APPENDIX J-2

Central Long Island Sound Dredged Material Disposal Site
Site Management and Monitoring Plan

Prepared for

U.S. Army Corps of Engineers
New England Division
696 Virginia Road
Concord, MA 01742-2751

Prepared by

Battelle
397 Washington Street
Duxbury, MA 02332

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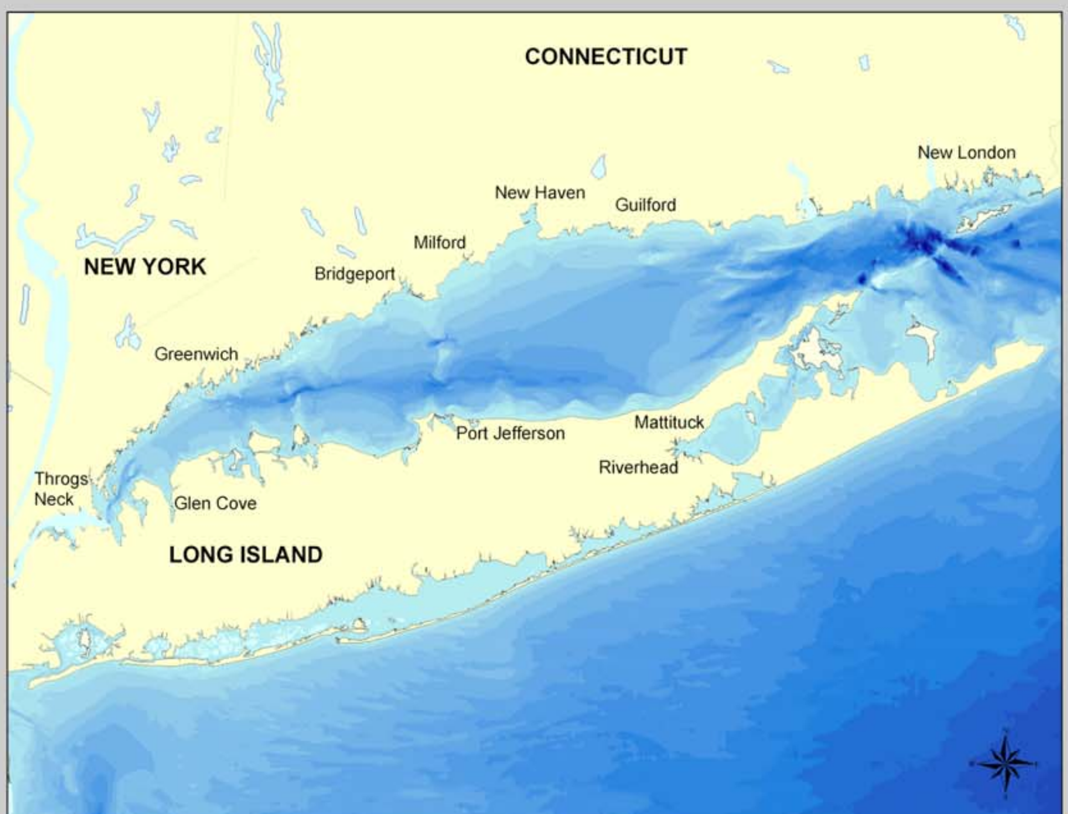
Site Management and Monitoring Plan

Draft

Prepared by U.S. Environmental Protection Agency
New England Region

In cooperation with U.S. Army Corps of Engineers
New England District



EPA

US Army Corps of Engineers®

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Prepared by

U.S. Environmental Protection Agency
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U.S. Army Corps of Engineers
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ACRONYMS AND KEYWORDS

CDM	Capping Dredged Material
CFR	Code of Federal Regulations
CLIS	Central Long Island Sound Dredge Material Disposal Site
Corps	U.S. Army Corps of Engineers
CPUE	Catch Per Unit Effort
CS	Cap Site
CSDS	Cornfield Shoals Disposal Site
CT	Connecticut
CTDEP	Connecticut Department of Environmental Protection
CTDPH	Connecticut Department of Public Health
CWA	Clean Water Act (Federal Water Pollution Control Act)
CZM	Coastal Zone Management
DAMOS	Disposal Area Monitoring System
DDT	1,1,1-trichloro-2,2-bis(*p*-chlorophenyl)ethane
deg	Degree
DEIS	Draft Environmental Impact Statement
DEP	Department of Environmental Protection
DMMP	Dredged Material Management Plan
DMSMART	Dredged Material Spatial Management Record Tool
EIS	Environmental Impact Statement
EFH	Essential Fish Habitat
EPA	U.S. Environmental Protection Agency
ER-L	Effects Range-Low
ER-M	Effects Range-Median
ESA	Endangered Species Act
FDA	Food and Drug Administration
FEIS	Final Environmental Impact Statement
GPS	Global Positioning System
H’	Shannon-Wiener Diversity Index
ITM	Inland Testing Manual
J’	Evenness Index
LIS	Long Island Sound
LISS	Long Island Sound Study
LORAN-C	Low Frequency Hyperbolic Radionavigation and time reference system

mg/kg	milligrams per kilogram
MPRSA	Marine Protection, Research, and Sanctuaries Act of 1972
N	North
NAD83	North American Datum 1983
NEPA	National Environmental Policy Act
NLDS	New London Dredged Material Disposal Site
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NRC	National Research Council
NY	New York
NYSDEC	New York State Department of Environmental Conservation
OSI	Organism Sediment Index
PAH	Polycyclic Aromatic Hydrocarbons
PCB	Polychlorinated Biphenyls
QA	Quality Assurance
RHA	Rivers and Harbors Act
RIM	Regional Implementation Manual
RPD	Redox Potential Discontinuity
SAIC	Science Applications International Corporation
sd	Standard Deviation
SMMP	Site Management and Monitoring Plan
SQUID	Sediment Quality Information Database
2,3,7,8-TCDD	Tetracholordibenzo-1,4-dioxin
TOC	Total Organic Carbon
USACE-NAE	U.S. Army Corps of Engineers, New England District
UDM	Unacceptably Contaminated Dredged Material
USCG	U.S. Coast Guard
USFWS	U.S. Fish and Wildlife Service (Department of the Interior)
W	West
WLIS	Western Long Island Sound Dredged Material Disposal Site
WRDA	Water Resources Development Act of 1992 (Public Law 102-580)
wt	Weight

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1.0 BACKGROUND

The U.S. Environmental Protection Agency (EPA) is considering the possible designation of the Central Long Island Sound Dredged Material Disposal Site (CLIS; Figure 1) in the central basin of Long Island Sound as an open-water dredged material disposal site consistent with the Marine Protection, Research, and Sanctuaries Act (MPRSA), 33 U.S.C. §§ 1401 *et seq*. The CLIS site would be used for the disposal of dredged material from navigation areas within Long Island Sound. Dredged material from either Federal projects of any size, or from non-federal projects involving greater than 25,000 cubic yards (19,114 cubic meters) of material, would have to satisfy the requirements of the MPRSA and Section 404 of the Clean Water Act, 33 U.S.C. § 1344 (hereafter cited as "CWA § 404") before disposal would be authorized at the site (see Section 3.1). Dredged material from non-federal projects involving less than 25,000 cubic yards (19,114 cubic meters) of material would only have to satisfy the requirements of CWA § 404, before disposal would be authorized at the site. This approach is in keeping with the mandate of Section 106(f) of the MPRSA, 33 U.S.C. § 1416(f). Prior to use of the site, each project must receive a permit issued by the U.S. Army Corps of Engineers (Corps) under either Section 103 of the MPRSA, 33 U.S.C. §§ 1413 (hereafter cited as "MPRSA § 103") or CWA § 404 and a Connecticut State Water Quality Certificate issued by Connecticut Department of Environmental Protection (CTDEP).

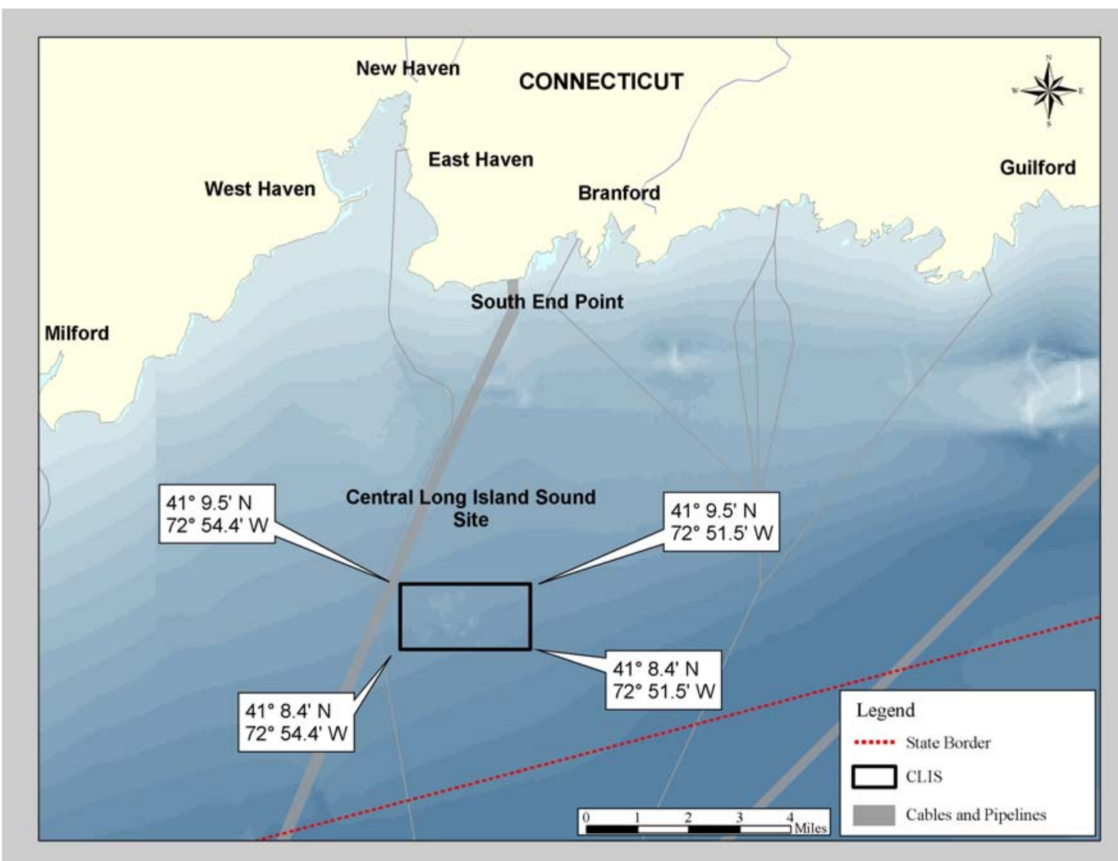

Figure 1. Location of the Reconfigured Central Long Island Sound Dredged Material Disposal Site

Management plans for ocean dredged material disposal sites are required pursuant to §102(c) of the MPRSA, as amended by §506(a) of the Water Resources Development Act (WRDA) of 1992. In accordance with MPRSA (section 103(a)) disposal activities at the site "will not unreasonably degrade or endanger human health, welfare, or amenities, or the marine environment, ecological systems, or economic potentialities." The purpose of this Site Management and Monitoring Plan (SMMP) is to synthesize prior site monitoring results and outline a monitoring program and management plan for the CLIS site that complies with the requirements of MRPSA Section 103a. Although this management plan focuses on MPRSA requirements, materials determined suitable for disposal under Section 404 of the CWA will also be disposed at the site. Regardless of the source of the material (i.e., CWA or MPRSA), however, all material disposed at the site will be subjected to the same monitoring requirements, as described in Section 6.

The SMMP is intended to serve as a framework to guide the development of future project-specific sampling and survey plans created under the monitoring program. The data gathered from the monitoring program will be routinely evaluated by EPA New England Region, the Corps New England District (NAE) and other partners (see Section 9.0) to determine whether modifications in site usage, management, testing protocols, or additional monitoring are warranted. The SMMP differs from a Dredged Material Management Plan (DMMP). A DMMP is not required for designating or selecting disposal sites under MPRSA, however, the Corps does prepare project-specific DMMPs when a continued need for maintenance dredging is demonstrated and available disposal site capacity is determined insufficient to meet the project’s needs for at least a 20 year period for the quantity of material to be dredged.

As discussed in the guidance for development of site management plans issued by EPA and the Corps ("Guidance Document for Development of Site Management Plans for Ocean Dredged Material Disposal Sites", February 1996), management of the disposal site involves: regulating the times, quantity, and physical/chemical characteristics of dredged material that is dumped at the site; establishing disposal controls, conditions, and requirements; and monitoring the site environment to verify that potential unacceptable conditions which may result in significant adverse impacts are not occurring from past or continued use of the disposal site and that permit terms are met. In addition, the plan also incorporates the six requirements for ocean disposal site management plans discussed in MPRSA § 102(c)(3), as amended. These are:

1. consideration of the quantity of the material to be disposed of at the site, and the presence, nature and bioavailability of the contaminants in the material [§102(c)(3) Section II C];
2. a baseline assessment of conditions at the site [§102(c)(3) Section III];
3. a program for monitoring the site [§102(c)(3) Section IV];
4. special management conditions or practices to be implemented at each site that are necessary for protection of the environment [§102(c)(3) Section V.A);

5. consideration of the anticipated use of the site over the long term, including the anticipated closure date for the site, if applicable, and any need for management of the site after closure [§102(c)(3) Section VI);
6. a schedule for review and revision of the plan (which shall not be reviewed and revised less frequently than 10 years after adoption of the plan, and every 10 years thereafter) [§102(c)(3) Section VII).

1.1 History of Dredging and Disposal in Long Island Sound

Material from projects in Connecticut and New York rivers, harbors, and coastal areas has been disposed of at open-water sites in Long Island Sound since at least the 1870s. While detailed records of dredging activities extend back to this time, disposal methods and sites for projects were not systematically recorded until the 1950s; however, there is evidence of continuous use of some sites since 1941 (Fredette *et al.,* 1992). From the 1950s through the early 1970s about 19 open-water disposal sites were active in Long Island Sound (Dames & Moore, 1981). Since the early 1980s, dredged material has been placed predominantly at four disposal sites: Western Long Island Sound (WLIS), Central Long Island Sound (CLIS), Cornfield Shoals (CSDS), and New London (NLDS). These sites were evaluated and chosen to receive dredged material pursuant to programmatic and site specific EISs prepared by the Corps in 1982 and 1991 (USACE, 1982a, 1982b, and 1991) (see Section 1.4, Other Relevant NEPA Documents). Based on information collected through the Corps' Disposal Area Monitoring System (DAMOS), it is estimated that about 37 million cubic yards (28 million cubic meters) of material may have been disposed of in western and central Long Island Sound since 1941. A more detailed summary of the disposal history at CLIS is provided in Section 5.2.

Estimated Sediment Disposal Volumes in Western and Central Long Island Sound, 1941-2001, from all Dredging Sources (USACE file data, 2003)

Disposal Site	Volume (cubic yards)
Central LIS	14,006,443
Western LIS	1,710,116
Stamford	2,904,884
Eatons Neck	12,972,303
Norwalk	1,313,150
Bridgeport	4,404,428
Milford	398,965
Total	37,710,289

2.0 SMMP OBJECTIVES

The intent of this SMMP is to provide a management framework and monitoring program (Section 6.0) that strives to minimize the potential for significant adverse impacts to the marine environment from dredged material disposal at CLIS. To this end, the SMMP identifies actions, provisions, and practices necessary to manage the operational aspects of dredged material disposal at CLIS. Section 40 CFR § 228.10(a) of the Ocean Dumping Regulations requires that the impact of disposal at a designated site be evaluated periodically. Section 40 CFR § 228.10(b) specifically requires consideration of the following types of potential effects when evaluating impact at a disposal site:

- Movement of materials into sanctuaries or onto beaches or shorelines [228.10(b)(1)];
- Movement of materials towards productive fishery or shellfishery areas

[228.10(b)(2)];

- Absence from the disposal site of pollutant-sensitive biota characteristic of the general area [228.10(b)(3)];
- Progressive, non-seasonal, changes in water quality or sediment composition at the disposal site when these changes are attributable to materials disposed of at the site [228.10(b)(4)];
- Progressive, non-seasonal, changes in composition or numbers of pelagic, demersal, or benthic biota at or near the disposal site when these changes can be attributed to the effects of materials disposed at the site [228.10(b)(5)];
- Accumulation of material constituents (including without limitation, human pathogens) in marine biota at or near the site (*i.e.,* bioaccumulation [228.10(b)(6)]).

40 CFR Section 228.10(c) requires that a disposal site be periodically assessed based on the entire available body of pertinent data and that any identified impacts be categorized according to the overall condition of the environment of the disposal site and adjacent areas. Because knowledge and understanding of impacts resulting from dredged material disposal have advanced substantially over the past several decades, the monitoring approach defined in this SMMP focuses on those factors that provide an early indication of potential unacceptable effects and provides for further assessments should these early indicators suggest potential impact may be occurring. The plan also incorporates ongoing regional monitoring programs in Long Island Sound that can provide additional information to inform the periodic assessment of impact.

The specific objectives of this SMMP are:

- **Objective 1: To ensure site management practices and disposal options are sufficient to avoid degradation or endangerment to the environment.** Management of CLIS involves 1) coordination among Federal and state agencies responsible for managing dredged material disposal in coastal waters, 2) regulating the timing of disposal(s), quantity of material, and physical/chemical characteristics of dredged material placed at the site, 3) instituting disposal controls, conditions, and requirements that avoid or minimize potential impacts to the marine environment, 4) ensuring permit conditions are met, and 5) monitoring to verify that unanticipated or significant adverse effects are not occurring from use of the disposal site. The phrase "significant adverse impact" is inclusive of all significant or potentially substantial negative impacts on resources within CLIS or its vicinity. Factors to be considered under this objective include:

    - Evaluating compliance with CWA or MPRSA permit conditions and conduct enforcement actions where warranted and as appropriate;
    - Providing reasonable assurance that use of the site will not adversely affect beaches, shorelines, or productive fish and shellfish areas.

- **Objective 2: To ensure a monitoring program and data review process that evaluates whether disposal of dredged material at the site unreasonably degrades or endangers human health and welfare, the marine environment, or economic potentialities.** The factors to be evaluated under this objective include:
  - Biotic characteristics on dredged material mounds and nearby areas;
  - Progressive, non-seasonal, changes in water quality or sediment composition at the disposal site;
  - Progressive, non-seasonal, changes in composition or numbers of pelagic, demersal, or benthic biota at or near the site(s);
  - Accumulation of material constituents in marine biota near the site.

To achieve these objectives, the SMMP includes the following components:

- A baseline assessment of current conditions against which future monitoring results can be compared;
- A description of special management conditions to be applied;
- A schedule for review and revision of the SMMP.

Recognizing and correcting any potential unacceptable condition before it causes any significant adverse impact to the marine environment or presents a navigational hazard to commercial and recreational water-borne vessel traffic is central to this SMMP. Therefore, the plan includes a monitoring program that uses a "leading indicator" approach to provide early evidence of unexpected responses as further described in Section 6.0. The identification of unacceptable impacts from dredged material disposal at CLIS will be accomplished in part through comparisons of the monitoring results to historical (*i.e.,* baseline) conditions, and in part through comparison to unimpacted nearby reference locations measured concurrently with site measurements. The timing of monitoring surveys and other activities will be governed by funding resources, the frequency of disposal at the site, and the results of previous monitoring data.

If site monitoring data demonstrates that the disposal activities are causing unacceptable impacts to the marine environment as defined under 40 CFR § Section 228.10(b), the site managers may place appropriate limitations on site usage to reduce the impacts to acceptable levels. Such responses may range from withdrawal of the site's designation to limitations on the amounts and types of dredged material permitted to be disposed or limitations on the specific disposal methods, locations, or schedule.

3.0 ROLES, RESPONSIBILITIES, AND AUTHORITIES

CLIS will be jointly managed by EPA and the Corps. In addition, EPA and the Corps will coordinate with the states of Connecticut and New York to ensure that dredged material disposal and impact assessments at the site follow applicable Federal and state regulations and criteria. Annual agency planning meetings will be held to ensure that this coordination and exchange of information occurs. During this meeting, the SMMPs will be reviewed and revised as necessary depending on current conditions and available site-specific and scientific information.

The MPRSA designated dredged material disposal sites in Long Island Sound are unique in that they fall under both MPRSA and CWA 404 jurisdiction (see Section 3.1). As such, authorization for disposal of dredged material from Federal navigation projects and large non-federal projects at the site must comply with both CWA and MPRSA requirements. Permits for disposal of dredged material from non-federal projects less than 25,000 cubic yards will be issued under the CWA only. In addition, all projects will comply with all relevant state requirements for disposal of dredged material, such as water quality certification requirements.

3.1 Federal Regulatory/Statutory Responsibilities

The primary authorities that apply to the disposal of dredged material in the U.S. are the Rivers and Harbors Act of 1899 (RHA), WRDA, CWA and MPRSA. The RHA regulates dredging and discharge of material in navigable waters and WRDA addresses research and funding in support of specific water resource projects for various needs (*i.e.,* transportation, recreation). It also modifies other Acts, as necessary (*e.g.,* MPRSA).

Section 404 of the Clean Water Act (33 U.S.C. § 1344) authorizes the Corps to issue permits for the disposal of dredged materials in the territorial sea, the contiguous zone, and ocean as long as the material meets guidelines developed by EPA pursuant to CWA § 404(b)(1). EPA's guidelines are promulgated at 40 CFR Part 230. These guidelines set forth environmental standards and analytical requirements for use in determining when the Corps should authorize disposal of particular dredged material at a particular location. The Corps' regulations governing the issuance of Section 404 permits are codified at 33 CFR Parts 320-338.

Because Long Island Sound is an estuary, it falls within the geographical jurisdiction of Section 404 of the Clean Water Act as described above. However, in 1980, Congress enacted the "Ambro Amendment[1]," an amendment to the MPRSA requiring that the disposal of dredged material in Long Island Sound from all Federal projects and non-federal projects that exceed 25,000 cubic yards (19,114 cubic meters) of dredged material comply with the MPRSA provisions, also known as the Ocean Dumping Act. Regulations implementing MPRSA were promulgated by EPA and are codified at 40 CFR Parts 220 to 228 (referred to as the Ocean Dumping Regulations). Under MPRSA Section 102, EPA is assigned permitting authority for non-dredged material. In addition, it authorizes EPA to designate sites or time periods for disposal according to site evaluation criteria promulgated by EPA at 40 CFR Part 228. Corps determinations to issue MPRSA permits for dredged material are subjected to EPA review and concurrence.

[1] The Ambro Amendment was first enacted during reauthorization of MPRSA in 1980, adding Section 106(f) (33 U.S.C. § 1416(f)) (Pub. L. No. 96-572). The language was amended again in 1990 (Pub. L. No. 101-596). As currently enacted, Section 106(f) reads: "In addition to other provisions of law and not withstanding the specific exclusion relating to dredged material in the first sentence in section 1412(a) [33 U.S.C. § 102(a)] of this title, the dumping of dredged material in Long Island Sound from any Federal project (or pursuant to Federal authorization) or from a dredging project by a non-Federal applicant exceeding 25,000 cubic yards shall comply with the requirements of this subchapter [MPRSA]."

Under Section 103 of MPRSA, the Corps is assigned permitting responsibility for dredged material, subject to EPA review and concurrence that the material meets applicable ocean disposal criteria. The Corps is required to use EPA-designated open-water disposal sites for dredged material disposal to the maximum extent feasible. If EPA designated sites are not available, the Corps may select ocean disposal sites. The Corps may select a site if a designated site is unavailable and the selected site may be used for two, 5-year periods. Section 33 CFR Part 336 describes the factors to be considered in the evaluation of dredging projects that involve discharge of dredged material into waters of the United States and Ocean Waters (MPRSA waters).

