Below please find responses to each of the concerns addressed in the 23 September letter. For ease of review, we have written in DEC's comments/questions in underline.

1. On pages 2 and 6, Item #1 asserts that contaminant discharge will be reduced by reducing the surface area of the sediments that are to be dredged from the marina. While this may be true, it makes the assumption that the sediment remaining in the marina after dredging will be uncontaminated, that no new contaminated sediment will be deposited in the marina and that the marina area will not have any impact on water quality. This assumption needs to be supported.

Tests performed on the sediments at Royal Marina indicate that they contain very little contamination (see Sampling Protocols and Results Appendix). As described in the Technical Appendix (p 13), coherent gray clays or gleys are encountered below varying thicknesses of surface sediments. It is widely understood that gleys such as these were deposited in a lacustrine environment several thousand years prior to the time when rising sea level filled the basin of Long Island Sound with brackish water. These gleys are therefore quite unlikely to be contaminated with dioxins, PCBs, and PAHs, as well as priority metals. Dredging of Royal Marina is directed to remove approximately three feet of sediments, down to these gray clays.

New sediment that accumulates in the Marina is likely to be less contaminated based on documented trends in contaminant input for New York Harbor[1] (& ref. below), San Francisco Bay (van Geen and Luoma, in press, and references therein), and other urban estuaries. The Pelham Project also sites specific work on sediment quality both in the Geophysical and Sedimentological Research section (p 12) as well as the Geochemical Research section (p 16). As noted in the this document, a number of methods will be used to characterize sediment quality, including the evaluation of concentrations of sensitive indicators such as Pb in long thin cores at several locations.

The DEIS and the Pelham Project both assume that the marina on the northwest coast of City Island and the containment facility around the Pelham Bay Landfill will act as sedimentary environments. As noted above (and below), improved sediment quality in the NY Harbor Estuary is expected to contribute to improved sediment quality in the marina, while this same tendency coupled with the biogeochemical mechanisms at work in the marsh environment of the containment facility are expected to greatly improve sediment quality around the landfill. The technical appendix documents the kinds of sediment and water quality improvement which can be expected in wetland environments. As stated in the Technical Appendix and in the Pelham Project, the purpose of this work is to assess and characterize new accumulations of specific sediment categories deposited on the site from local to regional sediment sources. The geophysical, hydrodynamic, and geochemical research and development framework of the Pelham Project will thus analyze this sediment stream to document how well characterized mechanisms of pollutant removal protect local environmental quality from chemicals of concern.

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[1] Ayers, R.U. and S.R. Rod. 1986. Patterns of Pollution in the Hudson-Raritan Basin. Environment. 28(4): 14-43. Bopp, et al. 1991. A Major Incident of Dioxin Contamination: Sediments of New Jersey Estuaries. Envrion. Sci. Technol., Vol. 25, No. 5. p. 951-956. Wenning, et al. 1994. Accumulation of Metals, Polychlorinated Biphenyls, and Polycyclic Aromatic Hydrocarbons in Sediments from the Lower Passaic River, NJ. Arch. Environ. Contam. Toxicol. 27, 64-81. Bopp, et al. 1998. Trends in Chlorinated Hydrocarbon Levels in Hudson River Basin Sediments. Environmental Health Perspectives, vol. 106, Supplement 4, August, 1998.

Data sets put together by Bopp, Chillrud, and their collaborators[2] as well as by EPA indicate that groups of specific pollutants have decreased in various portions of the New York/New Jersey Harbor River Estuary over time. While data sets are site specific, it is clear that overall tendencies are towards greatly improved sediment quality, between about a factor of five and an order of magnitude (see table 3, p 142 in Chillrud et al. 1996). This trend supports the generalizations expressed in the DEIS that sediment quality has improved in the past three decades in the NY/NJ Harbor Estuary.

The Pelham Project, in which a number of the above cited authors are collaborators, will augment and enhance such data for the western Sound and Eastchester Bay. Measurement of pre- and post-construction concentrations of chemicals of concern are central features of the documentation in the proposed research and development program. While such efforts have been outside of the scope of virtually all testing protocols for dredging projects to date, they are included in the Pelham Project in order to provide a solid basis for future policy decisions in the harbor estuary.

2. Item #2 on pages 2 and 6 assumes that the wetlands habitat created will be more valuable than the existing subtidal area that will be destroyed. Before that can be determined, the value of the existing habitat must be described in greater detail through current bathymetric and biological surveys. The DEIS should also discuss the value of the habitat exchange if the project does not manage to create a functional wetlands area and what provisions will be made to ensure that wetlands remain functional after the end of the study.

Item #2 on pages 2 & 6 states that "diverse habitat types" are more valuable than the present uniform habitat type. Specifically "... intertidal marsh, mudflat, rocky intertidal, rocky subtidal zones, and creeks" are known by all working ecologists and fisheries biologists to be more biologically diverse, ecologically productive, and therefore valuable than subtidal sedimentary habitat by itself. This, therefore, does not assume that created wetland habitat will be more valuable than existing subtidal area. The basic assumption of these portions, and the whole of the DEIS, is that habitat diversity is of much greater value than habitat uniformity. The DEIS provides documentation for this in terms of overall ecological productivity, biogeochemical capacities to remove chemicals of concern and improve water and sediment quality, and in terms of essential fish, invertebrate, and waterfowl habitat. Specifically, based on the primary literature cited in the DEIS and historic and recent work in biogeography, intertidal marsh, flat, intertidal rocky habitat, together with subtidal rocky and sedimentary habitat, are together more valuable than subtidal sedimentary habitat by itself. Extant habitat in Eastchester Bay presently lacks these former components in significant proportions. Since the former were essential constituents of the essential fish and estuarine habitat of historic Eastchester Bay, matching re-introduction ratios to past presence will enhance the value of present sedimentary benthic habitat (see accompanying benthic habitat survey). As noted in the Pelham Project, specific geochemical, hydrodynamic, biological and ecological measures will be utilized to evaluate changes as a

[2]Bopp, R.F. and H.J. Simpson, 1989. Contamination of the Hudson River: The sediment record. In Contaminated marine sediments- Assessment and remediation. Nat. Acad. Press. p. 401-416; Bopp, R.F., S.N. Chillrud, E.L. Shuster, H.J. Simpson and F.D. Estabrooks. 1998. Trends in chlorinated hydrocarbon levels in Hudson River basin sediments. Environmental Health Perspectives 106 (supplement 4): 1075-1081; Bopp, R. F., H. J. Simpson, S. N. Chillrud, and D. W. Robinson. 1993. Sediment-derived chronologies of persistent contaminants in Jamaica Bay, NY. Estuaries. 16(#3b): 608-616; Chillrud, S. N., H. J. Simpson, and R. F. Bopp. New York Harbor sediments as indicators of temporal trends in particle-reactive contaminants. Chapter 3 in Ph.D. thesis. Columbia Univ. 1996.

function of area and type of habitat covered and created in the process of building the containment facility.

The bathymetric and biological surveys are given in response to question 18 below. In terms of project success and the functional capacity of the intertidal wetland, as stated on page 1 of the Pelham Project Proposal: "Predicted outcomes of habitat construction and restoration efforts associated with the containment facility should be stated as testable hypotheses with developmental timetables, inviting and facilitating scientific and public evaluation of project success". As noted on page 8 of the DEIS, "Monitoring and maintenance would proceed for at least 3 years following (the initial planting)". This monitoring and maintenance will track the two fundamental variables governing plant survival, growth and development: hydrology and sediment size class (or, inversely, pore geometry and volume). By iterative approaches, the required hydrological and sediment size classes will be established, with the initial dredged materials, or through subsequent amendments, replanting as required.

3. The DEIS needs to discuss the ownership of the underwater lands and what is necessary to obtain any agreement or easement necessary for the use of the area.

NYC DPR indicates that responsibility for the underwater lands resides with this agency. Representatives of this agency have informed us that restoration of historic habitat, repair of liabilities of existing land adjoining the proposed constructed wetlands, and unearthing the creeks presently channelized in storm drains in order to create freshwater and brackish creeks and ponds with available flow and groundwater are also aims of NYC DPR.

4. Page 5 of the DEIS discusses seeding the creeks with oysters as a means of erosion control. Although this may be nice as a reintroduction of a historical species to the area and natural re-establishment of oyster may indicate improving water quality, the department is generally opposed to artificial introductions of shellfish to uncertified (closed) areas. This creates an "attractive nuisance" because oysters are commercially and recreationally valuable, but in this area would be a threat to public health.

