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New York State Department of Environmental Conservation
50 Wolf Road, Albany, New York, 12233-

Langdon Marsh
Acting
Commissioner

BLOOMFIELD, N.J.

June 22, 1994

Bruce Fidler
TAMS Consultants, Inc.
300 Broadacres Drive
3rd Floor
Bloomfield, New Jersey 07003

Re: Hudson River PCB
Reassessment RI/FS

Dear Mr. Fidler:

This is in response to your facsimile dated March 18, 1994 in which you request certain preliminary design information for Site 10. The attachment supplements my numerous telephone conversations with you on the subject and the numbering of the attachment coincides with your facsimile.

The information should be treated as confidential, it does not represent a final agency action by the Department. It is my understanding that you will be able to use the data without releasing it. It is to be referenced as a personal communication from me as the Hudson River PCB Project Manager.

If you should have any questions regarding the above, please contact me at (518) 457-9280.

Sincerely,

John R. Dergosits, P.E.
Project Manager
Hudson River PCB Project

cc: C. Dworkin, Esq.

Authorized for release by DEC, Jan. 10, 2002

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ATTACHMENT

Response to Question Number 1.

Geotechnical Investigation of Site 10

Site 10 encompasses about 254 acres, approximately midpoint between Locks 6 and 7 of the Champlain Canal. The site is bisected by a powerline which traverses the site in a north/south orientation. The Hudson River is approximately 300 feet west of the site. Ground surface elevations range from 130 to 180 feet above sea level or above 10 to 60 feet above the mean river level. Most of the site is relatively flat and lies between elevations 145 and 155.

A geophysical seismic survey of the site was performed by Weston Geophysical Corporation. The survey was conducted along nine seismic lines, totaling approximately 20,000 feet.

Mueser Rutledge subcontracted to Malcolm Pirnie to perform a geotechnical investigation at Site 10. This investigation included the installation of 28 piezometers, the drilling of 61 soil borings and the collection and analysis of soil samples. Geotechnical soil borings were conducted on a grid of 300 foot centers on the western portion of the site. Fewer borings were conducted on the eastern 1/3 of the site since limited construction is proposed in this area.

The following describes methods used at Site 10 during field investigation activities to ensure that representative samples and data were collected. Field activities at the site were conducted in two phases (Stage 1 and Stage 2), in order to more efficiently gather the information necessary to evaluate the suitability of Site 10 for construction of a PCB containment cell. Data from the Stage 1 investigation was used in planning the Stage 2 investigation. Field activities which were conducted at the site included the following:

- Soil sampling and soil borings;
- Bedrock monitoring well and piezometer installations;
- Documentation and soil description from excavation of a test trench;
- Overburden and bedrock hydraulic conductivity tests;
- Ground water pumping tests;
- Ground water sampling; and
- Water level measurements.

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The Stage 1 hydrogeologic investigation included the installation of three bedrock monitoring wells and seventeen piezometers installed in the brown (C_1) and gray (C_2) overburden units. The piezometers were installed in clusters at three locations at Site 10, adjacent to each of the three bedrock monitoring wells. Each Stage 1 cluster consists of one bedrock monitoring well and five to six overburden piezometers screened at various depths to provide detailed hydrogeologic data and to allow for the collection of ground water samples for environmental isotope analysis. The locations and depths of the Stage 1 well/piezometer clusters were based on a review of previous hydrogeologic reports and available geotechnical information for Site 10. The Stage 1 piezometers and wells were sampled for environmental isotopes (oxygen-18, deuterium, and enriched tritium) to determine the relative age of the ground water; in addition, overburden and bedrock hydraulic conductivity tests and water level measurements were performed on the Stage 1 wells and piezometers. The purpose of Stage 1 monitoring and sampling was to generally define the geology and hydrogeology of the site and to determine general ground water flow directions within the clays and silts as well as bedrock.

At completion of piezometer installations, falling or rising head tests were performed to confirm that the piezometers were operational and to determine in-situ permeabilities of the soils surrounding the intake. Malcolm Pirnie performed the field permeability tests and has obtained water levels in all the piezometers at regular intervals. Based on these field permeability tests, permeabilities were calculated. Measured permeabilities in Stratum C_1 range from 2.3×10^{-7} cm/sec to 8.2×10^{-5} cm/sec. The permeabilities in Stratum C_2 range from 1.6×10^{-7} to 3.6×10^{-5} cm/sec. In bedrock, permeabilities range from 8.2×10^{-7} to 2.4×10^{-4} cm/sec.

The Stage 2 investigation involved the installation of eight shallow bedrock monitoring wells and fourteen overburden monitoring wells; these wells were installed for the most part in clusters of one bedrock monitoring well and two overburden monitoring wells (one each in the brown and gray units). Finally, two deep bedrock monitoring wells were installed adjacent to two Stage 1 clusters. The Stage 2 wells provided more detailed information on the site stratigraphy, through soil sampling, test trenching and rock coring, and on the ground water flow regime, through hydraulic conductivity testing, ground water pumping tests and ground water measurements. In addition, the Stage 2 wells were used to gather ambient or existing ground water quality information.

General

At Site 10 the surficial, or overburden, deposits overlying the bedrock are glaciolacustrine sediments deposited during the Pleistocene epoch. The unconsolidated overburden deposits are primarily glacial lake clay and silt deposited as rhythms in lakes which developed as the glacier retreated. The uppermost deposits are firm, brown clay and silt (here referred to as the "C_1" unit). These upper brown

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sediments grade down into softer, saturated, gray clay and silt (the "C_2" unit). The rhythmic clay and silt deposits are up to 110 feet thick, with the upper, brown unit varying in thickness from 15 to 40 feet. In general, the thickness of the brown unit appears to be directly related to ground surface relief; it is thicker beneath topographically high areas and thinner in low-lying areas. Below the gray unit, a thin, discontinuous layer of sand or till was encountered in some places.