Section 307 of the Coastal Zone Management (CZM) Act of 1972 requires that Federal agencies proposing activities within or outside the coastal zone that affect any land or water use or natural resource of the coastal zone to ensure that those activities are conducted in a manner which is consistent to the maximum extent practicable with the enforceable policies of approved State coastal management programs. As part of this DEIS process, EPA has prepared a Federal determination of consistency with State approved Coastal Zone Management Programs. In addition, EPA will obtain concurrence from the National Marine Fisheries Service (NMFS) regarding an Endangered Species Act Section 7 review for CLIS. NMFS concurrence is requested to confirm that the proposed plan will not adversely affect threatened or endangered species or adversely modify critical habitat. EPA will also coordinate with NMFS to ensure that Essential Fish Habitat (EFH) issues are considered and addressed.

3.2 State Responsibilities

All projects authorized for dredged material disposal at CLIS are required to obtain a Connecticut State Water Quality Certificate from the CTDEP pursuant to Section 401 of the CWA [33 U.S.C., § 1341]. A state water quality certificate is also required for Federal disposal projects that receive authorization from the Corps, rather than a Corps permit. To receive certification, the dredged material discharge must be consistent with the provisions of the CWA and the Connecticut Water Quality Standards (Sections 22a-426 through 22a-363f of the Connecticut General Statues - Structures, Dredging, and Fill) and water quality certification is made in conjunction with issuance of a state permit under this statute. In some cases applicants may qualify for authorization under a state Programmatic General Permit, which is a more expedited process (CTDEP, 2001).

If CTDEP determines that a specific project has the potential to impact any endangered or threatened species, species of concern, or the essential habitats of these species, the application will require additional review by the Natural Diversity Data Base Staff (CTDEP, 2001). Although the Long Island Sound Dredged Material Disposal Site Designation DEIS concluded that dredged material disposal at this site does not have potential to impact endangered or threatened species, this will not preclude the need for Connecticut's concurrence on a project-by-project basis.

3.3 Surveillance, Enforcement, and Monitoring

All dredging, dredged material transport, and disposal must be conducted in compliance with the permits issued for these activities. To ensure compliance, the CWA and MPRSA provide for both surveillance and enforcement. The Corps and EPA share surveillance and enforcement responsibilities at CLIS. The Coast Guard may also assist with such surveillance (See 33 U.S.C. Sec 1417[c]). However, while all missions of the Coast Guard remain vital, maritime homeland security is currently at the forefront and mission priorities and resource constraints may not allow the Coast Guard to participate fully in these activities (USCG, 2003). The permittee is responsible for ensuring compliance with all project conditions including placement of material at the correct location and within applicable site use restrictions. Both the Corps and EPA have enforcement authority for CWA 404 projects. EPA has enforcement responsibility under MPRSA. The EPA and the Corps will cooperate to ensure effective enforcement of permit violations.

The Corps and EPA also share responsibility for monitoring of CLIS. Monitoring data may be generated by the agencies or through coordination or use of data gathered under other programs. Monitoring data from other agencies (*e.g.,* CTDEP Trawl Surveys and Long Island Sound Study programs) will be utilized as appropriate to maximize the availability of information at CLIS. EPA will lead the evaluation of these data for potential impacts from disposal. Under MPRSA, EPA has the responsibility for determining that an unacceptable impact has occurred as a result of dredged material disposal at CLIS. However, such determinations will be made in consultation with other agencies and be based on available monitoring data. The Corps and EPA share responsibility for developing any necessary mitigation plan. EPA is responsible for determining any modification to site use or de-designation.

Disposal will continue to be practiced using a taut-wire buoy to ensure that ultimate disposal locations are known and that post-disposal monitoring is effective. On-board inspectors will be used by the Corps for all disposal activities at CLIS to ensure compliance with this policy. These inspectors will be trained and certified by the Corps specifically for the dredged material disposal program. Any instances of non-compliance observed by the inspectors must be reported to the Corps within 24 hours and in writing to both the Corps and EPA within five working days of the observed violation. Both agencies will cooperate to ensure effective enforcement of all disposal requirements. Section 105 of the MPRSA gives authority to EPA to enforce permit conditions. Egregious violations of permit conditions may be referred by the Corps or EPA to the Department of Justice for criminal prosecution. Disposal activities will not generally be performed during poor sea conditions. Inspectors have been issued specific guidance on disposal under these conditions ("Guidance for Inspectors on Open-Water Disposal of Dredged Material, USACE NAE, January 1996).

Field surveys will be conducted periodically as available funding permits, however, EPA and the Corps will coordinate their monitoring efforts to ensure that the entire site is monitored within a five-year period at a minimum. The monitoring objective for each survey will be based on prior monitoring results and recommendations of the interagency dredged material management review group, in consultation with CTDEP, NYSDEC, and the Connecticut

Office of Long Island Sound Programs (OLISP) and the New York Department of State (NYDOS) for Coastal Zone Management issues.

4.0 MANAGEMENT APPROACH

Although dredged material disposal will be authorized under MPRSA Section 103, CWA Section 404, or both, the site will be managed in a manner that ensures the following site management goals are met:

- Ensure and enforce compliance with permit conditions;
- Minimize loss of sediment from the disposal site;
- Minimize conflicts with other uses of the area;
- Maximize site capacity;
- Minimize environmental impact from sediments placed at the site;
- Recognize and correct conditions before unacceptable impact occurs.

The practices that will be applied to address these management goals at CLIS include coordination among Federal and state agencies, testing of material for acceptability for disposal at the site, review of general and specific permit conditions, review of allowable disposal technologies and methods, implementation of inspection, surveillance and enforcement procedures, periodic environmental monitoring at the site and at relevant reference sites for comparative evaluation, and information management and record keeping. As previously noted, this SMMP was written as part of an MPRSA site designation process and, therefore, focuses primarily on MPRSA management requirements. However, all materials disposed at the site, whether originating from MPRSA or CWA permits will be monitored under the same program described in Section 6.

4.1 Management Practices

EPA and the Corps will jointly manage CLIS. In addition, they will coordinate with the states of Connecticut and New York. The effectiveness of the management approach depends on having efficient planning processes, consistent compliance and enforcement, a robust yet flexible monitoring plan, and an effective communication structure that includes timely receipt and review of information relevant to the site management goals. One component of this communication structure will be an annual agency planning meeting to review the SMMP with respect to current information and conditions as well as scientific advancements.

Management of CLIS has historically included and will continue to include the following practices for the disposal site:

- Evaluation of the suitability of material for disposal in accordance with the applicable requirements for the specific type of project (*i.e.,* MPRSA and CWA requirements apply to Federal projects and large private projects, with the more stringent conditions governing, while CWA requirements only are applied to material from small private projects);

- Specification of disposal conditions, location, and timing in permits as appropriate (*e.g.,* disposal will not occur between June 1 and September 30 to ensure that dredging windows for fisheries are met or disposal may be restricted during spring tides to ensure that water quality criteria are not exceeded outside the boundaries of the site);
- Enforcement of all permit conditions;
- Use and maintenance of disposal buoys at the site with disposal specified to occur at the buoy or designated coordinate;
- Positioning disposal buoys each year with the intent to create bowl-like features on the seafloor;
- Use of disposal inspectors or electronic vessel tracking or both to record all disposal events;
- As appropriate, placing current materials over historic sediments with higher levels of contamination to minimize potential environmental impact;
- Building disposal mounds to no shallower than 46 feet (14 meters) mean low low water;
- Conducting disposal site monitoring in a consistent, systematic manner;
- Holding technical advisory panel meetings for the monitoring program, as needed;
- Maintaining existing (historic) caps by augmenting the cap if cap thickness is reduced to less than 1.5 feet (approximately 0.5 meters);
- Specification of de-designation (*i.e.,* closure) conditions and dates.

In addition, special management practices may exist at CLIS for individual projects to improve site management, anticipate future disposal requirements, or improve the conditions at the site. Examples include:

- Managing sediment quality by placement of MPRSA authorized sediments over CWA authorized sediments;
- Specification of the dredged material volume that can be placed at specific locations within the site or the total dredged material volume placed in the site;
- Modifications to the site designation or to disposal methods, locations, or time of disposal.

In addition to management practices for the disposal site and individual projects, each SMMP must also include a monitoring plan (as described in detail in Section 6.0) and a coordination/ outreach component. Coordination and outreach will be continuous and include state and Federal agencies, scientific experts, and the public. To ensure communications are appropriate and timely, site management activities and monitoring findings will be communicated through three mechanisms: scientific reports and peer reviewed publications, participation in symposia, and public meetings and fact sheets.

4.2 Testing Requirements

National guidance for determining whether dredged material is acceptable for open-water disposal is provided in the Ocean Testing Manual (Green Book; EPA and USACE, 1991) and in the Inland Testing Manual (ITM; EPA and USACE, 1998). The Regional Implementation Manual (RIM; Guidance for Performing Tests on Dredged Material to be Disposed in Open Waters, EPA New England Region/USACE-NAE, 1997), consistent with the Green Book and the Inland Testing Manual, provides specific testing and evaluation methods for dredged material projects at specific sites or groups of sites. The Regional Implementation Manual that covers Long Island Sound is currently under review by EPA and the Corps, and should be finalized in 2003.

4.3 Disposal Conditions, Location, and Timing

The following list represents special conditions that are to be applied to projects using CLIS for disposal. These conditions may be modified on a project-by-project basis, based on factual changes (*e.g.,* administrative changes in phone numbers, points of contact) or when deemed necessary as part of the individual permit review process.

1. At least ten working days in advance of the start date, the First Coast Guard District, Aids to Navigation Office (617-223-8355 or 617-223-8356 or by e:mail at jmauro@d1.uscg.mil or mswanson@d1.uscg.mil) shall be notified of the location and estimated duration of the dredging and disposal operations.
2. At least ten working days in advance of the start date, the Coast Guard Captain of the Port Long Island Sound (203-468-4429 or 203-468-4444 or by e:mail at opcen@grumsolis.uscg.mil) shall be notified of the location and estimated duration of the dredging and disposal operations.
3. The Captain of the Port, Long Island Sound (203-468-4464) shall be notified at least two hours prior to each departure from the dredging site.
4. Every discharge of dredged material at the disposal site must be witnessed by an onboard inspector who has been trained by, and who holds a current certification from, the Corps' NAE. The disposal inspector shall be contracted and paid for by the permittee. A list of currently certified inspectors can be obtained from the New England District Regulatory Division at 978-318-8292. The inspector will require that all permit conditions and other special requirements are followed as applicable.
5. For the initiation of disposal activity and any time disposal operations resume after having ceased for one month or more, the permittee or the permittee's representative must notify the Corps. Notification must be made at least ten working days before the date disposal operations are expected to begin or resume by contacting the Corps Policy Analysis and Technical Support Branch at 978-318-8292. The information to be provided in this notification is: permit number, permittee name, name and address of dredging contractor, estimated dates dredging is expected to begin and end, name of disposal inspector, name of the disposal site and estimated volume of material to be dredged. Disposal operations shall not begin or resume until the Policy Analysis and Technical Support Branch issues a letter authorizing the initiation or continuation of open-water disposal. The letter will include disposal-point coordinates to use for

this specific project at that time. These coordinates may differ from those specified for other projects using the same disposal site or even from those specified earlier for this project. It is not necessary to wait ten days before starting disposal operations. They may start as soon as this letter is issued.

6. The permittee shall ensure that a separate Corps disposal inspection report (scow log; see Attachment B) is fully completed by the inspector for every trip to the disposal site and that this report is received by the Corps within one week of the trip date. The Regulatory Division telefax number is 978-318-8303. The original of this report must be mailed to: U.S. Army Corps of Engineers, Regulatory Division, Policy Analysis and Technical Support Branch, 696 Virginia Road, Concord, MA 01742-2751. For each dredging season during which work is performed, the permittee must notify the Corps upon completion of dredging for the season by completing and submitting the form that the Corps will supply for this purpose when disposal-point coordinates are specified.
7. Except when directed otherwise by the Corps DAMOS Program Manager for site management purposes, all disposal of dredged material shall adhere to the following: The permittee shall release the dredged material at a specified buoy or set of coordinates within the disposal site. All disposal is to occur at the buoy or specified coordinates with the scow at a complete halt. The Corps will provide buoys and the coordinates. This requirement must be followed except when doing so will create unsafe conditions because of weather or sea state, in which case disposal within 100 feet of the buoy or specified coordinates with the scow moving only fast enough to maintain safe control (generally less than one knot) is permitted. Disposal is not permitted if these requirements cannot be met due to weather or sea conditions. In that regard, special attention needs to be given to predicted conditions prior to departing for the disposal site.
8. EPA and the Corps (and/or their designated representatives) reserve all rights under applicable law to free and unlimited access to and/or inspection of (through permit conditions): 1) the dredging project site including the dredge plant, the towing vessel and scow at any time during the course of the project; 2) any and all records, including logs, reports, memoranda, notes, etc., pertaining to a specific dredging project (Federal or non-Federal); 3) towing, survey monitoring, and navigation equipment.
9. If dredged material regulated by a specific permit issued by the Corps or Federal authorization is released (due to an emergency situation to safeguard life or property at sea) in locations or in a manner not in accordance with the terms or conditions of the permit or authorization, the master/operator of the towing vessel and/or the Corps Disposal Inspector shall immediately notify the Corps of the incident, as required by permit. The Corps shall copy EPA on such notification no later than the next business day. In addition, both the towing contractor and the Corps-certified disposal inspector shall make a full report of the incident to the Corps and EPA within ten (10) days. The report should contain factual statements detailing the events of the emergency and an explanation of the actions that were ultimately taken.

4.4 Allowable Disposal Technologies and Methods

Dredging and dredged material disposal in Long Island Sound has historically been accomplished using a bucket dredge to fill split hull or pocket scows for transport to the disposal site or by using hopper dredges. Hopper dredges, which suction material from the bottom into split hull hoppers, have seen limited use in the past several years in Long Island Sound. Large dredging projects (greater than 500,000 cubic yards; 382,277 cubic meters), such as New Haven, Bridgeport, and Norwalk, have historically used scows of 5000 cubic yards (3823 cubic meters) capacity. For medium sized projects (200,000 to 500,000 cubic yards; 152,911 to 382,277 cubic meters) 1500 to 3000 cubic yards (1147 to 2294 cubic meters) scows are typically used. For projects under 150,000 to 200,000 cubic yards (114,683 to 152,911 cubic meters), scows of 1500 cubic yards (1147 cubic meters) or less are used. These types of equipment are expected to be used in the future in Long Island Sound.

4.5 Modifications to Disposal Practices and the Site

Based on the findings of the monitoring program (Section 6.0), modifications to the site use may be required. Corrective measures such as those listed below, but not limited to, will be developed by EPA New England Region and the Corps NAE.

- Stricter definition and enforcement of disposal permit conditions;
- Implementation of more conservative judgments on whether sediments proposed for dredging are suitable for open-water disposal;
- Implementation of special management practices to prevent any additional loss of contaminants to the surrounding area;
- Excavation and removal of any unacceptable sediments from the disposal site (an unlikely, worst case scenario given that the permitting program should exclude such material from the site to begin with, and since excavation could make matters worse by releasing contaminants during the process);
- Closure of the site as an available dredged material disposal area (*i.e.,* to prevent any additional disposal at the site).

4.6 Other Management Considerations

In addition to the management practices outlined in Section 4.1, other management considerations may be determined on a project by project basis through consultation with the NMFS and coordination with other state and Federal agencies. These may include the following:

- Use of marine mammal observers during disposal operations;
- Establishment of dredging windows;
- Compliance with Essential Fish Habitat (EFH) under the Magnuson Stevens Act and Endangered Species Act (ESA) concerns.

Any changes to special permit conditions will be discussed at the annual Agency planning meeting.

5.0 BASELINE ASSESSMENT

MPRSA 102(c)(3)(A) as amended by WRDA 92 requires that the SMMP include a summary of baseline conditions at the site. Much of the information provided in this section is based on surveys conducted in support of the site designation DEIS (EPA, 2003). This information will be updated as necessary based on any new information presented in EPA's Final EIS. Baseline conditions are defined as the conditions existing at the time data to support the FEIS were developed. The section includes first a general characterization of the site followed by a description of past disposal at the site including information on the dredged material disposal mounds in the site.

5.1 Site Characterization

This section provides a summary of the physical, chemical, and biological environment at the site.

5.1.1 Site Location

The CLIS dredged material disposal site is located in Connecticut state waters in the central basin of Long Island Sound approximately 5 nautical miles (6.5 miles) due south of South End Point, New Haven, Connecticut. It is approximately 1.1 by 2.2 nautical miles in size (2 by 4 kilometers) and is centered at 41°8.9' N and 72°53.0'W (NAD83) (see Figure 1).

5.1.2 Reference Areas

The baseline assessment activities conducted at CLIS as part of the EIS study sampled two historic disposal mounds, an active disposal mound within the site, a reference area outside of the disposal site, and two farfield stations outside of the disposal site. The DAMOS program has generally maintained three reference areas outside the disposal site, three of which (CLIS-REF, 2500W, and 4500E) are incorporated into this SMMP.

5.1.3 Physical Characteristics

The seafloor at CLIS slopes from a depth of 59 feet (18 meters) at the northwest corner to 74 feet (22.5 meters) in the southeast corner, with distinct disposal mounds from past dredged material disposal activities as high as 46 feet (14 meters) deep.

The bottom sediments at the CLIS site are composed of fine silts and clays characteristic of the low-energy environment found in deep areas of the western and central basins (Table 1). The site is in an area of sediment accumulation, which is indicative of a generally low current regime. Bokuniewicz and Gordon (1980) estimated that the area in which CLIS is situated has accumulated 200 to 600 g/m2/yr of sediment during the last 8,000 years.

Table 1. Average Grain Size and TOC Content at CLIS[1]

Station Type	Average % fines	Average % TOC
CLIS Active	81.8	2.2
CLIS Farfield	87.4	1.9
CLIS Historic	57.4	1.4
CLIS Reference	92.4	1.9

[1] Collected in February 2000 (USACE 2001a).

Tidal currents dominate the current regime at CLIS and predominately run east and west. Average peak ebb and peak flood currents range 20 to 30 centimeters per second (depth-averaged) with the spring tides 20 to 40 percent stronger. While currents throughout Long Island Sound are continuously driven by the rise and fall of the tide, they are also intermittently driven by strong, steady wind events and by the density effect of freshwater inflows. Peak near-bottom flood currents of 45 centimeters/second (1.5 feet/second) have been measured in the presence of winds in excess of 30 knots. The net west-southwestward flow (long-term mean) is approximately 2.5 centimeters per second and is indicative of the density driven estuarine circulation.

Tidal currents are intermittently supplanted by currents caused by strong, steady wind events and by the density effect of freshwater inflows. The 2-month current meter deployment, observed a peak near-bottom flood event of 45 centimeters/second (1.5 feet/second) associated with winds in excess of 30 knots (15 meters/second). Also observed was a net west-southwestward flow (long-term mean) of approximately 2.5 centimeters/second (0.08 feet/second) indicative of the density driven estuarine circulation.

Tidal ellipse parameters for surface, middle, and bottom currents measured in CLIS in the spring 2001 are presented in Table 2 (USACE, 2001b). The dominant flow direction is nearly east-west and the narrow ellipses indicate that there was little flow normal to the dominant flow direction. Amplitude decreases with depth and near-bottom amplitude is less than 25 centimeters/second (0.8 feet/second). Fifty to 95 percent of the current variance during the 2-month spring deployment period was due to the tide with 96 percent of the current variation in the x-direction due to tidal forcing at the bottom.

Table 2. Tidal Ellipse Parameters for Bottom, Middle and Surface Currents Measured at CLIS, Spring 2001

Layer	Dist. Bottom (m)	Major Amplitude (cm/s)	Minor Amplitude (cm/s)	Inclination (deg)	Phase (deg)	% Vx Tidal Variance	% Vy Tidal Variance
Surface	20.1	26.3	2.3	355.0	122.3	51.3	28.9
Middle	10.1	31.9	0.0	352.0	102.9	83.8	51.0
Near-Bottom	2.1	24.1	3.1	351.6	93.4	84.9	52.1
Bottom	~1.0	14.2	2.4	342.9	40.5	96.0	68.6

Source: USACE 2001b

The wind fetch at CLIS is limited by the semi-enclosed nature of Long Island Sound, which limits the wave heights that can be developed at the site. This is particularly true for winds from directions other than the east and northeast (along the axis of the Sound). Considering that winter storms can generate powerful winds from the northeast (northeasters), the potential effect of waves must be taken into account despite the limited fetch. Few wave measurements are available at or near CLIS. A 2-month record of waves made in the spring of 2001 at a station within CLIS recorded 5-foot (1.5-meter) high waves (significant wave height) with 4 to 6 second periods associated with a 10 meters/second (19 knot) wind event (winds from the east) (USACE, 2001b). Near bottom peak orbital wave velocities measured at 69-foot (21-meter) depth reached approximately 8 centimeters/second (0.3 feet/second). This, however, represents a very short record of potential wave activity. Therefore, the 12-year record of wind data from the Buzzards Bay Tower was analyzed for the periods from July 1985 to February 1994 and from May 1997 to March 2001 to develop wind climatology for the region. Using these data, wave height and period were determined for various wind conditions experienced in the Sound, using a simple fetch and duration model. The results for CLIS are presented in Table 3.

Table 3. Wave Height and Period at CLIS for Storms of Various Return Periods Estimated from Wind Data

Return Period (years)	Wind Direction (Degrees from True North)									
	0°		45°		90°		135°		180°	
	Wave Height (ft)[1]	Peak Wave Period (sec)	Wave Height (ft)	Wave Period (sec)	Wave Height (ft)	Wave Period (sec)	Wave Height (ft)	Wave Period (sec)	Wave Height (ft)	Wave Period (sec)
1	3.49	3.58	5.99	4.75	7.25	5.24	6.29	4.86	5.31	4.41
2	3.81	3.73	6.57	4.97	8.04	5.50	6.92	5.09	5.76	4.58
5	4.24	3.91	7.34	5.24	9.06	5.83	7.74	5.36	6.36	4.79
10	4.57	4.04	7.92	5.43	9.83	6.07	8.36	5.57	6.82	4.95
20	4.90	4.17	8.50	5.62	10.60	6.30	8.99	5.76	7.28	5.10
50	5.35	4.34	9.27	5.86	11.60	6.59	9.81	6.01	7.88	5.29
100	5.69	4.46	9.85	6.04	12.35	6.80	10.42	6.19	8.35	5.43

Return Period (years)	Wind Direction (Degrees from True North)					
	225°		270°		315°	
	Wave Height (ft)	Wave Period (sec)	Wave Height (ft)	Wave Period (sec)	Wave Height (ft)	Wave Period (sec)
1	6.05	4.70	6.10	4.74	4.49	4.09
2	6.52	4.87	6.53	4.89	4.80	4.21
5	7.13	5.07	7.10	5.08	5.21	4.37
10	7.59	5.23	7.53	5.22	5.52	4.49
20	8.06	5.37	7.96	5.36	5.83	4.61
50	8.67	5.56	8.53	5.54	6.25	4.75
100	9.14	5.70	8.96	5.67	6.57	4.86

[1]Wave heights are reported as significant wave height, which is the average of the one-third highest waves.

The prevailing direction of waves in the region follows the prevailing wind directions, from the north and northwest in fall and winter with occasional northeast events and from southwest in spring and summer. The data show a northeast storm with a return period of 2 years will generate waves of 8.0 feet (2.5 meters) with a 5.5 second period over the CLIS site. Storms with a return period of 10 years will generate 10-foot (3.0 meter) waves with a 6.1 second period over the site. The short period relative to wave height is indicative of locally generated, fetch-limited waves. The waves reported in USACE (2001b), with a peak wave height of 5 feet (1.5 meters), represent storms that can be expected several times a year.

Peak wave induced near-bottom orbital velocities calculated from linear wave theory for the 2 to 10 year storms are estimated to generate bottom orbital velocities of 17 to 31 centimeters per second. Velocities of this magnitude are not sufficient to cause significant resuspension and mound erosion at depths of approximately 69 feet (21 meters).

5.1.4 Sediment Quality

To evaluate sediment quality, concentrations of metals and organic chemicals measured in sediments collected from the site were evaluated (see Figure 2 for sampling locations). In addition, the results of toxicity tests conducted using these sediments were considered.

