

Northerly Island Ecosystem Restoration

Detailed Project Report & Environmental Assessment



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Study Partnership

Chicago Park District



US Army Corps
of Engineers®
Chicago District

Northerly Ecosystem Restoration Detailed Project Report & Environmental Assessment

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Appendix D – Real Estate Plan (INTENTIONALLY NOT INCLUDED)
Appendix E – Monitoring Plan
Appendix F – Coordination, 404b1, Draft FONSI
Appendix G – Geotechnical Engineering

EXECUTIVE SUMMARY

The non-Federal sponsor, the Chicago Park District (CPD) has requested that the Chicago District, USACE (U.S. Army Corps of Engineers) initiate a study under Section 506 Fishery and Ecosystem Restoration to ascertain the feasibility of restoration features to restore critical aquatic and migratory bird habitat. This study evaluates the feasibility and environmental effects of manipulating topography and subsurface hydrology in an effort to restore coastal habitat. This Detailed Project Report (DPR) and Integrated Environmental Assessment (EA) will assess and identify problems and opportunities, identify and evaluate measures, and recommend and design the most cost effective and feasible solution to the ecological problems currently existing within the area of study.

The Study area is a 91-acre manmade peninsula found on the shores of Lake Michigan in Chicago, Illinois (Figure 1). It is located south of the Adler Planetarium and provides protection to Burnham Harbor from Lake Michigan storms. The restoration would primarily occur on the south side of the island and encompass approximately 40-acres of land (Figure 2), which includes the two parking lots and building. From 1947-2002 the island was home to a small airport known as Meigs Field. Today, the northern end of the island is occupied by a music venue: the Charter One Pavilion. Northerly Island's unique location and vicinity within Lake Michigan provides an ecological refuge to a variety of organisms in an otherwise urban environment.

The Great Lakes maintain 20% of the world's freshwater and are important for social, economic, and ecological values throughout the region. However, these values can be lost as the integrity of the system begins to fail. The current state of the Great Lakes is less than promising. Invasive species, pollution, and habitat degradation are causing the natural geomorphic and hydrologic process to fail. As a result, the ecosystem struggles to maintain itself.

One crucial component that is important to ecosystem integrity and integrates both aquatic and riparian or buffer habitat, is wetlands. Historically, Chicago's shoreline was lush with vast expanses of wetlands. While restoring wetland in Chicago to their historical conditions is unlikely, converting small expanses of land into wetlands will provide critical habitat for a number of organisms. These patches of wetland would serve as an important refuge for migrant and resident bird species, as well as a variety of aquatic organisms (fish, amphibians, aquatic insects, etc.). The restoration, enhancement, and protection of critical wetland habitat would provide an ecological benefit that is supported by the GLFER program. The main problems at Northerly Island are as follows:

- Lack of a natural mosaic and gradient of submerged to upland coastal habitats
- Fragmentation of local habitat patches
- Overabundance of unnatural conditions that promote invasive species success
- Lack of rich coastal plant communities
- Lack of rare and sensitive coastal plant and animal species
- Lack of critical habitat for locally endangered and rare fauna
- Lack of migratory bird resting and forage habitats

Seven (7) measures, including the No Action measure, were input into USACE planning software in terms of costs and benefits. Based on inputs and criteria, the planning software generated sixty-six (66) alternative combinations for ecosystem restoration. The cost effectiveness analysis was used to ensure that certain options would be screened out if they produced the same amount or less output at a greater cost than other options with a lesser cost. Of these, thirteen (13) cost effective combinations were identified, which is inclusive of five (5) best buy plans also identified under the same analysis. The No Action plan is always deemed cost effective and a best buy plan. Fifty-three (53) alternative combinations were screened out as non-cost effective. An incremental cost analysis was performed on the best buy alternatives. The objectives of the incremental cost analysis are to provide information to assist in determining whether the additional output provided by each successive cost effective plan is worth the additional cost that must be incurred for implementation; that is, to assist in determining the scale of the recommended plan. This incremental cost analysis sorted and ranked the five (5) best buy plans for ecological restoration that would be considered as best buys, including the no action plan.

Alternative 5 is recommended, which consists of establishing a diverse coastal habitat mosaic at Northerly Island. The recommended plan has a total project cost of approximately \$ [REDACTED] (2012 price levels). This plan provides 205 net average annual habitat units over 40-acres of coastal zone. All costs associated with the restoration and preservation of the Northerly Island ecosystem have been considered.

The estimated Federal cost share of the project is about \$ [REDACTED] and the non-Federal share is about \$ [REDACTED]. The USACE would accomplish the plans and specifications phase, which includes additional design studies and plans and specifications, contract for construction, overall supervision during construction, prepare an operation and maintenance manual, and participate in a portion of the post construction monitoring. Prior to initiation of the design phase, the Federal Government and the non-Federal sponsor will execute a PPA (Project Partnership Agreement).

CHAPTER 1 – INTRODUCTION

1.1 – Report Organization

This Detailed Project Report (DPR) presents the results of the Northerly Island ecosystem restoration study. This report consists of seven (7) parts including a main report and six appendices with figures and tables. The report is structured as follows:

- Feasibility Report & Integrated Environmental Assessment
- Appendix A – Civil Design
- Appendix B – Cost Engineering
- Appendix C – Hazardous, Toxic, and Radioactive Waste (HTRW) Report
- Appendix D – Real Estate Plan
- Appendix E – Monitoring Plan
- Appendix F – Coordination, 404b1, Draft FONSI
- Appendix G – Geotechnical analysis

1.2 – Study Authority

42 U.S.C. § 1962d-22. GREAT LAKES FISHERY AND ECOSYSTEM RESTORATION

- (a) Findings - Congress finds that—
- (1) the Great Lakes comprise a nationally and internationally significant fishery and ecosystem;
 - (2) the Great Lakes fishery and ecosystem should be developed and enhanced in a coordinated manner; and
 - (3) the Great Lakes fishery and ecosystem provides a diversity of opportunities, experiences, and beneficial uses.
- (b) Definitions - In this section, the following definitions apply:
- (1) Great Lake
 - (A) In general- The term “Great Lake” means Lake Superior, Lake Michigan, Lake Huron (including Lake St. Clair), Lake Erie, and Lake Ontario (including the St. Lawrence River to the 45th parallel of latitude).
 - (B) Inclusions- The term “Great Lake” includes any connecting channel, historically connected tributary, and basin of a lake specified in subparagraph (A).
 - (2) Great Lakes Commission- The term “Great Lakes Commission” means the Great Lakes Commission established by the Great Lakes Basin Compact (82 Stat. 414).
 - (3) Great Lakes Fishery Commission- The term “Great Lakes Fishery Commission” has the meaning given the term “Commission” in section 931 of Title 16.
 - (4) Great Lakes State- The term “Great Lakes State” means each of the States of Illinois, Indiana, Michigan, Minnesota, Ohio, Pennsylvania, New York, and Wisconsin.
- (c) Great Lakes fishery and ecosystem restoration
- (1) Support plan
 - (A) In general- Not later than 1 year after December 11, 2000, the Secretary shall develop a plan for activities of the Corps of Engineers that support the management of Great Lakes fisheries.
 - (B) Use of existing documents- To the maximum extent practicable, the plan shall make use of and incorporate documents that relate to the Great Lakes and are in existence on December 11, 2000, such as lakewide management plans and remedial action plans.
 - (C) Cooperation- The Secretary shall develop the plan in cooperation with—
 - (i) the signatories to the Joint Strategic Plan for Management of the Great Lakes Fisheries; and
 - (ii) other affected interests.
 - (2) Reconnaissance studies- Before planning, designing, or constructing a project under paragraph (3), the Secretary shall carry out a reconnaissance study—

- (A) to identify methods of restoring the fishery, ecosystem, and beneficial uses of the Great Lakes; and
 - (B) to determine whether planning of a project under paragraph (3) should proceed.
- (3) Projects- The Secretary shall plan, design, and construct projects to support the restoration of the fishery, ecosystem, and beneficial uses of the Great Lakes.
- (4) Evaluation program
 - (A) In general- The Secretary shall develop a program to evaluate the success of the projects carried out under paragraph (3) in meeting fishery and ecosystem restoration goals.
 - (B) Studies- Evaluations under subparagraph (A) shall be conducted in consultation with the Great Lakes Fishery Commission and appropriate Federal, State, and local agencies.
- (d) Cooperative agreements- In carrying out this section, the Secretary may enter into a cooperative agreement with the Great Lakes Commission or any other agency established to facilitate active State participation in management of the Great Lakes.
- (e) Relationship to other Great Lakes activities- No activity under this section shall affect the date of completion of any other activity relating to the Great Lakes that is authorized under other law.
- (f) Cost sharing
 - (1) Development of plan- The Federal share of the cost of development of the plan under subsection (c)(1) of this section shall be 65 percent.
 - (2) Project planning, design, construction, and evaluation- Except for reconnaissance studies, the Federal share of the cost of planning, design, construction, and evaluation of a project under paragraph (3) or (4) of subsection (c) of this section shall be 65 percent.
 - (3) Non-Federal share
 - (A) Credit for land, easements, and rights-of-way- The Secretary shall credit the non-Federal interest for the value of any land, easement, right-of-way, dredged material disposal area, or relocation provided for carrying out a project under subsection (c)(3) of this section.
 - (B) Form- The non-Federal interest may provide up to 100 percent of the non-Federal share required under paragraphs (1) and (2) in the form of services, materials, supplies, or other in-kind contributions.
 - (4) Operation and maintenance- The operation, maintenance, repair, rehabilitation, and replacement of projects carried out under this section shall be a non-Federal responsibility.
 - (5) Non-Federal interests- In accordance with section 1962d-5b of this title, for any project carried out under this section, a non-Federal interest may include a private interest and a nonprofit entity.
- (g) Authorization of appropriations
 - (1) Development of plan- There is authorized to be appropriated for development of the plan under subsection (c)(1) of this section \$300,000. Other activities- There is authorized to be appropriated to carry out paragraphs (2) and (3) of subsection (c) of this section \$100,000,000.