The clay and silt overburden at the site can be subdivided into two units based not only on color but on other properties as well. Although the brown and gray sediments may have a similar depositional history, their density, structure, and of course color, permit them to be distinguished. N values (average blow counts) provide an indication of the change in penetration resistance while drilling. Generally, the N value decreased to below 5, commonly to "weight of rods", when the gray unit was encountered, compared to 5 to 20 for the brown unit. Pocket penetrometer values on samples from the gray sediments were typically less than 1 ton per square foot (tsf), while values for the samples from the brown unit were generally greater than 2 tsf. In addition, the gray unit is very cohesive and plastic. The gray unit appears to have a higher moisture content than the brown unit. However, laboratory determination of average water content for bulk samples indicates no relationship to sample depth. This may be due to the presence of more silt rhythms in the brown unit as compared to the gray unit.

BROWN UNIT (C_1)

The overlying brown unit was observed in the test trench, and in the CME core samples and/or split-spoon samples at all of the monitoring well borehole locations. Generally, the top one to two feet below ground surface were homogeneous, brown clay, likely disturbed by earlier farming practices on the site. Iron and sometimes gray mottling were characteristic and usually abundant.

Below this homogeneous zone, layering in the brown deposits became visible. Brown clay was by far the predominant material, but gray silt and occasional greenish fine sand laminae (approximately 0.04 inch thick) and seams (up to 0.5 inch thick) were also present. However, the unit also exhibited various beige, red, and green tones. These deposits formed a rhythmic sequence which was vertically very regular, with couplets about 1.5 to 2 inches thick (each consisting of clay and silt or clay and fine sand).

These couplets were observed to be continuous over distances of approximately 100 feet. The layers were, on a larger scale, flat-lying, though on a smaller scale gentle undulations were present. Silt layers were much more common in the couplets than fine sand. Across the site, the fine sand layers were observed in a one to two foot thick interval approximately three feet below grade; in the northern half of the

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test trench, a similar zone also appeared at around seven feet below the ground surface.

Other features in the shallow portion of the brown unit, observed especially in the trench, included fairly abundant roots, cracks, calcareous deposits, and staining, these phenomena often appearing to be closely related. The root matter itself was frequently still in place and was surrounded with either iron or gray staining or both, or with white calcareous deposits. These calcareous deposits were sometimes hard concretions and sometimes a flaky or dusty precipitate; the concretions could be either globular and thick, or thin stringers. The root structures sometimes appeared to be annealed by this calcareous material. Also, there occasionally appeared to be sediment deposited along the roots. These phenomena seem indicative of water movement along the roots. The sediment itself is apparently calcareous, as it effervesced when treated with 10% hydrochloric acid.

Both the calcareous material and iron staining also occurred without the association of roots or cracks, although this was less common. In these instances, the calcareous deposits occurred as crumbly white masses, up to 0.5 to 1 inch in diameter, while the iron staining occurred as small flecks, up to 0.1 inch in diameter.

Cracking in the brown unit also appeared to be commonly associated with the roots. These cracks were vertical and usually stained. In a few instances, offset beds, with up to 0.25 to 0.5 inch of offset, were observed. These were generally normal offsets, in which the hanging wall appeared to have moved downward relative to the footwall. This indicates that the mechanism creating these offsets was tensional, rather than compressional. These features are consistent with structural features described by numerous authors for similar glaciolacustrine sediments in other geographic locations, and therefore are not considered indicative of seismic activity. Possible causes include slumping of the sediments during the melting of buried ice blocks, and settling, compaction, and drying of the sediments after deposition and lake withdrawal.

The above features (roots, cracks, calcareous deposits and staining) were observed in much greater abundance in the upper several feet of the brown clay unit.

GRAY UNIT (C_2)

The rhythmic gray unit, which underlies the brown unit, was observed in split-spoon samples and CME cores at all of the monitoring well borehole locations. A transition zone several feet thick was observed between the upper brown and lower gray units, in which both gray and brown layers alternately occurred, often with various reddish and greenish layers. It is possible that the brown-gray interface represents the boundary between oxidized (brown) and unoxidized (gray) conditions, due to the long-term position of the water table within the clay. As in the brown unit, the gray unit contained rhythmically occurring, gray or greenish gray silt

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laminae. However, the frequency of these silt rhythms appeared to be lower than in the brown unit. While small roots and root masses were found in the gray clay unit, they were very rare. No calcareous stringers or staining were observed. Occasional cracks and bedding offsets were observed in the uppermost portions of the gray unit.

SAND AND TILL

In some locations at the site beneath the clay and silt units, a deposit of fine to coarse sand was encountered on top of the bedrock. Where it was encountered, the sand averaged two feet in thickness. The sand was observed in 7 of the 28 Mueser Rutledge borings which extended to bedrock, and in 5 of the 12 Malcolm Pirnie borings to bedrock. Because it was not present in all locations, this deposit is apparently discontinuous.

In some other locations beneath the clay and silt units, a gravelly till is present which averages 1.5 feet in thickness. The till was encountered in 8 of the 28 Mueser Rutledge borings which extended to bedrock, and in 2 of the 12 Malcolm Pirnie borings to bedrock. As with the sand deposit, the till occurred in only some locations and consequently appears to be discontinuous. The sand and till both occurred in 3 of the 12 Malcolm Pirnie borings.

The sand is gray to black and fine to coarse. The till is gray to black, of low to moderate compactness, and consisting predominantly of sand with small rock fragments and silt.

LABORATORY TESTING PROGRAM

All laboratory testing performed in conjunction with the subsurface exploration program was performed in the Mueser Rutledge (MRCE) laboratory in New York City.