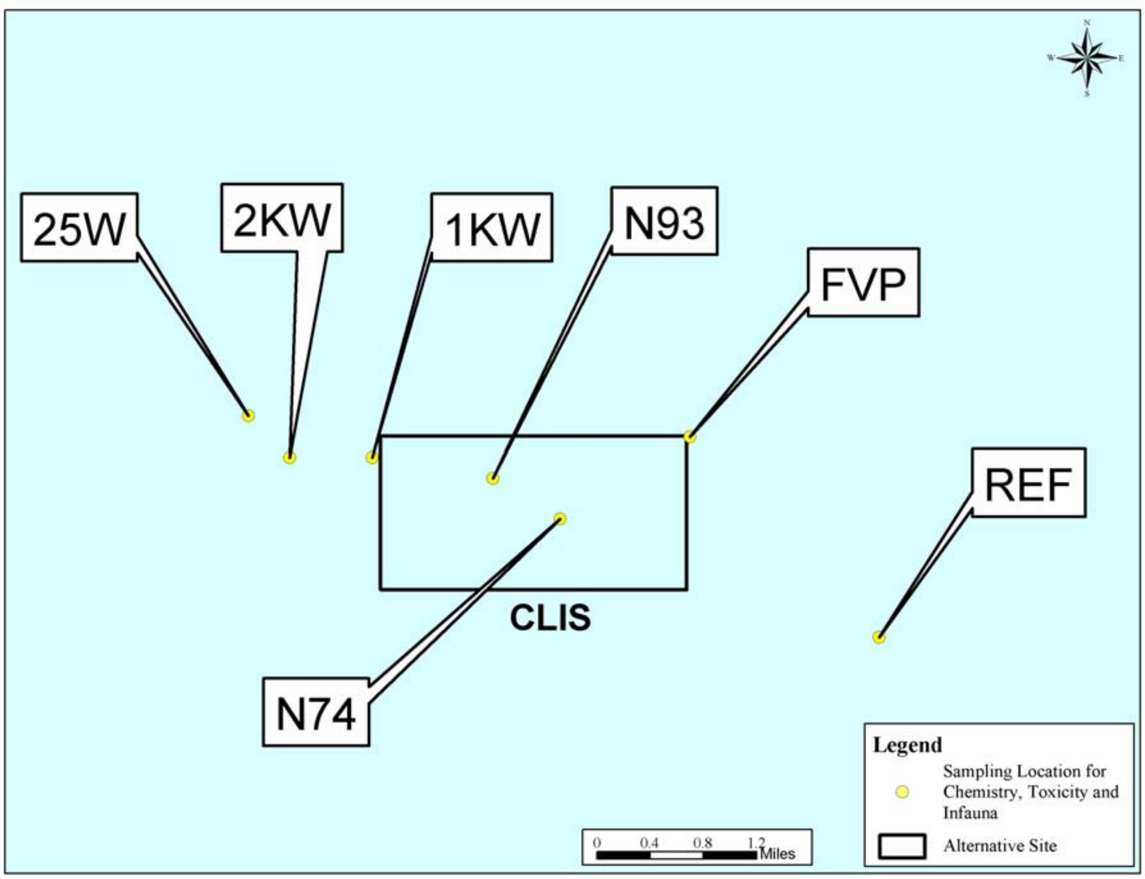

Figure 2. Sediment Sampling Locations Evaluated at CLIS During the EIS Process

At CLIS the average concentrations of four metals (copper, nickel, silver, and mercury) exceeded the Effects Range-Low (ER-L) for at least one type of station (Table 4). None exceeded the Effects Range- Median (ER-M). Average concentrations of silver, cadmium, copper, and mercury exceeded the average background concentration for depositional environments of Long Island Sound for at least one type of station. In general, average contaminant concentrations were higher in the active area samples than in samples from historical, farfield or reference locations.

Table 4. Summary of Metals Concentrations (mg/kg dry weight) in Sediment Samples from CLIS

Station	Silver	Cadmium	Chromium	Copper	Mercury	Nickel	Lead	Zinc
ER-L[1]	1.0	1.2	81	34	0.15	20.9	46.7	150
ER-M[1]	3.7	9.6	370	270	0.71	51.6	218	410
Sound-wide Sediment Concentrations[2]								
LIS average	0.27	0.16	67.9	**39.1**	0.12	**24.8**	36.1	103
LIS depositional environment average	0.44	0.25	**93.3**	**59.5**	**0.18**	**32.2**	**47.7**	146
CLIS [3]								
CLIS Active	**1.33**	0.58	79.3	**75.8**	**0.20**	**23.2**	44.2	139
CLIS Farfield	0.66	0.18	62.4	**51.2**	0.12	**22.7**	33.7	108
CLIS Historic	0.78	0.52	62.6	**85.1**	0.15	17.4	28.9	92.3
CLIS Reference	0.60	0.13	52.8	**44.0**	0.11	**23.1**	29.0	107

Shaded values exceed the average background level for Long Island Sound depositional environments; Bold values exceed the ER-L; Italicized values exceed the ER-M.
[1] Ecological effects values derived by Long *et al.* (1995)
[2] Mecray and Buchholtz ten Brink (2000)
[3] Collected in February 2000 (USACE 2001a)

The concentrations of the most common organic contaminants are low at CLIS (Table 5), and below relevant ecological effect levels. Concentrations were typically below the ER-Ls with the exception of total PCBs at the active and historic stations. Total analyte concentrations were generally higher at the historic or active stations than at the reference or farfield stations.

Table 5. Summary of Organic Chemical Concentrations (µg/kg dry weight) in Sediment Samples from CLIS

	Low Molecular Weight PAH	High Molecular Weight PAH	Total PAH	Total PCB	Total DDT	2,3,7,8-TCDD[1]
ER-L[2]	552	1700	4022	22.7	1.58	—
ER-M[2]	3160	9600	44792	180	46.1	—
Long Island Sound Average[3]	747	3470	2416	108	5.61	—
CLIS[4]						
CLIS Active	274	896	1036	**59**	0.40	0.00066
CLIS Farfield	203	624	748	7	ND	0.00021
CLIS Historic	298	855	1019	**95**	0.7	0.00053
CLIS Reference	202	674	783	16	0.8	0.00028

Shaded values exceed background levels; Bold values exceed the ER-L
[1] 2,3,7,8-TCDD is presented as a representative dioxin/furan
[2] Ecological effects values derived by Long *et al.*, 1995
[3] NOAA NS&T Benthic Surveillance Program 1984-1991 (http://ccmaserver.nos.noaa.gov/NSandT/NSandTdata.html)
[4] Source: USACE 2001a

The toxicity of sediment from CLIS and its reference sites evaluated with a 10-day, whole sediment amphipod *Ampelisca abdita* test in February 2000 found no apparent toxicity to amphipods at active, historic, and farfield sites associated with CLIS (Table 6).

Table 6. Mean and Standard Deviation (sd) Survival in the 10-day Solid-Phase *Ampelisca abdita* Acute Toxicity Tests, for CLIS March 2000

Station IDs	Percent Survival		Survival Statistically Different from Reference? [1]	Absolute Difference from Reference (%)
	Mean	sd		
Reference (REF)	97	3	NA	NA
1KW	98	3	No	+1
2KW	98	3	No	+1
FVP	94	5	No	–3
N74	100	–	No	+3
N93	98	4	No	+1

[1] Site sediments were compared only to their site-specific reference sediment.
Source: USACE 2000a

5.1.5 Water Column Characteristics/Circulation

CLIS is expected to exhibit similar water quality conditions to the central basin of Long Island Sound. The average annual salinity is expected to be higher than those sites farther to the west and water temperatures in the summer and fall are expected to be slightly lower. The water clarity in the summer months at CLIS will be higher than in the western basin of Long Island Sound and hypoxia is expected to be less significant. Based on the general trends documented for Long Island Sound, hypoxic conditions in the waters of CLIS are not a common annual occurrence. If they do develop, it is later in the season, less severe, and shorter in duration than in the waters farther west. The lower significance of hypoxia at CLIS results from generally lower levels of nutrients (primarily nitrogen) in the waters of the central Long Island Sound basin as compared to the western Long Island Sound basin. The levels of toxic contaminants at CLIS were measured and found to be low, meeting water quality standards for all listed parameters.

5.1.6 Biological Characteristics

This section summarizes the key biological communities at the CLIS site, including the benthic community, fish and shellfish, and endangered and threatened species.

Benthic Community

Benthic invertebrates sampled in July 2000 and 2001 (USACE, 2001c) from an active mound (NHAV93), two historical disposal mounds (FVP and NHAV74), a reference area (CLIS-REF), and two farfield stations 1000 meter (3280 feet) and 2000 meter (6561 feet) outside of the disposal site (1KW, 2KW) found CLIS and its nearby reference area shared several features. The abundance of infaunal animals within each area in July 2000 or 2001 was moderate, with about 10,000 to 17,000 individuals per square meter within the disposal site and about 16,000 individuals per square meter occurring within the reference area (Table 7). The average numbers of species found in the disposal and reference site samples were 29 to 36 and 27, respectively. The number of species at the reference site in July 2001 was slightly less than that found in July 2000 (32). The resulting Shannon-Wiener diversity (H') values calculated for the CLIS samples were moderate, ranging from 3.0 to 3.6. Rarefaction analysis showed that species diversity among stations within the disposal site were very similar although diversity at the historic mound station N74 was much higher than that at any other station. Diversity at the reference station in July 2000 and July 2001 was slightly lower than that at the other stations sampled.

Table 7. Comparison of the Biological Characteristics of CLIS

	CLIS[1]	Reference [2]
SPI Features (September 1999)[3]		
Grain Size (phi)	>4, 3–2	>4
Prism Penetration (cm)	13–16	15
Dominant Processes	Biological/Physical	Biological/Physical
RPD Depth (cm)	2.2–3.4	3.3
Successional Stage	I on III; III	I on III; III
OSI	6.2–9.2	8.7
Infaunal Community Features (July 2000, 2001)[4]		
Average Abundance (/sample)	413–682 (~10,000–17,000/m2)	640 (~16,000/m2)
Average Species (/sample)	29–36	27
Average Diversity (H′)	3.0–3.6	3.1
Average Evenness (J')	0.6–0.7	0.7
Five Most Abundant Taxa[5]	*Levinsenia gracilis* *Nucula annulata* *Ampharete finmarchica* *Tharyx sp. 1B* *Mediomastus ambiseta*	*Levinsenia gracilis* *Nephtys incisa* *Nucula annulata* *Tharyx sp. 1B* *Sigambra tentaculata*

[1] Five SPI stations; range or average of values shown
[2] Three SPI stations; range or average of values shown
[3] Source: SAIC 2002a
[4] Source: USACE 2002
[5] In order of decreasing abundance

The predominant species comprising the infaunal community within the disposal and reference sites were the small surface deposit-feeding worms *Levinsenia gracilis* and Tharyx sp. 1B and the small clam *Nucula annulata*. Other polychaete worms were numerically common within the disposal site (*Mediomastus ambiseta, Ampharete finmarchica*) or in the reference site (*Nephtys incisa, Sigambra tentaculata*). The clam *Nucula annulata* was abundant in July 2000, attaining a density of about 4,800 individuals per square meter and accounting for about 34 percent of the identified infaunal animals. However, the species was considerably less abundant at the stations sampled in July 2001, occurring at a density of about 250 individuals per square meter and accounting for only about 3 percent of the identified animals. Similar marked changes in abundance between the two years has been noticed previously for some infaunal animals in Long Island Sound (McCall, 1978).

The benthic communities evaluated using sediment profile camera images found a range of sediment characteristics and generally advanced successional stages both within CLIS and at its reference stations (Table 7). The camera data indicted that the quality of the sediments and benthic community were generally good.

Commercial/Recreational Fish and Shellfish Resources

Long Island Sound, a semi-enclosed estuary, is an important economic resource for both commercial and recreational/sport fisherman. The region is occupied by more than 83 fish species; however, only a few of them are considered year-round residents (Gottschall *et al.,* 2000). Standard research tows for fish and shellfish conducted by the CTDEP between 1984 and 2000 document that the highest catch per unit effort (CPUEs) in Long Island Sound were found in central Long Island Sound. The average fall CPUE near CLIS was 1,982 and the average spring CPUE relatively low at 588. The long-term (16 years) seasonal average was 1,285. Species richness in the vicinity of CLIS was the highest with fall and spring values of 13.7 and 14.3 respectively. Species diversity at stations near CLIS was almost identical to that inside the disposal site (USACE, 2003). More recent surveys (2000) show that spring trawls were dominated primarily by winter and windowpane flounder, while the fall trawls were dominated by scup and butterfish.

Based on the CTDEP data, lobsters, which were most abundant on muddy substrates, occurred Sound-wide in all seasons during the study period (*i.e.,* 1984 to 2000) and were moderately abundant at CLIS. Tows from the CLIS analysis area averaged over all years of data, contained about 85 lobsters in the fall and about 45 in the spring compared with an average of 137 lobsters per tow in other areas. With respect to other commercial shellfish species, commercially harvested clam species were not evident in benthic samples collected at the CLIS site during recent benthic characterization studies and there is no evidence of substantial populations.

Endangered/Threatened Species

This section provides a summary of known endangered, threatened, and “special concern” species within the Long Island Sound region. An endangered species is one whose overall survival in a particular region or locality is in jeopardy as a result of loss or change in habitat, overall exploitation by man, predation, adverse interspecies competition, or disease. Unless an endangered species receives protective assistance, extinction may occur. Threatened or rare species are those with populations that have become notably decreased because of the development of any number of limiting factors leading to a deterioration of the environment. A species may also be considered as a species of “special concern.” These may be any native species for which a welfare concern or risk of endangerment has been documented within a state (NYSDEC 2003). Endangered and threatened species are protected under the Federal Endangered Species Act, 16 U.S.C. §§ 1531 *et seq.* and under state law while species listed as “special concern” are protected only by state law.

<u>Endangered and Threatened Mammals.</u> In general, whales and other marine mammals are not frequently observed in Long Island Sound, however, incidental sightings have resulted in the inclusion of several species on the endangered species list for Connecticut and New York (CTDEP, 2003; NYSDEC, 2003; USFWS, 2003). Table 8 lists the species on the Federal endangered and threatened whale species list for Connecticut and New York. Pursuant to Section 7 of the Endangered Species Act, EPA requested input from NMFS on the identification of Threatened and Endangered Species in Long Island Sound. Based on information received, marine mammals are not expected to spend significant portions of time within the western and central basins of Long Island Sound, therefore no additional information has been provided.

Table 8. Endangered Marine Mammals and Reptiles for Connecticut and New York

Species	Federal Status[1]	CT Status[2]	NY Status[3]
Humpback whale (*Megaptera novaeangliae*)	Endangered	Endangered	Endangered
Humpback whale (*Megaptera novaeangliae*)	Endangered	Endangered	Endangered
Fin whale (*Balaenoptera musculus*)	Endangered	Endangered	Endangered
Right whale (*Eubalaena glacialis*)	Endangered	Endangered	Endangered
Kemp's ridley sea turtle (*Lepidochelys kempii*)	Endangered	Endangered	Endangered
Loggerhead sea turtle (*Caretta caretta*)	Threatened	Threatened	Threatened
Leatherback sea turtle (*Dermochelys coriacea*)	Endangered	Endangered	Endangered
Green sea turtle (*Chelonia mydas*)	Threatened	Threatened	Threatened
Hawksbill sea turtle (*Eretmochelys imbricata*)	Endangered	Endangered	Endangered

Source: [1]USFWS, 2003, [2]CTDEP, 2003; [3]NYSDEC, 2003;

<u>Endangered and Threatened Reptiles.</u> Sea turtles are the only endangered reptile species noted in the Long Island Sound area. Sea turtles are highly migratory and are often found throughout the world's oceans (NOAA, 1995). Pursuant to Section 7 of the Endangered Species Act, EPA requested input from NMFS, U.S. Fish and Wildlife Service (USFWS), CTDEP, and NYSDEC on the identification of Threatened and Endangered Species in Long Island Sound. Their assessment noted the five species of sea turtles as possibly being found in the waters of Long Island Sound.

Use of Long Island Sound by turtles appears related to the availability of prey, annual migration patterns, and age. The coastal waters of New York provide an important habitat for juvenile Kemp's ridley, green, and loggerhead turtles and adult-sized leatherbacks. Hawksbill turtles are only an incidental visitor to Long Island Sound, therefore Long Island Sound is not considered important habitat to the Hawksbill turtle.

<u>Endangered and Threatened Fish.</u> The shortnose sturgeon (*Acipenser brevirostrum*) is listed as an endangered species in both the state of Connecticut (CTDEP, 2003) and New York (NYDEC, 2003) and is managed by NMFS under the Endangered Species Act. Shortnose sturgeon occur in the lower Connecticut River from the Holyoke Pool to Long Island Sound. Shortnose sturgeon spawn in fresh water from the end of March to the first week of May (CTDEP, 2003). Populations of shortnose sturgeon in North America have declined due to overfishing, loss of habitat, limited access to spawning areas and water pollution. Unlike other anadromous species such as salmon and shad, shortnose sturgeon do not appear to make long-distance offshore migrations (NMFS, 2001a). It can be inferred that shortnose sturgeon utilizes portions of Long Island Sound since it is known to spawn in the Connecticut River. Shortnose sturgeon have not been observed in Long Island Sound during CTDEP trawls since 1984.

The Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*) is listed as "threatened in inland waters" for the state of Connecticut (CTDEP, 2003). This designation means that the Atlantic sturgeon is not protected within the waters of Long Island Sound under the Connecticut's endangered species legislation, but a moratorium on harvesting the species in Long Island Sound has been enacted. In February 2003, a proposal was made to change the status of the Atlantic sturgeon to "endangered in all state waters" (personal communication Tom Savoy, Connecticut Marine Fisheries Division). This proposal is still under consideration at this time.

Atlantic sturgeon is an anadromous species that lives up to 60 years, reaching lengths up to 14 feet (4 meters) and weighing over 800 pounds (363 kilograms) (NMFS, 2001b). Long Island Sound may be an important feeding or resting area on-the-way to and from spawning areas in the Hudson River because all sizes of Atlantic sturgeon have been seen or captured in the Sound. Atlantic sturgeon were caught in all three basins of Long Island Sound but were mainly located in the vicinity of Falkner Island (Savoy and Pacileo, 2003).

Endangered and Threatened Birds. Table 9 lists the Federal and state endangered and threatened coastal and marine birds and bird species of special concern that have been recorded in Connecticut or New York and may occur within the Long Island Sound region. As shown in the table, none of these species is expected to occur at the alternative sites due to their foraging and breeding requirements.

5.1.7 Bioaccumulation and Potential Risks

Based on data collected for NOAA's National Status and Trends Program, chemical contaminants in tissue from Long Island Sound are generally low and appear to be declining (Turgeon *et al*, 1989; O'Conner and Beliaeff, 1995). Concentrations of most chemicals tended to be highest in the western basin. In addition, chemical concentrations in fish, lobster, clam and worm tissue collected in support of the DEIS were also evaluated (see Figures 3 and 4 for sampling locations). These data were also low and showed little spatial variability across the areas evaluated.

As summarized in Tables 10 and 11, potential risks to human health and ecological receptors associated with exposure to sediments at the site are very low. The majority of measured tissue concentrations were well below Food and Drug Administration (FDA) limits as well as guidelines used by Connecticut Department of Public Health (CTDPH) to develop consumption advisories for PCBs. In addition, carcinogenic and non-carcinogenic risk estimates were within the acceptable risk range. With the exception of copper, tissue concentrations were below ecological effect values.

Table 9. Federal and State Endangered and Threatened Birds, and Birds of Special Concern in the Long Island Sound Area

	Classification	Season	Federal Status	CT State Status	NY State Status	Use of offshore, open-water areas
Black tern (*Chlidonias niger*)	Colonial waterbird	Spring – early fall	--	--	Endangered	None
Common tern (*Sterna hirundo*)	Colonial waterbird	Spring – early fall	--	--	Threatened	Occasional
Least tern (*Sterna antillum*)	Colonial waterbird	Spring – summer	--	Threatened	Threatened	Occasional
Roseate tern (*Sterna dougallii*)	Colonial waterbird	Spring – early fall	Endangered	Endangered	Endangered	Occasional
Great egret (*Ardea albus*)	Colonial waterbird	Summer	--	Threatened	--	None
Black rail (*Laterallus jamaicensis*)	Marsh	Spring – fall	--	Endangered	Endangered	None
Common Loon (*Gavia immer*)	Pelagic	Winter	--	--	Special Concern	Occasional
Pied-Billed Grebe (*Podilymbus podiceps*)	Pelagic	Permanent	--	Endangered	Threatened	None
Bald eagle (*Haliaeetus leucocephalus*)	Raptor	Winter	Threatened	Threatened	Threatened	None
Northern harrier (*Circis cyaneus*)	Raptor	Resident	--	Endangered	Threatened	None
Osprey (*Pandion haliaetus*)	Raptor	Spring and early-late fall	--	--	Special concern	None
Peregrine falcon (*Falco peregrinus*)	Raptor	Early fall		Endangered	Endangered	None
Piping plover (*Charadrius melodus*)	Shore	Spring – early fall	Threatened	Threatened	Threatened	None
Willet (*Catoptrophorus semipalmatus*)	Shore	Spring – early fall	--	Special concern	--	None

Source: NYSDEC Endangered Species List (www.dec.state.ny.us/website/dfwmr/wildlife/endspec/etsclist.html) 12/31/2002; CTDEP Wildlife Division Endangered and Threatened Species Series (http://dep.state.ct.us/burnatr/wildlife/learn/esfact.htm) 12/31/2002; USFWS, 2003, Alsop, 2001

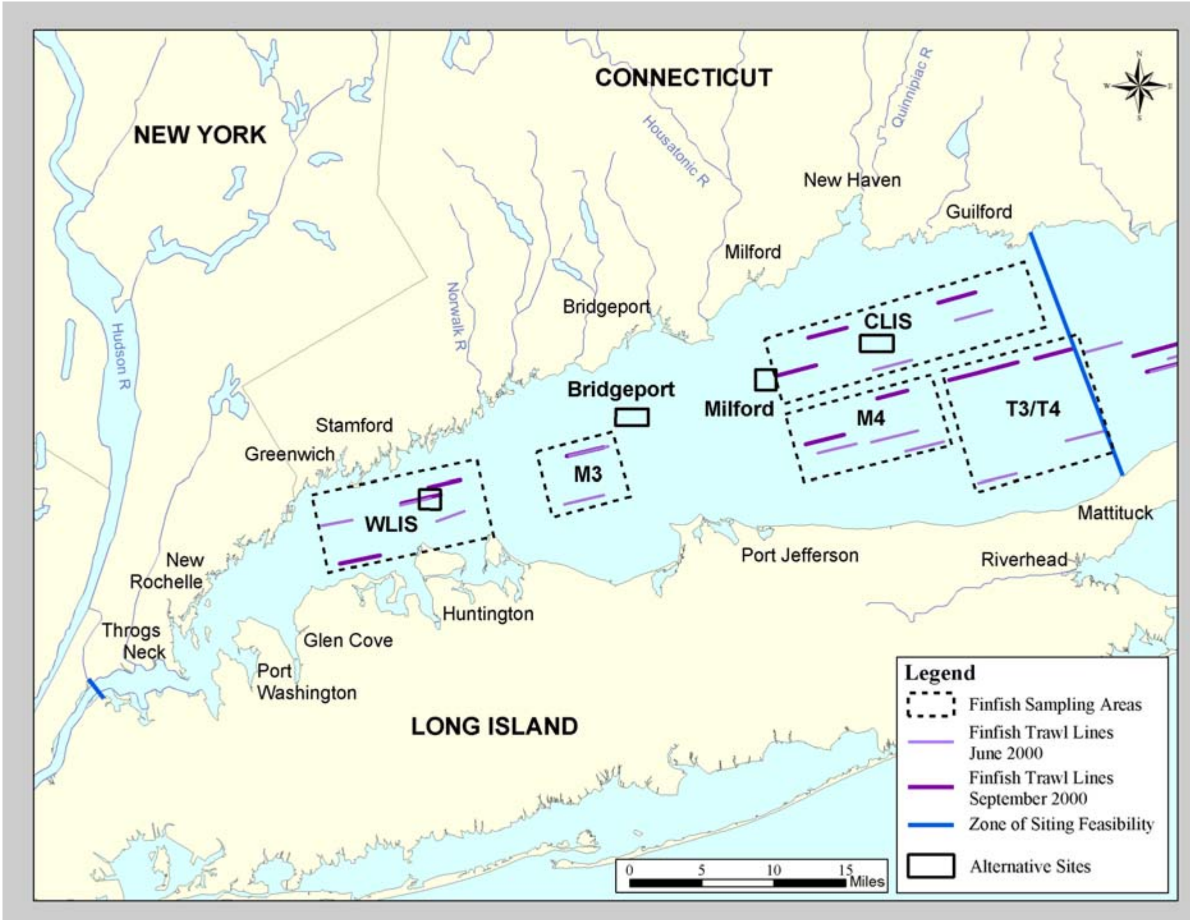

Figure 3. Finfish Sampling Locations, June and September, 2000
Source: USACE, 2000b