The DEIS does not discuss any reintroduction: oysters are already prevalent in adjacent habitat in and around Eastchester Bay. The point is to incorporate various structure enhancing members of the faunal community in this restoration as a means of effecting erosion control through the growth and development of the natural system. As stated, the proximate aim of the Pelham Project here is "Seeding creek beds with oysters and oyster shells to initiate oyster reef formation to minimize or eliminate creek bed erosion". Since the aim is to produce a modular containment facility containing somewhat more than an acre of intertidal marsh, in filling and emptying each tidal cycle water flow rates will reach ten cubic feet per second or more. To minimize erosion, it will be necessary to allow a creek form to organize itself into meanders. This means that sediment deposition will occur on the convex side, with scour occurring on the concave side of the meander. The aim of the Pelham Project is to minimize sediment mobilization, and create an environment which favors sediment deposition and treatment. This will require the incorporation of natural systems which dissipate energy in intertidal and creek environments and thereby stabilize sediments against perturbations. Materials in the abiotic environment are structured by biological components to organize the flow such that scouring energy is organized to maximize the exchange of nutrients or pollutants between biogeochemical systems-cordgrass and its cobionts. This aim is noted in the Pelham Project (p 5, inter alia) as well as the DEIS (p 3 inter alia). Alternatives to natural systems which dissipate and organize the energy of tidal movement are hardened rock or concrete engineered solutions, but these do not meet the aim of the Pelham Project of "... coupl(ing) the structural engineering practices of containment facility construction with the ecological engineering of habitat construction and restoration" (p 4), nor do they utilize the biogeochemical organizers of this process, i.e., "...saltmarsh cordgrass activity ... augmented by microbial cobionts and certain invertebrate animals".

Since oysters and black mussels are prevalent in the Eastchester Bay area at present, the best case scenario would be to protect the public from this attractive nuisance through the development of a citizens watchdog monitoring and protection program. To do this, the Pelham Project could explore such a program with environmental groups which have already expressed an interest in the protection of water quality enhancement biota in the area: SoundWatch, SoundWaters, New York Coastal Fisherman's Association, the Bronx Council for Environmental Quality, the New York Membership of the Sierra Club, the Stewardship Program of the NYC Soil and Water Conservation District, and local marinas, yacht clubs, sportsmen's groups, and bait and tackle shops. Initial conversations on this matter have also been initiated with the Bronx detail of the NYS Conservation Police.

<u>5. Page 7 discusses the migration of the landfill leachate to the north and east. More supporting documentation is needed of this including volumes and contaminants of concern. The landfill has been capped and the majority of leachate creation/flow due to infiltration will cease, but it will take 5+ years for this engineering solution to work. The other source of leachate creation is upflow from the bedrock. How will the created wetland affect this leachate flow.</u>

Empirical studies are the only means for characterizing leachate quantity, quality, or attenuation under various habitat restoration scenarios around the Pelham Bay Landfill. To date, assertions on any mitigation due to the biogeochemical removal by salt marsh environments, or due to any impact of decreased infiltration through capping are not substantiated. The Pelham Project is the only proposal on the horizon which aims to intensively study the post-closure surroundings of the Pelham Bay Landfill by characterizing the geochemistry and biogeochemistry of sediments and saltmarsh within and adjacent to the confined containment facility planned for the area around the landfill.

We are aware of no existing databases or long term empirical studies characterizing actual attenuation effects which follow landfill closure under a geomembrane cap. While it is expected that leachate flux will probably decrease but not cease under these circumstances, there are no empirically informed, well calibrated models to predict how this may occur. It is also possible that at least three independent inputs may contribute to ongoing leachate:

1) hydraulic conductivity may continue, since the cap may not be perfectly leak tight;
2) leachate may remain in the landfill and/or continue to be produced by ongoing breakdown of organic matter within which will continue to drain; and,
3) water table fluctuations may introduce leachate into natural groundwater flowing underneath the site, or move groundwater into the landfill.

It is expected that the boundary conditions established by any wetlands constructed around the landfill will increase the hydraulic head somewhat during low tide, thereby reducing discharge, and increasing sedimentation and hydraulic resistance of discharge areas around the landfill. Only the type of detailed surveys, modeling studies, and long terms monitoring proposed by the

Pelham Project can provide answers to the question of leachate movement and treatment into the landfill boundary.

The Pelham Project aims is to characterize leachate/groundwater flux, and to investigate biogeochemical processes which regulate COC removal. Integrated dimensional models will be used, incorporating monitoring and real-time data collection. The Woodward-Clyde work on the landfill characterized this flow to be about 80,000 gallons per day[3], but no real time data on the geochemistry of this flux was measured.

6. More detail is needed with respect to the leachate treatment aspect of this project including uptake by plants and animals and the effectiveness of treatment during cold weather periods.

Landfill leachate is now regularly treated with constructed and restored wetlands.[4] While differences occur between warm weather and cold weather performance of bio(geo)chemical processes, nitrogen, carbon, sulfur, and other biogeochemical cycles are operative in cold climates and during the colder periods of the annual cycle. The point made in many different places in the DEIS Technical Appendix is that little or no treatment is afforded by present circumstances, but, as the body of literature cited there and here attest, treatment is effected by constructed or restored wetlands. The only question which remains is, exactly how much.

The DEIS Technical Appendix gives the ranges for metals and other chemicals in the Pelham Bay Landfill leachate (p 11). This data was gathered by Woodward-Clyde for the RI/FS phase of the work involved in closure and capping (see footnote below), but no provision was made for post-closure detailing of outputs from the Pelham Bay Landfill. The Pelham Project would fill this information gap by documenting how specific physical-chemical sediment and biological interfaces affect water and sediment quality.

Since the general, 'average', macroscopic behaviors of constructed and restored wetlands are already detailed and described in several thousand peer reviewed articles, referenced, in part, below, and in the bibliography of Technical Appendix to the DEIS, relevant details for Eastchester Bay can only come from new geochemical characterizations. Developing the requisite picture of exactly how this geochemistry impacts the biota of Eastchester Bay requires the integrated Biological/Ecological Research outlined in the Pelham Project, coupling real-time, continuous data geochemical collection (p 15 & ff) with characterization of how key chemicals are partitioned between sediments, microbes, plants, and animals.

In sum, as noted on page 16 of the Pelham Project, detailed knowledge of the behavior of chemicals in leachate, water column, and sediments around the Pelham Bay Landfill will come from "Continuous monitoring of key properties inside and outside the marsh, as well as in the upper layer of marsh sediment." This is key to determining release and uptake at the chemical level in the estuary.