1.3 – Study Purpose & Background

Prior to European settlement the Lake Michigan coastal zone, in which Northerly Island resides, was one of the most diverse ecosystems in Cook County, Illinois. The vast expanse of wetlands that were left behind by glacial movements and the recession of ancient Lake Chicago included marsh, wet prairie, and wet savanna. First trading and industry, and then the onset of agriculture modified much of the unique plant communities. Ultimately, the City of Chicago was erected and in turn obliterated the natural geomorphology, topography and associate plant communities. The southern portion of Northerly Island is the primary focus for this study, which also includes the lake on the southern boundary of the study area.

The non-Federal sponsor, the Chicago Park District (CPD) has requested that the Chicago District, USACE (U.S. Army Corps of Engineers) initiate a study under Section 506 Fisheries and

Ecosystem Restoration to ascertain the feasibility of restoration features to restore critical aquatic and migratory bird habitat. This study evaluates the feasibility and environmental effects of manipulating topography and subsurface hydrology in an effort to restore coastal habitat. This Detailed Project Report (DPR) and Integrated Environmental Assessment (EA) will assess and identify problems and opportunities, identify and evaluate measures, and recommend and design the most cost effective and feasible solution to the ecological problems currently existing within the area of study.

1.4 – Study Area

The Study area is a 91-acre manmade peninsula found on the shores of Lake Michigan in Chicago, Illinois (Figure 1). It is located south of the Adler Planetarium and provides protection to Burnham Harbor from Lake Michigan storms. The restoration would primarily occur on the south side of the island and encompass approximately 40-acres of land (Figure 2) the two parking lots and building. From 1947-2002 the island was home to a small airport known as Meigs Field. Today, the northern end of the island is occupied by a music venue: the Charter One Pavilion. Northerly Island's unique location and vicinity within Lake Michigan provides an ecological refuge to a variety of organisms in an otherwise urban environment.

Figure 1 — Vicinity Map of Northerly Island; Downtown Chicago.



1.5 – Pertinent Reports, Studies & Projects

Reports & Studies

- 2011. Great Lakes Fishery and Ecosystem Restoration Proposal for Northerly Island – The proposal was developed by the Chicago District, United States Army Corps of Engineers. Goals and objectives of the project and how they benefit the ecosystem are discussed.
- 2011. Northerly Island Framework Plan – The framework plan provides detailed information on the layout of the island after restoration as well as the justifications behind them.

Figure 2 – Current Conditions of the Northerly Island Study Area.



CHAPTER 2 – INVENTORY AND FORECASTING

2.1 – Current Conditions

2.1.1 – Study Area Description

Naturally, this area was once the bottom of Lake Michigan within the littoral zone. After creation of the peninsula as part of Daniel Burnham's plan in 1925, the island became a small airport in 1946. The CPD owns the parcel and the southern portion of the island was planted for the most part with native grasses and turf grass to ensure the site would not become infested with non-native weeds.

Currently, no wetland or natural habitats are found within the study area (Photo 1). The lack of surficial hydrology and topography diversity makes it difficult to establish native coastal and wetland vegetation.

Photo 1 – View looking south to north across the restoration area.



The revetment walls around the island (Photo 2) prevent coastal erosion, but in many places they are beginning to fail (Photo 3).

Photo 2 — Riprap and concrete revetment on eastern boundary.



Photo 3 — Blowout exposing concrete revetment tiebacks.



Revetment walls are also used on the west side of Northerly Island where very little wave action occurs (Photo 4). These un-natural walls provide very little habitat and degrade the current lacustrine habitat for native fishes (Photo 5).

Photo 4 — Revetment wall on west side (Burnham Harbor).



Photo 5 — Segment of wall among lacustrine environment within Burnham Harbor.



Along the walls, a mixture of boulders, cobble, gravel, and rip-rap provide decent habitat for many species of fish (Photo 6). However, aquatic macrophyte abundance is low and could provide greater complexity within the aquatic ecosystem. Similarly, the lack of adjacent wetlands to the area limits species richness by prohibiting the recruitment of fish that need wetlands for spawning and foraging purposes.

Photo 6 — Rubble mound substrate along revetment walls.



2.1.2 – Physical Resources

Climate

The average yearly temperature for the City of Chicago ranges from a low of 43°F to a high of 59°F. The summer months tend to be moderately humid with temperatures typically between 78°F and 92°F. Winters in Chicago are variable, but often have average lows and high of 21°F and 34°F, respectively. Approximately 38 inches of snow falls on the city each year contributing to a total yearly mean of 40 inches of precipitation. Spring and fall temperatures are tend to me intermediate and considered the most pleasant. Despite the title “The Windy City,” Chicago’s average wind speeds range from 8 to 12 mph.

Air Quality

Cook County is currently in the Chicago nonattainment areas for the priority air pollutants PM-2.5 and 8-Hr Ozone. Illinois EPA in 2011 requested USEPA redesignate the Chicago nonattainment area to attainment of National Ambient Air Quality Standards for both of these air quality pollutants. If this redesignation is accepted, a maintenance period will be established for at least ten years afterwards to ensure continued attainment. The 2010 Illinois Annual Air Quality Report published by IEPA reported one exceedance of the 0.075 PPM 8-Hr ozone standard at Jardine Water Plant in 2010 (the closest air monitoring location to Northerly Island). Other priority air pollutants were either not exceeded or not monitored near the project site.

Water Quality

The 2010 Illinois Integrated Water Quality Report and Section 303(d) List indicated Lake Michigan waters in Illinois were rated as “fully supporting” the following designated uses: aquatic life use, primary contact (swimming) use, secondary contact use, and public and food

processing water use. Fish consumption use was not supported due to contamination from PCBs and mercury. It is noted, however, that the waters of Lake Michigan Bays and Harbors, which would include the locations in Burnham Harbor where Northerly Island fish habitat project features are planned, were only assessed for the aquatic life and fish consumption uses.

Geology & Glacial Stratigraphy

Silurian Age Bedrock – The underlying regional bedrock is Silurian-age dolomite, most likely of the Niagaran Series (Willman 1971). This rock resulted from marine deposition when all of northeastern Illinois and much of the neighboring Great Lakes region was the floor of a tropical sea from about 440 to 410 million years ago.

Soils

Naturally, the soils within the Chicago Lakeplain consisted of poorly drained clays, silts, sands, and gravels. However, Northerly Island is manmade and does not possess naturally occurring soils. The fill material primarily consists of clays, loams and sand fill. Foreign debris occurs on the site as well, chiefly consisting of cement and asphalt chunks that have been used as *ad hoc* erosion control.

Fluvial Geomorphology & Topography

The study area does not have any fluvial geomorphic features. Topography of the island is flat, with the surface elevation of 586 ft.

Land Cover, Hydrology & Hydraulics

The study area is currently propagated in both native and non-native grasses. Currently, there is no surficial hydrology exposed, and subsurficial hydrology is controlled by Lake Michigan levels. Hydraulic functions of the study area are mostly the result of wave action from Lake Michigan. There are no streams or drainage patterns within the study parcel, thus stream hydraulics are not present.

2.1.3 – Ecological Resources

General Study Area Habitat

In general, habitat of the Northerly Island is minimal; however, it does provide critical resting habitat for migratory birds. Native and non-grasses provided minimal cover for small, migratory bird species. Small ornamental trees also are scattered throughout the site which also provide cover for resting migratory birds. Aquatic habitat is limited to the littoral shelf areas surrounding the peninsula. This habitat primarily consists of old rubble mound revetment materials and large pieces of concrete and stone. This manmade habitat attracts several species of fish and may provide mudpuppy (*Necturus maculosus*) foraging habitat.

Plant Communities

The majority of the project area does not support any stable native plant communities, predominately being mowed turf grass made up of non-native species including Kentucky blue grass (*Poa pratensis*), tall fescue (*Festuca elatior*), common plantain (*Plantago major*), English plantain (*Plantago lanceolata*), hairy crab grass (*Digitaria sanguinalis*), yarrow (*Achillea millefolium*), sidewalk knotweed (*Polygonum arenastrum*), white clover (*Trifolium repens*), and common dandelion (*Taraxacum officinale*).

Ornamental prairies occur in several areas on the perimeter of the site and along trails where mowing does not occur. These areas contain typical prairie species used in native landscaping projects and resemble a highly disturbed prairie community composed of predominantly early successional and aggressive species such as Indian grass (*Sorghastrum nutans*), Canada wild rye (*Elymus canadensis*), yellow coneflower (*Ratibida pinnata*), black-eyed Susan (*Rudbeckia hirta*), hairy aster (*Aster pilosus*), and false sunflower (*Heliopsis helianthoides*). Non-native and invasive species also dominate unmowed and planted areas including bird's foot trefoil (*Lotus corniculata*), red clover (*Trifolium pratense*), yellow foxtail (*Setaria glauca*), white and yellow sweetclover (*Mellilotus* spp.), common ragweed (*Ambrosia artemisiifolia*), queen Anne's lace (*Daucus carota*), and smooth brome (*Bromus inermis*).

Macroinvertebrates

Macroinvertebrate surveys have not been conducted in the waters surrounding Northerly Island; however several studies in Southern Lake Michigan have been done. Garza and Whitman of the United States Geological Survey investigated macroinvertebrate assemblages of Southern Lake Michigan and observed macroinvertebrates from forty taxa. Approximately 81% of the observed taxa consisted of *Chaetogaster diastrophus* and Nematoda. Nalepa et al. (1998) also conducted surveys throughout Southern Lake Michigan that encompasses areas adjacent to the City of Chicago. Their study identified three main groups of macroinvertebrates including *Diporeia* (Amphipoda), Oligochaeta (worms), and Sphaeriidae (bivalves). It is likely that water around Northerly Island will have abundant populations of macroinvertebrates similar to the composition described in the aforementioned studies.