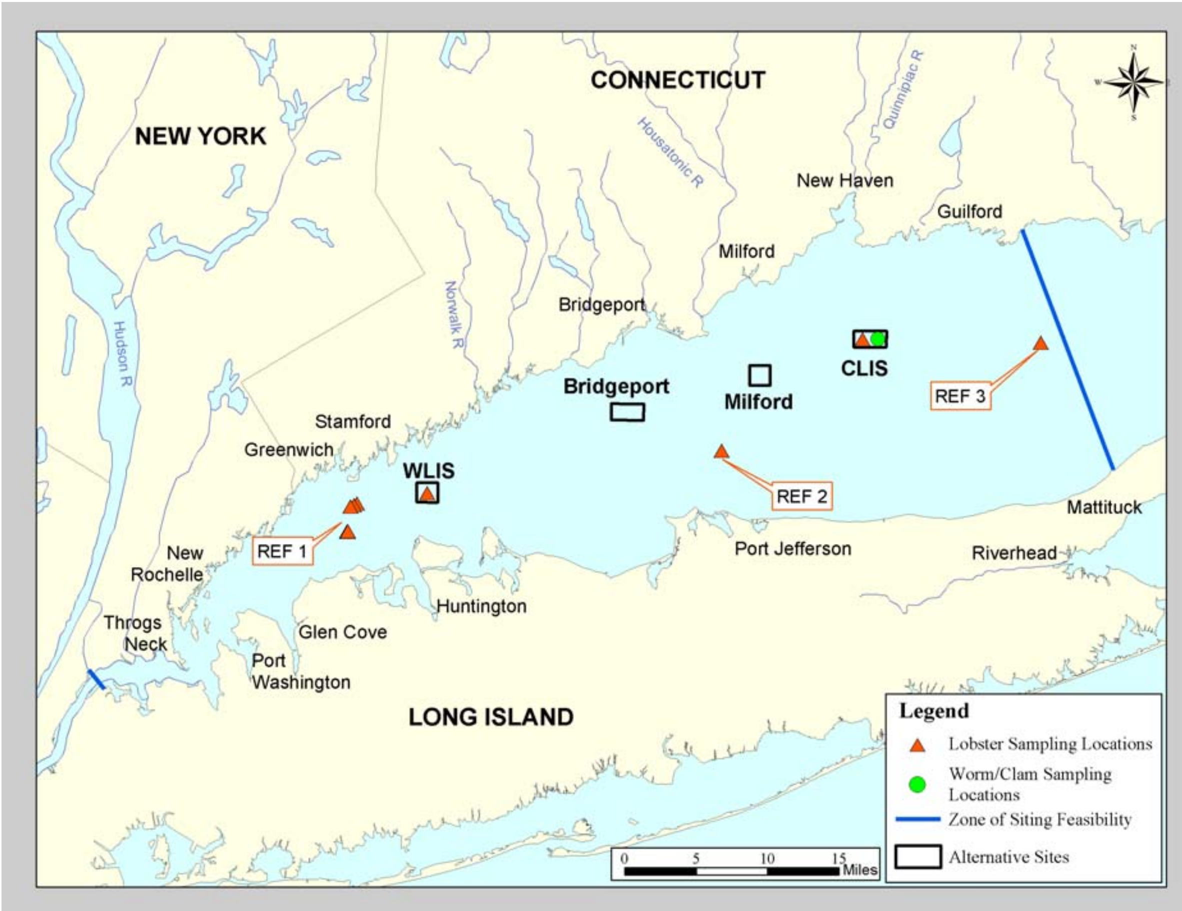

Figure 4. Benthic Tissue (Lobster, Clam, and Worm) Sampling Locations
Source: USACE, 2000b

Table 10. Comparison of Lobster and Finfish Edible Tissue Concentrations (wet weight) to Human Health Action Levels (*i.e.*, FDA Action Levels)[1]

Station	Species	Total PCB (µg/kg)	Total DDT (µg/kg)	Total Chlordane (µg/kg)[2]	Aldrin (µg/kg)	Dieldrin (µg/kg)	Heptachlor (µg/kg)	Heptachlor Epoxide (µg/kg)	Mercury (mg/kg)
FDA Human Health Action Levels		2000	5000	300	300	300	300	300	1
CLIS	Winter Flounder	82 – 108	6 – 9	1.19 - 1.25	0.02 U	0.75 – 1.04	0.02 U	0.02 U	0.01 -0.02
	Scup	72 – 168	5 -12	0.5 – 0.7	0.02 U	0.34 – 3.9	0.02 U	0.02 U	0.06 –0.07
	Bluefish	300	30	4	0.02 U	7	0.02 U	0.02 U	0.10
	Striped Bass	368	37.4	1.90	0.02 U	3.5	0.02 U	0.02 U	0.33
	Lobster	14 - 20	0.9 – 1.2	0.06 – 0.1	0.03 U	0.3 – 0.9	0.04 U	0.02 U	0.17 – 0.33
Strata M3	Winter Flounder	84 – 250	6 – 8	1.16 – 1.56	0.02 U	0.71 – 0.94	0.02 U	0.02 U	0.02 - 0.03
	Scup	80 – 250	5 – 20	0.5 – 1.0	0.02 U	0.39 - 5	0.02 U	0.02 U	0.08 - 0.09
	Bluefish	854	24	3.2	0.02 U	7.5	0.02 U	0.02 U	0.09
	Lobster	7.8 - 10	0.6 – 0.9	0.09 – 0.1	0.02 U	0.4 – 0.6	0.02 U	0.02 U	0.04 – 0.06
CLIS	Winter Flounder	60 – 68	5.2	1.13 – 1.56	0.02 U	0.77 - 0.89	0.02 U	0.02 U	0.02
	Scup	60 - 88	5 - 9	0.55 – 1.12	0.02 U	0.44 – 1.54	0.02 U	0.02 U	0.03 - 0.09
	Striped Bass	308	28.5	1.55	0.02 U	1.19	0.02 U	0.02 U	0.21
	Lobster	12 - 32	1.1 - 2	0.1 – 0.2	0.02 U	0.6 – 1.6	0.02 U	0.02 U	0.05 – 0.08
Strata M4 and Strata T3/T4	Winter Flounder	44 - 86	3 - 7	0.7 – 1.1	0.02 U	0.3 –1.0	0.02 U	0.02 U	0.01 – 0.03
	Scup	32 – 228	3 - 7	0.5 - 1	0.02 U	0.2 –5.1	0.02 U	0.02 U	0.03 - 0.07
	Lobster	18 - 32	1.1 – 2.1	0.09 – 0.17	0.02 U	0.4 – 0.6	0.02 U	0.02 U	0.04 – 0.06

Shaded cells indicate that maximum values are greater than the minimum CTDPH consumption restriction level (*i.e.,* 100 µg/kg for Total PCBs) (Toal and Ginsberg, 1999).

[1] Half the Detection limit reported for those analytes that were not detected.

[2] Total chlordane is the sum of cis Chlordane and trans-Nonachlor, as described in FDA (1989).

[3] Total PCBs defined as two times the sum of the congeners

U = Not detected

Table 11. Comparison of Benthic Tissue Concentrations to Ecological Effects Values[1]

Analyte	Ecological Effects Values[2]	Lobster				Clam		Worm	
		CLIS		CLIS		CLIS		CLIS	
		Average	Maximum	Average	Maximum	Average	Maximum	Average	Maximum
PAHs (ug/kg wet)									
Anthracene	3750	0.08	0.12	0.06	0.07	1.16	1.36	1.44	2.36
Benzo(a)pyrene	8000	1.38	2.04	0.87	1.32	3.94	4.61	6.22	9.30
Total PAH	10000[3]	14.54	18.61	11.91	14.55	54.03	74.13	78.17	118.05
Total PCBs (ug/kg wet)									
Total PCB	4000[4]	15.7	32.72	16.3	19.82	28.36	35.54	66.22	83.2
Pesticides (ug/kg wet)									
Aldrin	299	0.02 U	0.02 U	0.02 U	0.02 U	0.06	0.13 U	0.06	0.07
Chlordanes	64	0.10	0.13	0.10	0.12	0.29	0.32	0.57	1.26
Total DDT	3000[5]	1.25	2.13	1.15	1.25	1.71	1.94	5.13	6.37
Dieldrin	4.37	1.10	1.62	0.89	2.40	0.15	0.27	0.38	0.60
Endosulfans	2.85	0.11 U	0.11 U	0.11 U	0.11 U	0.33 U	0.39 U	0.32 U	0.38 U
Metals (mg/kg wet wt)									
Arsenic	12.6	3.06	4.37	5.71	6.95	1.05	1.16	3.64	4.45
Cadmium	3	0.02	0.04	0.03	0.04	0.17	0.21	0.14	0.22
Chromium	11.8	0.04	0.04	0.04	0.04	0.40	0.54	0.16	0.20
Copper	9.6	**14.86**	**17.82**	**22.24**	**25.58**	2.60	3.25	2.99	4.25
Lead	11.9	0.06	0.24	0.01	0.02	0.78	1.05	0.53	0.72
Mercury	0.2[6]	0.06	0.08	0.08	0.10	0.01	0.01	0.01	0.01
Nickel	3.8	0.06	0.09	0.06	0.08	1.20	1.31	0.52	0.63
Silver	1.5	0.32	0.41	0.54	0.66	0.16	0.18	0.05	0.07
Zinc	1517	18.29	24.14	19.75	24.60	15.95	18.14	19.68	20.91

Bolded values indicate exceedence of the ecological effects values
[1] Half the detection limit reported for those analytes not detected.
[2] The ecological effects values represent tissue concentrations that are believed to be "safe" for aquatic organisms. They are derived from the final chronic value of US EPA Water Quality Criteria (as suggested by Lee *et al.*, 1989) unless otherwise noted.
[3] Source: Widdows *et al.*, 1987
[4] Source: Hansen, 1974
[5] Source: Neufield and Pritchard, 1979
[6] Source: Friedmann *et al.*, 1996

5.2 Disposal Site History

The CLIS Disposal Site has been one of the most active dredged material disposal sites in New England. CLIS has the longest known continuous record of use of any disposal site in Long Island Sound. There are records of volumes received at the site from 1941 to 1945 and again from 1954 to the present day. Overall, CLIS has received close to 14 million cubic yards (11 million cubic meters) since 1941. CLIS receives the largest volumes from Federal navigation projects in New Haven, Stamford, Norwalk, and Bridgeport harbors, with numerous smaller harbors in Connecticut and New York contributing to the total disposal volumes.

Since at least 1974, dredged material at CLIS has been placed at distinct mounds and managed to maximize site capacity and containment of material (SAIC 1995, 2002a). Dredged material disposal at CLIS was managed through controlled placement of small to moderate volumes of sediment to form individual deposits on the seafloor. Usually one deposit was formed for each year of disposal, but in years when disposal volumes were modest, several years often formed into one mound deposit (*e.g.,* 95/96 and 97/98, Table 12). Beginning in 1984, mounds were deliberately placed in rings to form a network of mounds to facilitate containment of larger projects in artificial containment cells (SAIC 2002b). The containment cell concept was developed to limit the spread of unacceptably contaminated dredged material (UDM) and to facilitate coverage of the material with capping dredged material (CDM) for a Federal navigation project in 1993 to 1994 (Fredette 1994). This project formed the NHAV 93 mound, the first capped disposal mound with a smaller volume of CDM than the underlying UDM (Morris *et al.,* 1996). The result of these management practices is a suite of twenty-two disposal mounds distributed throughout the site, some of which have been partially covered by subsequent disposal projects (Figure 5). A summary of the active dates, volume of material received and the source of the material for each mound is provided in Table 12. In addition, a more detailed summary of those mounds created prior to 1994 is provided in Section 5.2.1.

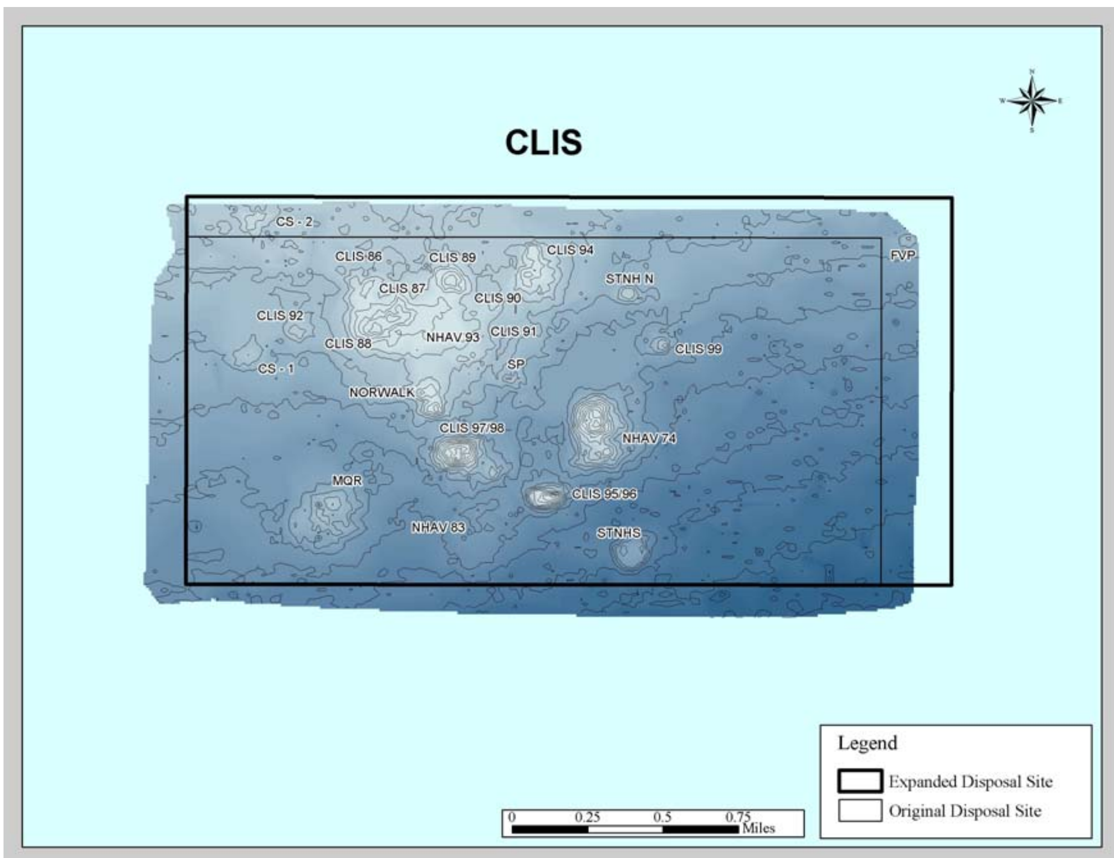

Figure 5. Bathymetric Chart of CLIS (SAIC 2002b)

Table 12. Disposal Locations, Volumes, and DAMOS Mound Designations for CLIS Based on Estimated Barge Volumes[1]

Year	Mound	Project(s)	DAMOS Contribution	Volume (cubic yards)
1974-5	NHAV-74	New Haven	57, 63	1,569,600
1979	STNH-N	Stamford, New Haven	57, 63, 95	77,172
1979-80	STNH -S	Stamford, New Haven	57, 63,95	346,228
1980-1	NORWALK	Norwalk	57, 63, 95	782,446
1982-83	MQR	Mill and Quinnipiac Rivers Black Rock Harbor New Haven Harbor	57, 63, 95	1,180,078
1983	CS-1	Black Rock Harbor New Haven	57, 63, 95	113,665
1983	CS-2	Black Rock Harbor New Haven	57, 95	104,770
1982-3	FVP	Black Rock Harbor	57, 63	71,940
1986-7	CLIS 86	Milford, Norwalk Cove, Bridgeport	63, 68	310,577
1987-8	CLIS 87	Milford, New Haven, Bridgeport	94	93,290
1988-9	CLIS 88	West River, New Haven, Northport	94	440,731
1989-90	CLIS 89	Branford, Mamaroneck, Eastchester, Cos Cob, West River, Stratford	94	199,033
1990-1	CLIS 90	New Haven, Branford	97	77,172
1991-2	CLIS 91	New Haven, Branford	Database	75,673
1992-3	CLIS 92	Guilford, Branford, Pier 66	Database	52,355
1993-4	NHAV 93	New Haven	111, 117	1,516,643
1994-5	CLIS 94[2]	Norwalk, New Haven, West River, Stony Creek, Milford	94, 120	519,624
1995-7	CLIS 95/96	Milford, Bridgeport, West River, Saugatuck	139	428,470
1997-9	CLIS 97/98	Branford, Housatonic, West River, Mamaroneck, Bridgeport, New Haven	139	675,335
1999-00	CLIS 99	New Haven, Mamaroneck, West River, Greenwich	139	112,488

1. Barge volumes were derived from scow log records as reported in DAMOS reports and contained in the scow log database (Dr. Thomas Fredette, personal communication, June 2003).
2. Includes volume from CS-90-1 disposed in 1990 now covered by CLIS 94

5.2.1 Summary of CLIS Mounds Created Before 1994

NHAV-74

The largest of the CLIS site mounds, NHAV-74 (Figure 5) was created in 1974 by the disposal of 1.6 million cubic yards (1.2 million cubic meters) of New Haven Harbor channel muds which were then capped with clean sand. The capping was performed, however, without the monitoring required to provide an estimate of the original cap thickness (although a sediment profile image from 1985 detected a mud-free sand cap 1 to 10 centimeters [0.4 to 4 inches] in depth at station 200N). The overall mound measured approximately 5 meters (16 feet) in height and greater than 500 meters (1640 feet) in diameter. It has retained these general dimensions with time, and grain-sizes are now typically in the silt-clay category due to natural deposition.

Sediment chemistry data for the NHAV-74 mound is available for 1984 and 1986. Compared to reference values, the 1986 results showed significantly greater levels of copper, mercury, lead, zinc and oil and grease in the top 2 centimeters (0.8 inches), and all of these plus chromium in the lower 2 to 10 centimeters (0.8 to 4 inches) of sediment. However, all metal concentrations from this station were in the low to moderate range as developed by the New England River Basin Commission (NERBC, 1980), with the exception of zinc at a "High" of 445 mg/kg (dry wt.) in the lower 2 to 10 centimeters (0.8 to 4 inches) of sediment in one replicate. Of all the sediment parameters quantified, all but mercury and carbon were lower in the top 2 centimeters (0.8 inches) than in the deeper sediments.

Sediment profile image-based surveys of this mound occurred in 1984, 1985, 1986, and 1991. In the 1984 to 1986 timeframe, these images indicated that approximately half of the 17 stations were in Stage I recolonization and half were in Stage III. Average RPD depths during this time frame were in the 3 to 4 centimeters (1.2 to 1.6 inches) range, although erosion at the central station noted in the 1986 survey (approximate loss of 3.5 centimeters [1.4 inches], possibly due to Hurricane Gloria) resulted in an RPD depth of 0.8 centimeters (0.3 inches). The 1991 draft survey reported that the mound had fully recovered.

STNH-N

The STNH-N mound (Figure 5) was formed during May to June 1979 with the disposal of approximately 26,000 cubic meters (34,000 cubic yards) of Stamford Harbor dredged materials capped by 33,000 cubic meters (43,000 cubic yards) of sandy sediments from the mouth of New Haven Harbor. The Stamford Harbor material contained moderate to high NERBC concentrations of all metals quantified (except for low levels of Vanadium) and moderate to high levels of oil and grease. Chemistry data for the capping sediments is apparently not available. The resulting cap was a maximum of 12 feet (3.5 meter) thick at the mound apex, and approximately 1 meter (3 feet) thick 100 to 200 meters (328 to 656 feet) away from the apex.

A benthic macrofauna study performed from 1977 through 1982 (Brooks, 1983) showed that the sandy cap was quickly (*i.e.,* within 15 months) recolonized with a community "totally different in species composition and feeding type and greater in numbers of species and individuals" than in the surrounding silty bottom. With time, however, this sand-based ecosystem has undergone change to a more silt-based system due to bioturbation and sedimentation, especially in the thinly capped outer areas of the mound. A 1986 benthic community analysis of the mound's center, however, continued to show higher numbers of species and individuals as well as different dominant species (polycheates) compared to the mollusc-dominated reference area.

Sediment profile image-based monitoring of this mound occurred in January and August 1983, September 1984, August and November 1985, and July 1986. Collectively these surveys indicate a successful recolonization by Stage III organisms, with the percent of replicate photos indicating a Stage III sere ranging from 65 percent in 1984 to 94 percent in

1986. However, in the fall of 1985, Hurricane Gloria caused significant but temporary loss of Stage III taxa at STNH-N.

Sediment chemistry analyses have been performed at the STNHN mound at least annually from 1979 to 1986 as well as in 1990. The 1986 sampling effort involved seven stations (three replicates each) and included body burden analysis of *Nephtys incisa*, and the 1990 sampling was part of a sediment core study by the Corps to assess long-term cap effectiveness.

The 1986 sampling showed that mercury was the only parameter significantly greater than reference levels, with mean values for both upper (0 to 2 centimeters; 0 to 0.8 inches) and lower (2 to 10 centimeters; 0.7 to 4 inches) sediments ranging from 0.17 to 0.92 mg/kg (SAIC, 1990c). These values correspond to low to moderate NERBC ranges. As part of the 1986 work, a statistical analysis of the upper versus the lower core layers showed that arsenic, iron, and lead were significantly higher in the upper sediments. The body burden analysis showed significantly higher tissue concentrations of chromium, copper, and zinc, none of which were significantly elevated in the sediments.

The 1990 coring study (Fredette *et al.,* 1992) indicated that for all but one of the five cores, the sandy cap material was visually and chemically distinct compared to the underlying mound material. This was interpreted to mean that the cap was effectively isolating the sediment contaminants in the mound material. One core (40W) did, however show a chemical gradient of increasing concentrations with depth for copper, zinc and TRPH (total residual petroleum hydrocarbons) rather than a sharp divide between cap and mound. Consistent with the working hypotheses of the study, this gradient suggests that contaminant migration from mound to cap may be occurring on a limited basis. The fact that this gradient extended over four different sediment textures (sand/shell hash, clay, variable, and silt), however, indicates that there is not a clear textural divide between the mound and cap layers at this station to begin with.

STNH-S

The STNH-S mound (Figure 5) was formed from the same base material (Stamford Harbor and during the same general timeframe as STNH-N, but with silt as a cap material instead of sand. More specifically: from March to June 1979, approximately 38,000 cubic meters (50,000 cubic yards) of contaminant containing sediments from Stamford were disposed followed by 110,000 cubic meters (144,000 cubic yards) of capping silts from New Haven Harbor; from September to October 1979 an additional 6,000 cubic meters (8,000 cubic yards) of Stamford material was disposed; and from January to June 1980 an additional 110,700 cubic meters (145,000 cubic yards) of New Haven Harbor silts was disposed. The quality of the Stamford sediment was similar to that discussed above from the STNH-N mound, and the quality of the New Haven silts were generally in the low to moderate NERBC range.

