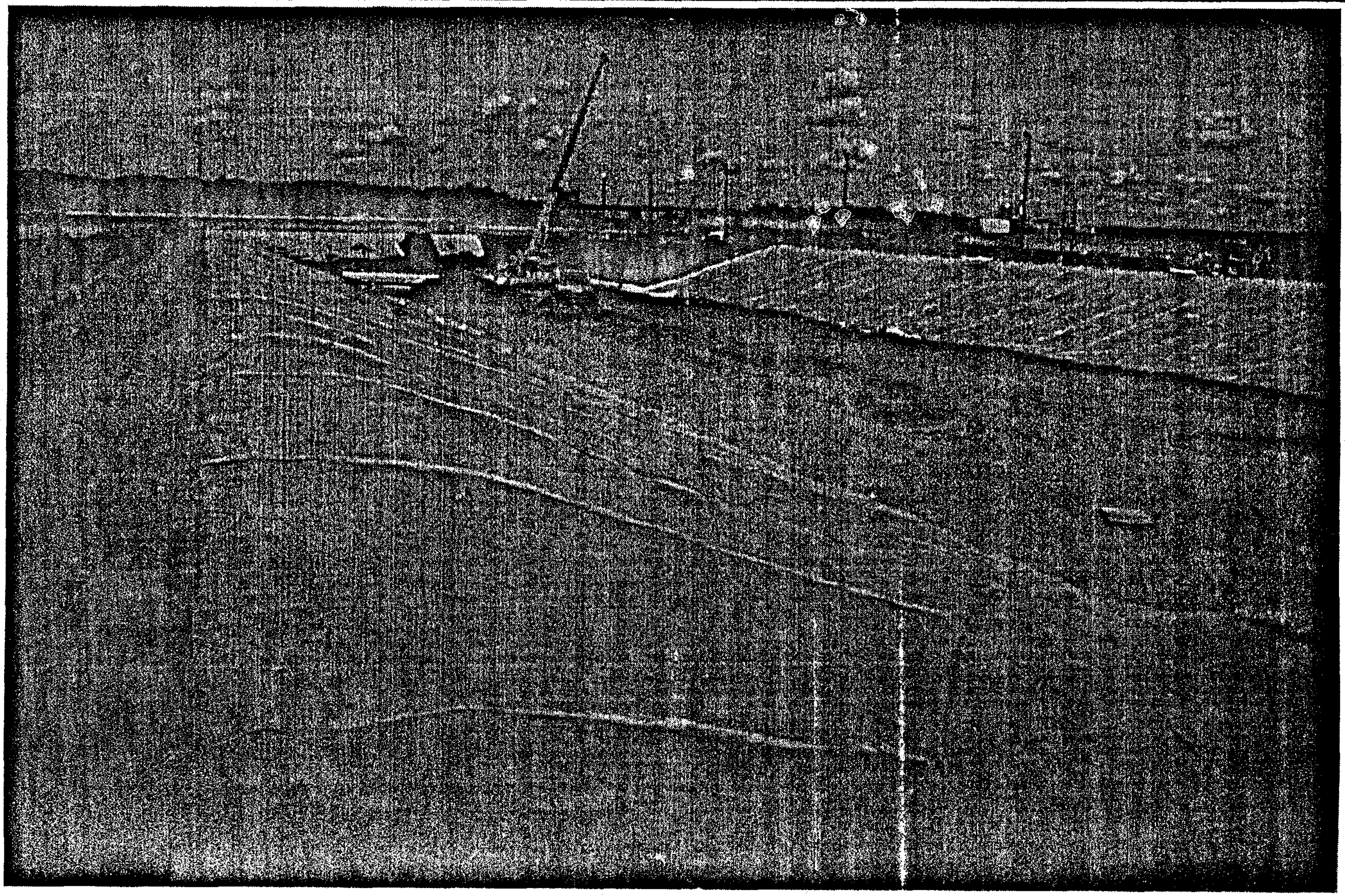
Onsite TSCA/RCRA Landfill



HOT-SPOT DREDGING EFFECTIVENESS

Grasse River NTCRA - Massena, NY

by

Dr. Louis Thibodeaux

Jesse Coates Professor of Chemical Engineering

Emeritus Director of EPA's Hazardous Substance Research Center/South and Southwest Region (HSRC/S&SW)

Louisiana State University

Note: Funds for evaluting this NTCRA project, as well as other dredging projects provided by:

- *EPA's HSRC/S&SW*
- *Alcoa Inc.*
- *Gordan A. and Mary Cain Endowment to LSU's Chemical Engineering Dept.*

PCB Mass Removal

- **2000 cubic meters of sediment and 300 cubic meters of boulders removed**
  - **~85% of targeted NTCRA volume**
  - **initial average depth of 59 cm to average dredged depth of 9.5 cm**
- **Estimated 88% removal of PCB mass within NTCRA area**
  - **average PCB concentration reduction from 1300 ppm to 160 ppm (1995 data)**
  - **~3230 kg PCB removed**
  - **~25% reduction of PCB mass within the entire Grasse River 6 mile study area**
- **Dredging effective for PCB mass removal**

PCB Reduction in Surficial Sediments
(critical parameter for biota exposure and water column flux)

- **Considering all pre- and post-dredging (1995 and 1997) data collected within 0-30.5 cm sediment depth**
  - **~53% average PCB concentration reduction from 518 ppm to 243 ppm**

- **Dredging ineffective for reduction of surface layer PCB concentrations to typical guidance/regulatory levels**

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Containment of Dredged Solids

During dredging, three layers of silt curtains (aided by low water flow):

- **Retained and isolated high sediment solids concentrations suspended during dredging**

- **Some suspended solids did escape with total suspended solids (TSS) levels at perimeter monitoring points between 5-25 mg/L above background**