Atterberg Limits - Atterberg limit tests were performed to confirm the classification and properties of the Strata C_1 and C_2 clays, and results are as follows. The liquid limit ranged from 37 to 69 percent of dry weight for Stratum C_1 soils, and ranged from 32 to 46 percent of dry weight for Stratum C_2 soils. The plastic limit had values between 23 and 29 percent of dry weight for Stratum C_1 soils, and between 20 and 23 percent of dry weight for Stratum C_2 soils.

Consolidation Tests - Eight samples were chosen from undisturbed sample borings for consolidation tests. The consolidation tests have confirmed that stratum C_1 is highly preconsolidated with respect to current overburden pressure and Stratum C_2 is, by comparison, slightly preconsolidated with respect to existing effective overburden pressure. From existing ground surface to approximately Elev. 140, Stratum C_1 values of preconsolidation stress range from 11.7 to 13.8 tons per square

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foot (tsf) as compared with maximum effective overburden pressures of 0.5 tsf. These high preconsolidation stresses are probably due to desiccation during periods of depressed water levels following the deposition of Stratum C_1. Between about Elevs. 140 and 132, a transition zone between Strata C_1 and C_2 was encountered in most of the borings. The preconsolidation stresses in this zone are 40.0 to 4.5 tsf above effective overburden pressures. Below about Elev. 132, Stratum C_2 is preconsolidated in the range of 1.0 to 1.5 tsf above the existing effective overburden pressure.

Strength Tests - Strength testing predominately consisted of unconsolidated undrained (UU) triaxial shear tests with confining pressures equal to 80 percent of the effective overburden stress. Occasionally, where silt seams were not visually evident, unconfined compression (UNC) tests were performed. Where the UU tests indicated low strength results and sensitive silt layers were evident within the sample, consolidated undrained (CU) triaxial shear tests were performed with the samples consolidated to 80 percent of the effective overburden pressure. Strength testing of undisturbed samples indicates that the Stratum C_1 clays are much stiffer than Stratum C_2 deposits with a transition zone between the strata. Upper Stratum C_1 clays, from ground surface to about Elev. 140, are stiff with measured compressive strengths varying between 0.8 and 2.6 tsf. Laboratory testing of these upper Stratum C_1 clays are characterized by failures on slickensided or fissured surfaces (four or seven samples tested) with a corresponding reduction in measured compressive strength. Results from such tests are not indicative of the in-situ strength of Stratum C_1 along a continuous slip plane. Ignoring the fissured and slickensided failures, the Stratum C_1 clays compressive strengths are in excess of two tsf. In the transition zone, about Elevs. 140 to 132, a drop-off in compressive strength was noted. With the exception of one UU test with a strength of 0.7 tsf, compressive strengths in this zone varied between 1.4 and 1.8 tsf. A consolidated undrained triaxial test was performed on the low strength sample and resulted in a compressive strength of 1.5 tsf. The sample tested was consolidated to 80 percent of existing overburden and, if not disturbed, should be indicative of its in-situ strength. Below about Elev. 132, there is a sharp drop-off in compressive strength of the Stratum C_2 clays. Compressive strengths of Stratum C_2 vary between 0.4 and 1.1 tsf and average about 0.5 tsf. The strength of Stratum C_2 clays are very sensitive to slight sample disturbance which is probably reflected in the low observed strengths. The undrained shear strength is equal to one-half the compressive strength.

Permeability Tests - Six undisturbed tube samples were subjected to falling head permeability tests. The permeability samples were about 2.8 inches in diameter and between 2.6 and 3.7 inches long. The samples were tested in a flexible wall permeameter with back pressures of 50 psi. Cell pressures were chosen to produce an effective stress of 80 percent of the in-situ effective overburden stress for each sample tested.

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The tests measured vertical permeability of Strata C_1 and C_2 clays. The vertical permeability is an indication of the clay permeability and generally does not reflect the presence of more permeable horizontal layers such as silt varves or sand partings. Stratum C_1 permeabilities range from 0.24 x 10^{-7} cm/sec to 0.36 x 10^{-7} cm/sec and average 0.3 x 10^{-7} cm/sec. Stratum C_2 permeabilities range between 0.36 x 10^{-7} cm/sec and 0.93 x 10^{-7} cm/sec and average 0.7 x 10^{-7} cm/sec.

Water Content Profile - There is no specific water content trend with depth. Natural water contents within Strata C_1 and C_2 generally range between 30 and 40 percent of dry weight. In general, the liquid and plastic limits decrease with depth in Stratum C_1 and increase slightly with depth in Stratum C_2. Natural water contents of Stratum C_1 clays fall far below the liquid limit, indicative of its heavy overconsolidation. Natural water contents of Stratum C_2 clays plot essentially at the liquid limit.

Response to Question Number 3.

Hazardous Waste Requirements at Site 10

The Department by letter dated March 18, 1986 required that the Project Sponsor Group apply for a Certificate of Environmental Safety and Public Necessity (6NYCRR Part 361), when we last attempted to obtain approvals for the Hudson River Project. A copy of the referenced letter is attached. Although the size of the project has expanded, I have no reason to believe that the requirements outlined in that letter would change.

Response to Question Number 6.

Proposed Containment Facilities at Site 10

The proposed containment facility will consist of four lined containment cells with a nominal capacity of about 3.5 million cubic yards, a roughing and storage pond, and a water treatment plant. The containment facility footprint and related construction (including roads, ditches, etc.) will occupy approximately 145 acres. Containment cells 1, 2, 3 and 4 will occupy approximately 16.5, 22.1, 16.1 and 14.5 acres, respectively, as measured at the berm centerlines. The estimated dredge solids volume of each cell, allowing for four (4) feet of freeboard is 515,000, 638,000, 414,000 and 365,000 cubic yards, respectively. The dry spoils volume, (remnants and dredge spoil sites) that can be placed above the dewatered sediment is 662,000, 520,000, 217,000 and 128,000 cubic yards, respectively.