Fishes

Fish surveys have been conducted around Northerly Island for several decades. Twenty-four (24) native species and ten (10) non-native species have been identified from the surrounding area (Table 1). Important rare and sensitive species include the trout perch (*Percopsis omiscomaycus*), lake chub (*Coueseuis plumbeus*), burbot (*Lota lota*), and mottled sculpin (*Cottus baridii*). Important native game fishes include smallmouth bass (*Micropterus dolomieu*), largemouth bass (*Micropterus salmoides*), rock bass (*Ambloplites rupestris*), and yellow perch (*Perca flavescens*). Non-native, introduced game fish include the Pacific Salmonids (*Oncorhynchus* spp.), European brown trout (*Salmo trutta*), and rainbow smelt (*Osmerus mordax*). Non-native invasive species include common carp (*Cyprinus carpio*), goldfish (*Carassius auratus*), alewife (*Alosa pseudoharengus*), sea lamprey (*Petromyzon marinus*) and round goby (*Neogobius melanostomus*). Invasive species of concern for this project are the common carp and gold fish since they are herbivores. Measures will be taken to exclude the adult forms of these two species.

Table 1 – Fishes collected around Northerly Island between 1950- 2005.

Species	Common name	Species	Common name
<i>Lepomis macrochirus</i>	bluegill	<i>Percopsis omiscomaycus</i>	trout perch
<i>Micropterus dolomieu</i>	smallmouth bass	<i>Pimephales notatus</i>	bluntnose minnow
<i>Micropterus salmoides</i>	largemouth bass	<i>Pimephales promelas</i>	fathead minnow
<i>Perca flavescens</i>	yellow perch	<i>Pungitius pungitius</i>	nine-spine stickleback
<i>Lepomis cyanellus</i>	green sunfish	<i>Rhinichthys cataractae</i>	longnose dace
<i>Lepomis gibbosus</i>	pumpkinseed	<i>Lota lota</i>	burbot
<i>Ambloplites rupestris</i>	rock bass	<i>Oncorhynchus kisutch</i> *	coho salmon
<i>Ameiurus melas</i>	black bullhead	<i>Oncorhynchus mykiss</i> *	rainbow trout
<i>Catostomus commersonii</i>	white sucker	<i>Oncorhynchus tshawytscha</i> *	Chinook salmon
<i>Cottus bairdii</i>	mottled sculpin	<i>Salmo trutta</i> *	brown trout
<i>Couesius plumbeus</i>	lake chub	<i>Carassius auratus</i> *	goldfish
<i>Dorosoma cepedianum</i>	gizzard shad	<i>Cyprinus carpio</i> *	common carp
<i>Gasterosteus aculeatus</i>	three spine stickleback	<i>Neogobius melanostomus</i> *	round goby
<i>Notemigonus crysoleucas</i>	golden shiner	<i>Petromyzon marinus</i> *	sea lamprey
<i>Notropis atherinoides</i>	emerald shiner	<i>Osmerus mordax</i> *	rainbow smelt
<i>Notropis hudsonius</i>	spottail shiner	<i>Alosa pseudoharengus</i> *	alewife
<i>Notropis stramineus</i>	sand shiner		

*non-native species

Amphibians & Reptiles

Reptiles and amphibians that may be present in the area include the American bullfrog (*Rana catesbeiana*), American toad (*Bufo americanus*), painted turtle (*Chrysemys picta*), and the garter snake (*Thamnophis sirtalis*). The area may also support populations of the state threatened salamander known as the mudpuppy (*Necturus maculosus*). These salamanders spend their entire life underwater, foraging rocky shoals for crayfish.

Resident & Migratory Birds

The Northerly Island study area resides within a band of important state natural areas and parks that span Lake/Cook County, Illinois. These natural areas serve as a crucial foraging and breeding grounds along the Lake Michigan flyway, which is an important migration route for many songbirds. The coast of Lake Michigan provides a visual north-south sight line, which the birds have evolved to follow as they undergo migration. During the migration periods, March to May and September to mid-October, more than five million song birds are believed to traverse this flyway.

Nearly 300 species of resident and migratory birds have been observed in the Chicagoland area. Approximately 253 species of birds have been observed on Northerly Island or at the adjacent bird sanctuary. Of the 253 species, 187 species are classified as migrants and 57 are residents (Plate 1). The remaining nine species were identified to genus or were classified as hybrids. Twelve species of birds observed within or adjacent to the project area are listed as state endangered or threatened (Plate 1). The large number bird species present within the study area will benefit from the restoration of Northerly Island and may assist in the re-establishment of some state listed species.

Mammalian Community

Common mammals that are adaptive to urban landscapes may occur within the project boundaries. These species include raccoon (*Procyon lotor*), thirteen-lined ground squirrel (*Spermophilus tridecemlineatus*), cottontail rabbit (*Sylvilagus floridanus*), gray squirrel (*Sciurus carolinensis*), fox squirrel (*Sciurus niger*), and opossum (*Didelphis virginiana*). With close proximity to Lake Michigan, muskrat (*Ondatra zibethicus*) and the North American beaver (*Castor canadensis*) are also possible within the study area.

Threatened & Endangered Species

Federally-listed Threatened, Endangered, Proposed and Candidate Species were reviewed for the project area by the Chicago District. The following federally listed species and their critical habitats are identified by the USFWS as occurring within Cook County:

- Piping plover (*Charadrius melodus*) – Endangered – Wide, open, sandy beaches with very little grass or other vegetation
- Eastern massasauga (*Sistrurus catenatus*) – Candidate – Graminoid dominated plant communities (fens, sedge meadows, peat lands, wet prairies, open woodlands, and shrublands)
- Hine's emerald dragonfly (*Somatochlora hineana*) – Endangered – Spring fed wetlands, wet meadows and marshes
- Eastern prairie fringed orchid (*Platanthaera leucophaea*) – Threatened – Moderate to high quality wetlands, sedge meadow, marsh, and mesic to wet prairie.
- Leafy-prairie clover (*Dalea foliosa*) – Endangered – Prairie remnants on thin soil over limestone
- Mead's milkweed (*Asclepias meadii*) – Threatened – Late successional tallgrass prairie, tallgrass prairie converted to hay meadow, and glades or barrens with thin soil
- Prairie bush clover (*Lespedeza leptostachya*) – Threatened – Dry to mesic prairies with gravelly soil

Northerly Island is a manmade island that currently does not have any of the critical habitats required by the list species above. Habitats that will be restored through this project include pond, marsh, wet prairie, mesic prairie, and savanna. Recent surveys done by the USACE Chicago District and other state and local agencies found no federal or state listed species or viable critical habitats within the restoration site. For these reasons, we conclude the Northerly Island Section 506 Restoration Project will have “no effect” on listed species or proposed or designated critical habitat.

The addition of pond and fringe marsh to Northerly Island would provide spawning and foraging habitat for the state threatened banded killifish (*Fundulus diaphanus*). Similarly, the pond would be designed to provide foraging habitat and refuge for the state threatened mudpuppy (*Necturus maculosus*). In addition, the twelve state listed bird species found within the project area (Plate 2) would benefit from the native plant community restoration.

2.1.4 – Cultural Resources

Archaeological & Historical Properties

The National Register of Historic Places has 321 listings located within the City of Chicago. These include 270 structures and 51 historic districts. Properties currently listed on the National Register of Historic Places that are located near the project area include the Adler Planetarium, the Field Museum of Natural History, and the Shedd Aquarium. The former Meigs Field airport terminal building constructed in 1961, although not currently listed, is eligible for listing to the National Register of Historic Places. This project will not alter or impact the terminal building.

Chicago maintains its own list of City Landmarks totaling approximately 275 individual structures and 53 historic districts. Many of these landmarks are also on the National Register of Historic Places. No Chicago City Landmarks are located near Northerly Island.

Northerly Island is an artificial, man-made peninsula. In the early 1940's because of needed additional land for the proposed airport runways, approximately 26 acres were added to the southern end of the island.

No intact archaeological features or deposits are present within Northerly Island.

Land Use History

The project area is comprised of approximately the southern half of Northerly Island. Although the design for Northerly Island was included in Daniel Burnham's' 1909 "Plan of Chicago", construction did not begin until 1920 and finish in 1925. Briefly utilized as parkland, the island served as the site of the 1933-1934 "Century of Progress: World's Fair." Plans to locate an airport on the island were proposed in 1935 after the World's fair, but World War II and an unsuccessful proposal by Chicago to locate the future United Nations Headquarters on Northerly Island delayed airport construction until 1946. The airport was named Meigs Field after local newspaper publisher and aviation booster Merrill C. Meigs. Meigs Field operated as Chicago's lakefront airport from 1946 until 2002 when it was closed by the city. Since then the island has been converted to open/green space by the Chicago Park District.

Social Properties

Chicago is located in northeastern Illinois near the southwestern tip of Lake Michigan. It straddles the basin divide between the Great Lakes and Mississippi River watersheds. Chicago is the third most populous city in the United States with an ethnically and racially diverse population of approximately 2.8 million people. Median household income for the City of Chicago is \$43,650 (2010), and the median home cost is \$238,567 (2010). Surrounding communities include Evanston, Oak Park, Cicero, and Evergreen Park.

Recreational Activities

Northerly Island is a central recreational park on the Chicago lakefront. The northern half of the park is focused on active park use and features basketball, tennis, baseball and Chicago's famous softball leagues during the spring, summer and fall. A temporary seasonal music

pavilion is also present. The southern half of the park is dedicated to passive park use and is primarily a nature preserve containing hiking trails and bird watching areas. Cross-country skiing and snowshoeing are common winter activities.

A multitude of additional recreational facilities exist within the City of Chicago. Public beaches, marinas and fishing areas are present along the city's Lake Michigan lakefront. Parks provide softball fields, soccer fields, and tennis courts. Nature areas provide opportunities for hiking and bird watching.

Hazardous, Toxic & Radioactive Waste (HTRW) Analysis

During the HTRW investigation, existing environmental data were examined in order to determine expected soil and groundwater conditions and risk of contamination at the site. This information was then used to determine whether a Phase II investigation or other measures were warranted for the project. Twelve soil and one groundwater sample were collected from locations on the project site during past investigations related to an adjacent jet fuel LUST. The LUST location is outside the project limits. The samples were collected in 2002 by the parties responsible for the LUST, and were analyzed for BTEX and PAHs. Documentation of the sampling was obtained from IEPA. These samples had been collected to compare soil and groundwater conditions surrounding the LUST to soil conditions in more remote locations of the site which were not impacted, in order to determine appropriate remedial actions for the LUST. The sampling results showed that some of these background samples exceeded the corresponding TACO residential soil and groundwater cleanup objectives for several PAHs. The investigation concluded that these elevated levels of PAHs were a result of the fill and construction materials used to create the manmade peninsula.