An interim bathymetric survey in November 1979 revealed that approximately 10,000 cubic meters (13,000 cubic yards) of material had been lost from the top of the mound, most likely from the passage of Hurricane David in September 1979. The top of the mound was eroded from a peak at 17 meters (55 feet) depth to a flat top at approximately 19 meters (62 feet). After final placement of New Haven silt in June 1980, the maximum thickness of the cap material was approximately 4 meters (13 feet). Since the interim loss of material, the mound has been generally stable.

Recolonization of the STNH-S mound has been monitored by diver surveys, benthic community analyses (1979 and 1980), and sediment profile image cameras (1983 to 1987). Initially, the post-capping September 1980 community analysis showed the mound's recolonization at two of three stations (center and outer edge) to be similar in diversity and abundance compared to reference. However, the 1985 and 1986 sediment profile image surveys indicated a potentially stressed condition with lower levels of Stage III animals present. The most recent camera survey in 1987 indicated significantly improved conditions at this mound.

As at the STNH-N mound, sediment chemistry analyses have been performed at STNH-S at least annually from 1979 to 1986, as well as in 1990. The 1990 sampling was part of the same coring study discussed above for STNH-N. The 1986 sampling reported low NERBC metal concentrations in all replicates, except for high (*i.e.,* > 0.15 mg/kg) levels of mercury (mean of 0.16 mg/kg). Two of the five cores from the 1990 coring study showed a sharp visual and chemical divide at 160 centimeters (63 inches) between the mound and cap material, while the other three cores apparently did not penetrate below the cap layer. Overall, the STNH-S cores showed greater sediment heterogeneity and higher concentrations of copper, zinc and TRPH in the cap layers than in those of the STNH-N cores.

Norwalk

Dredged material from Norwalk Harbor was used to form this mound (Figure 5), with material being disposed in both 1980 and 1981. Since inner harbor sediments contained higher contaminant concentrations, especially for mercury and lead, the disposal strategy called for disposing the inner harbor sediments first so that they could then be covered with outer harbor sediments. Due to water depths too shallow to allow dredge access, however, some cleaner sediments originally slated as cap material were disposed before the material containing higher levels of contaminants. A total of approximately 438,000 cubic meters (573,000 cubic yards) of sediments were disposed, forming a double-peaked mound measuring approximately 2 meters (7 feet) high and 300 meters (984 feet) in diameter.

Sediment chemistry analyses were performed for this mound annually from 1981 to 1986 (except for 1985). Compared to reference values, the most recent 1986 results for the mound center show significantly greater levels of chromium, copper, mercury, lead, and zinc in the top 2 centimeters (0.79 inches) , and arsenic, copper, mercury, lead, zinc and oil and grease in the lower 2 to 10 centimeters (0.8 to 4 inches) of sediment. Compared to the NERBC criteria, all replicate values of the 1986 samples were in the low to moderate range, with the exception of two "High" mercury values of 2.44 (top) and 4.15 (bottom) (SAIC, 1990c).

Sediment profile image-based surveys of the Norwalk mound were performed annually from 1983 through 1986. These images indicate a steady improvement in recolonization, although some center and southern stations had not fully recovered to the Stage III sere as of 1986.

MQR

Disposal at the MQR mound (Figure 5) occurred in two separate stages in 1982 and 1983. Based on bathymetric results, the March through June 1982 disposal resulted in 70,000 cubic meters (91,500 cubic yards) of Mill River sediments covered by 190,000 cubic meters (248,000 cubic yards) of Quinnipiac River sediments. Both rivers discharge into New Haven Harbor. Both sources had high NERBC levels of cadmium, copper, mercury, lead and zinc, although the Quinnipiac River concentration ranges were slightly lower, and the Mill River sediments included low density, high water content pulp mill waste. In April 1982, the "worst surface evidence of impact noted to date" (SAIC, 1984a) was observed at the MQR site, including a 200 meter (656 foot) slick, surface mortality of *Cyanea*, and 2 centimeters (0.8 inches) diameter foam rubber balls on both the surface and seafloor.

Moving to the March through May 1983 disposal, based on scow logs approximately 66,800 cubic meters (87,000 cubic yards) of material from Black Rock Harbor (Bridgeport) was covered by 400,000 cubic meters (523,000 cubic yards) of material from New Haven Harbor. The periods of deposition of the two sources overlapped to some extent, and two barge loads (approximately 3,000 cubic meters[4,000 cubic yards]) of Black Rock Harbor were reportedly dumped after the New Haven Harbor sediments. The Black Rock Harbor sediments had concentrations of heavy metals (cadmium, copper, mercury, lead, nickel, vanadium, and zinc), polychlorinated biphenyls (PCBs), and polycyclic aromatic hydrocarbons (PAHs) (SAIC, 1993). The final mound measured approximately 450 meters (1470 feet) in diameter with a cap 2 to 3 meters (6.6 to 9.8 feet) thick. Sediment types were predominantly silt-clay.

Analyses of MQR sediment chemistry were performed in 1982 (pre-Black Rock Harbor), 1983 (post-capping), 1984, 1986 and 1991 (in conjunction with the bioassay discussed above). The 1986 testing also included analysis of body burden concentrations in *Nephtys incisa*. In 1986, both the upper and lower sediment cores showed significantly higher concentrations of all metals analyzed as well as oil and grease compared to reference sediments. None of the metal concentrations were in the NERBC high category, however.

Recolonization of the MQR mound was assessed via sediment profile image in January (interim) and August (post-capping) 1983, annually 1984 to 1987, and in 1991 and 1992. In addition, a benthic community analysis was performed in 1986. Although the interim sediment camera and SCUBA surveys prior to placement of Black Rock and New Haven Harbor sediments showed considerable epifaunal activity and benthic conditions similar to STNH-S. Subsequent surveys have indicated an abnormally slow recolonization rate. In 1986, for example, both the sediment profile image and benthic community analysis indicated extremely stressed conditions at this mound. The camera results showed a dominance of Stage I organisms (although Stage III animals were documented for the first time), and the community analysis revealed significantly lower species richness (20 vs. 35) and abundance (100 vs. 2,042) compared to reference.

The 1986 body burden analysis revealed significantly higher levels of chromium, copper, and lead (1.0, 30, and 9.5 mg/kg dry wt., respectively) compared to reference animals. Although this level of bioaccumulation is a possible explanation for the problematic recolonization rate, both the FVP and STNH-N mounds (which did not have recolonization problems in 1986) also exhibited similarly elevated levels of body burdens (SAIC, 1990a).

In 1987, four years after the final cap was placed, Stage I organisms continued to dominate, although increased levels of Stage III animals were appearing. The next sediment camera survey in 1991, however, showed that benthic recolonization conditions had again regressed. Median Organism-Sediment Indices (OSI) (a measure of the successional and habitat quality of the sediments) and Redox Potential Discontinuities (RPDs) were significantly below reference values. The August 1992 survey revealed that benthic conditions had improved, but that MQR overall remained stressed relative to reference sites.

Consistent with the DAMOS tiered monitoring approach, after the subnormal 1991 sediment profile image results the Corps proceeded with a more intensive monitoring program of the MQR mound. This included an amphipod bioassay and sediment chemistry analyses. The collected sediments caused 55 to 90 percent mortality in the test animals, compared to 0 to 25 percent mortality in the control. No clear toxicants were identified in the sediment chemistry, although high PAHs and metals were suspected. Based on the slow recolonization rate after benthic disturbances at the MQR mound relative to adjacent CLIS mounds, it was concluded that most likely the cap material used when the mound was disposed had not been clean enough. That material was selected in an era when suitability criteria were less comprehensive (*e.g.,* there were no criteria for PAHs).

The lack of a well-established benthic community prompted the Corps to initiate recapping procedures as a corrective measure to cover the original MQR sediments with additional clean material that would replenish the existing cap and further isolate the underlying contaminants. To that end, approximately 36 000 cubic meters (47,000 cubic yards) of dredged sediment suitable for open water disposal was disposed at the MQR mound during the 1993 to1994 disposal season. A DAMOS survey, conducted in July of 1994 to characterize the initial sediment chemistry and recolonization status of this newly disposed material, indicated that the region is recovering well from the 1993 to 1994 disposal. The recolonization rate suggests that the MQR mound is quickly establishing a stable, healthy benthic community. RPD depths, successional stage, and OSI values all indicate that this trend will continue into the future.

CS-1

The CS-1 and CS-2 mounds were used for comparative purposes to assess the relative merits of capping with silt (CS-1) versus sand (CS-2), or versus no cap at all (FVP). CS-1 (Figure 5) was formed in April and May 1983 with the disposal of approximately 33,200 cubic meters (43,400 cubic yards) of contaminated Black Rock Harbor silts followed by approximately 53,700 cubic meters (70,000 cubic yards) of New Haven Harbor silts (SAIC, 1984d). The resulting mound was approximately 1 meter (3.3 feet) high and 250 meters (820 feet) in diameter. The initial capping operation, however, provided incomplete coverage of the Black Rock Harbor sediments. Additional cap material was added in 1984 and 1985.

Post-disposal sediment profile image-based surveys of CS-1 have occurred in June and August 1983, September 1984, August and October 1985, July 1986, and in June 1991. In addition, nearby sediment locations to the north and east have been photographed in 1987, 1988, and 1990 as part of DAMOS investigations for CLIS-86 and CLIS-88. The 1983 surveys showed continuous improvement of benthic conditions 2 and 4 months after disposal. The August 1983 survey estimated that approximately half of the replicate stations held an OSI value of +6 or greater, an indication of recovered or unstressed conditions. The August 1985 survey showed an increase of Stage III taxa compared to 1984, but the October 1985 (post-Hurricane Gloria) and 1986 assessments indicated more stations exhibiting a Stage I sere than in August 1985. The 1991 cruise reported that all but one station at CS-1 had recovered to the Stage III level.

Analysis of sediment chemistry at CS-1 occurred in 1983, 1984, and 1986. In the 1986 data set, all sample replicate values were within the low NERBC category. However, lead, copper, and carbon were significantly greater than reference levels for the 0 to 2 centimeters (0 to 0.8 inches) sediments, and mercury, copper, and carbon were greater than reference levels for the 2 to 10 centimeters (0.8 to 4 inches) sediments. PCBs from a single composited sample were reported at 0.09 mg/kg, an order of magnitude below that for the FVP mound (SAIC, 1990c).

CS-2

The CS-2 mound (Figure 5) was formed during the same timeframe and with the same source material (38,100 cubic meters [50,000 cubic yards] of Black Rock Harbor sediment) as CS-1. The cap sediment (approximately 42,000 cubic meters [55,000 cubic yards]), however, was a sandier material from New Haven Harbor. The coverage of the underlying Black Rock Harbor material was better than at CS-1, but was less than 40 centimeters (16 inches) thick in approximately 15 percent of the mound area. The maximum cap thickness was estimated at 1.4 meters (4.6 feet). The overall mound measured approximately 250 meters (820 feet) in diameter.

Recolonization of the CS-2 mound has been monitored via sediment profile image on the same schedule as CS-2, except that the most recent survey occurred in 1986, not 1991 (*i.e.,* 5/83, 8/83, 9/84, 8/85, 10/85 and 7/86). As with CS-1, DAMOS investigations of the nearby CLIS-86 mound included coverage of the CS-2 area. CS-2 recolonization generally proceeded at the same rate as at CS-1, although CS-2 was comparatively more stressed in the early 1983 surveys. The 1987 survey for CLIS-86 showed that all of the stations in the CS-2 area had at least one sample replicate at a Stage III sere.

Sediment chemistry analysis at CS-2 has also occurred on the same schedule as at CS-1, but with additional analyses done as part of the 1990 coring study mentioned above (see STNH-N and STNH-S). The 1986 analysis reported that mercury (mean = 0.17 mg/kg) was the only parameter significantly elevated above reference in the upper sediments, and that chromium (mean = 39 mg/kg) was the only parameter elevated in the lower sediments. All of the replicate sediment chemistry values, however, fell within the low NERBC category.

The 1990 coring study showed that the cap material at CS-2 had a varied sediment texture and contaminant profile. Only two of the five cores (stations 80NE and CTR) were interpreted as having penetrated below the cap into the mound layer. The depth of the cap at these locations was estimated to be 60 and 40 centimeters (24 and 16 inches), respectively. Isolated pockets of elevated contaminant concentrations were found to be present within the core from station CTR. Although the intermediate metal concentrations (falling between normal CS-2 cap material ranges and those measured in the Black Rock Harbor sediments which formed the mound) initially were considered as possible evidence of upward contaminant migration, it was concluded that the CTR core was most likely an isolated pile of New Haven material for the following reasons: 1) the concentrations of metals were within the ranges of New Haven material disposed elsewhere, 2) mixing was unlikely because the core was taken at the center of the mound where the cap would presumably be the thickest, and 3) chemical migration was not evident in the other core which recovered mound material at CS-2.

FVP

The FVP (Field Verification Program) mound (Figure 5) was created in spring 1983 with the disposal of approximately 55,000 cubic meters (72,000 cubic yards) of dredged material from Black Rock Harbor in Bridgeport, CT. This material was left uncapped for research and comparative purposes, since Black Rock Harbor material was also used at cap sites CS-1, CS-2, and MQR. The mound was situated in the far northeast corner of the CLIS site to minimize potential impacts from other site disposal mounds. The resulting mound measured approximately 250 meters (820 feet) in diameter and 1.8 meters (5.9 feet) in height, with grain sizes predominantly in the silt-clay range.

Since January 1984, a distinct sand layer has been observed in the center area of the mound, first at the sediment surface and then covered with silt over time. The formation of this layer may have been due to erosive currents near the mound apex, although the subsequent sedimentation of fines discounts an ongoing erosion problem. Hurricane Gloria in 1985 caused additional erosion of 5 to 10 centimeters (2 to 4 inches) at stations near the apex (Parker and Revelas, 1989).

The FVP mound has been extensively investigated as part of a joint Corps-EPA research program. Post-disposal sediment profile image-based surveys of the mound occurred numerous times in 1983, 1984, and 1985, as well as once per year in 1986, 1987, and 1991. In summary, the initial surveys showed the mound at a Stage I sere from May to July 1983 (although two stations were classified as azoic), a Stage II sere in September 1983, and at a Stage III level, similar in quality to reference levels, by December 1984 (19 months after disposal).

The 1985 surveys, however, revealed a reversal of this successional process, with a relatively low abundance of Stage III infauna throughout the year. In October, only 28 percent of replicate photos of the mound in October showed evidence of Stage III organisms. Reference station levels of these taxa also dropped during this timeframe, but not as much as at the mound stations. The erosional disturbance of Hurricane Gloria in September apparently exacerbated these retrograde benthic conditions.

By 1986, this downturn reversed with an increase in Stage III organisms on the mound. Sixty-six percent (66 %) of mound station replicate photos showed a Stage III sere. RPD depths also increased to levels similar to reference stations. In an accompanying benthic community assessment, the mound was also comparable to reference levels of species richness (37 vs. 35), although numbers of individuals were much less (average 487 vs. 2053). The 1987 sediment camera survey revealed that, with the exception of a stressed mound center, the overall habitat quality of the mound area was similar to that of the ambient seafloor. The most recent camera survey in 1991 showed a fully recovered benthic environment.

The most recent sediment chemistry data for the FVP mound is the July 1986 DAMOS data set. In the top 2 centimeters (0.8 inches) of sediment, chromium, copper, mercury and oil and grease were significantly above reference levels, and in the bottom 2 to 10 centimeters (0.8 to 4 inches) these parameters plus arsenic, lead, and zinc were above reference levels. Of all the ten mounds sampled in the 1986 survey, FVP exhibited the highest maximum concentrations of chromium and copper. Compared to the NERBC criteria; all replicate metal values fell within the low to moderate categories. PCBs from a single composited sample were reported at 0.82 mg/kg (SAIC, 1990c).

It should be noted that mound sediment data for 1985 is also available from the EPA's FVP research (*i.e.,* Munns, *et al.,* 1989). Compared to the 1986 DAMOS data set discussed above, this 1985 data (taken during the reversal in recolonization progress) indicated higher values for cadmium (8.1 mg/kg vs. 4 mg/kg), chromium (370 mg/kg vs. 266 mg/kg), copper (756 mg/kg vs. 529 mg/kg) and zinc (385 mg/kg vs. 272 mg/kg).

Considerable tissue chemistry data are also available for *Nephtys incisa* as a result of the FVP research program. Munns *et al.* (1989) showed that organic body burden levels remained at two to three times background levels for at least 1.5 years after disposal, reflecting persistent levels of sediment (as opposed to water column) contaminant levels. More recently, the July 1986 DAMOS cruise generated data indicating that chromium (average 1.5 mg/kg dry wt.), copper (47 mg/kg) and lead (8.4 mg/kg) were significantly higher than in reference tissues. As with the MQR mound, these 1986 results suggest some degree of correlation between sediment and tissue contaminant levels, since at FVP chromium, copper, and lead were significantly elevated in both media.

NHAV-83

The NHAV-83 mound (Figure 5) was created in the fall of 1983 by the disposal of dredged material from New Haven Harbor. A December 1983 survey reported the mound to be irregularly shaped, approximately 1.5 meters (4.9 feet) high, and approximately 300 meters (984 feet) in diameter (although additional material 20 to 40 centimeters (8 to 16 inches) thick extends beyond this area). Sediment types before and after disposal were predominantly in the clay to silt range.

Sediment profile image-based surveys of NHAV-83 were taken in January and September 1984, August 1985, July 1986, and August 1987. Collectively these surveys reveal that recolonization of this mound proceeded slower than expected. In July 1986, 11 of 17 stations still exhibited Stage I benthos, and RPDs were a relatively shallow 2 to 3 centimeters (0.8 to 1.2 inches) deep, possibly due to the area-wide hypoxia observed that year. By 1987, however, recolonization conditions had significantly improved. The 1987 survey reported the number of sediment profile image replicates showing Stage III taxa up from 24 percent to 63 percent, and generally deeper RPDs, although some stations still had RPDs less than 3 centimeters (1.2 inches).

Sediment chemistry data for NHAV-83 has been published for the 1986 cruise. In the top 2 centimeters (0.8 inches) of sediment at the mound center, copper and mercury were found to be significantly above reference levels. In the bottom 2 to 10 centimeters (0.8 to 4 inches), these two metals plus chromium, lead, and zinc were significantly above reference levels. Compared to the NERBC criteria, all replicates fell within the low range, except for two replicates of mercury (0.62 and 0.92 mg/kg) and one replicate of lead (104 mg/kg), all three of which fell within the moderate range (SAIC, 1990c).

CLIS-86

The CLIS-86 mound (Figure 5) was formed in the 1985/86 disposal season by the disposal of approximately 164,000 cubic meters (214,000 cubic yards) of dredged material (based on scow log records) from multiple permit and Federal projects. In addition, some of the material disposed during the following 1986/87 disposal season was located at and around the CLIS-86 mound, adding approximately 0.6 meters (2 feet) to the CLIS-86 mound peak. The July 1986 survey reported a north-south radius of 350 to 400 meters (1148 to 1312 feet), an east-west radius greater that 600 meters (1969 feet), and a peak height of 1.5 to 2 meters (4.9 to 6.6 feet). Grain sizes at that time were predominantly silt-clay, although some stations also had components of very fine to medium sand.

Two sets of sediment chemistry data from 1986 (center only) and 1987 (center, 400E and 400W) are available for the CLIS-86 mound. The 1987 survey only assessed the top 2 centimeters (0.8 inches) of sediment. Stations 400E and 400W are discussed here, but the reader should bear in mind that these stations are at the extreme edges of the mound, and may reflect sediments from sources other than the CLIS-86 mound.

The 1986 survey indicated that concentrations of chromium, copper, mercury, lead, and zinc in both the top and lower layer of sediment were significantly higher than reference levels. Oil and grease in the lower sediments was also significantly greater than reference levels. All metal concentrations from this survey were in the low to moderate NERBC range, with the exception of high levels of lead at 373 and 218 mg/kg in one replicate (upper and lower core, respectively) and copper at 514 mg/kg (lower core) in one replicate (SAIC, 1990c).

The 1987 survey indicated a general decrease in sediment metal concentrations compared to the 1986 survey, with only copper at station 400E (82 mg/kg) reported as significantly elevated above reference levels. In addition, all sediment metal levels including copper fell within the low NERBC category, except for two replicate samples with moderate (*i.e.,* 0.5 to 1.5 mg/kg) levels of mercury (1.06 mg/kg at 400E and 0.52 mg/kg at 400W). The 1987 survey also included analyses for 29 organochlorine pesticides and PCBs. For the three stations near the CLIS-86 mound, 190 µg/kg of 4,4'-DDT at station 400E was the only compound of this type detected (SAIC, 1990b).

Sediment profile image-based surveys for CLIS-86 were performed in 1986, 1987, and 1990. These surveys indicate that the mound's recolonization improved with time. In July 1986 approximately half of the stations exhibited Stage III characteristics, while in August 1987 all but 3 stations near the center out of 40 total stations exhibited Stage III taxa. The draft survey from July 1990 indicates that the CLIS-86 mound had fully recolonized to the Stage III level.

In addition to the sediment chemistry and sediment profile image sampling, body burden analyses for *Nephtys incisa* were performed at this mound as part of the 1987 survey. The same three stations used for the sediment chemistry work were sampled (center, 400E, and 400W). The results indicated that tissue levels of copper (center and 400W) and iron (center only) were significantly higher than in reference animals. Tissue PCB concentrations, however, were all less than in reference animals (SAIC, 1990b).

CLIS-87

The CLIS-87 mound (Figure 5) was formed by disposal of approximately 147,937 cubic meters (193,000 cubic yards) of dredged material during the 1986/87 disposal season from multiple permit and Federal projects. Included in this material was a small volume of contaminant-bearing sediments that were capped with 8,400 cubic meters (11,000 cubic yards) of clean sediment. Disposal of all material during the 1986/87 season resulted in the formation of a broad, low feature located between the CS-1, CS-2, and CLIS-86 mounds, with a peak height of approximately 1.6 meters (5.3 feet) and a diameter of 600 to 700 meters (1968 to 2297 feet).

Due to its proximity to the CLIS-86 and CLIS-88 mounds, and to the fact that this northwest corner of the CLIS site was used for disposal through consecutive years, the area impacted during the 1986/87 disposal season has generally been monitored in association with these other mounds. Thus, the CLIS-86 and CLIS88 sections of this document should be referred to for the chemical and biological characteristics of the CLIS-87 area.

CLIS - 88

The CLIS-88 mound (Figure 5) was formed approximately 200 meters (656 feet) southeast of the CLIS-86 mound as a result of disposal of dredged material during the 1987/88 disposal season from multiple permit and Federal projects. The volume of material disposed according to scow log records is estimated to be 312,000 cubic meters (408,000 cubic yards). The volume disposed based on bathymetry and sediment profile image, however, was estimated to be approximately 164,000 cubic meters (214,000 cubic yards). The resulting mound was a circular, relatively steep-sided mound with a maximum thickness of 3.6 meters (12 feet) and a diameter of approximately 400 to 800 meters (1312 to 2624 feet). In the 1988 survey, the majority of stations consisted of silt/clay sediments, although many stations also had significant portions of fine sand.

Sediment profile image-based surveys of CLIS-88 were performed in 1988, 1990, and 1991. These surveys indicate that diverse recolonization of this mound occurred within one year. The 1988 survey reported that, although the RPD depths were significantly shallower than at reference areas, all but two of 37 stations revealed evidence of Stage III taxa in at least one replicate. The draft 1990 survey reported that Stage III benthos had returned to all stations monitored. The draft 1991 report confirmed this overall successful rate of recolonization.

CLIS-89

Disposal of dredged material during the 1988/89 disposal season resulted in the formation of the CLIS-89 mound (Figure 5) approximately 400 meters (1312 feet) northeast of the CLIS-88 mound. Scow logs for this time period estimate the volume disposed at approximately 421,700 cubic meters (551,000 cubic yards) from multiple permit and Federal projects.

Sediment profile image-based surveys of the CLIS-89 mound were performed in 1990 and 1991. The 1990 draft survey reported mostly Stage I organisms present, while the 1991 survey reported that recolonization had been completely successful.

Sediment data were apparently collected as part of the 1990 survey, but these data were not included in the draft report for that cruise.