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Dredged material will be delivered to the containment cells at a rate of 13 to 15.5 million gallons per day (mgd), 17 hours per day, in the form of a sediment-water slurry. Approximate solids concentration will be 5 percent by weight, depending on the method of dredging selected. The contaminated sediments will remain in the secure containment facility for an indefinite period of time.

The containment facility will have a 36-inch clearance from the top of slurried material to the top of the liner, and a 48-inch clearance from the top of the material to the top of the berms. Overflow from the containment cells will be conveyed to the 4-acre roughing and storage pond. The pond will give flow equalization capacity and will provide additional solids removal capacity required prior to treatment of the slurry water. Any significant accumulations of settled solids in the pond will be recycled back to the containment cells for encapsulation.

The water treatment plant will occupy approximately 3.5 acres and will be designed to treat a constant flow of 13 mgd on a seven day per week basis. The plant will separate PCB-contaminated solids that may remain in the effluent after sedimentation in the containment cells and the roughing and storage pond from the transport water prior to discharging the treated water to the Hudson River. The plant will consist of three solids contact clarifiers and a sand filter. A separate chemical feed building will also be provided adjacent to the treatment plant.

A double composite liner with primary and secondary leachate collection systems will underlie the containment facility to prevent migration of PCBs to the groundwater The liner system will consist of the following, from bottom to top: a three-foot thick compacted clay secondary liner; a secondary leachate collection system constructed of two layers of drainage net (geonet), except on side slopes where there will be only one layer of drainage net, covered top and bottom with filter fabric (geofabric); a primary soil liner consisting of two feet of compacted clay; a primary synthetic liner identical to the secondary liner made of textured 80 mil HDPE; two layers of synthetic drainage net (one layer on the side slopes) covered top and bottom with a filter fabric to serve as a primary leachate collection system; and a one foot layer of sand designed to serve as a protective layer over the primary leachate collection system.

Upon completion of the dredging phase of the project, the containment cells will be dewatered by a combination gravity-fed/pump underdrain collection system. The dry material (i.e., sediments from the dredge spoil areas and remnant deposits) will be placed on top of the de-watered dredged material. The roughing and storage pond will be drained and all PCB-contaminated materials will be removed and placed in one of the four cells. The water treatment plant will be dismantled at the completion of dredging and a small package plant or storage tank will remain in place to provide for treatment of leachate.

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Upon completion of the water treatment phases of the project, the containment cells will be closed and covered with a low permeability soil and membrane liner cap, graded and landscaped.

The facility is designed to control surface water. No potentially contaminated water will be discharged to Dead Creek or the Hudson River. During the early stages of construction, a perimeter ditch will be constructed around the containment cell areas to collect and divert uncontaminated overland flow around the site to the Hudson River. Streams will be redirected to the perimeter ditch and drainage swales will be eliminated. The perimeter ditch will be designed to accommodate a 24-hour, 25-year storm event. Surface water flow into the cell and treatment facilities will be prevented by both the perimeter ditch and the containment berms. Surface drainage will be diverted to the Hudson River rather than to Dead Creek.

During operation, overflow water from the containment cells will be pumped to the Roughing and Storage Pond that serves as an equalization basin for feed to the return water treatment plant. Treated water will be discharged to the Hudson River via an open channel and outfall pipe, which is designed to withstand the expected flood levels without significant damage. After closure, surface flow will be directed to the perimeter ditch and discharged to the Hudson River or the mitigation wetland. Overflow from the mitigation wetland would be conveyed to Dead Creek via a spillway.

Response to Question Number 9.

Water Treatment at Site 10

Water Treatment Plant General

Dredge water is pumped at a constant rate from the roughing and storage pond basin to the water treatment plant. The water treatment plant will consist of three solids-contact clarifiers with provisions for the addition of flocculating chemicals, followed by gravity sand filtration. Settled sludge from the clarifiers will be pumped back to the active containment area, filter backwash will be returned to the roughing and storage pond and clarified water will be returned to the Hudson River by gravity flow. Associated with the water treatment plant will be a sludge pumping facility and a chemical feed building which will provide storage and metering facilities for the flocculation chemicals.

Sludge Pumping Facility

The sludge pumping facility will consist of a heated building located within the Water Treatment Plant diking. The facility will be comprised of three pumps, and

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appropriate valving to isolate each pump and prevent backflow. The pumps will be sized so that any two will be capable of pumping one day's sludge production (an estimated 173,000 to 226,000 gallons of 5 percent solids slurry) from each clarifier back to the active containment cell in an eight-hour period.

As the potential for long sludge pumping distances exists, positive displacement pumps will be used. Two pump types have been identified as being suitable for the task. Either air driven, double-diaphragm pumps or mechanical rotor and stator pumps.

The pumps, associated piping and fittings will be fabricated using steel or iron in contact with the sludge. Other materials which may be in contact with the slurry (such as pump diaphragms) will be of sufficient strength and durability for the needs of the project.

Chemical Feed Building

A prefabricated steel building will be erected on the site to house water treatment chemical storage tanks, pump station controls and chemical feed pumps. Depending on space constraints, showers, sinks and lockers may also be provided in the building for use by the water treatment plant operators and other personnel.

In the Chemical Feed Building the polymer feed system will consist of fiberglass or plastic (PVC, HDPE or Polypropylene) chemical storage tanks holding approximately 5,000 gallons of cationic polymer. Two chemical feed pumps will draw from the tank and inject polymer into a two-inch chemical make-up water line. Two pairs of chemical feed pumps will withdraw diluted polymer from the make-up line and pump it to an injection point on the leachate collection forcemain and on the dredge water influent line. Piping from the chemical feed pumps will be run on overhead pipe racks to reduce interference with other operations.