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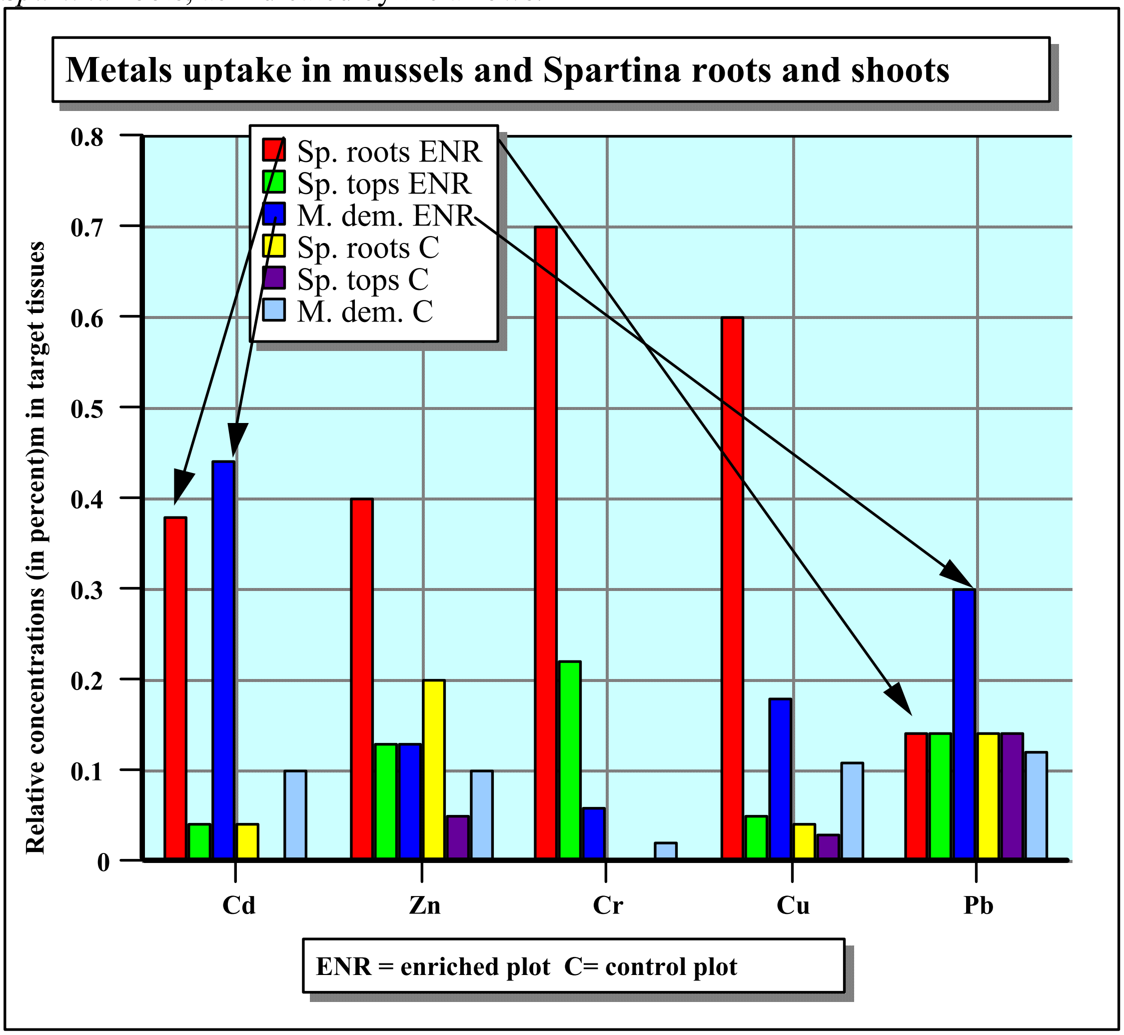
[3]Woodward-Clyde Consultants, Inc. 1993. Remedial Investigation Report. Pelham Bay Landfill, Bronx, New York. April - June 1993. Woodward-Clyde, New York.

[4]Constructed Wetland for the Treatment of Landfill Leachate, ed. by G. Mulamoonil, E. McBean, and F.A. Rovers. 1998. Lewis Publishers, Boca Raton, FL. Leachate Treatment System Using Constructed Wetlands, Town of Fenton Sanitary Landfill, Broome County, New York. 1993. Energy Authority Report 94-3 (dated November 1993). Energy Research and Development Authority. Constructed Wetlands for Water Quality Improvement, ed. by G.A. Moshiri, Chapts 50, 51, & 52. Lewis Publishers, Boca Raton, FL.

In general terms, metals in sediments are partitioned differentially between plant and animal tissue in various environments. The argument on this matter was simplified in the DEIS and Technical Appendix for the sake of brevity. Since nitrogen, phosphorous, and dissolved organic carbon are basically nutrients for microbes, plants and animals, the only question which remains regards metals. The Technical Appendix addresses this question from the classic and recent literatures (pp 22-23), and notes how input variability is a critical factor for past scientific studies. In general, however, there are patterns of uptake and partitioning of various metals. Data from a classic paper on metals partitioning is graphed below to show similarities and differences between *Spartina* roots and shoots and the ribbed mussel. The Y axis indicates percentage uptake. For the five metals listed, only cadmium and lead are higher in the ribbed mussel than in *Spartina* roots, as indicated by the arrows.



This figure elucidates the general pattern of rhizosphere/leaf & stem interactions modulating metal behavior within the plant, with differential uptake and/or storage characterizing the role of the ribbed mussel, one critical faunal element in metal transport and fate. The text of the original article stresses that sediments retain the highest concentrations of metals, and that, within these, microbial and biogeochemical reactions are major regulators of metal behavior in salt marshes.

The Pelham Project will characterize baseline water quality in Eastchester Bay, and monitor input and output water from constructed marshes to evaluate biogeochemical effects of these constructed marshes.

<u>7. The DEIS should discuss what provisions will be made for evaluating the created wetlands after the end of the three year study, what criteria will be used, what provisions there will be if the criteria are not met and what plans are being made to maintain the area after the end of the study.</u>

The Pelham Project plan describes a three year evaluation of a pilot dredged material containment facility through a heavily instrumented, intensive research program evaluating engineering criteria, hydrodynamics, geophysics, biology/ecology, and geochemistry. Since, to our knowledge, no such integrated and comprehensive steps towards evaluating the physical and (bio)geochemical processes of developing ecological systems on dredged sediments have been taken before, the initial scope was described of three year duration. The project will seek funding to continue after this initial 3 year period, in order to span at least the full five year monitoring recommendations of the Harbor Estuary Program. Such support for longer term monitoring would allow the Pelham Project to compare results of shorter versus longer monitoring for salt marsh restoration, and provide a means of evaluating specific benchmarks in marsh development which could be used to inform the Harbor Estuary Programs guidance documentation.

Because of its ongoing value as an information source, it is likely that the Pelham Project will continue in some form beyond the initial three year period. Research and development programs of this magnitude almost inevitably uncover new issues while documenting previously unresolved mechanisms governing the physical and biogeochemical behavior of natural systems. Longer term monitoring and evaluation could be insured from the onset by funding commitments to match the preferred evaluation period.

This first stage of the Pelham Project is a pilot to evaluate design, construction and implementation methods, as noted in the Research Tasks section of the Pelham Project. The characterization of sediment stabilization and conditioning methods will provide the basis for the buildout phase of the rest of the structure over several additional years. As this approach becomes a major solution to the dredging, landfill leachate, and non-point pollution problems, the research and development component of the Pelham Project will be called upon to answer specific questions after the first three years.

Modeling and monitoring will be utilized to develop predictive frameworks for the behavior of sediments, as noted on page 1 of the Pelham Project, addressing both the growth and development of *Spartina*, as well as contingency plans to meet sediment and plant coverage specifications. This approach is commensurate with the mission of the Pelham Project to demonstrate the feasibility, long term stability, and advantages of engineered constructed wetlands for dredge material treatment and disposal, including an evaluation of uptake of leachate COCs, stability of sediments, growth and development of *Spartina* and macrofaunal elements. Since hundreds of saltmarshes have been restored on various kinds of sediment by Environmental Concern, Inc., and thousands in sum when the work of the Army Corps, and many municipalities, agencies, and private countries around the country are added, the experience base for such predictions is in place to make this work a success. Design specifications for planting success will be met by iterative replanting and sediment reconditioning, as necessary.

8. How does this project tie in with other proposed wetlands to be created near the landfill. How is this project related to studies by Sven Hoeger of Creative Habitat during the landfill remediation?

The description of the New York Coastal Fisherman's plan which was described in the minutes of the local community board proceedings (with S. Hoeger of Creative Habitat) for a restored wetland near Watt Avenue in the southern tier of Pelham Bay Park appears to be a modification of a restoration plan developed for this and adjacent areas in 1994-1995 by Gaia Institute staff. This and other plans to increase the area of marsh will increase seed and propagule source exchange between developing marsh systems, with the likely effect of increasing biodiversity and biogeochemical capacity.

In terms of tie-in with other proposed wetlands in the locale and region, the Pelham Project is also coordinated with the work of the Harbor Estuary Program Restoration and Acquisition subgroup to conserve, restore, and protect critical habitat in the Western Sound and in the NY/NJ Harbor Estuary.

9. Page 12, #1. Again assumes that the created wetland have more value than the subtidal habitat. This must be better documented.

9. The DEIS goes to some length to indicate that habitat types cannot be valued in isolation. As the DEIS states on page 12: "This project will create saltmarsh around the landfill and park perimeter by constructing a stone dike, replacing (emphasis added), in the process, intertidal and subtidal rocky habitat (which has been lost). This recreation of the mosaic of diverse and productive habitat types destroyed by (past) landfilling will allow the present structure to become more fully integrated with the natural and historic landscape of the region."