The environmental soil samples mentioned above were located towards the center of the peninsula, at approximately 60' intervals along a straight line beginning at the northern end of the project site (Appendix C, Figure 8). The sample results were compared to TACO residential remediation objectives, Chicago background soil concentrations, and Threshold and Benchmark Open Space Reserve values given in the Calumet Area Ecotoxicology Protocol. TACO residential remediation objectives are based on human health criteria, and are the most stringent standards out of an array of objectives developed for various property uses. The TACO objectives for the five PAHs exceeded at the site are based on values for the ingestion exposure route, with an assumed 350 days/year exposure to the material. However, future use of the site will not be residential in nature; rather, human exposure will be limited to construction workers during project construction, and periodic exposure to site maintenance personnel and short-term visitors to the site. It is therefore believed that the residential criteria are exceedingly conservative for the protection of human health at the project site, and TACO residential remediation objectives are not applicable for determination of human health risks associated with the site. IEPA also defines background PAH concentrations that are representative of soils in Chicago, which may be used as an alternative to residential closure values. PAHs are released into the environment primarily due to combustion or burning of fuels such as oil, coal, or wood. As a result, automobiles, planes, and power generation have greatly contributed to the widespread presence of these chemicals in urban environments. The Threshold and Benchmark Open Space Reserve values were used to determine the potential for impacts to ecological receptors, and are discussed in greater detail below.

The twelve soil sample results, an average, and the four comparison values for the five PAHs with TACO residential exceedances are shown in (Appendix C, Table 5). This data shows that while a fair portion of these samples exceed TACO residential closure objectives, few are above Chicago background levels. All exceedances above background are by a small margin. When the twelve samples are averaged, background levels are not exceeded. Because earthwork proposed for this ecosystem restoration project would involve excavation and redistribution of material on various locations of the site by heavy construction equipment, it is likely soils will be greatly homogenized, and use of average values is therefore appropriate in this evaluation. Based on this existing sampling data, it was concluded that fill materials at the site have PAH concentrations that are typical of ambient Chicago conditions.

In addition, the twelve soil sampling results were also compared to threshold and benchmark soil values given in the Calumet Area Ecotoxicology Protocol to assess the potential risk to wildlife and other ecological receptors posed by the existing level of PAHs at the project site. This Ecotox Protocol was developed and is supported by an assembly of agencies, including USEPA, USFWS, Illinois EPA, Illinois DNR, as well as several local agencies. It was created for the specific purpose of providing appropriate standards and guidance for cleanup and ecological rehabilitation of potentially contaminated properties in the Calumet Area. The standards were designed to ensure the health of plants and animals of the Calumet Area on sites where historical environmental pollutants are a concern. The "Calumet area" as defined in the protocol is a 20-square mile area on Chicago's far southeast side, which has plans for future ecological rehabilitation and conversion of lands to open space reserves. Although the Northerly Island project site is not within the boundaries of the Calumet Area, the protocol is applicable to this project, based on the natural divisions of the Calumet Region. The protocol takes into account both point source industrial discharges, and indirect urban pollution sources such as atmospheric deposition and stormwater runoff. Therefore, the type of habitat restoration activity planned for Northerly Island is the precise type of situation this protocol was developed for. Threshold values are defined as concentrations believed protective of ecological receptors in the Calumet Area, derived from toxicity studies that identified no observable adverse-effect levels. Benchmark values are defined as concentrations expected to impact ecological receptors in the Calumet area, derived from toxicity studies that identified lowest observable adverse effect levels. Although two of the twelve samples exceeded the threshold values of at least one PAH by small margins, the average concentrations of PAHs from the twelve samples were all below threshold levels. Because the earthwork proposed for this project will likely result in soils that are greatly homogenized, the use of average values is therefore appropriate. No sample exceeded benchmark values. The Ecotox Protocol states that areas with chemical concentrations below threshold values are not expected to need rehabilitation to protect the habitat's receptors, and therefore, no further action is needed. This information was the basis for the determination that PAH levels in soils at Northerly Island will not pose an ecological risk to the proposed project.

The groundwater sample that was collected on the project site exceeded the TACO Class I Groundwater Remediation Objective for four PAHs (Appendix C, Table 6). Because the Class I groundwater standard was developed for potable water resources, and no potable water wells exist or are planned to be installed at the site, the slight exceedances above these values do not appear to pose a concern for the project. These slight exceedances also do not pose a risk for construction workers who may have incidental dermal contact with the groundwater. The Calumet Area Ecotoxicology Protocol discussed above does not provide comparison values for

groundwater quality, and does not give any specific guidance to ensure groundwater is protective of ecological receptors. The Calumet Area Ecotoxicology Protocol does have standards for surface water, but comparing the ground water sample to a surface water standard does not accurately inform the study due to a variety of intervening factors. While groundwater infiltration will initially be a primary source of water into the pond and wetland areas created by the project, it is not valid to assume the resulting surface water quality would be comparable to that of the groundwater. Once brought to the surface and opened to the atmosphere, the PAH compounds present in the groundwater will be broken down by a variety of natural processes including volatilization, photodegradation, biodegradation, and oxidation. Furthermore, surface waters created at the project site will be highly affected by clean rainfall and Lake Michigan water inputs. Because of these factors, it is not possible to mathematically predict surface water quality at the site based on existing groundwater data. Considering these numerous natural processes will act to reduce PAH concentrations in surface waters, it is believed that groundwater quality will not pose a threat to biological receptors at the project site. As discussed above, the PAH compounds present in both the soil and groundwater at the site are ubiquitous in urban environments such as the city of Chicago due to their constant inputs by common sources such as automobile and airplane exhaust. The finding that groundwater at Northerly Island exceeds TACO Class I potable water standard for these ubiquitous compounds is not indicative of any unusual or elevated environmental risk or concern. Considering the above, it is not believed that groundwater quality at the project site poses a human or ecological risk to the proposed project.

Based on the information detailed above, it is believed that soils and groundwater at the Northerly Island project site do not pose an HTRW concern in terms of liability, human health and safety, or ecological health. Although the existing sampling data represents only a portion of the site, no evidence has been found to suggest that soils or groundwater on the remainder of the site would have greater concentrations of pollutants. No investigation can wholly eliminate uncertainty regarding the potential for encountering an recognized environmental conditions (REC) associated with a project area. As a result of this HTRW analysis, USACE Chicago District has concluded that there is sufficient information to demonstrate that the work proposed for the Northerly Island Restoration site has little potential for encountering an REC.

The plan for construction is to achieve a zero balance of cut and fill, in order to eliminate disposal costs associated with these materials. Due to Illinois Clean Construction & Demolition Debris (CCDD) requirements, materials may not be acceptable for off-site reuse based on debris content. Although existing data indicates the material has concentrations of anthropogenic compounds less than the metropolitan background, the CCDD regulations also require environmental testing before removal to ensure the material meets this standard. If any excess material is required to be removed from the site and does not meet the CCDD requirements, the material would be required to be landfilled.

Additional soil borings are planned to be conducted to confirm the soil conditions in the area of excavation. The soil borings would include field identification of soil type, as well as screening for the presence of volatile compounds by use of a photoionization detector (PID). If these borings reveal unexpected soil conditions that will have an HTRW-related impact to the project, the HTRW investigation will be revised at that time.

Project analyses including the HTRW analysis and Geotechnical analysis identified limited information on subsurface conditions within the project site especially in the southeastern portion where substantial excavation is proposed. Consequently additional subsurface information will be obtained prior to the completion of the feasibility report to fill in the data gaps to confirm the subsurface conditions are comprised of suitable material; thereby reducing the risk and uncertainty associated with HTRW and geotechnical suitability related to the excavation of these fill materials used to build Northerly Island in the past century. If not confirmed, the results of the subsurface investigation and management of resulting risks can be addressed in this section of the final report.

2.2 – Problems and Opportunities

The Great Lakes maintain 20% of the world's freshwater and are important for social, economic, and ecological values throughout the region. However, these values can be lost as the integrity of the system begins to fail. The current state of the Great Lakes is less than promising. Invasive species, pollution, and habitat degradation are causing the natural geomorphic and hydrologic process to fail. As a result, the ecosystem struggles to maintain itself.

One crucial component that is important to ecosystem integrity and integrates both aquatic and riparian or buffer habitat, is wetlands. Historically, Chicago's shoreline was lush with vast expanses of wetlands. While restoring wetland in Chicago to their historical conditions is unlikely, converting small expanses of land into wetlands will provide critical habitat for a number of organisms. These patches of wetland would serve as an important refuge for migrant and resident bird species, as well as a variety of aquatic organisms (fish, amphibians, aquatic insects, etc.). The project will provide critical wetland habitat that will contribute to the restoration of the lacustrine ecosystem of the Great Lakes, and thus it is authorized under the GLFER program. The main problems at Northerly Island are as follows:

- Lack of a natural mosaic and gradient of submerged to upland coastal habitats
- Fragmentation of local habitat patches
- Overabundance of unnatural conditions that promote invasive species success
- Lack of rich coastal plant communities
- Lack of rare and sensitive coastal plant and animal species
- Lack of critical habitat for locally endangered and rare fauna
- Lack of migratory bird resting and forage habitats

2.3 – Habitat Assessment Methodology

Many methods are available to measure current ecosystem resource conditions and to predict future conditions of those resources. Habitat assessment methods developed for individual species may have limitations when used to assess ecosystem restoration problems and objectives. They do not consider communities of organisms and typically consider habitat in isolation from its ecosystem context. The assessment methodology selected for this study is community based and governed by how well the technique meets the needs of the study goals, objectives, and level of detail. The assessment methodology, or Habitat Suitability Index (HSI), focuses on native species richness and function of plant communities. This HSI was developed to assess the ecological value of the proposed future without-project condition and any

proposed management measures for Northerly Island restoration project. This index is based on how native species of plants will respond to a given condition and will be quantified through use of the Floristic Quality Assessment (FOA).