Chemical feed pumps will be sized so that each unit in a pair will have sufficient capacity to provide necessary chemicals. Flow-proportioned chemical addition will be controlled using outputs from magnetic flow meters on the leachate collection forcemain, the dredge water influent line, and the chemical make-up water line.

Chemical requirements are discussed in subsection 4.3.5. For the prescribed dosage of 52 mg/l the polymer usage rate will range from an average of 800 gallons to 1,000 gallons (peak) per day. Dilution water for each flow case will be 78,000 gallons and 88,000 gallons, respectively.

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PROCESS DESIGN

General

Design of the process for removal of PCBs from the water accompanying the sediments dredged from the River is based on the fact that PCB compounds are hydrophobic. That is, the vast majority of PCB in the dredged material will be adsorbed on the sediment particles rather than dissolved in the water. Therefore, if all of the solids are removed, most of the PCB will be removed and the dredge water can be returned to the River with a minimal (0.005 - 0.020 ppm) amount of PCB as compared to the large amount (2.5 -15.0 ppm, or 50 to 300 ppm on sediment alone with inflow at 5 percent solids) which entered the process.

Several laboratory sedimentation studies have been completed by Malcolm Pirnie have been completed on the material to be dredged. These included long tube experiments to determine discrete settling rates and jar tests to determine the most effective flocculation chemicals and chemical dosages. The results of these studies are used for the design of the water treatment facilities. Settling velocities as defined by Stoke's law are also used.

Containment Area

The minimum containment area size is dictated by the volume of material which must be stored as a result of the planned dredging activity. This size of the area must also be sufficient to allow the dredged solids to settle. It is proposed to dredge approximately 2.12 million cubic yards of PCB contaminated sediment. The volume is to be split into four cells separated by dikes. As a settling basin, each containment area will be an order or magnitude larger than that necessary to settle all of the particles that are settleable without chemical addition for coagulation.

Roughing and Storage Pond

Under normal operating conditions, there will be very little carry-over of solids from the containment area that will be removed in the roughing and storage pond. It will serve primarily as a storage basin for the water treatment plant, allowing it to operate continuously when dredging operations are shut down.

The roughing and storage pond will also act as a buffer between the containment area and the water treatment plant. It is sized so that in the event that the containment area is completely bypassed, it will provide an influent to the water treatment plant equivalent to the effluent form the active containment area under normal operating conditions. This is accomplished by sizing it to remove the smallest particle that the containment area will remove.

The roughing and storage pond pumping station will be controlled from a panel in the chemical feed building or from local start/stop switches at the pumps. The pump discharge rate will be adjusted to maintain a reasonably constant flow to the treatment plant even though the water surface elevation in the roughing and storage pond may vary somewhat. A chart recorder mounted in the control panel will provide a continuous record of the rate of flow through the pumping station.

Particle Settling Calculation

The rate at which a particle will settle by gravity in a fluid is dependent on a number of factors, including the particle size, shape and density, and the density and viscosity of the fluid. This subject has been long studied, and a relationship known as Stoke's Law is appropriate for the particle sizes of interest. This relationship is:

$$Vc = \frac{Gdp^2(Pp - P)}{18\mu}$$

where	G	- acceleration due to gravity = 32.2 ft/s^2
	Dp	- particle size
	Pp	- particle density
	P	- fluid density
	μ	- fluid viscosity
	Vc	- terminal velocity

For sedimentation calculations the flow rate divided by the terminal velocity is equal to the minimum surface area required to settle a particle of size Dp. There is a limit, however, to the size of particles that can be settled by gravity. As particle size gets smaller, the terminal velocity, or settling rate gets smaller. At very small particle sizes, particles become influenced by forces in the fluid, other than gravity, which keep them from settling readily. Thermal gradients or wind action will cause currents which compete with gravity and keep the particles in suspension.

According to Metcalf and Eddy (1979), the smallest particle size which is settleable is 10 μm. Particles smaller than this can be settled but require the addition of a coagulation chemical, which has the effect of coalescing the small particles into larger "flocs" which will settle more readily.

The settling rate of 10 μm (or 0.01 mm) particle is, according to Stoke's Law, 14.3 ft/day, which corresponds to an overflow rate of 107.0 gpd/ft^2. At an average flow of 13 MGD this corresponds to a required settling area of 2.79 Ac. Note that even though the containment area is an order of magnitude larger than the roughing and storage pond, it cannot effectively remove particles smaller than 10 μm.

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Chemical Addition

Jar tests conducted by Malcolm Pirnie in 1980 indicated that the best coagulation chemical (polymer) to use would be Nalco 7132 (since 1980 this chemical has been renamed by the Nalco Chemical Company as Nalco 8100). The optimum chemical dose was found to be 0.026 mg/l per mg/l of suspended solids. At a suspended solids concentration of 2000 mg/l this corresponds to a dose of 52 mg/l. Other combinations of polymer and alum were also tested to find an alternate coagulation method that cost less than polymer alone. A combination of alum, polymer and caustic (110 mg/l Alum {10 mg/l Al^{+3}}, 2 mg/l Nalco 7132, 5 mg/l caustic {sodium hydroxide}) was found that gave acceptable results. Although the alum-polymer-caustic system is less expensive in material costs, it requires more material storage and handling facilities. It will also increase the amount of solids produced by approximately 15%.