CLIS-90

Disposal of dredged material from multiple permit and Federal projects during the 1989/90 disposal season resulted in the formation of the CLIS-90 mound (Figure 5) approximately 300 meters (984 feet) southeast of the CLIS-89 mound. Scow logs for this time period estimate the volume disposed at approximately 201,400 cubic meters (263,000 cubic yards). Additional material was disposed during this season as part of a limited capping project at the CS-90-1 site, but this site is discussed separately below.

Sediment profile image-based surveys of the CLIS-90 mound were performed in 1990 and 1991. Both surveys revealed that the mound remained dominated by Stage I benthos.

CS-90-1

The Cap Site (CS)-90-1 mound (Figure 5) was formed in the 1989/90 disposal season by the disposal of 28,720 cubic meters (37,500 cubic yards) of contaminant-bearing sediments from Harbor Village (Mianus River, Greenwich, CT) followed by capping with 78,550 cubic meters (103,000 cubic yards) of clean sediments from the Branford River. Post-disposal surveys showed that the initial cap was uneven, being thicker than planned in some locations and thinner than planned in others. This apparently resulted from imprecise disposal on the specified capping coordinates. Since the post-disposal survey, additional cap material has been placed at this location to further thicken the cap.

Sediment profile image-based surveys of the CS-90-1 mound were performed in 1990 and 1991. Both of these surveys indicate that the mound was dominated by Stage I benthos only.

NHAV-93

The NHAV-93 mound (Figure 5) was formed from October 1993 to March 1994 by the disposal of approximately 500,000 cubic meters (653,600 cubic yards) of dredged material from inner New Haven Harbor and 90,000 cubic meters (117,600 cubic yards) from five private terminals capped by approximately 569,000 cubic meters (744,000 cubic yards) of material from outer New Haven Harbor. This project was atypical of other site capping projects, as the overall goal was to fill in a depression formed by a ring of several existing disposal mounds. The dredged material was predominantly silt/clay in nature, although the outer harbor sediments contained a smaller percentage of fines. Source sampling of the inner harbor sediments showed moderate to high chromium, copper, and zinc concentrations and elevated levels of PAHs. Post-capping bathymetric surveys verified physical coverage of the underlying mound, at least within the detection limits of the survey (plus or minus 10 centimeters [4 inches]).

A DAMOS survey conducted in July of 1994 to characterize the initial sediment chemistry and recolonization status of this new disposal mound found no major topographic changes in the NHAV93 mound compared to the March 1994 postcap bathymetric survey. The majority of the mound area met or exceeded the predicted recolonization rates from the DAMOS tiered monitoring and management protocol with Stage I assemblages being predominate and occasional Stage II and Stage III organisms present at peripheral stations. However, three stations on the NHAV93 mound were identified as areas of concern. Although monitoring indicated that the cap thickness was sufficient, sediment profile image photographs from three of the monitoring stations showed evidence of a localized recolonization problem. Patchy Stage I communities, shallow RPD depths, and low OSI values suggest a potential sediment toxicity issue or possibly very high organic content.

6.0 MONITORING PROGRAM

Dredged materials managed under both MPRSA and CWA will be disposed at CLIS. However, all monitoring of the site will be conducted under MPRSA requirements. Effective environmental monitoring programs draw on available knowledge and understanding to establish approaches and clearly define monitoring objectives that focus on the primary issues of concern. Historically, monitoring of disposal sites in New England has relied on the Corps DAMOS Program as the tool for data collection. The DAMOS program uses a tiered monitoring framework (Germano *et al.,* 1994). Thus, the monitoring program presented in this section incorporates many of the features of the DAMOS framework. The goal of the monitoring program for CLIS is to generate information that will:

- indicate whether disposal activities are occurring in compliance with permit and site restrictions;
- support evaluation of the short-term and long-term fate of materials based on MPRSA site impact evaluation criteria;
- support assessment of potential significant adverse environmental impact from dredged material disposal at CLIS.

To achieve this goal, data will be developed in two areas: 1) compliance with conditions in disposal permits and authorizations and 2) environmental monitoring of CLIS and nearby regions (as defined in Section 6.3). The latter information will be evaluated together with historic and ongoing dredged material testing data and other accessible and relevant databases (*e.g.,* Sediment Quality Information Database [SQUID], Dredged Material Spatial Management and Resolution Tool [DMSMART]). These data will be provided to the EPA, Corps, and states of Connecticut and New York at least one month prior to the annual agency planning meeting. The evaluation of impacts from disposal at the site will be accomplished through a comparison of the conditions at the disposal mound(s) to historical conditions (*e.g.,* changes in historic mound height and footprint) or to unimpacted nearby reference stations. The meeting participants will use this information and the monitoring data gathered in the previous year to assess the potential impact and plan monitoring surveys. EPA and the Corps will coordinate to implement the appropriate action (e.g., field surveys, additional investigations, or management actions [or subset of actions]) within the tiered Monitoring Program and to define appropriate actions to mitigate unacceptable situations.

This monitoring plan provides a general framework for the monitoring program and guides future sampling efforts at CLIS. Specific details about those efforts (*e.g.,* sampling design, statistical comparisons) will be developed in project-specific survey plans considered during the annual agency meeting. Similarly, the schedule for the monitoring surveys will be governed by the frequency of disposal at the site, results of previous monitoring surveys, and funding resources. The data gathered under this monitoring plan will be evaluated on an ongoing basis to determine whether modifications to the site usage or designation are warranted.

Section 6.1 describes the organization of the monitoring program and summarizes the measurement program, schedule, and results that would lead to implementing additional studies. Sections 6.2 and 6.3 respectively, provide general information quality assurance requirements and a summary of the primary data collection tools.

6.1 Organization of Monitoring Program

The monitoring program is organized into two parts: compliance monitoring and environmental monitoring. Compliance information includes data relevant to the conditions in permits and authorizations and will be gathered separately from the environmental data.

The environmental monitoring program for CLIS is developed around four fundamental premises that establish the overall monitoring approach from a data acquisition perspective as well as the temporal and spatial scales of the measurement program:

- Testing information from projects previously authorized to use the site for dredged material disposal can provide key information about the expected quality of material that has been placed in the site;
- Lack of benthic infaunal community recovery on recently created mounds provides an early indication of potential significant adverse impact;
- Some aspects of the impact evaluation required under MPRSA Section 102(c)(3) can

be accomplished using data from regional monitoring programs (*i.e.,* progressing water quality changes; fisheries impact);

- Measurement of certain conditions in the site can be performed at a lower frequency (*e.g.,* long term mound stability) or only in response to major environmental disturbances such as the passage of major storms.

The first premise requires that historic and ongoing dredged material testing results be available and reviewed to identify mounds where sediment quality might be reduced relative to other mounds and to track the quality of material in the future. The remaining premises require various types and scales of monitoring to ensure dredged material disposal at CLIS is not unduly impacting the marine environment. Thus, the monitoring program is further organized around five management focus areas that are derived from the six types of potential effects required for evaluation under MPRSA [40 CFR § 228.10(b)] as described in Section 2:

- **Management Focus 1: Movement of dredged material.** This focus combines the requirements under 40 CFR 228.10(b)(1) (Movement of materials into sanctuaries, or onto beaches or shorelines) and 40 CFR 228.10(b)(2) (Movement of materials towards productive fishery or shellfishery areas) into one focus;
- **Management Focus 2: Absence of pollutant-sensitive biota.** Addresses 40 CFR 228.10(b)(3) (Absence from the disposal site of pollutant-sensitive biota characteristic of the general area);
- **Management Focus 3: Changes in water quality.** Addresses 40 CFR 228.10(b)(4) (progressive, non-seasonal, changes in water quality or sediment composition at the disposal site when these changes are attributable to materials disposed of at the site);
- **Management Focus 4: Changes in composition or numbers of biota.** Addresses 40 CFR 228.10(b)(5) (Progressive, non-seasonal, changes in composition or numbers of pelagic, demersal, or benthic biota at or near the disposal site when these changes can be attributed to the effects of materials disposed at the site);
- **Management Focus 5: Accumulation of material constituents in biota.** Addresses 40 CFR 228.10(b)(6) (Accumulation of material constituents [including without limitation, human pathogens] in marine biota at or near the site [*i.e.,* bioaccumulation]).

A tiered approach, based on a series of null hypotheses[2], is used to monitor compliance and address concerns under each Management Focus. Tier 1 evaluates a series of hypotheses addressing "leading indicators" that provide early evidence of unacceptable environmental responses or conditions. Examples include documentation of whether recolonization is proceeding as expected or whether mounds are deposited as planned and that no post-deposition movement is occurring. Should the hypotheses under Tier 1 be falsified, the findings would be evaluated and decisions to conduct Tier 2 activities made. The specific

[2] A null hypothesis, H_0, represents a theory that has been put forward, either because it is believed to be true or because it is to be used as a basis for argument, but has not been proved. The null hypothesis is often the reverse of what the experimenter actually believes.

condition that will initiate Tier 2 or Tier 3 monitoring will be decided between EPA and the Corps. Based on the type of event/action that has occurred, EPA and the Corps will work to implement the appropriate management practice with the Monitoring Program.

The measurement program under Tier 1 focuses on both individual dredged material and the overall site conditions. New mound construction will be evaluated within one to two years of completion and the entire site will be evaluated within successive five-year periods. While specific monitoring activities are defined under each Tier, the actual monitoring conducted in a given year must be consistent with budgetary constraints. Thus, prioritization of monitoring by organizational focus and findings of the monitoring program must be done annually during the Agency planning meeting.

Tiers 2 and 3 provide for progressively more detailed and focused studies to confirm or explain unexpected or potentially significant adverse conditions identified under Tier 1. For example, if Tier 1 monitoring under Management Focus 2, indicates that the benthic community was not recovering on recently deposited sediments, successive Tiers would enable examination of potential causes by incorporating additional investigation of sediment characteristics and quality. However, if the results from the Tier 1 data do not suggest impact, Tier 2 activities would not be invoked.

The following sections describe the monitoring approach that will be applied to each management focus. Each subsection provides the following:

- Intent of the data gathered under the focus area;
- Statement of relevant questions and hypotheses to be addressed within each tier;
- Summary of the measurement approach and tools to be used under each successive Tier.

Attachment A provides flow charts that summarize the tiered approach for each management focus as well as a table that summarizes each of the hypotheses and the leading indicators that would require action.

6.1.1 Compliance Monitoring

Compliance monitoring includes evaluation of information and data relevant to the conditions in permits and authorizations and will be gathered separately from the environmental data. The question that will be addressed is:

H_0 0-1: Disposal operations are not consistent with requirements of issued permits/authorizations.

This hypothesis will be evaluated by review of the disposal inspectors report and any variances identified will be discussed by the EPA and the Corps on a project-specific basis to determine the potential magnitude of effect and the appropriate action.

6.1.2 Management Focus 1: Movement of the Dredged Material

This management focus addresses two concerns relative to the disposal of dredged material at CLIS. The first is site management and compliance. The second is movement of the material after disposal. The questions that will be addressed include:

- Is the material deposited at the correct location?
- Are mounds constructed consistent with the site designation?
- Are mounds stable and dredged material retained within the disposal site?

The latter question directly address management concerns about material moving into sanctuaries, or onto beaches or shorelines and towards productive fishery or shellfishery areas.

Tier 1

The site designation specifies that CLIS is a non-dispersive site; therefore movement of materials out of the site is not expected. Loss of mound material could mean that the material is being lost inappropriately and may potentially impact areas outside of the site, if transported beyond the site's boundary. For the purpose of Tier 1, this question is addressed through two hypotheses.

H_0 1-1: Loss of dredged material from any mound deposited at CLIS is not greater than 1.5 feet (0.5 meter):

This hypothesis will be tested by determining the dimensions of disposal mounds created in a given dredging season and performing periodic monitoring of the mound using precision bathymetry techniques (see Section 6.3). Baseline data for new or modified mounds will be collected within one year following disposal. Bathymetric surveys of mounds (historic and recently completed) will also be performed periodically. The bathymetry of the entire site will be fully documented every 2 to 4 years.

Information on mound size and height will be compared with previous data to determine if loss of material has occurred. If the height and volume of a mound changes by more than 1.5 feet (0.5 meters) within any five year interval, further study of the characteristic of the mound and surrounding area will be conducted under Tier 2.

H_0 1-2: Major storms (greater than 10 year return frequency) do not result in erosion and loss of material from disposal mounds at CLIS.

This hypothesis tests whether storms that produce waves greater than 10 meters in height with a period of 6 seconds have eroded mounds. Previous studies and sediment erosion modeling conducted during the site designation process suggest that a storm having a ten year return probability may cause a small amount of erosion on the mounds that approach the mound height restrictions (14 meters [46 feet] below mean low water) and potentially transport material from deposited mounds. However, storms of greater magnitude may interact with recently deposited sediments or sediments that are below the limiting erosion depth and result in movement of material from the mounds.

This hypothesis will be tested by determining the dimensions of disposal mounds within 2 months following the passage of storms with a ten-year return frequency. Dimensions will be determined using precision bathymetry techniques (Section 6.3.1). The decision to conduct post-storm surveys will be made jointly by the site managers. If a mound changes in height by more than 1.0 feet (0.3 meters) from the previous survey, the site and surrounding area will be examined as defined under Tier 2.

Tier 2

Significant loss of material from the deposited mound may result in changes to sediment characteristics either within or beyond the site boundaries. Change in bathymetry and sediment characteristics immediately outside of the site would be indicative of potential unacceptable transport. Tier 2 investigates whether significant erosion of mound height determined under Tier 1 results in the relocation of material outside of the site boundaries.

H_0 1-3: Material lost from disposal mounds at CLIS does not change the (a) bathymetry or (b) sediment characteristics in areas adjacent to the site.

This hypothesis will be tested by determining changes in bathymetry and sediment characteristics within 1 kilometer (0.6 miles) beyond the site boundary. The survey design will take into account the expected direction of transport based on the predominant current direction and velocity (*e.g.,* it may not be necessary to survey the entire area within 1 kilometer [0.6 miles] of the site).

Precision bathymetry (Section 6.3.1) will be used to define substantive changes in bathymetry and topography (greater than 1 foot [30 centimeters]). Side-scan sonar, geotechnical, and sediment profile imagery may also be used to evaluate changes in sediment characteristics (see Section 6.3.2). The sediment profile imagery can be used to observe layers of material too thin to detect by precision bathymetric methods and can also be used to evaluate if the benthic community in the sediments has been disturbed or is under stress (as defined in Management Focus 2, Tier 2). Comparison of sediment profile imagery data from areas of concern to reference areas will be used to determine whether the transported material has a potential significant adverse biological effect.

Changes in bathymetry across the mound apex or apron of more than 1.0 feet (0.3 meters) or development of large areas of predominately muddy sediments not previously documented may be an indication of substantial transport of material from the site. If such changes are documented, Tier 3 characterization of sediment quality or further characterization of benthic communities may be required.

Tier 3

The premise of this Tier is that significant transport of material beyond the site boundary could affect the benthic productivity of the area. Therefore, characterization of sediment quality may be required.

H_0 1-4: Material transported beyond the CLIS boundaries does not result in significant degradation of sediment quality.

Sediment chemistry, toxicity, and benthic community structure will be measured at representative locations (determined through interagency coordination) from outside the deposited material and at CLIS references sites to test this hypothesis (see Section 6.3.4).

Chemical and toxicity testing and analysis will be conducted using methods required by the EPA/Corps Interim Regional Testing Manual (EPA/USACE, 1997) or subsequent approved documents. Benthic community sampling and analysis methods will the same as those conducted during site designation studies. Statistical comparisons and numbers of samples will be determined during project-specific survey planning.

Data from the area of concern will be compared statistically to data collected concurrently from the CLIS reference sites to determine if the quality of transported material is unacceptable. The decision of unacceptable conditions will be based on all three measures (*i.e.,* sediment quality, benthic community analysis, and toxicity).

6.1.3 Management Focus 2: Absence from the Disposal Site of Pollutant-Sensitive Biota Characteristic of the General Area

The premise underlying this management focus is that the infaunal community on disposal mounds recovers rapidly after disposal ceases. Therefore, the absence of or slower-than-expected recovery of the benthic infaunal community indicates a potential biological impact at the mound and by implication the ability of the site to support higher trophic levels. The long history of disposal site monitoring in New England has resulted in an excellent understanding of the rate at which benthic infauna recover from disturbances such as those caused by dredged material disposal as well as the types of communities that are expected to recolonize the mounds (SAIC 2003, 2002a, 2002b; Morris, 1998;1997; Morris and Tufts, 1997; Morris *et al.,* 1996; Wiley *et al.,* 1996; Murray, 1996; Wiley, 1995; SAIC, 1996; Germano *et al.,* 1995; Wiley, 1994; SAIC, 1990a; SAIC, 1990b; SAIC, 1990c; SAIC, 1998; Parker and Revelas, 1989; Parker and Revelas, 1988; Rhoads and Revelas, 1985; Germano and Parker, 1985; Morton *et al.,* 1984; Morton *et al.,* 1984; Morton, 1983; Brooks, 1983; Feng, 1982; Arimoto and Feng, 1984; SAIC, 1982; Morton, 1982; Morton, 1980; Feng, 1980; Stewart, 1980; Morton, 1980; SAIC, 1980; SAIC, 1980). Thus, the questions that the monitoring program addresses are directed at determining if benthic recovery is proceeding as expected and if pollutant sensitive organisms are growing on the mounds. For Tier 1, these questions include:

- Do opportunistic species return to the mound within a growing season?
- Are the infaunal assemblages consistent with similar nearby sediments or expected recovery stage?
- Are benthic communities and populations similar to surrounding sediments?

If these questions are answered in the affirmative, the biological community on the mounds is recovering as expected and significant adverse impact from the disposal operations is not demonstrated. If the questions are answered in the negative, investigation into potential causes is conducted under Tier 2.

Tier 1

This tier focuses on the biological recovery of the mound surface by sampling for specific, opportunistic, benthic infaunal species and the recolonization stage relative to nearby sediments.

H_0 2-1: The population density of opportunistic polychaetes on the disposal mound is not significantly less than that on the ambient seafloor outside the disposal site boundaries.

H_0 2-2: Stage 2 or 3 assemblages (deposit-feeding taxa) are not present on the disposal mound one year after cessation of disposal operations.

These hypotheses will be tested with sediment profile imaging on the disposal mounds created in a given dredging season and by periodic imaging of older mounds (see Section 6.3.2). This evaluation includes estimates of grain size classes, which is a key variable affecting the types of organisms observed in the images. The initial sediment profile imaging survey should be conducted within one to three years of mound completion. Evaluation of selected historic (inactive) mounds and imaging of the CLIS reference stations will be incorporated into this periodic survey of active mounds. Sampling of historic mounds can be sequenced across years depending on budgets and the conclusions of the previous data review at the annual agency coordination meeting. However, the entire site, including all historic mounds, should be sampled at least once in a given five-year period.

Significant adverse impact will be determined from comparison of the sediment profile imagery data on the active and historic mounds to that of the reference stations. If the comparison of the mound data to the reference areas finds no significant difference, the biological community on the mounds would be considered to be recovering as expected and significant adverse impact from the disposal operations not demonstrated. If there are significant differences in the sediment profile imagery data between the mounds and reference site and the grain size information from the images cannot explain the difference, further investigation into the potential causes of the difference is conducted under Tier 2.

Tier 2

This Tier is executed if differences in the benthic recolonization data on a dredged material mound cannot be explained by differences or changes in grain size. The hypotheses are designed to determine if the observations made under Tier 1 are localized (mound specific) or regional and to determine the affect of different sediment grain size distributions on the biological observations.

H_0 2-3: The absence of opportunistic species and Stage 2 or 3 assemblages is not confined to the disposal mounds.

H_0 2-4: Sediment grain-size distribution on the disposal mound is not significantly different from the ambient seafloor.

These hypotheses examine whether or not the differences observed in Tier 1 extend beyond the disposal mounds and whether the grain size distribution within and outside the site can explain the biological observations. If diminished recolonization (successional) stage data is widespread and substantial movement of material is not observed under Tier 1 or 2 of Management Focus 1 or if poor water quality conditions (*e.g.,* sustained low dissolved oxygen levels) are known to have occurred in the region (Management Focus 3), assignment of the dredged material disposal as the cause is questionable. However, if the differences are widespread and cannot be attributed to other factors, an investigation of cause would be initiated under Tier 3 of this Management focus.

These hypotheses will be tested with sediment profile imaging (see Section 6.3.2). The sediment profile image survey will be designed to sample representative conditions in the site and extend systematically to areas at least 1 kilometer (0.6 miles) beyond the site boundaries.

The full suite of information developed from the sediment profile images will be used to evaluate the similarity or differences of the areas sampled. This evaluation includes estimates of grain size classes, which is a key variable affecting the types of organisms observed in the images. The data will be used to address the above hypotheses.

If the results find the effect is widespread and that grain size distributions can not explain the biological observations, additional cause effect studies defined under Tier 3 may |be conducted.

Tier 3

Tier 3 is conducted if the benthic recolonization data developed under Tier 2 indicate that potential impacts are widespread (*i.e.,* encompass areas within and beyond the site boundaries). This Tier attempts to determine if the Tier 2 findings are the result of contaminants in the sediments or sediment toxicity. Tier 3 studies will only be conducted after a review and concurrence by the agencies managing the site.

H_0 2-5: The benthic community composition and abundance is not equal that at reference sites.

H_0 2-6: The toxicity of sediment from the disposal site is not significantly greater than the reference sites.

Sampling and analysis of the sediments for benthic infaunal enumerations and community analysis will be conducted to determine whether pollution-sensitive taxa are present beyond the site, evaluate the status of the infaunal community, and compare the community to measures of sediment quality (see Section 6.3.2 and Section 6.3.4). Sediment chemistry and toxicity will be measured at representative locations from within the deposited material and at CLIS references sites (see Section 6.3.4).

Chemical and toxicity measures will be conducted as defined in the Interim Regional Testing Manual (EPA/USACE, 1997) or subsequent approved documents. Data from the area of concern will be compared statistically to data collected concurrently from the CLIS reference sites to determine if the quality of transported material is unacceptable. The number of stations to include in the testing will be determined at the annual meeting. The decision of unacceptable conditions will be based on all three measures.

6.1.4 Management Focus 3: Changes in Water Quality

The premise underlying this management focus is that water quality in the central basin of Long Island Sound is affected by many different sources and that dredged material placed at the site exerts a low oxygen demand on the water column. Moreover, dredged material plume studies indicate the cloud of particles resulting from dredged material disposal has a very short duration in the water column and turbidity levels reach ambient levels within minutes to hours. This fact, coupled with required testing that ensures residual material meets water quality criteria within an initial mixing period (within four hours within the site and always outside the site) before the material can be accepted at the site, minimizes any long-term, cumulative impact to the water column. Therefore, it is expected that significant short-term adverse effects are unlikely to result from the disposal operations and that long-term monitoring programs underway in the Sound provide the level of information necessary to determine if the dredged material disposal at CLIS is affecting the overall quality of water in the central basin of the Sound. Relevant questions for water quality include:

- Is water quality in CLIS different during disposal operations than in areas outside the site?
- Does dredged material disposal have a substantive impact of water quality measures such as dissolved oxygen?

As discussed under Management Focus 1 and 2, dredged material placed at CLIS must pass the requirements of the EPA/Corps Interim Regional Testing Manual (or subsequent approved manuals) for disposal at CLIS. Thus, short-term water quality impacts are not expected. Ample evidence exists, as documented in the DEIS (EPA, 2003), that dredged material disposal poses minimal potential to impact water quality in the short time scales that residual material remains in the water column. Thus, a measurement program to document whether short-term changes in water quality during disposal occur is not proposed under Tier 1.

Tier 1

Under this tier, it is assumed that water quality at CLIS is not degraded by disposal of dredged material. Moreover, it is assumed that regional monitoring programs can provide sufficient information to assess whether disposal of dredged material at CLIS contributes significantly to the changes in water quality of the central basin of the Sound. It is also assumed that the quality of the sediment placed at the site does not affect the marine environment as the sediments undergo testing for acceptance into the site. Thus, sediment quality issues are not tested under this Tier, but rather are evaluated under the tiered monitoring structure under Management Focus 2.