Aquatic System Response
(comparison to pre-dredging conditions)

- **PCBs were mobilized and transported down river during dredging**
  - **at a location ~0.9 kilometers downstream of NTCRA, water column PCB congener concentrations increased ~5X**
  - **adjacent to NTCRA, caged fish PCB levels increased ~50X**
- **For the immediate months following NTCRA dredging, disturbed bottom sediments continued to contribute to localized PCB levels**
  - **caged fish PCB levels increased ~6X**
- **The last three years of intensive monitoring show no measurable improvement in**
  - **PCB congener water column concentrations and mass flows within the Grasse River study area**
  - **lipid normalized PCB congener concentrations in resident fish**

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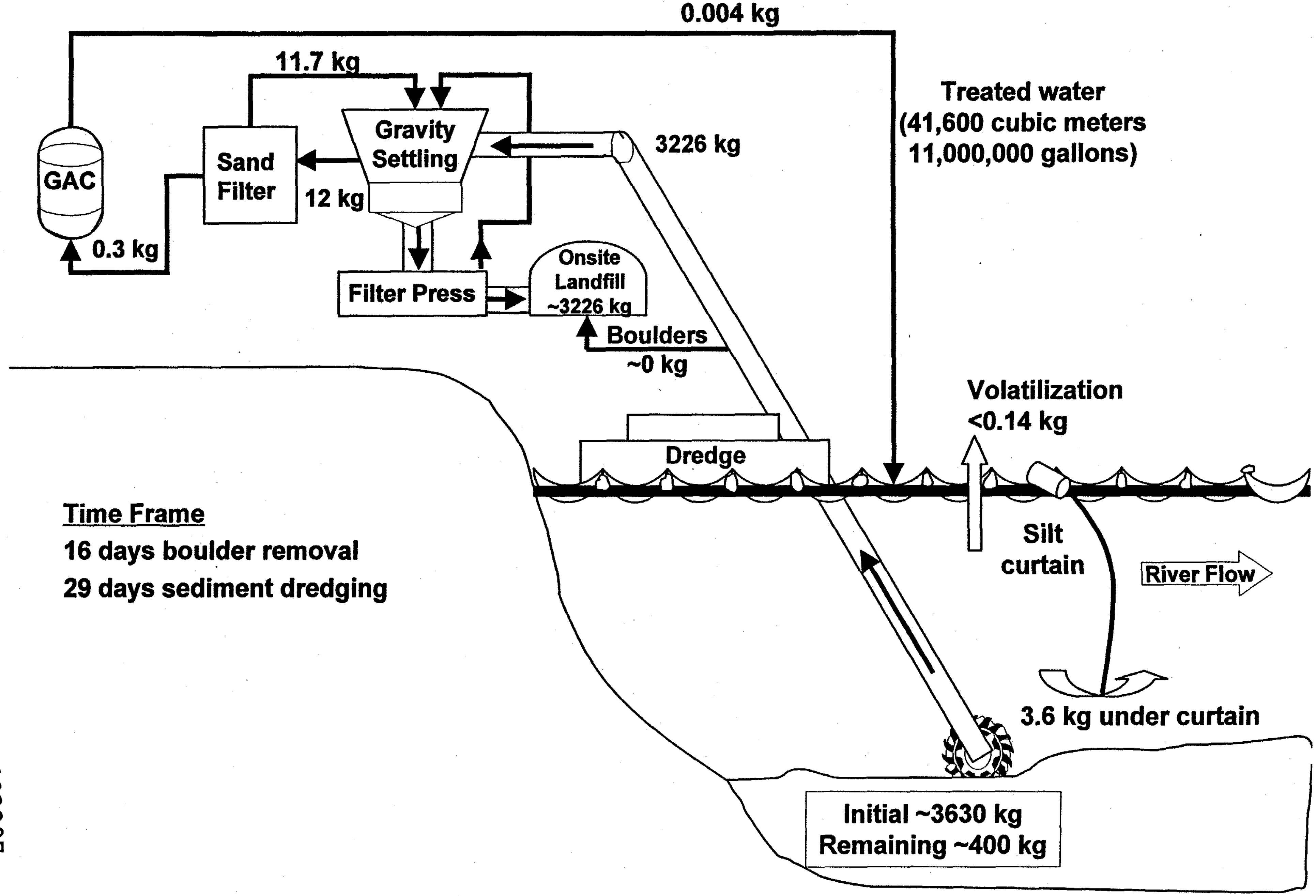
Dredging PCB Mass Balance Schematic

Environmental Dredging and On-shore Treatment



Time Frame

16 days boulder removal

29 days sediment dredging

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NTCRA Project Costs

Item	Cost ($)	% of Total Cost
Engineering Design	675,000	13.9
Mobilization/Equipment Installation/ Demobilization	1,504,000	30.9
Engineering/Site Construction	118,000	2.4
Boulder Removal	192,000	3.9
Sediment Removal/Dewatering/ Water treatment	1,081,000	22.2
Transportation/Disposal	425,000	8.7
Monitoring/Documentation	575,000	11.8
ALCOA Management	300,000	6.2
TOTAL PROJECT COST	4,870,000	100

- ***Cost per cubic yard of material removed = ~$2120/cubic meter (~$1620/cubic yard)***
- ***Note: costs do not include Agency oversight or preparation of EE/CA***

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Reports Available

- Non-Time Critical Removal Action Documentation Report - Volumes I and II, prepared for Alcoa, Inc. by Blasland Bouck & Lee, Inc., December 1995

- Effectiveness of Environmental Dredging - a Study of Three Sites, Karl Duckworth and Louis Thibodeaux, Final Report, Louisiana State University (LSU), Chemical Engineering Department, January 2000