Floristic Quality Assessment

The determination of “quality” with respect to plant assemblages has been the subject of much research and development since the mid 1970’s. Quality, as used in this study, is essentially an assessment of the degree to which native plant species are present within defined plant communities. Plants are exceptional indicators of short and long term disturbance in terms of habitat function and structure. Out of the approximate 2,500 plant species known to occur in the Chicago Region, around one-third were not present before European colonization. Non-native species did not evolve within the same environmental conditions as the native species, and their persistence indicates a certain degree of functional disablement. Numerically describing the quality of an area using vegetation reflects the level of disturbance to the biological integrity of the site. In the Chicago Region, there is one commonly used approach that attempts to describe plant community quality with a simple numerical metric, which is the FOA (Swink and Wilhelm 1979). This assessment tool was designed to be used as an all inclusive method, not just as a way to identify high quality sites. The FOA was originally developed for the Chicago Region, but has since been developed for regions and states throughout North America. This method has been extensively studied and shows great promise as a quick and easily understood method of assessing the quality of plant communities.

The FOA method specifically excludes the use of “indicator” species, instead assessing the sensitivity of individual plant species that inhabit an area. Species “conservatism” is used as its basis for assessment; conservatism being known as a level of tolerance each plant species exhibits to disturbance type, amplitude, and frequency, as well as fidelity to specific habitat types. As an area’s equilibrium is disturbed - the habitat’s capacity to absorb disturbance is weakened, the first plants lost will come from the high end of the conservatism spectrum. Therefore, what is being measured is the extent to which an area supports conservative native plants. As a result, each native species has been assigned a coefficient of conservatism (C), ranging from 0 to 10. C values were assigned to species within a predefined geographic area by Swink and Wilhelm (1979). A 0 is assigned to species that are highly tolerant to disturbance and are considered general in their habitat distribution and a 10 is assigned to species with a very low tolerance to disturbance which display very specific relationships to certain habitat types. The following descriptions of categories were used to assign coefficients of conservatism to native plant species:

- 0-3 Wide range of ecological tolerance and found in a variety of conditions
- 4-6 Mid range of ecological tolerance and a smaller variety of conditions
- 7-8 Low range of ecological tolerance and associated with advanced succession
- 9-10 Very low range of ecological tolerance and niche specific

It has been demonstrated that sites with mean C and Floristic Quality Index (FQI) values less than 2.8 and 20 respectively, as surveyed during the growing season, are degraded or derelict plant communities. Sites with mean C values that approach 3.2 are considered to be moderately disturbed. When site inventories yield mean C values greater than 3.4 or higher, one can be confident that there is sufficient native character present for the area to be at least regionally

noteworthy - such landscapes are essentially irreplaceable in terms of their unique composition of remnant biodiversity. Sites with mean C and FQI values greater than 4.0 and 50, respectively, are rare and indicate highly significant natural areas of statewide importance.

With an active land management plan and time, the mean C and FQI values will reflect the extent to which conservative species are being recruited and the floristic quality is improving. In this way, the FQA method can be used to assess restoration management decisions, as well as to document floristic changes (positive or negative) in the landscape over time.

Based on species inventory, the FQA generates two essential metrics: the Mean C, which is the average coefficient of conservatism for a site, and the FQI, which is derived by multiplying Mean C by the square root of the number of native species inventoried,

$$\text{Equation 1: } FQI = \bar{C}\sqrt{N}$$

where C is the coefficient of conservatism and N is the species richness. The FQI, therefore, is a function of both conservatism (function) and species richness (structure). Typically, larger sites have a greater number of habitat types and likely will have greater species richness. Generally, both mean C and FQI values are considered in the evaluation of an area or landscape unit. Based on statistical analysis of previous studies, the FQI shows a significant positive relationship to species richness (Ervin et al. 2006) and as such the Mean C value represents the more comparable and accurate metric.

Habitat Suitability Index

Habitat outputs for the future without and future with project condition were estimated over the entire 50 year period of analysis. In order to restore the ecosystem within the project site, both ecosystem function and structure were addressed through the methods described above. These predicted benefits are resultant of the measures described in Section 3.1. The following were used for the HSI:

- Lacustrine Littoral Zone (LL) = C
- Pond (P) = C
- Emergent Marsh (EM) = C
- Wet Prairie (WP) = C
- Mesic Prairie (MP) = C
- Savanna (S) = C

where C = coefficient of native plant conservatism and is the HSI score. Total habitat outputs, in terms of habitat units (HUs) were calculated by multiplying the affected area times the habitat suitability index:

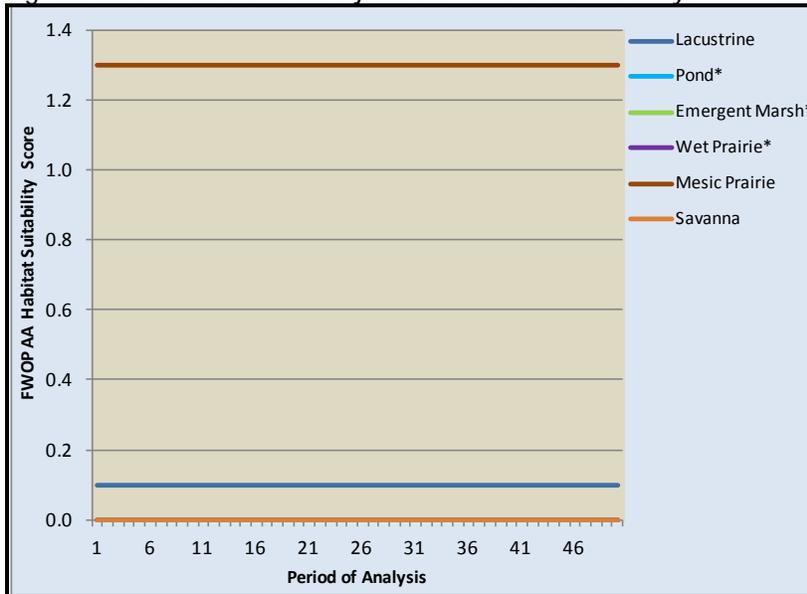
$$HUs = A(HSI)$$

where A is the affected habitat area expressed in acres.

2.4 – Future Without-Project Conditions (FWOP)

Without restoration at Northerly Island, a monotonous ecosystem that is conducive to generalist and invasive species would exist (Figure 3). The lack of high quality spawning and refugia habitat in the area would likely add to the propagation of invasive fish, as many native species require very specific spawning conditions (i.e. vegetated wetlands). Similarly, riparian invasive species may continue to spread if proper maintenance is not conducted. The lack of wetland habitat would limit and perhaps prevent the ability of aquatic migrant bird species from utilizing the area. Overall, the future conditions of Northerly Island if not restored would maintain a somewhat benign ecosystem that would cause further degradation to the integrity of the surrounding environment.

Figure 3 – Future Without-Project Conditions for Northerly Island.



* FWOP AAHSI graph lines are covered up by savanna. All four habitat types currently do not exist on Northerly Island and therefore all equal zero.

Table 2 – Future without Project Conditions for the six habitat types.

Description	Mean C	AAHSI	Acres	AAHUs
Lacustrine	0.1	0.1	1.7	0.2
Pond	0.0	0.0	0.0	0.0
Emergent Marsh	0.0	0.0	0.0	0.0
Wet Prairie	0.0	0.0	0.0	0.0
Mesic Prairie	1.3	1.3	8.0	10.4
Savanna	0.0	0.0	0.0	0.0

2.5 – Goals, Objectives & Constraints

The primary goal of this Feasibility Study is to determine a cost effective restoration plan, whether it be the No Action Plan or a plan with recommended restoration activities. Since the site is rather diverse in geomorphic features, the plan must account for how the system functions as a whole.

National Ecosystem Restoration (NER) Goal

The goal of this proposed project is to restore native wetlands and create a complex ecosystem to benefit fish, amphibians, reptiles, mammals, and migratory birds.

NER Objectives

Federal and non-Federal Objectives

The Federal (USACE) and non-Federal sponsors' goals and objectives for water resources implementation studies establish the overall direction for this study. The specific objectives were derived from the identification of the study problems and opportunities and are discussed in the subsequent sections.

The USACE also has a national objective for ecosystem restoration in response to legislation and administration policy. This objective is to contribute to the nation's ecosystems or National Ecosystem Restoration (NER) by restoring degraded ecosystem structure, function, and dynamic processes to a less degraded, more natural condition. Contributions to NER are increases in ecosystem value and productivity and are measured in non-monetary units such as acres or linear feet of habitat, function, average annual habitat units, or increased species number or diversity.

The non-Federal sponsor for the project, the Chicago Park District, has general goals for ecosystem restoration. These are to improve and increase aquatic and terrestrial habitats as well as improve ecological functions along the coast of Lake Michigan to support sustainable populations of diverse and valuable plant and animal species. Specifically, this study aims to protect, enhance, naturalize and restore coastal ecosystems. The following objectives are those that will be directly measured for alternative analysis within this feasibility study:

- Increase species richness of lacustrine, coastal, and wetland plant communities
- Increase coastal wetlands that provide refugia for migrating water birds
- Increase habitat heterogeneity throughout the island
- Reduce and/or eradicate invasive species
- Increase acres of wetland and buffering habitats to provide critical life requisites for migrant birds, fish, reptiles, and amphibians

NER Constraints

Planning constraints are items of consideration that limit the planning process and are used along with the objectives in the formulation and evaluation of solutions. The establishment of planning constraints is done in concert with the entire study team and in cooperation with stakeholders. A list of planning constraints for the NER purpose follows.