H_0 3-1: Spatial and temporal trends in water quality in waters near CLIS do not indicate CLIS as a source of change.

This hypothesis examines the trend in leading water quality indicators (*e.g.,* chlorophyll, dissolved oxygen, turbidity) in the vicinity of CLIS. These parameters are consistently measured at a series of locations near CLIS by the Long Island Sound Study Program. The data from this and other relevant programs will be obtained by the agencies managing CLIS and evaluated to determine whether or not there are spatial gradients in the measures near CLIS that can be attributed to the site and whether there are long term changes in water quality in the general vicinity of the site.

Consistent gradients pointing to CLIS as a potential source of poor water quality or long-term trends determined to show detrimental changes in water quality will trigger assessments under Tier 2 of this management focus.

Tier 2

Measurements under this Tier will be triggered if trends evaluated under Tier 1 suggest CLIS as a potential cause of poor water quality in the central basin of Long Island Sound.

H_0 3-2: Water quality at CLIS is not different than nearby areas.

This hypothesis will be tested through water quality surveys designed to evaluate short-term gradients in water quality during disposal operations. If significant sustained short-term changes are found, further evaluation of the relationship to dredged material disposal will be undertaken (Tier 3) after discussion by the managing agencies.

Tier 3

Specific hypotheses cannot be defined for this Tier at this time and will be developed through interagency coordination at such time the Tier is deemed necessary. However, they may include special studies that determine the sediment oxygen demand to evaluate the contribution of the site to spatial and temporal dissolved oxygen trends in the water column. Such studies would compare the sediment oxygen demand levels in sediments within and outside the site including the three CLIS reference locations. Special plume tracking studies may also be mounted to examine the specific effects of individual dredged material plumes on water quality during the disposal season.

6.1.5 Management Focus 4: Changes in Composition or Numbers of Pelagic, Demersal, or Benthic Biota at or Near the Disposal Site

This management focus addresses regional changes in species composition and abundance. Two areas of study are considered: finfish and macrobenthic organisms such as lobster. These organisms will be monitored in the vicinity of CLIS. As discussed in the DEIS (EPA, 2003), significant short-term adverse effects to these communities are unlikely to result from the disposal operations. Long-term impacts to fish and shellfish populations in Long Island Sound are also unlikely, but are more difficult to predict. However, these populations are regularly monitored by the State of Connecticut through their fish trawl surveys. These surveys are anticipated to provide sufficient data to develop information necessary to determine if the dredged material disposal at CLIS is affecting the fish and lobster populations in the central basin of the Sound. Relevant questions include:

- Is the composition of the pelagic and demersal fish community affected by disposal operations at the site?
- Is the composition of macro benthic biota affected by disposal operations at the site?

The DEIS identifies endangered species in general as a concern for dredge material disposal in Long Island Sound. However, the DEIS found that no significant impact would be expected to endangered species from disposal at CLIS.

Tier 1

H_0 4-1: Disposal of dredged material has no significant long-term impact on fish/shellfish populations or abundance.

This hypothesis will be addressed with data developed under the CTDEP fish trawl surveys. These data are collected on a yearly basis under a stratified random sampling design. Data from near the site will be compared with data obtained from other similar areas (depth, sediment type, *etc*.) in the central basin of Long Island Sound to determine if there are significant spatial difference that could be related to dredged material disposal at CLIS.

H_0 4-2: Material and operations has no significant direct impact on threatened and endangered species.

The need to test this hypothesis during Tier 1 monitoring would be determined during the annual agency meeting. Methodologies may include the placement of marine mammal observers on tugs or hopper dredges. In addition, turbidity plumes may also be monitored during disposal operations at least once every five years.

Tier 2

If the data reviewed under Tier 1 suggest that dredged material disposal at CLIS is potentially having an adverse affect on the fish or shellfish populations or abundance, special studies to evaluate the distribution of these species in and near the site will be developed. These studies would address the distribution and composition of the fish and macrobenthic organism species within the site and in areas contiguous to the site boundaries. Control areas with similar habitat and depths to those found at CLIS would be identified and sampled to provide a control on the sample design. Specific study questions and sampling design will be developed and approved by the agencies managing CLIS before any study is conducted.

If studies under Tier 2 demonstrate a link between reduced fish or shellfish species and abundances and dredged material disposal at CLIS, additional studies to determine cause will be implemented under Tier 3.

Tier 3

Studies conducted under this tier may include evaluation of the availability of prey species in the site and surrounding areas and evaluation of bioaccumulation of chemicals in the fish and macro benthic species. Studies of prey species may include evaluation of the successional stage, infaunal community analysis (as described in Section 6.3) or bioaccumulation studies similar to those defined under Section 6.1.5 below. Specific study questions and sampling design will be developed and approved by the agencies managing CLIS before any study is conducted.

6.1.6 Management Focus 5: Accumulation of Material Constituents in Marine Biota at or Near the Site

The intent of this management focus is to evaluate whether significant potential for bioaccumulation results from disposal of dredged material at CLIS. The basic premise of this management focus is that testing of sediments for open water disposal eliminates material that pose an unacceptable risk to the marine environment from disposal at CLIS. Moreover, because bioaccumulation of contaminants is a phenomena, it may not result in the impairment or death of organisms in and of itself. However, because bioaccumulation may result in transfer and possible biomagnification of certain chemicals throughout the food chain, which may pose potential unacceptable risks to marine organisms and humans that are not addressed through the evaluation of benthic community recovery, measurements for potential bioaccumulation are precautionary and prudent.

Such bioaccumulation data can serve two purposes. The first is to help understand whether transfer of chemicals from sediments to organisms could be contributing to a significant adverse biological response (*e.g.,* failure of a benthic infaunal community to thrive). The second is to estimate potential risks posed from bioaccumulation of contaminants at the site. The challenge in the monitoring program is how to best develop the information. Two questions are relevant under this Management Focus:

- Are risk levels from sediments placed at CLIS low?
- Does the bioaccumulation potential from the deposited sediments remain low after deposition?

There are several ways to address these questions. The first question is best addressed by continuing to test potential projects for potential risk (as currently practiced in the region) and by compiling test results into a readily available database. Addressing the second question involves periodically evaluating bioaccumulation potential for sediments at and near the disposal site. Methods for developing this information can range from estimating bioaccumulation potential using bioaccumulation models, to measuring the levels of contaminants in organisms collected from a site, to conducting controlled laboratory bioaccumulation studies with test organisms. These approaches are used in a tiered manner to address bioaccumulation concerns at CLIS.

If either of these questions is answered in the negative, significant adverse impact from the disposal operations may be present. Question 1 will be addressed through evaluation of the testing data submitted as part of the permit application and approval process. Question 2 is addressed under the Tiered approach below.

Tier 1

The premise of this Tier is that bioaccumulation potential at CLIS, and thus risk, does not increase after the sediments are deposited.

H0 5-1: Bioaccumulation potential of sediments collected from CLIS is not significantly greater than the baseline condition determined during site designation or at site reference stations.

This hypothesis will be tested by periodically collecting sediments from within CLIS and its reference areas and measuring the level of contaminants in the sediments. If statistically significant increases in sediment chemistry above baseline conditions are found theoretical bioaccumulation calculations will be performed. These may be performed in association with any sampling for sediment chemical analysis (*i.e.,* Tier 3 Management Focus 4). Such surveys should be designed to address other relevant management evaluations. If such sample collections are not performed within any five-year interval, a survey may be planned and conducted as a precautionary evaluation.

If the bioaccumulation modeling indicates a significant increase in potential bioaccumulation relative to baseline conditions or reference areas more specific studies that directly measure bioaccumulation may be conducted under Tier 2.

Tier 2

Direct evidence of bioaccumulation from sediments placed at CLIS may be obtained by comparing bioaccumulation in organisms collected from within and near (reference stations) the disposal site. The study may include collection of representative infaunal organisms from these locations and comparing the level of chemicals in their tissues or testing sediments under controlled laboratory conditions (*i.e.,* bioaccumulation bioassays) or both.

The specific study questions and sampling design will be developed and approved by the agencies managing CLIS before any study is conducted.

If significant increases in bioaccumulation are determined to exist in the sediments from the site, ecological and human health risk models may be run to examine the significance of the increase. If risks increase significantly studies described under Tier 3 would be implemented.

Tier 3

This Tier tests for transfer of bioaccumulated compounds at the site into higher trophic levels.

H_0 5-2: Bioaccumulation of material constituents in higher tropic levels that reside at or near the site does not result from disposal of dredged material at CLIS.

Proving the source of contaminants measured in higher trophic level species is a difficult and complex task. Therefore, careful experimental design is required to make a cause effect link to the sediments deposited in CLIS. The specific study design will be developed and approved by the agencies managing CLIS before any study is conducted.

6.2 Quality Assurance

An important part of any monitoring program is a quality assurance (QA) regime to ensure that the monitoring data are reliable. Quality assurance has been described consisting of two elements:

- Quality Control - activities taken to ensure that the data collected are of adequate quality given the study objectives and the specific hypothesis to be tested, and include standardized sample collection and processing protocols and technician training (National Research Council (NRC), 1990).
- Quality Assessment - activities implemented to quantify the effectiveness of the quality control procedures, and include repetitive measurements, interchange of technicians and equipment, use of independent methods to verify findings, exchange of samples among laboratories and use of standard reference materials, among others (NRC, 1990).

Relevant laboratories are required to submit Quality Assurance (QA) sheets with all analyses on a project-specific basis (see RIM, ITM and Green Book for further details).

6.3 Monitoring Technologies and Techniques

This section describes equipment and approaches typically used to evaluate dredged material disposal sites in the northeast United States. Use of consistent techniques increases comparability with future and historic data; however, monitoring methods used at CLIS are not limited to these technologies. New technology and approaches may be used as appropriate to the issues and questions that must be addressed. The applications of equipment and survey approach must be tailored to each individual monitoring situation, as warranted.

6.3.1 Mound Erosion

Loss of deposited dredged material (erosion) at the site will be investigated using bathymetry (SAIC, 1985). Typically this methodology applies a minimum area bounded by rectangular dimensions of approximately 800 meters to 1200 meters centered around a disposal buoy and aligned with the major axis of the tidal ellipse at the site will be surveyed. Side scan sonar and sediment profile imaging systems (Germano and Rhoads, 1982; 1994) may also be used and is useful for defining broad areas where grain size may have changed or identify thin layers of dredged material, respectively (Rhoades, 1994). Specific survey requirements and application of these measurement tools will be defined for each tier and situation investigated. Evidence of mound erosion will need to be evaluated carefully to distinguish between actual erosion and mound consolidation.

6.3.2 Biological Monitoring

Benthic recovery at disposal mounds will be measured by sediment profile imagery (Germano and Rhoads, 1982; 1994). Stations will center on the disposal buoy and sampled in a star pattern at 100 meter intervals (if more than one area is used in the year then these additional areas will be surveyed in a similar manner). In addition, stations in a cross pattern at 100 meter intervals at each of the three reference sites will be obtained. At each station three photos will be taken with the sediment profile imaging camera. Image analyses will provide the following information:

- Sediment grain size;
- Relative sediment water content;
- Sediment surface boundary roughness;
- Sea floor disturbance;
- Apparent Redox Potential Discontinuity (RPD);
- Depth of camera penetration;
- Sediment methane;
- Infaunal successional stage;
- Organism-Sediment Index (OSI).

6.3.3 Water Quality

The National Estuary Program's Long Island Sound Study (LISS) (http://www.epa.gov/region01/eco/lis/index.htm) routinely measures temperature, salinity, and dissolved oxygen using vertical hydrocasts. In addition, water samples will be collected via Niskin bottle and analyzed via Winkler titration at selected stations. Data collected near CLIS will be obtained from the LISS program and evaluated. Should site specific monitoring be required, methodologies comparable to the LISS program data collections will be used (http://www.epa.gov/region01/eco/lis/index.htm).

6.3.4 Sediment Quality

Grab samples of the sediments will be collected and analyzed for grain size, total organic carbon, and selected contaminants such as trace metals (*e.g.,* mercury, lead, zinc, arsenic, iron, cadmium, copper), total PCBs, total PAH, and pesticides (EPA/USACE, 1997). The number of stations and locations will be defined during survey planning and will be sufficient to enable characterization of within and among station variability. A minimum of two replicate samples should be obtained from each station sampled including each of the three CLIS reference stations.

Toxicity tests will be selected from those used to evaluate dredge material proposed for disposal at CLIS (EPA/USACE, 1997). The number of stations and locations will be defined during survey planning and will be sufficient to enable characterization of within and among station variability. A minimum of two replicate samples should be subjected to testing and include each of the three CLIS reference stations.

6.3.5 Living Resources

Data from the CTDEP Trawl Survey (http://www.dep.state.ct.us/burnatr/fishing /geninfo/fisherie.htm#Coastal%20Programs) will be obtained and analyzed to determine whether the diversity and abundance of recreational and commercial fish in the vicinity of CLIS area differs from other similar areas (depth, sediment type, etc) of the Long Island Sound.

A body burden analysis will also be conducted to determine the concentrations of persistent, bioaccumulatable chemicals such as trace metals (mercury, lead, iron, cadmium, copper) and total PCBs in benthic invertebrates. The methodologies used will be consistent with those recommended in the EPA and Corps Interim Regional Testing Manual (EPA/USACE, 1997). The specific species to be evaluated as well as the number of stations and locations will be defined during survey planning and will be sufficient to enable characterization of within and among station variability. A minimum of three replicate samples should be obtained from each station sampled including each of the three CLIS reference stations. Benthic infaunal organisms analyzed may include *Nephtys incisa* or other infaunal species representative of the site and its contiguous areas that have sufficient tissue mass to enable chemical analysis.

Sampling and chemical analysis of higher trophic levels will be at the discretion of the site managers and focus on determining bioaccumulation in species that can clearly document whether bioaccumulations from the deposited sediments may be determined.

6.3.6 Bioaccumulation Measurements

Measurement of bioaccumulation will include collection of representative benthic infaunal species within the site and at reference locations. At least two types of organisms (filter feeders and sediment feeders) will be obtained and genus level species aggregated into field replicates. Sufficient biomass to enable quantifications of bioaccumulatable compounds will be obtained from grab samples (or other appropriate sample collections device). Tissue will be prepared and analyzed using methods consistent with EPA/USACE (1997). The number of stations and locations will be defined during survey planning and will be sufficient to enable characterization of within and among station variability. Between three and five replicate samples should be obtained from each station sampled including each of the three CLIS reference stations.

Laboratory based bioaccumulation testing will follow the requirements outlined in EPA/USACE (1997).

7.0 ANTICIPATED SITE USE AND QUANTITY AND QUALITY OF MATERIAL TO BE DISPOSED

MPRSA 102(c)(3)(D) and (E) requires that the SMMP include consideration of the quantity of the material to be placed in the site, and the presence, nature, and bioavailability of the contaminants in the material as well as the anticipated use of the site over the long term. CLIS is designated to receive dredged material only. No other material may be placed in the site.

Projected dredging volumes for the western and central regions of Long Island Sound include a mix of large and small Federal navigation projects and many small private dredging projects (marinas, boatyards, and harbors, and a few large private projects), which is consistent with the pattern of dredging in Long Island Sound over the past 20 years. A total of 16 million cubic yards of material are anticipated to be dredged in western and central Long Island Sound over the next 20 years. Of this volume approximately 1 million cubic yards is anticipated to be derived from improvement dredging. Approximately 13.9 million cubic yards of material is expected to be from Federal navigation projects with the rest of the volume coming from other facilities in Long Island Sound. Sediments projected for disposal are expected to come primarily from maintenance dredging projects, although expansion dredging may be required for deeper draft vessels or from increased commerce in Long Island Sound.

Historically one third of the dredged material volume comes from large projects (>500,000 cubic yards; 382,277 cubic meters), one third from medium sized projects (200,000 to 500,000 cubic yards; 152,911 to 382,277 cubic meters), and one third from small projects (<200,000 cubic yards; 152,911 cubic meters). The sediment properties are expected to be variable although the predominant sediment type is likely be silty material (silts, organic silts, sandy silts, *etc.*). About 70 percent of the maintenance material volume can be characterized as silty material. Approximately, 10 percent the expansion material are expected to be sands and clays.

All projects using CLIS for disposal must be either permitted or authorized under MPRSA and the CWA (see Section 3.0). The quality of the material will be determined on a project specific basis under the testing requirements necessary to meet open-water disposal requirements of either CWA 404 or MPRSA 103. The quality of MPRSA material will be consistent with EPA's Ocean Dumping Regulations (40 CFR Part 227), as implemented under the EPA and Corps Interim Regional Testing Manual (EPA/USACE, 1997). Any updates to the Interim Regional Manual (EPA/USACE, 1997) will be in force when approved by the EPA and Corps.

A specific closure date for CLIS has not been assigned as of the date of this SMMP. The capacity of the site will be evaluated at least every three years.

8.0 REVIEW AND REVISION OF THIS PLAN

MPRSA 102 (c)(3)(F) requires that the SMMP include a schedule for review and revision of the SMMP, which shall not be reviewed and revised less frequently than 10 years after adoption of the plan, and every 10 years thereafter. The EPA, the Corps, and states have agreed to review this plan annually as part of the annual agency planning meeting agenda (Section 3.2). A formal review and revision of this SMMP will take place every 5 years beginning from the date of designation unless the frequency is modified during the annual agency planning meeting.

9.0 COORDINATION/OUTREACH

To ensure a disposal program that minimizes impacts to the marine environment, the following management practices will continue to be implemented at the CLIS as a matter of policy. First and foremost, all proposed dredging projects will be reviewed for suitability for ocean disposal by both the Corps and EPA.

An interagency dredged material management review group composed of representatives from EPA, Corps, NMFS, USFWS, and New York and Connecticut state representatives meets approximately every two months to discuss management and monitoring of New England dredged material disposal sites.

To assess compliance with applicable permit conditions and to track overall site usage, permittees will be required to provide written documentation of disposal activities to the Corps during disposal operations and after dredging is complete. Disposal permits and authorizations will include standardized requirements for this reporting to include the source of the dredged material, the amount of the material disposed, the rate of disposal, the date, time and LORAN-C coordinates (or differential GPS, if available) of disposal as well as the due-date for the documentation itself.

The Corps will provide EPA with summary information on each project at two stages of the dredging and disposal process. A Summary Information Sheet will be provided when dredging operations begin, and a Summary Report will be submitted when dredging operations have been completed.

The EPA and the Corps will continue to inform and involve the public regarding the monitoring program and results. For example, the DAMOS Program holds periodic symposia (typically every three years) to report results and seek comment on the program. In addition, DAMOS monitoring results are published in an ongoing series of technical reports that are mailed to interested people and organizations and also distributed at various public meetings. The Corps also has prepared and distributed several Information Bulletins and brochures. To better meet this need, a series of presentations on different aspects of the dredging and disposal process has been prepared. In addition, site related reports can be reviewed at both the Corps Technical Library and the EPA regional library:

U.S. EPA (New England)
Library
One Congress St., 11th Floor
Boston, MA
Hours: Monday-Friday 8:00-5:00

U.S.ACE
NAE Technical Library
696 Virginia Road
Concord, MA 01742
Hours: Monday-Friday 7:30-4:00

Any party interested in being added to the DAMOS mailing list should mail the appropriate information to the Corps at:

U.S. Army Corps of Engineers, New England Division
Regulatory Division
Marine Analysis Section
696 Virginia Road
Concord, MA 01742

10.0 FUNDING

The costs involved in site management and monitoring will be shared between EPA New England Region and the Corps NAE. This SMMP will be in place until modified or the site is de-designated and closed.

Those monitoring programs conducted under other Federal (*i.e.,* Long Island Sound Study) and state agencies (*i.e.,* CTDEP Trawl Survey) will depend solely on funds allocated to the programs by those agencies or other supporting agencies.