The DEIS here states that a primary value of habitats derives from their interaction with other habitat types, and is thus based on a large body of scientific literature documenting how species richness or diversity is a function of habitat diversity. MacArthur stated this thirty years ago[5]: "...the number of ...species could be predicted in terms of the structure of the habitat...". What he showed is that the more diverse habitat structure, the more diverse species composition. More recent papers have demonstrated how habitat diversity at various scales is specifically responsible for species richness.[6]

As described in the primary literature, habitats support ecological communities through interaction with other ecological communities in adjacent and nearby habitats. Increased diversity and density of organisms at edges between habitats has been documented repeatedly in a large body of literature. It had already been repeatedly demonstrated in the literature three decades ago that the diversity and density of organisms increases in the zones between different habitats, that is, in ecotones.[7] The value of subtidal habitat is thus increased by proximity to other intertidal and subtidal habitat types because of the ecotones between these habitat types, and, as specifically noted in the DEIS from direct measures and mechanisms in the more recent

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[5] Mac Arthur, R.H. 1968. The Theory of the Niche., *In* Population Biology and Evolution, ed. by R.C. Lewontin. Syracuse University Press, Syracuse, NY pp 159-176; , although the point had been made in an earlier paper, Mac Arthur, R.H. & J.W. Mac Arthur 1961. "On Bird Species Diversity. Ecology 42: 594-498.

[6] Mac Arthur, R.H. & R. Levins. 1964. "Competition, Habitat Selection, and Character Displacement in a Patchy Environment," Proc. Nat. Acad. Sci. 51:1207-1210.

[7] Odum, E.P. 1971. Ecology, 3rd Edition. p 157. Saunders Publishing, Philadelphia, PA.

literature, because of the increased foraging and protection afforded various stages of the life cycle of the various species by the connection of different habitat types[8]. The Pelham Project will document these changes in geochemistry and hydrodynamics which impact fin fish, invertebrate, macrophyte, and microbial populations and consortia with pre and post-construction geochemical, hydrodynamic, and ecological measures of habitat diversity. Also, as noted on page 8 of the DEIS, "Monitoring and maintenance would proceed for at least 3 years following (the initial planting)". This monitoring and maintenance will track the two fundamental variables governing plant survival, growth and development: hydrology and sediment size class (or, inversely, pore geometry and volume). By iterative approaches, the required hydrological and sediment size classes will be established, with the initial dredged materials, or through subsequent amendments.

The bathymetric and benthic surveys given in question 18 indicate that much of the Eastchester Bay habitat surrounding the Pelham Bay Landfill and southern tier of Pelham Bay park is presently limited to a relatively flat, subtidal basement of fine sedimentary materials. This area is inhabited by what appears to be a relatively a relatively uniform fauna, consisting largely of annelids (plume worms). The containment facility will be designed to raise a portion of this area to intertidal grade, and distribute rock over other substantial sections, greatly increasing habitat types and connections. Subtidal rock surfaces and variegated surfaces in the benthic environment elevated above the flat sedimentary plain in the course of construction and through water movement into and out of the facility will increase material fluxes between sediment and rocky surfaces with the water column, including oxygen fluxes. Such exchanges support a larger variety of invertebrates. The rock armor surfaces of the stone dike similarly provide substrata for increasing species richness, as shown in a number of environments.[9] (See also #2).

10. Page 13, #8. Better documentation of the occurrence of threatened/endangered species is necessary. This item also discusses ducks and winter flounder. The DEIS should address the potential migration of contaminants through the food chain to these and other biota. Also, silversides are mentioned as a major prey species for flounder - this may be true for Summer Flounder (Fluke) but not for Winter Flounder. Which species is being referred to?

Beginning with water birds, Dave Kunstler of NYC DPR has gathered field data through observations at a dozen sites throughout Pelham Bay Park since February, 1994. The present habitat value for rare and endangered species of this category is limited (common loon (special concern), ruddy duck (S1), barn owl (special concern) and Fosters tern (S1) have been seen here in winter, by New York Natural Heritage Program). By increasing habitat diversity and food type, the Pelham Project should act to increase the diversity of this list.

The ecological mosaic to be restored by the Pelham Project will provide breeding and foraging habitat for Atlantic silversides, a principle food of the fluke or summer flounder. At the same time, the habitat diversity proposed by the Pelham Project supports a greater diversity of polychaete worms, amphipods, isopods, pelecypods, and macrophytes, food materials for winter flounder throughout their range[10].

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[8] As noted in the Technical Appendix to the DEIS. See Bohnsack et. al. 1991; and Irlandi & Crawford 1997.
[9]Douglas, M. & P.S. Lake 1994. Species richness of stream stones: an investigation of the mechanism generating the species-area relationship. Oikos, 69: 387-396.
[10]Klein-MacPhee. 19798. Synopsis of Biological Data for Winter Flounder, *Pseudopleuronectes americanus* (Walbaum). FAO Fisheries Synopsis No. 117. NOAA Technical Report NMFS Circular 414. US Dept. of Commerce, Washington, D.C.

To our knowledge, no other steps are presently under consideration to monitor protected, endangered or other species, or reestablish essential fish habitat. The Pelham Project has the added value of addressing non-point source pollution sources as well as any potential contaminants from the Pelham Bay Landfill or other sources. Thus, only the Pelham Project will provide for enhancement of monitoring in and around Eastchester Bay, augmenting, complementing and extending the work by NYC DPR staff members (M. Feller, D. Kunstler, R. DeCandido and their associates), the volunteers of the annual bird migration census, and others, to collect and integrate data on protected, endangered, or important species, including essential fish and waterfowl habitat of the Eastchester Bay/Pelham Bay Park area.

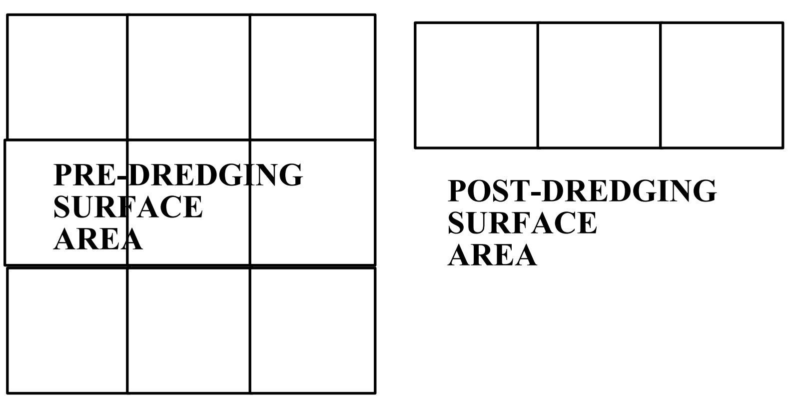
<u>11. Technical Appendix, page 4. Again assumes that sediment remaining in Royal Marina after dredging is "clean" and that there will be no new accumulation of contaminated sediment.</u>

Pages 1 - 4 of the Technical Appendix focus on two primary means by which any contaminants will be reduced in effective concentration or eliminated: changes in gross interfacial geometry of dredged sediments within the containment facility; and, increased (bio)geochemical capacity of COC removal by containing sediments beneath the envelope of a developing saltmarsh rhizosphere, and by increasing the diversity of biogeochemical systems.

As stated on page 4:

"Calculations characterizing the surface to volume ratio of the proposed containment configuration indicate that this structure will reduce the release of COCs contained in the dredged material to the water column by a factor of about three, i.e., a three fold reduction in the ratio of the sediment/water column interface to sediment volume will lead to about a threefold reduction in the movement of COC's through sediment surfaces."

This will lead to a change in geometry as shown in Figure 1 in the Technical Appendix, and below, from sediments spread beneath an approximately three acre surface, to packed below approximately a one acre surface. Since contaminants are released through the surface, this step alone will diminish contaminant release.



While page four in the Technical Appendix does not address the assumption that sediment remaining in Royal Marina is clean, it does lay out the basic mechanism of interfacial geometry which is known to decrease and to regulate COC release, as well as the increasing the quantity and activity of the fundamental regulators of pollutant uptake and degradation: "The biogeochemistry of the marsh microbial communities will provide an additional measure of protection to the water column through documented abilities to destroy and sequester major point and non-point source pollutants, including those found in dredge materials, landfill leachate, surface runoff, storm water, and combined sewer overflow (CSO) discharges." Because of increases in oxidation/reduction potential and the scale of the air, water, and sediment interface, biogeochemical activity is substantially increased. The Pelham Project will document the behavior of these fundamental modification of the sediment/water column interface, as well as pore water activity.