Water Treatment Plant

The water treatment plant will consist of three 125 foot diameter solids-contact clarifiers followed by a multi-compartment sand filter. Laboratory settling tests conducted by Malcolm Pirnie, Inc. in 1980 indicated that at optimum coagulant dosages, suspended solids were almost completely removed by gravity sedimentation at overflow rates of 500 gpd per square foot. After applying a 0.7 safety factor the overflow rate would be 350 gpd per square foot. This is markedly less than the 1440 gpd per square foot recommended as the upper limit for solids-contact units used for potable water clarification (Great Lakes Upper Mississippi River Board of State Public Health and Environmental Managers, 1987). To assure the removal of solids from the return water, it will be filtered through a single media filter at a loading rate of 5 gpm per square foot.

Both the solids-contact clarifier and filter systems will consist of multiple units which will allow the system to continue operating when one unit is take out of service for maintenance. The filter unit shown is compartmentalized to allow for backwashing during operation.

PCB Removal Effectiveness)

PCB compounds are hydrophobic (do not mix readily with water) oils and hence dissolve only slightly in water. Most of the PCB present in the dredged sediments to be treated is adsorbed onto the surface of the sediment particles. PCB removal in the process outlined is accomplished not by removing PCB directly but by removing the sediment solids to which they are attached. Since the treatment plant removes PCB by removing sediment, its effectiveness is directly related to its solids removal efficiency. The process and chemicals investigated are expected to provide 99% or better removal of suspended solids (2000 mg/l reduction to 5 mg/l), so very good PCB removal rates are expected.

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The concentration of PCBs found dissolved in the dredge water is directly related to the amount of PCBs absorbed onto the sediment particles by a factor known as the partition coefficient. Given a concentration of PCB in microgram per gram (μg/g) of sediment it is possible to estimate the concentration in the water column. The relationship for the partition coefficient is:

$$K = \frac{PCB_{SED}\ (\mu g/g)}{[PCB_{WAT}\ (\mu g/l)/1000]}$$

Given the concentration of PCBs on the sediments and a partition coefficient, an estimated concentration of PCBs dissolved in the water can be calculated. The total PCBs in the water treatment plant effluent will consists of these dissolved PCBs plus the PCBs attached to the suspended solids remaining in the effluent (SS_{EFFSS}) is obtained by the following equation.

$$PCB_{SED}\ (\mu g/g).SS_{EFFL}(mg/l).(1\ g/1000\ mg) = PCB_{EFFSS}\ (\mu g/l)$$

The total effluent PCB concentration is therefore:

$$PCB_{TOT}(\mu g/l) = PCB_{WAT}(\mu g/l)\ \ PCB_{EFFSS}\ (\mu G/L)$$

Previous studies give K at 20°C for trichlorobiphenyls as 20,100. More chlorinated isomers have higher K values and less chlorinated isomer have lower K values and less chlorinated isomer have lower K values. The actual isomer distribution in the dredged sediment is expected to center around the higher isomers (the tetrachlorobiphenyls, which are the most common isomers in Aroclors 1248 and 1016) so use of the trichlorobiphenyl partition coefficient will give a conservative (high) estimate of the return water PCB concentration. For an average sediment PCB concentration of 31 μg/g (the approximately average concentration of the Thompson Island Pool sediments) the total return water PCB concentration would be 1.70 μg/l with 9.1 percent of this being carried on the sediment. ~~For an average sediment PCB concentration of 31 μg/g (the approximately average concentration of the Thompson Island Pool sediments) the total return water PCB concentration would be 1.70 μg/l with 9.1 percent of this being carried on the sediment~~. For an average sediment PCB concentration of 100 μg/g, which may be expected is some of the more contaminated areas, the return water PCB concentration will be 5.5 μg/l, again with 9.1 percent of this carried on the sediment. This analysis shows that the concentration of PCBs in the water does not depend as much on the <u>amount</u> of sediment in the water as it does on the <u>concentration</u> of PCBs <u>on</u> the sediment.

Other researchers have demonstrated a relationship between suspended solids concentration and concentration of dissolved PCB in the water column (DiToro and Horzempa, 1983). Based on this work, for sediments with a fixed concentration of PCB, a reduction in the dissolved PCB concentration is expected as the quantity of suspended solids is reduced by treatment (gravity settling, chemically assisted settling and finally, filtration). The magnitude of this effect in the proposed treatment system is uncertain. While the DiToro and Horzempa study supports the principle that water column PCB concentration will likely decrease during the course of the treatment, for purposes of a conservative estimate of treated effluent PCB concentration, it is assumed that the amount of PCBs dissolved in the water remains the same from the beginning to the end of the process.

The use of filtration/carbon adsorption to remove dissolved PCB from the water has been investigated in the past. It was not considered cost-effective. With an estimated 4 percent of PCB either missed or lost to resuspension, it was determined that the additional PCBs removed by filtration/carbon adsorption would be only 0.3 percent of the total PCB in the areas to be dredged - approximately 95.7 percent already having been removed n the containment area and sedimentation basin. However the cost per pound to remove this 0.3 percent would have been 100 times the cost per pound to remove the first 95.7 percent increasing the cost of the whole process substantially with a very minor improvement in effluent quality. In addition, should sufficient funds be available to consider carbon treatment, it is thought that removing more contaminated sediment from the River and thereby removing a larger mass of PCB from the ecosystem would be a more prudent option. For these reasons filtration/carbon adsorption was not considered a viable treatment option.

[redacted]

J. Dergosits - June 22, 1994

Response to Question Number 11.