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Attachment A

Hypotheses Flowcharts and Summary Table

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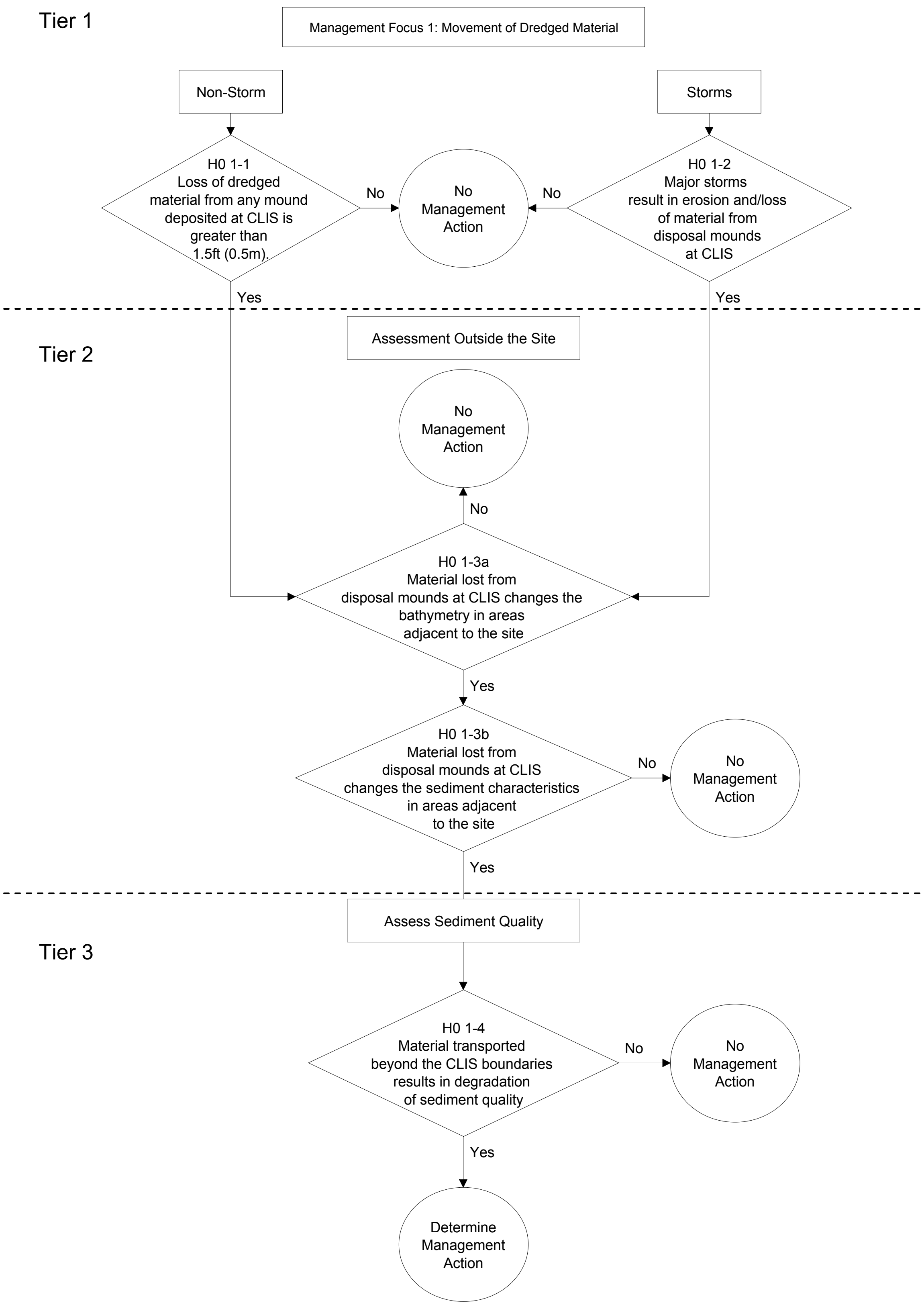
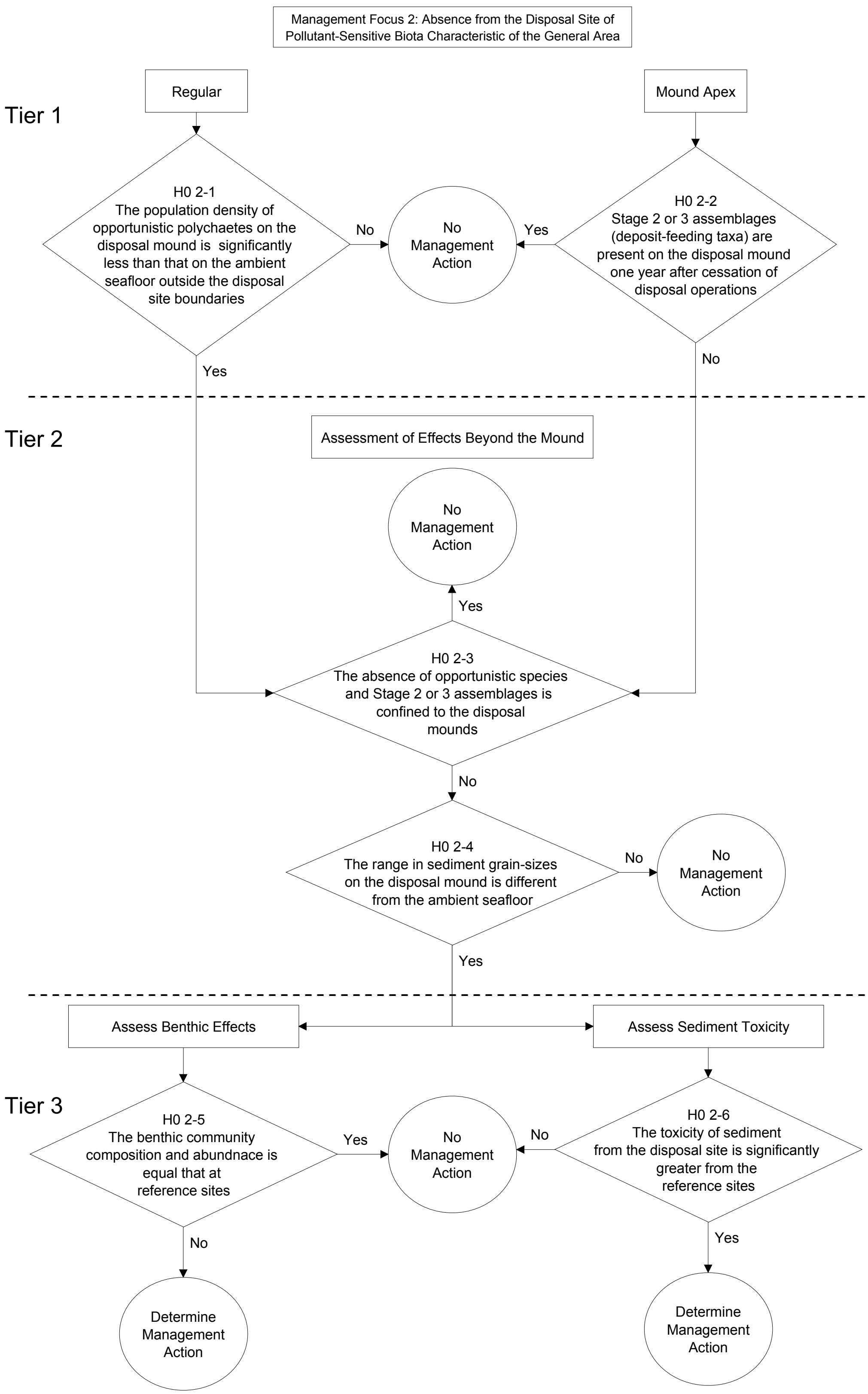
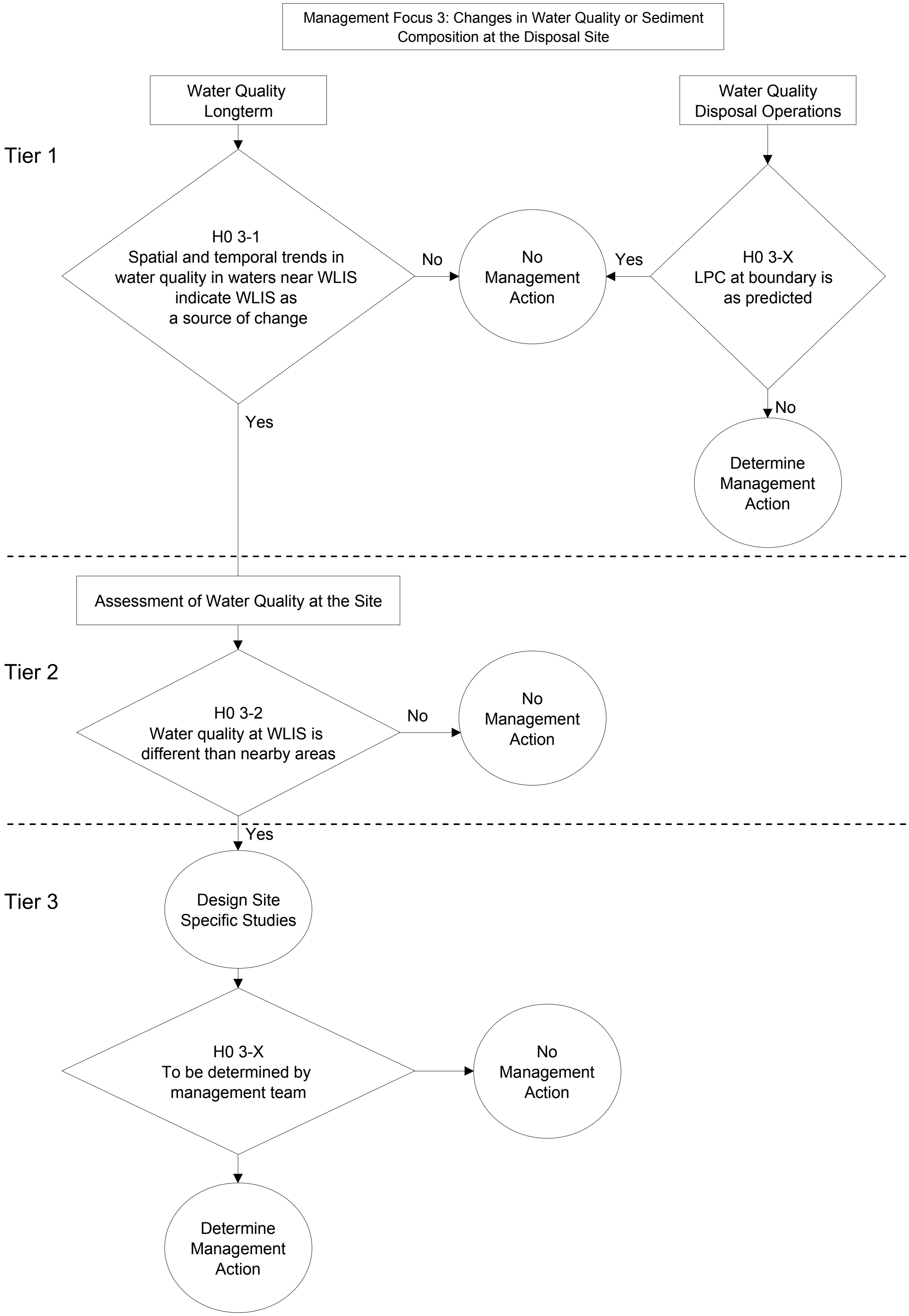
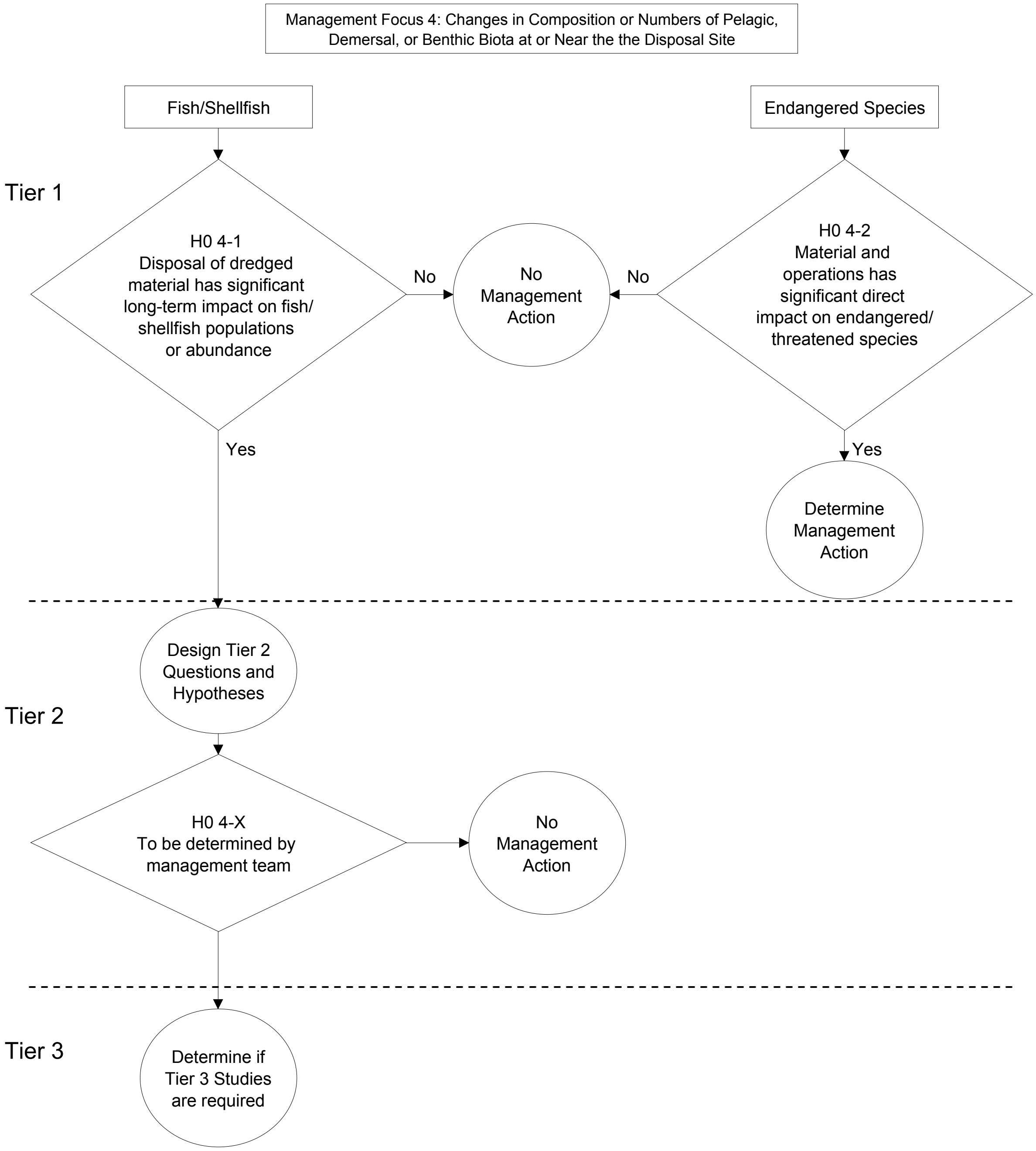

Tier 1
Management Focus 1: Movement of Dredged Material
Non-Storm
Storms
H0 1-1
Loss of dredged material from any mound deposited at CLIS is greater than 1.5ft (0.5m).
No
No Management Action
No
H0 1-2
Major storms result in erosion and/loss of material from disposal mounds at CLIS
Yes
Yes
Tier 2
Assessment Outside the Site
No Management Action
No
H0 1-3a
Material lost from disposal mounds at CLIS changes the bathymetry in areas adjacent to the site
Yes
H0 1-3b
Material lost from disposal mounds at CLIS changes the sediment characteristics in areas adjacent to the site
No
No Management Action
Yes
Tier 3
Assess Sediment Quality
H0 1-4
Material transported beyond the CLIS boundaries results in degradation of sediment quality
No
No Management Action
Yes
Determine Management Action


Management Focus 2: Absence from the Disposal Site of Pollutant-Sensitive Biota Characteristic of the General Area
Tier 1
Regular
Mound Apex
H0 2-1
The population density of opportunistic polychaetes on the disposal mound is significantly less than that on the ambient seafloor outside the disposal site boundaries
No
No Management Action
Yes
H0 2-2
Stage 2 or 3 assemblages (deposit-feeding taxa) are present on the disposal mound one year after cessation of disposal operations
Yes
No
Tier 2
Assessment of Effects Beyond the Mound
No Management Action
Yes
H0 2-3
The absence of opportunistic species and Stage 2 or 3 assemblages is confined to the disposal mounds
No
H0 2-4
The range in sediment grain-sizes on the disposal mound is different from the ambient seafloor
No
No Management Action
Yes
Assess Benthic Effects
Assess Sediment Toxicity
Tier 3
H0 2-5
The benthic community composition and abundnace is equal that at reference sites
Yes
No Management Action
No
H0 2-6
The toxicity of sediment from the disposal site is significantly greater from the reference sites
No
Determine Management Action
Yes
Determine Management Action


Management Focus 3: Changes in Water Quality or Sediment Composition at the Disposal Site
Water Quality Longterm
Water Quality Disposal Operations
Tier 1
H0 3-1 Spatial and temporal trends in water quality in waters near WLIS indicate WLIS as a source of change
No
No Management Action
Yes
H0 3-X LPC at boundary is as predicted
No
Determine Management Action
Yes
Assessment of Water Quality at the Site
Tier 2
H0 3-2 Water quality at WLIS is different than nearby areas
No
No Management Action
Yes
Tier 3
Design Site Specific Studies
H0 3-X To be determined by management team
No Management Action
Determine Management Action


Management Focus 4: Changes in Composition or Numbers of Pelagic, Demersal, or Benthic Biota at or Near the the Disposal Site
Fish/Shellfish
Endangered Species
Tier 1
H0 4-1
Disposal of dredged material has significant long-term impact on fish/ shellfish populations or abundance
No
No Management Action
No
H0 4-2
Material and operations has significant direct impact on endangered/ threatened species
Yes
Yes
Determine Management Action
Design Tier 2 Questions and Hypotheses
Tier 2
H0 4-X
To be determined by management team
No Management Action
Tier 3
Determine if Tier 3 Studies are required

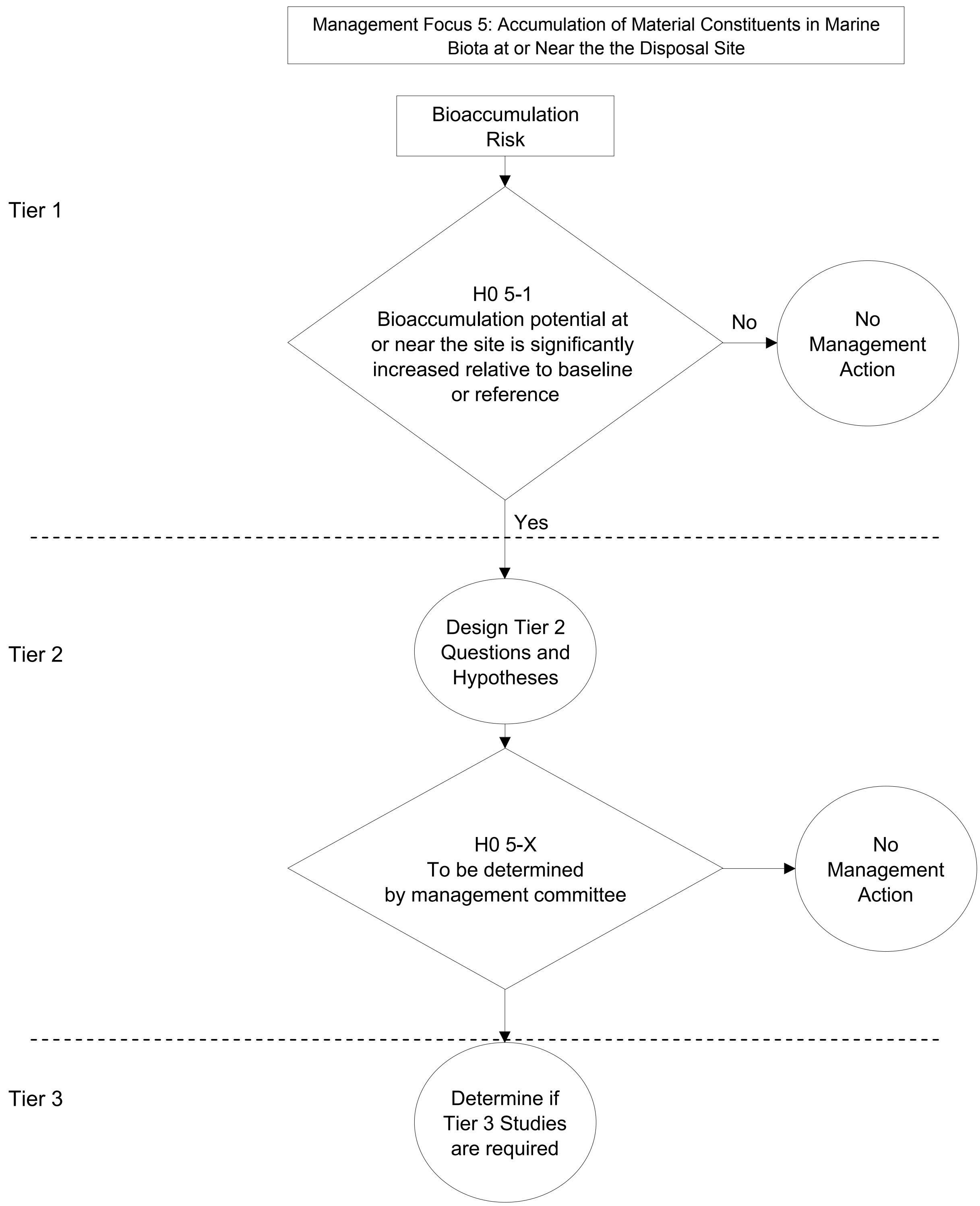

Management Focus 5: Accumulation of Material Constituents in Marine Biota at or Near the the Disposal Site
Bioaccumulation Risk
Tier 1
H0 5-1
Bioaccumulation potential at or near the site is significantly increased relative to baseline or reference
No
No Management Action
Yes
Tier 2
Design Tier 2 Questions and Hypotheses
H0 5-X
To be determined by management committee
No Management Action
Tier 3
Determine if Tier 3 Studies are required

Table 1-1. Summary of Hypotheses and Leading Indicators for Each Management Focus

	Management Focus 1: Movement of the Dredged Material	**Management Focus 2: Absence of Pollutant-Sensitive Biota**	**Management Focus 3: Changes in Water Quality**	**Management Focus 4: Changes in Composition or Numbers of Biota**	**Management Focus 5: Accumulation of Material Constituents in Biota**
TIER 1					
Hypothesis 1	Baseline taken within 1 yr after disposal; entire site bathymetry at 3-4 yr intervals	SPI within 1-3 yrs of disposal and survey of historic mounds once every 5 yrs.	Annual water quality measured in site vicinity (LISS Monitoring program data)	Annual CTDEP trawl survey data	Sediment bioaccumulation potential estimated for sedimetnts collected witihin site and ref. areas at least every 5 yrs
Condition(s) triggering Tier 2 monitoring:	Mound changes by > 1.0 ft w/in 5 yr interval	Significant differences between site and ref. areas	Consistent gradients in measures of long-term water quality changes in vicinity	Significant differences in commnity composition or abundance from baseline or contiguous areas is found	Significant increase in bioaccumulation potential relative to baseline conditions or reference areas
Hypothesis 2	Bathymetry taken ≤ 2 months after 10-yr storm	SPI w/in 1-3 yrs of disposal and survey of historic mounds once every 5 yrs.	N/A	N/A	N/A
Condition(s) triggering Tier 2 monitoring:	Mound changes by > 1.5 ft from last survey	Significant differences between site and ref. areas	N/A	N/A	N/A
TIER 2					
Hypothesis 3	Bathymetry and sediment char. survey w/in 1 km. of site boundary	SPI at site and ref. areas at least 1 km away; grain size analysis	Water quality measured at site and ref. areas	No hypothesis but studies may include measurement of species distribution at site and ref. areas	No hypothesis but studies will involve the collection of biota from site and ref. areas
Condition(s) triggering Tier 3 monitoring:	Apex or apron bathymetry changes are > 1.5 ft or large undocumented areas w/ muddy sed.	Widespread differences between site and ref. areas are not caused by other factors	Significant short-term WQ gradients are found	A link between reduced biota or diversity and dredged material at the site is found	Significant bioaccumulation is detected
Hypothesis 4	N/A	SPI at site and ref. areas at least 1 km away; grain size analysis	N/A	No hypothesis but studies may include species distribution at site and ref. areas	Further studies not yet determined

Table 1-1. Summary of Hypotheses and Leading Indicators for Each Management Focus (continued)

	Management Focus 1: Movement of the Dredged Material	Management Focus 2: Absence of Pollutant-Sensitive Biota	Management Focus 3: Changes in Water Quality	Management Focus 4: Changes in Composition or Numbers of Biota	Management Focus 5: Accumulation of Material Constituents in Biota
TIER 2 (Cont'd)					
Condition(s) triggering Tier 3 monitoring:	N/A	Widespread differences between site and ref. areas are not caused by other factors	N/A	N/A	Further studies not yet determined
TIER 3					
Hypothesis 4	Sed. chem, toxicity, and benthic community measured at site and ref. areas	Sed. chem, toxicity, and benthic community measured at site and ref. areas	No hypothesis but studies may include evaluation of sediment oxygen demand	No hypothesis but studies may include prey evaluation, bioaccumulation, succession, etc.	Further studies not yet determined
Conditon triggering Management Action	All three measures are deemed unacceptable	All three measures are deemed unacceptable	Low dissolved oxygen at site and ref. areas is linked to dredged material	A link between. reduced biota or diversity and dredged material at the site is found	A cause-effect link between sediment and higher trophic levels is detected
Hypothesis 4	N/A	Sed. chem, toxicity, and benthic community measured at site and ref. areas	No hypothesis but studies may include evaluation of sediment oxygen demand	No hypothesis but studies may include prey evaluation, bioaccumulation, succession, etc.	Further studies not yet determined
Conditon triggering Management Action	Significant movement of material outside of the site and significantly impaired benthic community	All three measures are deemed unacceptable	Low dissolved oxygen at site and ref. areas is linked to dredged material	A link between reduced biota or diversity and dredged material at the site is found	A cause-effect link between sediment and higher trophic levels is detected

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Attachment B

Scow Log Sample

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INSPECTOR'S DAILY REPORT OF DISPOSAL BY SCOW

NOTE: Dredged material volume stated below is approximate and shall not be used for measurement and/or payment.

Permittee ____________________ Disposal Area ____________________
Permit/Contract No. ____________________ Date ____________________
Project ____________________ Towboat ____________________
Dredging Contractor ____________________ Owner ____________________

Trip No.	Scow No.	Started From Place	Started From Time	Disposal Time	Returned To Place	Returned To Time	Round Trip Time	Round Trip Dist.	Lat/Long Coordinates* Specified	Lat/Long Coordinates* Actual	Dist./Dir. From Buoy

Trip No.	No. of Pockets Loaded	No. of Pockets Dumped	Reason Pocket Not Dumped	Disposal Depth	Disposal Speed	Weather	Sea Conditions/ Visibility	Approx. Volume (CY)	Scow Draft

Comments:

*Check the datum used ___NAD27 ___NAD83. Also note any factors that may affect reliability of navigation instrument and readouts.

Time On	Time Off	Hours On Duty
	Total Hours On Duty	

Reviewed By: Permittee's Representative or, for Corps Projects, Corps' Resident Engineer or Field Inspector

To the District Engineer, U.S. Army Engineer District, New England, Concord, Massachusetts:

I certify that I informed the tug captain of the conditions of the U..S. Army Corps of Engineers permit or contract regarding the distance from the buoy and the speed of the scow during the release of the dredged material. I also informed the captain that failure to comply with these conditions would constitute a violation of the permit and would be reported to the Corps. I certify that this report is correct and that I am not an employee of the dredging or towing firm, or the permittee, nor have I been employed by any of them at any time during the past six months. The approximate volume of dredged material stated on this report is only an estimate. It was made either by me, the dredging or towing contractor, or the Corps of Engineers Resident Engineer of Field Inspector. I do not certify that it correctly states the volume of material dredged.

____________________ ____________________
Signature of Disposal Inspector (Certification No.)

Print Name Here ____________________

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