<u>12. Technical Appendix, page 6. Provide information on the amount of leachate and contaminants of concern from the landfill occurring now.</u>

NYS DEC's Record of Decision for the Pelham Bay Landfill states:

"The total amount of leachate generated from all areas of the landfill is projected to be reduced up to 70% through the placement of final cover and the installation of the trench along the southwest perimeter by Pelham Bay Park. The remaining significant source of leachate will be from the saltwater intrusion into the landfill, which is estimated to affect about a 125 foot width around the landfill that "touches" Eastchester Bay. It is estimated that the leachate that will be generated from this tidal flushing will be significantly "cleaner" because the leachate from the interior portion of the landfill will be drastically reduced by the capping and the leachate from the 125 foot perimeter area has been flushed for years; most of the contaminants in this area have been removed. Therefore, the contaminants in this leachate will decrease after closure" (pp 24-25).

The Pelham Project is the only effort on the horizon which can provide a verifiable quantitative evaluation for these assertions in the Record of Decision. This will, of course, require the very precise approach to analysis documented in the Pelham Project Proposal, since the quantities of materials in the leachate, as determined by Woodward & Clyde, are not high. As noted in the Technical Appendix (p 11), "Even the most problematic metals in the leachate, Fe, Cr, Pb, Ni, and Cu range from 4 to 0.003 mg/l (see discussion of test results in Appendix). The most highly concentrated pollutant discharged, from samples to date, is ammonia, ranging from about 10 to 1000 ppm (Woodward and Clyde 1993)." Woodward-Clyde reported a groundwater discharge of 80,000 gallons per day. The following discharges would occur at the above noted concentrations and mass flow:

metals concentration in ppm	metals* discharge in lbs/day	metals* discharge in lbs/yr.	ammonia concentration in ppm	ammonia* discharge in lbs/day	ammonia* discharge in lbs/yr.
max. 4	2.67	973	10	7	2,433
min. 0.003	0.002	1	1,000	667	243,324

* assuming 80,000 gpd of ground water derived leachate from the Pelham Bay Landfill

The addition of mounded leachate from precipitation prior to capping would multiply these estimates by a factor of less than 2, since one foot of infiltration over the 80+ acres of the landfill each year would generate somewhere between 50,000 and 100,000 gallons of precipitation-derived leachate each day. More refined estimates and measures will be provided by the Pelham Project, i.e., the determination of inputs and outputs, together with modeling transport and fate of contaminants. As noted in the Gaia Institute work for NYC DEP in the early 1990s, and also by collaborators in the Pelham Project, the presence of sediments and intertidal marshes around the landfill should diminish tidal inputs into the landfill and resist the flow of leachate out into Eastchester Bay. At the same time, biogeochemical processes in constructed marshes and sediments will contribute additional regulative mechanisms which will modify the flow of ammonia, DOC, metals, and other COC's.

13. Page 10, Tech. App., bottom. The leachate/groundwater at the landfill is one contiguous plume.

The requirements of the principle of continuity, as defined in the physics of flow, must be met by leachate or any other incompressible fluid. This means that the product of fluid velocity and sectional area is the same for the same fluid moving between any two points[11]. This does not mean, however, that the hydrostatic head under the cap would lead to uniformly equal flow rates in all directions. Layers of garbage of various ages and compositions covered by layers of cover material with varying hydraulic properties act to create a complicated two and three dimensional structure. This three dimensional, discontinuous layer cake structure is further complicated by the even higher dimensional interactions of pressure and flow. There is even variability in the former parameter, i.e., pressure, through monthly and yearly oscillations of the tidal cycle which modify the total head of the leachate mound by changing the boundary conditions. Added to this are stochastic events such as storm surges and internal changes with layers through further microbial action turning cellulosic materials into more gel-like materials. In short, how the heterogeneous materials beneath the landfill behave is a matter which can only be described through the specific empirical studies outlined in the Pelham Project . While the force main to Hunts Point WWTP is still in operation, unless leachate is removed equally from all sectors of the water table beneath the landfill, forces acting to move water outward from the hydrostatic head are likely to be quite different in different places.

14. Page 11, third para. The landfill is 89.3 acres.

The text has been amended to read 89.3, as opposed to the pre-closure approximation of 81 acres.

15. Page 14. The section on circulation and the calculations are unclear. Also, please discuss the impact of the structure on sedimentation and scouring of adjacent areas.

Analysis of circulation changes for Eastchester Bay are proceeding through standard steps. A first order approximation has already been generated, based on the evaluation of changes in the geometry of flow around a confined containment facility constructed around the Pelham Bay Landfill. This indicates that such constructions will have no significant impact on the circulation of Eastchester Bay. These results are based on a quantitative analysis using standard tools in fluid dynamics: the Reynolds and Froude numbers.

[11] Elementary Mechanics of Fluids, by H. Rouse. 1946, Constable & Co., Ltd., London. pp 13-16.

The Pelham Project will go further in this analysis (and already has, in performing a bathymetric and benthic survey, see below). To our knowledge, no baseline data presently exists on circulation in Eastchester Bay. The Pelham Project will need to generate this knowledge-base before comparative empirical studies can be initiated. Towards this end, the Pelham Project has already mapped the bathymetry of the sections of Eastchester Bay around the Pelham Bay Landfill and southern tier of Pelham Bay Park.

Circulation studies necessarily focus on the properties of flow. Specific measures of actual flow patterns and velocities are central to the research program of the Pelham Project, and these will be used in conjunction with fluid dynamics analyses to characterize flow. Systematic changes in Reynolds and Froude numbers will be investigated by calculating how these numbers change with changes in the scale of flow caused by construction of the stone dike, compared to the no-build alternative. These changes can then be used to chart changes in inertial compared to viscous and gravitational forces. These are basic indicators of the structure and behavior of fluid systems, intrinsic to scientific and engineering studies of fluids. Analyses for the following two zones are shown below:

a) Building a 300' wide containment facility in the constricted area of the Hutchinson River between the Shore Road Bridge to the spit of land at the western shore of the opening of Turtle Cove would decrease the width of the outlet by about one third. Decreasing the sectional area of the width of the water flow path by a third will increase the velocity by a factor of 1.5. Since the Reynolds number is proportional to the product of the characteristic dimension (depth) and the flow velocity, there will not be a significant change in the corresponding Reynolds number before and after construction. While it is quite common for the Reynolds number of a dynamic section of an estuary to vary over orders of magnitude, the structural change imposed by stone dike construction will have a low impact on the ratio of inertial to viscous forces at work in Eastchester Creek-Hutchinson River.

b) Opening of Eastchester Bay west and south of the Turtle Cove spit of land to Rodman's Neck, where width of the discharge of the Hutchinson River into Eastchester Bay increases from about 900' to 1,300', so the width, L, would change in proportion to the distance from the shore to the stone dike divided by the width of the Bay at that point, L, or 300'/900' to 300'/1300',- that is, from a quarter to about a third, constricting the channel and thus increasing velocity and the Reynolds number. The smaller coefficients in this downstream case would make this impact on the Reynolds number even smaller than that in the narrower section of the estuary discussed above.

The interaction of tidal currents with the boundary conditions, the confining borders of Eastchester Bay, determine and constrain a large number of physical, chemical, and ecological phenomena. One of the means for evaluating potential changes in behavior of Eastchester Bay due to the construction of a containment facility/salt marsh is to quantify any such modifications in terms of the Froude number, that is, the ratio of inertial to gravitational forces ($F = V2/gl$). Viewed as the distribution of momentum along the linear run of water movement, since widths will be decreased from the Shore Road Bridge to Rodman's Neck by a quarter to a third. This constriction will, as noted above, increase velocity. It will have an even more pronounced effect on momentum, a function of the square of velocity. This is likely to increase the intensity of circulation in the nearshore area around the stone dike (see accompanying aerial photograph figure and spread sheet). Given the apparent low biodiversity and biomass (see benthic survey below) of this habitat at present, an increase in velocity gradients is likely to increase mass exchange between the water column and sediments, and, therefore, increase the diversity of benthic habitat types and, thus, secondary productivity and biodiversity. The Pelham Project will describe expected outcomes in the post-construction environment based on hydrodynamic changes. The relationship between these hydrodynamic changes and habitat diversity will also be detailed. Post-construction monitoring will evaluate these inferences.