Project Costs

PROJECT COST ESTIMATE

River Sampling and Analysis	$ 11,100,000
River Dredging/Treatment Plant Operation	$ 54,900,000
Remnant Deposit Translocation	$ 13,800,000
Dredge Spoil Area Translocation	$ 23,500,000
Site 10 Construction	$ 71,400,000
Ground Water Monitoring	$ 3,100,000
Site 10 Closure	$ 28,000,000
Site 10 Post-Closure	$ 21,600,000
Waterford Water Works Alternative Supply	$ 100,000
	$227,500,000

Notes:

ENR Index 4946
All numbers rounded to the neareast 100,000
Costs for canal maintenance dredging not included in this estimate
Dredging costs reflect upper pool pipeline transport with lower pool scow transport

NYSDEC estimates the total cost for the Hudson River PCB Project to be approximately $280 million. The table above presents the approximate cost for the key components of the project. The costs presented in this table do not include the estimates for land acquisition, NYSDEC administration (e.g., staffing and overhead), crop mitigation, environmental monitoring, and escalation. An escalation factor has not been added to those items that will occur in more than one year, such as the 30-year post-closure period. The estimate presented in the table for post-closure is simply the product of the annual cost multiplied by 30 years. The final cost of the completed project is expected to approach $280 million when the above noted items are included.

Excavation/Translocation of Remnant Deposits and Dredge Spoil Areas

A volume of approximately 1,369,800 cy of PCB-contaminated material having approximately 139,200 pounds of PCBs is proposed to be removed from the four remnant deposits and eight dredge spoil areas. This material will be excavated and translocated to the encapsulation facility.

The remnant deposit areas contain the highest concentrations and largest mass of PCBs in the Hudson River, with an estimated 71,800 pounds of PCBs in 465,200 cy of sediments that were exposed when the former Fort Edward dam was removed in 1973. In-place, the remnant deposits represent a potential long-term source of PCBs to the lower Hudson River.

In the feasibility study for the Hudson River PCB sites, USEPA recommended an interim in-place containment for Remnant Deposits 2, 3, 4 and 5. Subsequently, General Electric undertook the interim remediation of the four remnant deposits in 1990. The typical cap construction operation for the remnant deposits included grading the site to a slope of approximately 3.5 percent and capping the site with an average of eight inches of sand, a synthetic clay liner called "Claymax", topped with a minimum of 12 inches of sand and six inches of topsoil, and revegetated with grasses. The banks along the river were stabilized with riprap and fences were erected to restrict public access.

As is noted in the 1984 Record of Decision this interim remediation is not expected to prevent PCBs leaching from the remnant deposits into the Hudson River. Since these measures will not prevent leaching of PCBs into the Hudson River from these sites, the remnant deposit areas have been included for planning purposes as part of this project. Unless USEPA (or GE) is able to demonstrate the feasibility of practical field application of a PCB destruction-decontamination technology within a timeframe compatible with New York State's planned actions, the Project Sponsor Group will endeavor to have appropriate portions of the remnants excavated and translocated to a secure encapsulation facility at Site 10.

The dredge spoil areas do not appear to contribute substantially to the river's contamination, but pose risks to the public near these sites due to potential groundwater and air contamination. Three of the eight dredge spoil areas, Old Moreau, Special Area 13 and Buoy 212, were capped with sand, topsoil and grass in 1979. As interim remediation in 1991, Special Area 13 and Buoy 212 were graded, clay-capped and revegetated. These three dredge spoil areas have approximately 65,500 cy of cover material that will be excavated and translocated with the PCB-contaminated sediments. All the dredge spoil areas are unlined and continue to pose a potential source of contamination to groundwater. The eight dredge spoil areas have approximately 67,400 pounds of PCBs in approximately 839,100 cy of sediment.

Selected Dredging Alternative

The preferred dredging method for both the Lower and upper Pools is hydraulic cutterhead; this method will minimize the amount of material lost at the dredgehead. In the upper Pools, hydraulic pipeline is the preferred method of transporting material to Site 10. This method reduces project impacts to commercial and recreational traffic, reduces wear on the Locks 5 and 6, and increases production rates. The result is lower direct dredging costs and indirect costs associated with the impacts mentioned above. In the Lower Pools, the preferred dredging method of transporting material to the pumpout facility at Lock 5 is a combination of scow and pipeline transport. This alternative will cost an estimated $8.62 million more than scow transport only; however, it was chosen because it will eliminate the impacts to commercial and recreational traffic using the canal and reduce the wear on Locks 3 and 4.

	Volume (CY)	Area (sq. ft.)
UPPER POOLS		
Thompson Island	718,600	8,249,800
Lock 6 Pool	141,500	1,770,100
Lock 5 Pool	284,200	3,465,900
Subtotal	1,144,300	13,485,800
LOWER POOLS		
Lock 4 Pool	314,700	3,722,800
Lock 3 Pool	146,000	1,769,500
Lock 2 Pool	192,100	2,068,000
Subtotal	652,800	7,561,300
TOTAL	1,797,100	21,046,100

In addition to the 1,797,100 cy identified to be dredged from the upper and lower pools, another 300,000 cy from canal maintenance and an estimated 23,000 cy from the area above the Fort Edward Terminal Channel would be dredged as part of this project. The total volume of sediment proposed to be dredged from the Hudson River is 2,120,100 cy.

The total time required, including mobilization and demobilization, is estimated to be approximately 17 dredge months for the upper Pools and 10 dredge months for the Lower Pools.

Use of two 12-inch hydraulic dredges pumping via pipeline directly to Site 10 is the more economical of the methods evaluated for the upper Pools. Estimated dredging costs for the upper Pools over a two-year period are shown below.

UPPER POOLS		PIPELINE TRANSPORT	SCOW TRANSPORT
Thompson Island Pool		$ 9,458,000	$12,562,000
Lock 6 Pool		2,399,000	2,783,000
Lock 5 Pool		4,678,000	5,361,000
Mobilization and Demobilization (two seasons)		4,330,000	5,060,000
	Subtotal	$20,865,000	$25,766,000
1991 to 1992 Escalation (3%)		$ 626,000	$ 773,000
Contingencies (10%)		2,087,000	2,577,000
Bonds and Insurance (1.5%)		313,000	386,000
TOTAL UPPER POOLS DREDGING COSTS		$23,891,000	$29,502,000

A summary of the dredging costs for the alternative transport method considered for the Lower Pools is shown below.