Any measures/alternatives implemented should:

- Avoid impacts to recreational traffic in the adjacent Burnham Harbor
- Avoid damage to the structural integrity of the existing revetment walls
- Avoid measures with high operation and maintenance costs

CHAPTER 3 – PLAN FORMULATION AND EVALUATION

The formulation, evaluation, and comparison of alternative plans comprise the third, fourth, and fifth steps of the Corps' planning process. These steps are often referred to collectively as plan formulation. Plan formulation is an iterative process that involves cycling through these steps to develop a reasonable range of alternatives, and then narrow those plans down to a final plan, which is feasible for implementation.

Plan formulation for ecosystem restoration (ER) presents a challenge because alternatives have non-monetary benefits. To facilitate the plan formulation process, the methodology outlined in the Corps' Engineering Circular 1105-2-404, "Planning Civil Work Projects under the Environmental Operating Principles," 1 May 2003 was used. The steps in the methodology are summarized below:

1. Identify a primary project purpose. For this portion of the study, ecosystem restoration (ER) is identified as the primary purpose.
2. Formulate management measures to achieve planning objectives and avoid planning constraints, where measures are the building blocks of alternative plans.
3. Identify and select those sites most beneficial for ecological restoration.
4. Formulate, evaluate, and compare an array of alternatives to achieve the primary purpose (ER) and identify cost effective plans.
5. Perform an incremental cost assessment on the cost effective plans to determine the NER plan.

3.1 – Measure Identification

The primary activity of this project is to establish a heterogeneous wetland ecosystem complex to benefit aquatic life and migratory birds. These measures are a result of a collaborative effort between the USACE and the CPD, which are based off of natural areas along the coastline of Lake Michigan. Plate 02 illustrates the habitat measures' geographical extent.

Lacustrine Littoral Zone (LL)

Currently, the western side of Northerly Island has a long continuous rubble mound shelf (1.7-acres) that consists of riprap, cobble, gravel, and boulders along the revetment wall. This area provides a minimal habitat for macroinvertebrates and some fishes, however very little vertical structure exists, particularly in the form of macrophytes. This area can be enhanced to provide both lithophilic (stone loving) spawners and those fish species that spawn on submerged vegetation with locally scarce habitat. The first step would be to place jersey barriers or some type of low cost, but stable retaining wall near the edge of the rubble mound shelf. Then, the riprap would be covered with a foot of additional glacially derived gravel and cobble that would extend towards the shoreline for about 1/3 of the distance. Next, rounded boulders and flat slate rocks would be stacked to create mudpuppy habitat on top of the newly place stone shelf. The shelf contours would not be uniform throughout area so that bathymetry would be diverse. The second portion of this measure would be to place a mixture of sand and silt from the gravel/cobble line inland to the revetment. Native aquatic macrophytes that would be planted include eel grass (*Vallisneria americana*) and pondweeds (*Potamogeton* spp.). A temporary adult common carp barrier (fence/net) would be placed around this area to prevent uprooting the young macrophytes prior to establishing. Burnham Harbor boat traffic would not be impeded.

Geomorphic Contouring (C)

This measure seeks to restore hydrogeomorphic heterogeneity to the project site. The entire site would be graded to achieve different hydrologic conditions in order to establish coastal plant community types. The lowest point of the contouring would be the bottom of the pond habitat, which at its deepest point would be 4-feet below the Ordinary High Watermark (OHW). The pond then will grade into emergent marsh, which would have 6" of standing water. The topography would then grade from marsh to wet prairie. The wet prairie surface elevation will be flush with the OHW, since wet prairie soils need to be saturated for the most part of the year. The mesic prairie and savanna would have different elevations of ground water, depending on site contouring. Grading plan scenarios were crafted to have zero balance of cut and fill. No material will leave the project foot print.

Pond (P)

The pond would be approximately 4.1-acres. Maximum depth of the pond would be around 4', with average depths of 2' to 4'. The varying depths will provide an array of habitat types for fishes and other aquatic life. Excavated materials from the pond will be used to re-contour the project area accordingly. The bottom substrate of the pond should consist of sand, gravel, cobble, and boulders. Interstitial spacing provided by cobble and boulders will provide habitat for macroinvertebrates. In addition to the aforementioned substrate, large flat slate rocks would be strategically placed to promote establishment of the state threatened salamander, *Necturus maculosus* (mudpuppy). The corridor that would connect the pond to the lake would be about 1 to 2' in depth with the same substrate types as previously mentioned. The mouth of the corridor would also have a galvanized steel mesh fence that will sit just below the water line to prevent large invasive species such as *Cyprinus carpio* (common carp) and non-native Salmonids from entering the pond ecosystem. By having a decreased depth at the mouth of the corridor, the size of the steel fence would be limited and fashioned to be aesthetically pleasing.

Emergent Marsh (EM)

Approximately 2.2-acres of emergent marsh would be established around the perimeter of the pond and corridor described above once geomorphic contouring was complete. In order to ameliorate the unnatural soil conditions of the site for proper biogeochemical cycling, a soil amendment consisting of leaf compost will be incorporated into the top 6" of soil during late summer or early fall at a rate of 62 short tons per acre. Incorporating a soil amendment will decrease bulk density and increase soil organic matter, while enhancing microbial communities and stimulating vegetative diversity. Then, live plugs of native emergent species would be planted in this zone. During the establishment period following the planting of native macrophytes, spot applications of herbicide will be conducted for all invasive herbaceous species for the remainder of the project. Two prescribed burns will occur over a 5 year period to further suppress invasive species and promote the establishment of native vegetation. This measure can also stand on its own and is not dependent on the Pond (P) measure. This would be achieved by creating a depression that is set 6" below the OHW.

Wet Prairie (WP)

This habitat measure would restore 3.3-acres of wet prairie throughout Northerly Island. In order to achieve this habitat type, the geomorphic contouring would set the elevation of the soil surface at the OHW. In order to ameliorate the unnatural soil conditions of the site for proper biogeochemical cycling, a soil amendment consisting of leaf compost will be incorporated into the top 6" of soil during late summer or early fall at a rate of 45 short tons per acre. Incorporating a soil amendment will decrease bulk density and increase soil organic matter, while enhancing microbial communities and stimulating vegetative diversity. Then, seed and live plugs of native wet prairie species would be planted in this zone. During the establishment period following the planting and seeding of native wet prairie flora, spot applications of herbicide would be conducted for all invasive herbaceous species for the remainder of the project. Two prescribed burns will occur over a 5 year period to further suppress invasive species and promote the establishment of native vegetation.

Mesic Prairie (MP)

Approximately 10-acres of mesic prairie will be established at slightly higher elevations from the wet prairie, resulting through geomorphic contouring. Then, seed and live plugs of native mesic prairie species would be planted in this zone. During the establishment period following the planting and seeding of appropriate native prairie species, spot applications of herbicide will be conducted for all invasive herbaceous species for the remainder of the project. The area will be mowed twice each year for the first two years to reduce the amount of non-native species that seek to suppress the establishment of slower growing native prairie vegetation. Two prescribed burns will occur over a 5 year period to further suppress invasive species and promote the establishment of native vegetation.

Savanna (S)

Approximately 18-acres of savanna would be established for this project, much of which will sit atop elevated hills and slopes resulting from the geomorphic contouring. A diverse seed mix of native savanna plants will be applied to these areas as well as the planting of native oaks and a variety of shrubs. The Chicagoland area was once a large oak savanna and played an important role to a number of organisms. The addition of a savanna will promote native species establishment, increase habitat diversity, and provide critical resting and foraging habitat for migratory birds and the slopes of the savanna may provide nesting habitat for several Lake Michigan turtle species. During the establishment period following the planting and seeding of appropriate native savanna species, spot applications of herbicide will be conducted for all invasive herbaceous species for the remainder of the project. The area will be mowed twice each year for the first two years to reduce the amount of non-native species that seek to suppress the establishment of slower growing native vegetation. A prescribed burn will occur once trees and shrubs have established to further suppress invasive species and promote the establishment of native vegetation.

3.2 – Measure Costs & Assumptions

Detailed discussion on planning level feature costs is presented in Appendix B – Cost Engineering. Conceptual, planning level cost estimates were prepared for measures/features

that were identified by the study team in conjunction with the non-Federal sponsors (Table 3). These cost estimates do not represent complete project construction cost estimates, but rather individual measures of work or components of the entire project. The measures were used to provide an economic basis for the development of project alternatives. Once the project alternatives have gone through the plan formulation process, and additional design information was developed for the recommended plan, a more detailed and reliable cost estimate was performed (Appendix B). Estimates were developed using cost information from previous studies, lump sum and unit prices, quantities of excavation and placement, and for plant, labor and material methods. A 25% contingency was applied to all measures. Planning level unit costs were placed into a matrix to utilize the different costs for each measure of work.

Cost Annualization: Annualizing costs is a method whereby the project costs are discounted to a base year then amortized over the period of analysis. The base year for this project was determined to be the year in which the first phase of the project is to be completed (calendar year 2012). Costs that occur prior to this year need to be compounded to the base year, while those occurring after the base year need to be discounted to the base year. The period of analysis for the Section 506 project is 50 years. Discounting to the base year is the present value method. Costs are compounded or converted to present value for the base year then amortized over the 50-year period of analysis to give the annual cost. Discount rate was determined by the appropriate Economic Guidance Memorandum 08-01, Federal Interest Rates for Corps of Engineers Projects. The method shown in the above table does this for each measure. The individual measures of the project have the construction period spread out over 1 to 5-years, depending on magnitude or redundancy. Each year of every measure is either compounded or discounted to the base year. Calculation of the measures Average Annual Cost (AA Cost) is completed by multiplying the present value to the 50-year amortization factor.

Real Estate: An Initial Value Estimate (IVE) of the lands necessary to implement measures for this ecosystem restoration project was included in the Average Annual costs per measure. The IVE provided by the real estate section determined that a total of \$10,000 at about \$400 per acre should be used to accomplish plan formulation. This number is preliminary and does not constitute the gross appraisal.