16. Page 19. Hydrocarbons. The DEIS claims that leachate treatment/pollution reduction will be a benefit of this project, yet makes unsupported assumptions that this will occur. It is likely that most of these reactions also occur in sediments (as opposed to soils). This claim needs much better support.

The extensive body of knowledge on the treatment of pollutants by natural and constructed wetlands has by now contributed many thousands of peer reviewed papers in the US alone. Even landfill leachate is now regularly treated with constructed and restored wetlands.[12] The burden of proof now lies with anyone attacking these peer-reviewed publications to prove that these findings are false, or non-replicable. This is unlikely at this juncture in the development of the science.

Recognizing this, however, we nonetheless agree with the assessment that any assumptions regarding how restored or constructed wetlands will behave vis a vis specific pollutant loadings in Eastchester Bay are, in essence, unsupported unless and until the Pelham Project is built and the tests actually carried out. The Pelham Project was, in fact, specifically designed to fill hydrodynamic, geophysical, biological, ecological, hydrodynamic, and geochemical gaps in the knowledge base of ecosystem restoration. It can only do this by resting firmly on prior work. For example, the abbreviated bibliography of the Technical Appendix contains more than ten references to hydrocarbon degradation by biogeochemical systems. The Gaia Institute database contains more than a hundred more. Together with those in the prior footnote, these references themselves contain many hundreds to thousands of references from peer reviewed literatures describing hydrocarbon mineralization under various circumstances. These facts, however, are as yet unsupported by tests in constructed marshes on dredged sediments around the Pelham Bay Landfill. Such specific tests are the purpose of the Pelham Project, which aims to provide rigorous evaluation of physical and biogeochemical processes through continuous and real time monitoring of inputs and outputs. Existing literature has thus been pressed into the service of a general predictive framework on the behavior of biogeochemical systems vis a vis specific pollutants and toxics. Since the existing literatures lack the requisite specificity and interdisciplinary syntheses necessary to predict input and output behavior of developing intertidal marsh and microbial communities, the Pelham Project will utilize before and after measures, as well as the closely monitored dynamic behavior of these environments to put their description on a much more rigorously defined foundation.

17. Technical Appendix, page 7. In order to determine whether there is a measurable improvement in water quality in the area, the existing water quality must be determined first. How and when will this be done? What plans are there to measure water quality during

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[12] Constructed Wetland for the Treatment of Landfill Leachate, ed. by G. Mulamoonil, E. McBean, and F.A. Rovers. 1998. Lewis Publishers, Boca Raton, FL. Leachate Treatment System Using Constructed Wetlands, Town of Fenton Sanitary Landfill, Broome County, New York. 1993. Energy Authority Report 94-3 (dated November 1993). Energy Research and Development Authority. Constructed Wetlands for Water Quality Improvement, ed. by G.A. Moshiri, Chapts 50, 51, & 52. Lewis Publishers, Boca Raton, FL.

construction during the construction of the containment facility, the creation of the wetlands and to verify water quality improvement subsequent to completion?

The Pelham project was devised to determine pre and post-construction water and sediment quality, and monitor, model, and predict specific outcomes (see specifics in Pelham Project Proposal). Since the mission of the Pelham Project is to demonstrate the feasibility, long term stability, and advantages of engineered constructed wetlands for dredge material treatment and disposal, the intrinsic aim of this work is to provide a sound foundation to evaluate water and sediment quality results where dredged materials are used to construct intertidal wetlands.

18. Technical Appendix, page 14, top. Provide characterization of the soft sedimentary habitat that would be lost - bathymetry and biological survey.

Bathymetry

Introduction. A bathymetric survey of Eastchester Bay around the Pelham Bay Landfill and the southern tier of Pelham Bay Park was carried out on 17 January 1999 by Roelof Versteeg from Lamont-Doherty Earth Observatory of Columbia University. The area surveyed extended from about 500' south and west of the Shore Road Bridge to the southern reach of Pelham Bay Park, due east of the eastern terminus of Watt Avenue. The survey vessel tracked an envelope of from 300' to more than 700' around this zone.

Methods & Materials. Bathymetry was collected using a Furuno LS6000. Bathymetric data (in feet) were recorded every second. Data were coregistered with time, latitude and longitude, which were obtained from a Trimble Ag132 DGPS with satellite provided differential correction. Survey tracklines were monitored using Visual Series from Nobeltec. Tracklines followed the shore line, and were spaced approximately 10 feet apart, with the first trackline within 10 feet of the shore line. During the survey several points were sampled multiple times to ensure data consistency.

Post acquisition the data were checked and quality controlled to eliminate inconsistencies (e.g. during several minutes the differential correction was lost). After this the data were corrected for the tide cycle elevation. This correction was based on the available tide charts as no tide gauge was in place during this survey. The resulting data were gridded and contoured. For this contouring, areas with no data outside the survey were assigned a value of 0 depth. The resulting map has depth units of feet and dimensions of meters relative to the starting point of the survey.

The resulting map is in very good agreement with the existing NOAA map of this area, and with an independent depth sounder on the vessel which was used for this survey.

Results. The sediment surface of the area of Eastchester Bay surrounding the Pelham Bay Landfill and southern tier of Pelham Bay Park has very low relief. Over most of the area surveyed, depth is stable within a two foot isocline over tens to hundreds of feet (see Figure below). The apparent slope of much of the 30+ acres surveyed is one to a few percent. This uniformity in sediment grade, together with an apparent lack of benthic features, acts to minimize habitat types in this area.

Benthic Habitat: Sediments

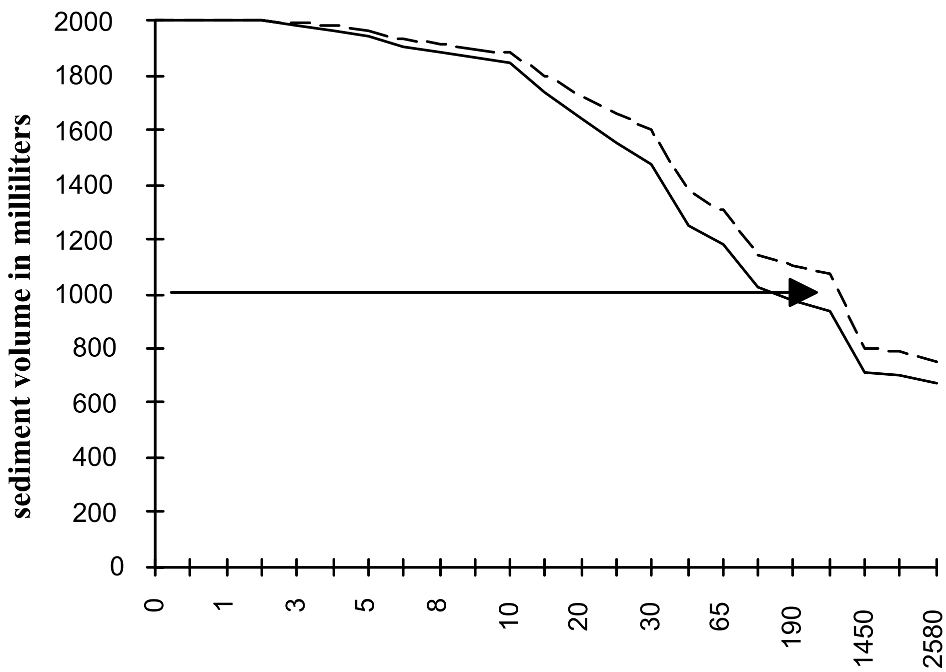
Introduction. Sediments from the area of the proposed confined containment facility adjacent to the Pelham Bay Landfill and the southern Tier of Pelham Bay Park were sampled on two occasions: January 17, 1999 & April 8, 1999. The first set of five samples were collected during the bathymetric survey on 17 January 1999. Here sediments and benthic organisms were screened from materials collected by Gaia Institute staff. Analyses followed to assess wet weight per sample, and a preliminary survey of benthic invertebrates and their by-products was carried out by GI staff with the assistance of the Ecological Engineering graduate students at Queens College. The sediments were analyzed using two methods, sedimentation rate and light scattering, by Maurizio Marezio-Bertini, a graduate student in the Earth and Environmental Engineering Department of the Henry Krumb School of Mines at Columbia University. A second set of three samples was collected on 8 April 1999. One of these samples was screened, while the remaining two were left unscreened prior to analysis (the latter carried out by R. Prezant and E. Chapman, Marine and Aquatic Biology Laboratory, Queens College of CUNY).