LOWER POOLS		COMBINATION TRANSPORT	SCOW TRANSPORT
Lock 4 Pool[(1)]		$ 8,073,000	$ 8,073,000
Lock 3 Pool		6,936,000	3,503,000
Lock 2 Pool		10,320,000	5,280,000
Mobilization/Demobilization (one season)		1,790,000	1,670,000
	Subtotal	$27,119,000	$18,526,000
1991 to 1992 Escalation (3%)		$ 813,000	$ 556,000
Contingencies (10%)		2,712,000	1,853,000
Bonds and Insurance (1.5%)		407,000	278,000
TOTAL LOWER POOLS		$31,051,000	$21,213,000

Note: Both transport alternatives use scow transport in Lock 4 Pool to a pumpout facility at Lock 5.

The dredging production and cost estimates are based on dredge ladder swing speeds of 30 feet per minute for the digging swing and 60 feet per minute for the cleanup swing in open water, 20 feet per minute for the digging swing speed, and 40 feet per minute in shoreline areas. If, due to unacceptable dispersion of contaminated material, a reduction of swing speeds is required, the time required to perform the work and the resulting costs would increase on a proportionate basis. For example, if the swing speeds are reduced to 20 and 40 feet per minute, the total time required would increase by 7.8 dredge months and the dredging costs by $10.4 million. An additional mobilization would also be required.

Exhibit 23 (RCMP - 2)

• New York State Department of Environmental Conservation
Ray Brook, NY 12977
(518) 891-1370

Henry G. Williams
Commissioner

March 18, 1986

Russell C. Mt. Pleasant, P.E.
Assistant Director, Division of Water
Dept. of Environmental Conservation
50 Wolf Road
Albany, NY 12233-0001

Re: Notice of Requirement for a Certificate of Environmental Safety and Public Necessity
Application No. 50-86-0024
Hudson River PCB Reclamation/ Demonstration Project

Dear Russ:

We have reviewed your Application for Approval to Construct a Solid Waste Management Facility for the above noted project and have determined that a Certificate of Environmental Safety and Public Necessity (Certificate) is required. The information required for a Certificate Application is specified in 6 NYCRR Subsection 361.3(e).

In addition, a permit to construct and operate a hazardous waste management facility is required pursuant to 6 NYCRR Subpart 373-1. The information required for a permit application is specified in Section 373-1.5. Since there is no application form available at this time, we need a covering letter stating what permit is being applied for and describing the project. The application that you previously submitted (Form 47-19-2) is not needed; therefore, I am returning it to you.

Other permits/approvals from the Department required for this project that have been identified at this time include a State Pollutant Discharge Elimination System (SPDES) Permit, a Waste Transporter Permit and a Certification of Water Quality pursuant to Section 401 of U.S. Public Law 95-217 (401 Certification). A brochure entitled "Getting a DEC Permit - SPDES Permit," instructions and the application forms for the SPDES Permit are enclosed. As discussed at our meeting on February 11, 1986, the SPDES Permit is required for the discharge of return water during the project and the discharge of leachate from the collection system. We also need a written statement requesting issuance of a 401 Certification and a copy of the properly completed application and supporting information for the Federal permit requiring the certification. If the 401 Certification is for the same scope of activities proposed in the original project and a new application for a Federal permit is not required, we can utilize the information provided for the original project.

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We have determined that there is insufficient information available to apply for a Waste Transporter Permit at this time and that information is not required to process the other applications. Therefore, there is good cause not to require the Waste Transporter application as part of the other applications.

Other major items discussed at the February 11, 1986 meeting and their subsequent resolution include:

1. The Project Sponsor section of DEC will serve as the lead agency for SEQR compliance. The Regulatory Review section will function as an involved agency with the primary responsibility to identify requirements related to the regulatory permits/401 Certification.

2. The Project Sponsor as lead agency will explore the possibility of entering into a Memorandum of Understanding with the U.S. Environmental Protection Agency (EPA) to establish co-lead agencies at the State and Federal levels. This arrangement would combine the State SEQR and Federal NEPA review process. The role of EPA will be to insure that environmental review and NEPA requirements are met.

3. The Project Sponsor will compare the currently proposed project with the previous project. Where there is a material change in the scope of the project as originally proposed which was not adequately addressed in the previous Environmental Impact Statement (EIS), such as the new PCB containment site (Site "G"), a Draft Supplemental EIS will be submitted as part of the required applications

4. No Air Permits are required, but air monitoring conditions will be imposed in conjunction with other permit approvals.

5. The wetland on proposed Site "G" is not protected pursuant to Article 24 ECL, but requirements for its protection imposed by EPA must be met.

6. Cultural resource concerns associated with Site "G" will be addressed in the Draft Supplemental EIS. Since the proposal is subject to review under Section 106 of the National Historic Preservation Act of 1966 (part of the EPA review), separate consultation pursuant to the State Historic Preservation Act (Article 14 of the Parks, Recreation and Historic Preservation Law) and implementing regulations (9 NYCRR Part 428) is not required.

Any questions of a technical nature concerning the requirements for the certificate or the permit to construct the hazardous waste management facility should be directed to Ray Cowan in the Warrensburg office (518-623-3671). Any questions of a technical nature concerning the SPDES Permit application or the 401 Certification should be directed to Wiley Lavigne in the Ray Brook office (518-891-1370). Please contact me if you have any questions on the administrative processing of the applications, when you need input on the Draft Supplemental EIS prior to its acceptance for public review or if any questions or information needs develop and you need assistance in identifying the appropriate Regulatory staff to contact.

Very truly yours,

Richard A. Wild

Richard A. Wild
Regional Permit Administrator

RAW:mb
Enc. cc: J. Eckl, R. Cowen