Table 3 – Total & Average Annual Costs per Measure.
INTENTIONALLY REMOVED

3.3 – Measures Benefits

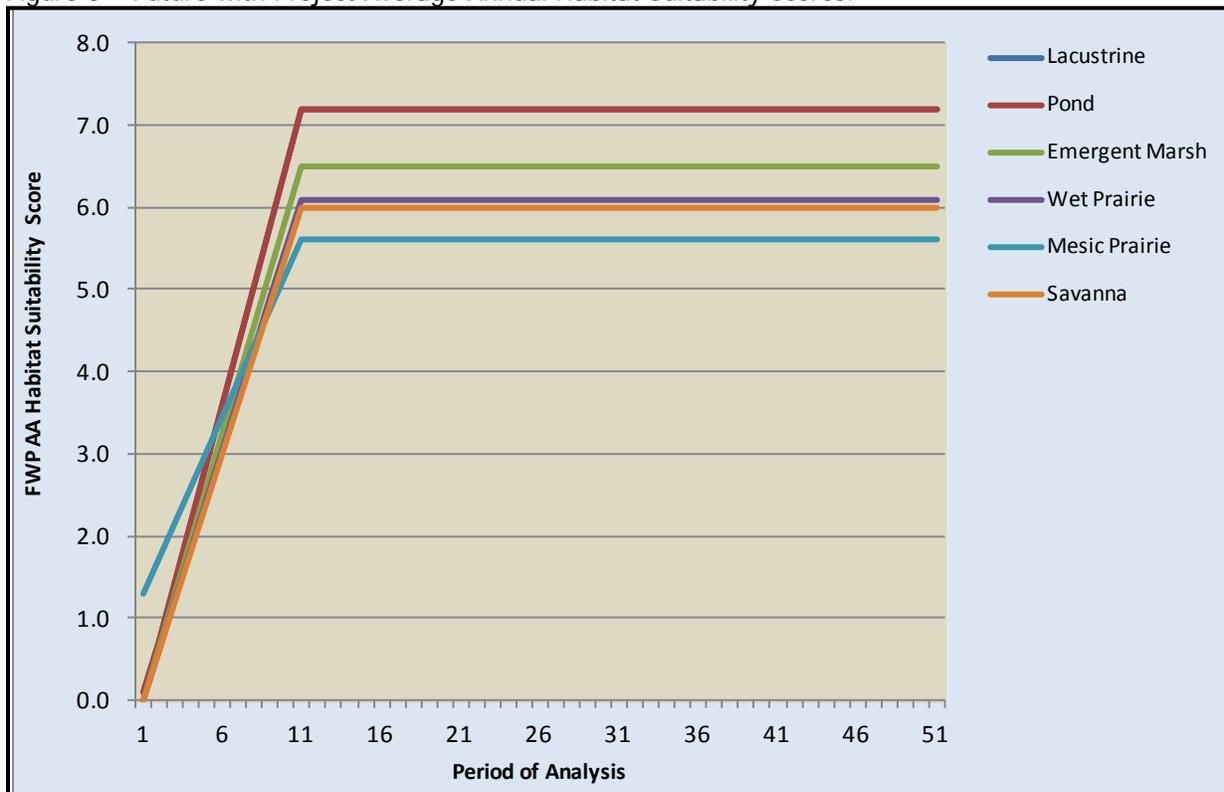
The evaluation of habitat benefits is a comparison of the with-project and without-project conditions for each measure (Table 4 & Figure 3). Environmental outputs are the desired or anticipated measurable products or results of restoration measures and plans. The term “outputs” is often used interchangeably with “benefits” or “habitat units (HUs).” Ecosystem restoration proposals may possess multiple output categories, as well as other effects that may need to be considered, but the evaluation must at least address cost and an output category that has been determined to represent reasonable ecosystem restoration benefits. A comparison of the future without-project and future with-project HUs was performed in order to determine if a measure, or group of measures, will actually have beneficial effects to the Northerly Island coastal ecosystem. The measures for this study were evaluated using Mean C methodology described in Section 2.3.

Table 4 – Total & Net Average Annual Habitat Units per Measure*

Code	Description	Mean C	AAHSI	Acres	AAHUs	NAAHUs
LL	Lacustrine	7.2	6.4	1.7	10.9	10.8
P	Pond	7.2	6.4	4.1	26.3	26.3
EM	Emergent Marsh	6.5	5.8	2.2	12.8	12.8
WP	Wet Prairie	6.1	5.4	3.3	18.0	18.0
MP	Mesic Prairie	5.6	5.1	10.0	51.4	41.0
S	Savanna	6	5.4	18.0	96.4	96.4

*see Table O2 for FWOP AAHUs

Figure 3 – Future with Project Average Annual Habitat Suitability Scores.



The addition of the new native habitat types on Northerly Island will provide a heterogeneous ecosystem that will promote species diversity. Each habitat type will provide important stop-over, nesting, and foraging opportunities to a unique suite of bird species. The pond and emergent marsh will provide forage, spawning, and refuge habitat for a wide range of fish as well as amphibians. Overall, the proposed plan will greatly benefit the overall ecological integrity of the study area.

3.4 – Alternative Plan Generations

Seven (7) measures, including the No Action measure, were input into the IWR-Planning Suite in terms of costs and benefits shown in Tables 3 and 4. All measures were deemed combinable except LL with C. All measures except for the Lacustrine Littoral (LL) measure were dependent

upon the Geomorphic Contouring (C) since this measure is required to restore hydrology and geomorphic conditions, but has no direct benefits associated with its activities. Based on these inputs and criteria, the IWR-planning software generated 66 alternative combinations for ecosystem restoration. These alternative combinations move forward to the cost effective and incremental cost analysis steps in the following sections.

3.5 – Cost Effectiveness / Incremental Cost Analysis

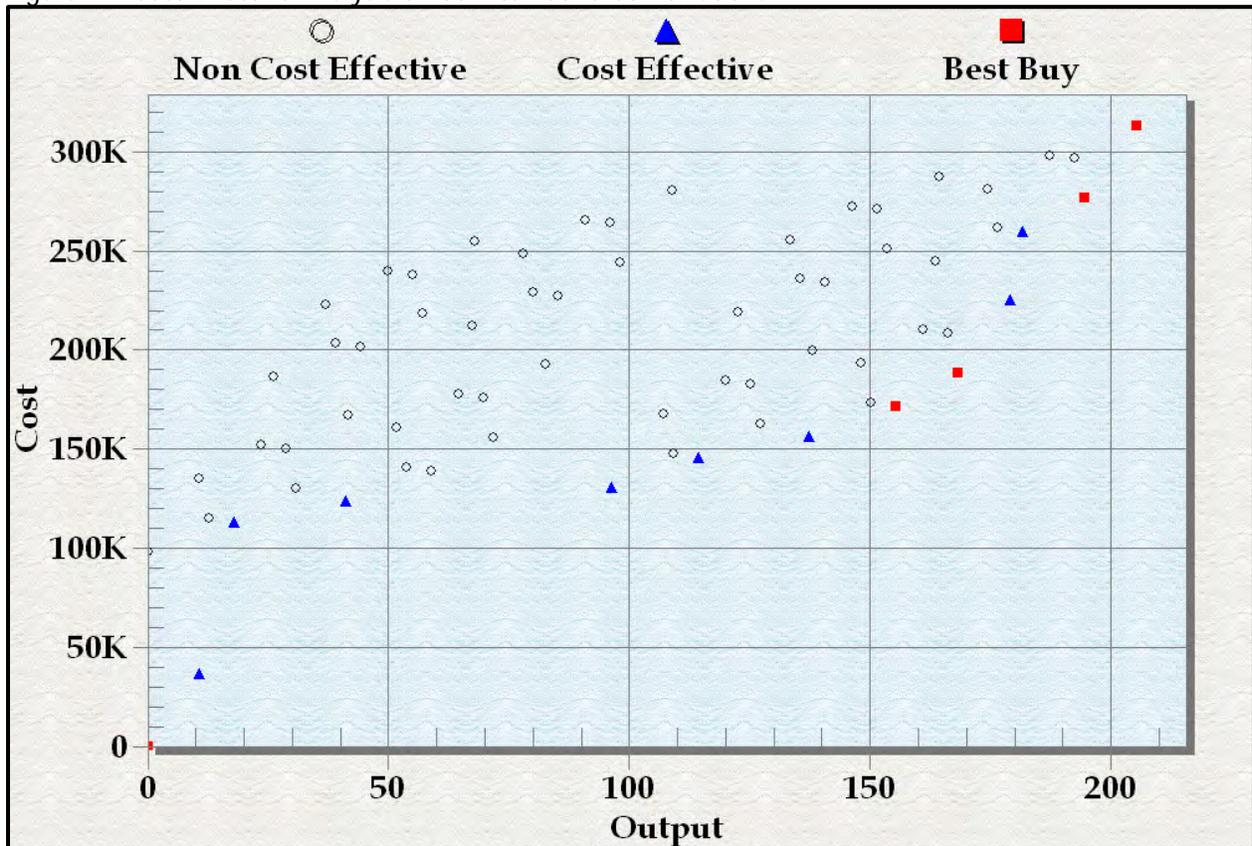
Cost effectiveness and incremental cost analysis (CE/ICA) are two distinct analyses that must be conducted to evaluate the effects of alternative plans according to USACE policy. First, it must be shown through cost effectiveness analysis that a restoration plan's output cannot be produced more cost effectively by another alternative. *Cost effective* means that, for a given level of non-monetary output, no other plan costs less and no other plan yields more output at a lower cost. Subsequently, through incremental cost analysis, a variety of alternatives and various-sized alternatives are evaluated to arrive at a "best" level of output within the limits of both the sponsor's and the USACE's capabilities.

The subset of cost effective plans are examined sequentially (by increasing scale and increment of output) to ascertain which plans are most efficient in the production of environmental benefits. Those most efficient plans are called "best buys." As a group of measures, they provide the greatest increase in output for the least increases in cost. They have the lowest incremental costs per unit of output. In most analyses, there will be a series of best buy plans, in which the relationship between the quantity of outputs and the unit cost is evident. As the scale of best buy plans increases (in terms of output produced), average costs per unit of output and incremental costs per unit of output will increase as well. The incremental analysis by itself will not point to the selection of any single plan. The results of the incremental analysis must be synthesized with other decision-making criteria (i.e., significance of outputs, acceptability, completeness, effectiveness, risk and uncertainty, reasonableness of costs) to help the study team select and recommend a particular plan.