Methods and Materials. A ponar dredge with a sampling area of 230 cm^2 was dropped at five locations offshore from the southern tier of Pelham Bay Park and the Pelham Bay Landfill on 17 January (n=5), and again on 8 April (n=3). Samples from Eastchester Bay were processed through a three gallon Sieve Bucket lined with 30 mesh brass wire cloth. For the 17 January sample, materials which remained on the screen were shaken dry and weighed. Replicate sediment samples were then subjected to the standard sedimentation rate tests described immediately below. Benthic invertebrate data follows this sediment data.

Before running sedimentation tests, samples were blended and homogenized. After blending and homogenization, samples were introduced in sedimentation jars. Then, the jars were filled with distilled water up to the reference mark. Two different jars were used: jar #1 had a height of 34.4 cm and an internal diameter of 8 cm; jar #2 had a height of 41 cm and an internal diameter of 8.9 cm.

Before starting the sedimentation test, the jars were shaken for five minutes to ensure a satisfactory suspension of the sediments. After shaking, the jars were put on the vertical position and time was started. Readings were take every minute for the first ten minutes, every five minutes after the first ten minutes and in between the first hour. After the first hour, readings were taken at intervals of 40 – 60 minutes. After the first day of testing, readings were taken three times a day for the second day, and once a day for the following days. The tests were run for five days (results for about two days are shown below).

Sedimentation over 2,580 Minutes of Eastchester Bay Sediments



The data obtained were plotted in a linear X-Y plot, where the X-axis represented time and the Y-axis represented the decrease in height of the suspended column. The arrow points to the midpoint in settling, approximately 225 minutes (3 hr, 45 min) after initiation.

These results are commensurate with a particle size distribution consisting of silts in smaller size class ranges (see below).

Particle size analysis by light scattering

Methods & Materials. Particle size analyses were run with two samples (Lot 4051-449/7348-752 #3, #4), by light scattering. A MICROTAC 7995 Particle Size Analyzer was used to carry out the analyses.
The samples were introduced into the mixing chamber to obtain a stable suspension. The suspension was then introduced into the analyzer equipped with a laser beam. The scattered light of the laser beam was recorded and analyzed by the internal computer and a printout of the particle size distribution was obtained. In particular, the printout contained the 16, 50 and 84 percentiles, which were used to characterize the particles of the samples. The results are summarized in Table 1.

Table 1: Particle size distribution obtained by light scattering.

Percentile	Sample #3	Sample #4
16%	0.00142	0.00136
50%	0.00427	0.00443
84%	0.01173	0.01469
Max	0.02700	0.02700

The results show that in both samples only 16% of the particles are smaller than 0.00142 mm and 0.00136 mm, respectively. They also show that 84% of the particles are less than 0.00427 mm and 0.00443 mm, respectively.

It can be concluded from the results that the sediments have particles in the silt range (>0.002 mm , <0.075 mm), with the smaller particles in the clay range (<0.002 mm). No particles in the sand range (>0.075 mm, <2 mm) were detected.

Benthic Habitat: Invertebrates

To evaluate benthic invertebrate taxa and frequency, screened material was inspected macroscopically, and under a dissecting microscope. The three samples from Eastchester Bay within the area of the proposed confined containment facility were dominated by amphipods, especially two congeners of ampeliscids. There are also many tube dwellers in the samples. These organisms are probably able to stay near the sediment/water column interface, despite apparent unconsolidated structure of the sediments. A few tube dwelling polychaetes were found (spionids) and some "free living" species (*Eteone* and *Nereis*). A very few, small juvenile clams were also found in the samples. These are probably young of the year spat. Given habitat structure, it is unlikely that these organisms would survive long.

Eastchester Bay/Pelham Bay Landfill & Southern Tier of Pelham Bay Park Benthic Species List, April 1999 (identified by Eric Chapman & Robert Prezant, Marine and Aquatic Biology Laboratory, Queens College of CUNY):

Crustacea:
Amphipoda

Cumacea

Mollusca
  Bivalvia

Annelida
  Polychaeta

These data are similar to data from benthic samples from Western Long Island Sound published elsewhere (shown below). The 12 taxa found in approximately a 700 cm^2 sample are comparable to the ≈ 21 species per sample reported by EPA for the NY/NJ Harbor Estuary[13] . With 151 organisms per this sample area, however, the abundance, by extrapolation, is somewhat low for the Harbor Estuary, as indicated in the table below:

[13]Sediment Quality of the NY/NJ Harbor System: An Investigation under the Regional Environmental Monitoring and Assessment Program (R-EMAP). 1998. Adams, D.A., J.S. O'Connor, & S.B. Weisberg. EPA/ 902-R-98-001. March 1998. Table 6-2.

There are some differences between the sites sampled, with 16 taxa at the Watt Avenue southern terminus of the area, and 4 and 7 taxa along the southern and western faces of the landfill, respectively. Total taxa vary between 53 and 47, with the highest density collected due east of Watt Avenue. These results are presented below.

In sum, while organisms were present in all of sediment samples collected in the area of the proposed confined containment facility (n = 8), the structure and behavior of these sediments indicates a very high silt/clay content as well as low bulk organics (i.e. very little to no visible detritus). The structure and behavior of these sediments are thus indicative of a very low energy regime.

Available evidence indicates that this area does not afford essential fish habitat for bottom dwelling organisms such as winter flounder, *Pseudopleuronectes americanus*.

<u>19. Technical Appendix, page 16. Need detailed plan and discussion of stormwater pond creation and discharge to wetlands.</u>

Stormwater presently enters Eastchester Bay along the eastern margin of the southern tier of Pelham Bay Park. At times, these discharges provide substantial volumes of water, but any non-point pollutants such as nitrogen and BOD are discharged without treatment into Eastchester Bay/Western Long Island Sound. Four discharges occur along the section of Pelham Bay Park along Eastchester Bay which provide opportunities for the restoration of three to ten acres of freshwater pond and wetland habitat.

As indicated in the accompanying figure, these ponds and wetlands would be created by redistributing fill along the margin and inland from Eastchester Bay. Much of the stormwater and walkway infrastructure in this section of the park is in a degraded condition which includes potentially serious liabilities for the City of New York. This would be repaired and replaced. Ecologically, these ponds and wetland habitats and fringes would increase biodiversity and ecological productivity, since much of the upland habitat which would be displaced by restored ecosystems is now occupied by mugwort, with some *Phragmites* . By redistributing between 15,000 and 50,000 cubic yards of material, these areas would be refurbished as wetland and pond habitat. From measured flow rates of a one to 10 plus cubic feet/second of stormwater and dry weather discharge, hydroperiod for treatment of this water would vary between about a day to a couple of hours.

Grading such freshwater ponds would be done to maximize fringing wet areas. Fine grading would include a diversity of submerged, emergent, and mesic habitat, as indicated in the plan below. Plantings would include species from the list below.

Pond sites will be surveyed with ground penetrating radar to identify areas of fill and saturated zones in the substratum. A global positioning system and surveying equipment will be utilized optimize aerial extent and minimize damage to existing vegetation. These methods, together with core samples, will be utilized to integrate this freshwater pond, wetland, and creek construction with on-site wetlands already established by NYC DPR. The Pelham Project team will analyze width, depth, length, and head of these creeks to minimize sediment transport to maintain habitat in the freshwater and tidal sections of these restored creeks.

<u>20. Technical Appendix, page 17. Do not support introduction of oysters or black (blue) mussels. Ribbed mussels are acceptable.</u>

As stated in the DEIS Technical Appendix, the aim of the Pelham Project is to create habitat which sustains the growth and development of those components of the biota which act to stabilize sediments against perturbations. The performance criteria for planting success include coverage and survival. Together these are good predictors of resistance to storm driven wave disturbance and other perturbations. Marshes of substantial scale, where the flow of tidal exchange is organized into creek forms, demonstrate unique features of sediment stabilization. As noted in the DEIS Technical Appendix (p 17), velocity gradient of differing scalar values are regulated by different structures with these systems: low velocity flows in the ten centimeters per second range are regulated by Spartina stems plus mussel beds knit together with roots and byssal strands at the creek edges. Creek beds where flow velocities achieve tens of centimeters per second are regulated and stabilized by oyster beds and reef development. As noted in the Technical Appendix, these structures appear in conjunction with the higher current velocity zones on the concave side of creek bends. Since the forces of physics will propagate the bends of creeks and creek beds through new sediment banks[14], physical forces, by themselves, run counter to regulatory intent in terms of the stabilization of sediments in containment facilities. As pointed out in the Technical Appendix, since creek edge cord grass, mussel bed, and oyster reef development together act to both decrease scour and distribute tidal and storm surge forces in a manner which maximizes filtration and sediment bed stability, the development of these systems is commensurate with the best management of dredged sediment stabilization, and noted in the Response to Comments of NYC DEP on the public notice section of the DEIS (pp 14-15).

As noted in the SEQR EIS (p 7), oyster beds have returned to much of the area around Eastchester Bay, expanding from long-standing populations in Pelham Bay Lagoon (T. Kazimiroff, per comm.), to presently occupying areas along the shores Eastchester Bay, Palmer Inlet, Weir, Westchester, and Pugsley Creeks (PSM, per. observ). Patches of these organisms stabilizing dredged sediments, together with already widespread mussel beds, will add about 1% or less to the area of extant 'attractive nuisance' distributions of these organisms. On the other hand, the Pelham Project would distribute information and produce signage on how mussel beds and oyster beds and reefs may play a large role in increasing biodiversity, acting as refugia for larval and juvenile fish and invertebrates, as well as nitrogen removal and protection from hypoxia. Thus habitat recreation and restoration can allow for the redevelopment of interacting species guilds which the public, through the development of a citizens watchdog and monitoring program, will find it worth their while to protect. As noted below, this one step would increase the level of surveillance and protection of shellfish beds many-fold. The program at once serves as a means for increasing public health protection by stabilizing dredged sediment, researching and informing the public of health risks and protections associated with local shellfish, and empowering citizens groups to enforce the protection of shellfish in closed beds. With only two state enforcement officers presently available to make such observations and enforcements, this program would immediately increase the protection of the citizens of New York some several to a hundred times or more, based on the number of observations of suspicious activities around closed shellfish beds. This could be achieved with a minimal or negligible increase in attractive nuisance shellfish beds in the western Sound.

[14] Dingman, SL. <u>Fluvial Hydrology</u>. 1984. WH Freeman, NY. pp 133-179.

<u>21. Technical Appendix, page 25-26. A more thorough discussion of the alternative disposal options is needed. What are the costs? Discuss upland and in-water options.</u>

Alternative disposal options & costs, upland and in-water: As the closure of many marinas over the past decade indicates, maintenance dredging costs have become, in many cases, prohibitive. The following four upland and two subaqueous cases provide direct examples of the kinds of cost multipliers of maintenance which are diminishing the viability of the water based economy.

Available disposal costs:

OENJ site:	\$56/cubic yard
SeaLand Site	\$47/cubic yard
SK Koppers Koke	\$47/cubic yard
New Bayonne (OENJ)	mid 30s, + dredging, probably \$40-\$42/cubic yard
Newark Bay subaqueous pit	\$29 + dredging, \$34/cubic yard
HARS- unrestricted	≈\$10/cubic yard

These pricing translates into dredging costs which are comparable in scale to major capital investments in marinas. The dredging cost for a twenty thousand yard job thus ranges from about two hundred thousand to more than a million dollars.

Pennsylvania mines (estimated)

OENJ Site

SeaLand Site

SK Koppers Koke-Kearney

New Bayonne (OENJ) Site

Newark Bay Subaqueous pit

HARS-unrestricted (low volume)

HARS-unrestricted (high volume)

These dredging and disposal costs can be measured against annual marina income streams. Yearly charges for boats are about a hundred and ten dollars per foot. This covers both summer dockage and winter storage. The contribution of this major income stream is limited by the number of boats which can be accommodated. The figures below indicate the number of boat customers necessary to cover these dredging costs:

Pennsylvania mines (estimated)

OENJ Site

SeaLand Site

SK Koppers Koke-Kearney

New Bayonne (OENJ) Site

Newark Bay Subaqueous pit

HARS-unrestricted (low volume)

HARS-unrestricted (high volume)

Noting that the Royal Marina, one of the larger facilities on City Island, can service about a hundred boats, it is apparent that the highest dredging and disposal costs would eliminate all income from this stream for three to four years. The lower dredging and (subaqueous pit) disposal costs would eliminate income for about two years, while even HARS disposal would eliminate most of a years income. Since this dredging would also defer any profits for five to ten plus years, from a fiscally responsible business perspective, dredging could not be justified.

22. Sampling Protocols and Results Appendix. Sediments were not analyzed for Dioxins. Is there a rationale for why this was not done? Give more detail on the "standard sampling protocols" that were used. What were the QA/QC and chain of custody procedures?

Adding testing for dioxins would have increased the cost of sampling to about $20,000, or, about $1 per cubic yard of material to be dredged. This cost was judged to be too high an initial penalty. For investors in a marina, testing for dioxin allows for a more complete determination of sediment COCs, but at a cost of a few to several percent of gross annual income. Even worse, such testing does not provide any determination of the range or cap of dredging and disposal costs. Since the dioxin test does not contribute to the development or use of a rational decision tree, where outcomes can determine likely scenarios for future action, it has no immediate place in rational decision making in business practice at present. The Pelham Project aims to rectify this serious problem by identifying risk-based and concentration-based approaches to dredging and sediment decontamination.

A corer was used to collect sediments at the four corners and at middle of Royal Marina. The clear, acrylic liner permitted observation, which allowed for the visualization of approximately one to three feet of fine black sediments overlying gray clays or gleys.

QA/QC & Chain of Custody. Gaia Institute staff performed the sampling, labeled the collection vessels, and packed these materials in a cooler supplied by ETL. This cooler was then handed to the ETL staff member together with the signed chain of custody documentation.

23. Samples were collected at the north side and south side of the marina but not in the center. The three north side samples were composited as were the three south side samples. Were all core similar in grain size and TOC? Was there any stratification of the cores? What led to the decision to composite the samples and only sample both ends of the marina? No detection limits were given for the various analytes. Metals were compared to NYS DEC sediment criteria but not VOC's of SVOC's.

Six samples sites were determined prior to sampling as a means of providing coverage of edges and central areas, so collection occurred at the periphery and center sections of the marina. Sediments all gave the appearance of similarity in grain size, with no apparent stratification above the level of gray clays or gleys.

While the sampling protocols for Royal Marina sediments were originally designed to maximize degrees of freedom for within and between sample comparisons, representatives of the Army Corps indicated that composite sampling was often more acceptable (to marina owners), because cost factor differences could be substantial between two and six samples, plus controls. Composite samples also provide the opportunity to process a large enough sample at a palatable cost. There is a good economic reason for this, since $12,000 to $15,000 for testing equals $.60 to $.75 per yard for this 20,000 yard job. This expense occurs before there is any way of evaluating the cost of the whole dredging job, and, therefore, whether dredging can benefit the marina financially. Thus, without any defined relationship between costs and benefits, marina owners and/or investors must perform a preliminary investigation for the regulatory process which levies a cost of between half a dollar and more than a dollar per yard of potential dredging work. Compositing samples is a means of minimizing a cost inherent in the regulatory framework.

Compositing was judged an appropriate approach on statistical grounds since it does not modify total amounts of COCs in the sample. Where three samples are so mixed, however, degrees of freedom diminish to one (six samples to two composite samples, where DF = n-1), and within sample variability would be unresolved by a factor of three. This is a substantial price to pay in terms of available replicatible data. On the other hand, however, considering that such composite testing may allow marinas to maintain or improve their businesses, the lower resolution of the data may be justified by the net increase in information on chemicals of concern in sediments. While statistical tools could be developed to maximize information from such samples, these tools have not yet been made available to the regulated community.

While Gaia Institute samplers and their colleagues remain acutely interested in VOCs and SVOCs, these tests would have added substantially to the cost of this initial sampling. Also, when guidance was requested as to appropriate testing target compounds, the Army Corps supplied us with specific testing requirements from the State of New Jersey, but produced no such documents from New York State.