Cost Effectiveness

The cost effectiveness analysis was used to ensure that certain options would be screened out if they produced the same amount or less output at a greater cost than other options with a lesser cost. Sixty-six (66) alternative combinations were analyzed for cost effectiveness. Of these, thirteen (13) cost effective combinations were identified (Figure 4), which is inclusive of the five (5) best buy plans. The No Action plan is always deemed cost effective and a best buy plan. Fifty-three (53) alternative combinations were screened out as non-cost effective.

Figure 4 – Cost Effective Analysis on 66 Alternative Combinations.



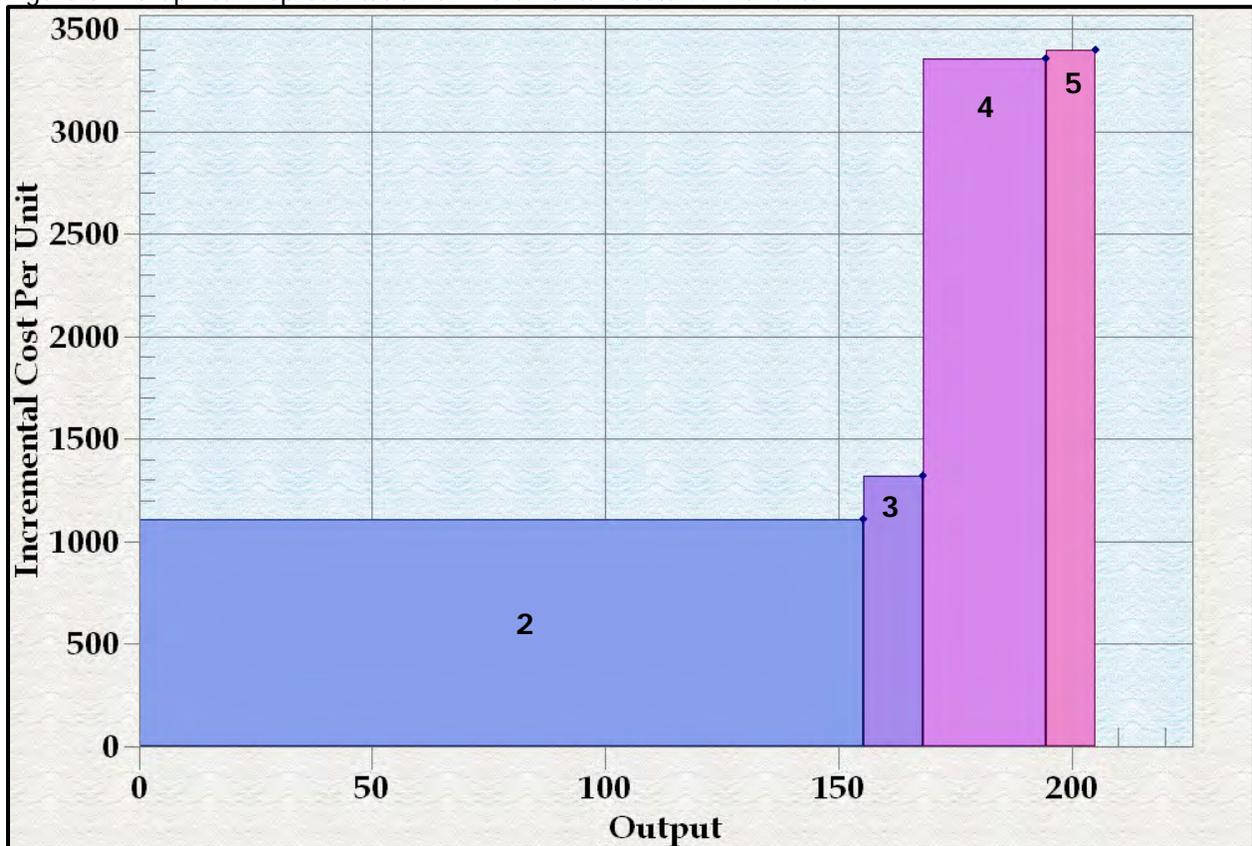
Incremental Cost Analysis

An incremental cost analysis was performed on those alternative combinations deemed cost effective. The objectives of the incremental cost analysis are to provide information to assist in determining whether the additional output provided by each successive cost effective plan is worth the additional cost that must be incurred for implementation; that is, to assist in determining the scale of the recommended plan. This incremental cost analysis has identified five (5) alternative combinations for ecological restoration that would be considered as best buys, including the no action plan. These are presented in Table 5 and Figure 5.

Table 5 – Incremental Cost Analysis of 5 Best Buy Plans.

#	Alternative Plan	HU	AA Cost	AA Cost / HU	Inc. Cost	Inc. HU	Inc. Cost / HU
1	No Action Plan	0	\$ -	\$ -	\$ -	0	\$ -
2	C & WP & MP & S	155.4	\$ 171,630	\$ 1,104	\$ 171,630	155.4	\$ 1,104
3	C & EM & WP & MP & S	168.2	\$ 188,492	\$ 1,121	\$ 16,862	12.8	\$ 1,317
4	C & P & EM & WP & MP & S	194.5	\$ 276,679	\$ 1,423	\$ 88,187	26.3	\$ 3,353
5	LL & C & P & EM & WP & MP & S	205.3	\$ 313,399	\$ 1,527	\$ 36,720	10.8	\$ 3,400

Figure 5 – Graphical Representation of Incremental Costs vs. Benefits.



3.6 – Alternative Plan Trade-Off Analysis

Alternative plans that qualified for further consideration will be compared against each other in order to identify the selected sites and their associated alternatives to be recommended for implementation. A comparison of the effects of various plans must be made and tradeoffs among the differences observed and documented to support the final recommendation. The effects include a measure of how well the plans do with respect to planning objectives including NER benefits and costs. Effects required by law or policy and those important to the stakeholders and public are to be considered. Previously in the evaluation process, the effects of each plan were considered individually and compared to the without-project condition. In this step, plans are compared against each other, with emphasis on the important effects or those that influence the decision-making process. The comparison step concludes with a ranking of plans.

3.6.1 – Significance of Ecosystem Outputs

Because of the challenge of dealing with non-monetized benefits, the concept of output significance plays an important role in ecosystem restoration evaluation. Along with information from cost effectiveness and incremental cost analyses, information on the significance of ecosystem outputs will help determine whether the proposed environmental investment is worth its cost and whether a particular alternative should be recommended. Statements of significance provide qualitative information to help decision makers evaluate whether the value

of the resources of any given restoration alternative are worth the costs incurred to produce them. The significance of the Northerly Island restoration outputs are herein recognized in terms of institutional, public, and/or technical importance.

The five best buy alternatives were quantitatively assessed for native plants (Section 2.3), since they are the secondary driver to ecosystem structure and function; primary drivers being hydrology, hydraulics, geomorphology, soils, chemical composition, etc. The following are the five alternative combinations, with Alternative 5 being the most beneficial in terms of restoring a holistic ecological reserve and Alternative 1 not providing any net benefits since it is the No Action Plan:

1. No Action
2. Geomorphic Contouring w/ Wet Prairie, Mesic Prairie & Savanna
3. Geomorphic Contouring w/ Emergent Marsh, Wet Prairie, Mesic Prairie & Savanna
4. Geomorphic Contouring w/ Pond, Emergent Marsh, Wet Prairie, Mesic Prairie & Savanna
5. Geomorphic Contouring w/ Lacustrine, Pond, Emergent Marsh, Wet Prairie, Mesic Prairie & Savanna

Alternatives 2 – 5 would generally benefit native species; however, it is only Alternative 5 that provides for and connects all of the habitats surrounding the Northerly Island. The addition of the pond, emergent marsh and lacustrine habitat would provide critical spawning habitat for many native game and non-game fishes. In addition, the aquatic plants would provide important structure and substrata for spawning fish that lay adhesive eggs and provide cover for refuge for juvenile fish. The aquatic features would also provide critical habitat for the state threatened banded killifish and the mudpuppy. These two species have been observed immediate area and have been collected throughout much of Southern Lake Michigan; this is the basis for the assumption that these species would recruit to the study area.

Institutional Recognition

Significance based on institutional recognition means that the importance of an environmental resource is acknowledged in the laws, adopted plans, and other policy statements of public agencies, tribes, or private groups. Sources of institutional recognition include public laws, executive orders, rules and regulations, treaties, and other policy statements of the Federal Government; plans, laws, resolutions, and other policy statements of states with jurisdiction in the planning area; laws, plans, codes, ordinances, and other policy statements of regional and local public entities with jurisdiction in the planning area; and charters, bylaws, and other policy statements of private groups.

Clean Water Act – restore the chemical and biological integrity of the Nation's waters. Lake Michigan water is very good. Small improvements to water quality would be gained via the lacustrine and pond habitat proposed for the west of Northerly Island. Restoration of native submergent macrophytes would not only improve habitat diversity, but also biogeochemical processes important in sequestering nutrients and releasing oxygen.

Endangered Species Act of 1973 – all Federal departments and agencies shall seek to conserve endangered species and threatened species. The purpose of the act is to provide a means whereby the ecosystems upon which endangered and threatened species depend may be conserved and to provide a program for the conservation of such endangered and threatened

species. It is expected that project features would be beneficial to state listed species such as the banded killifish, mudpuppy and the 12 bird species listed in Plate 1.

Fish and Wildlife Conservation Act of 1980 – all Federal departments and agencies to the extent practicable and consistent with the agencies authorities should conserve and promote conservation of non-game fish and wildlife, and their habitats. Restoring the wetland and vegetative structure of the Northerly Island coastal zone and increasing the native plant growth would increase the habitat diversity of the system. Also, the proposed features would restore the connectivity between lake and nearshore coastal habitats, as well as increase habitat structure and availability. Removal of unnatural habitats would reduce the abundance ratio of exotic to native species. All habitat improvements will benefit plants, invertebrates, fish, birds, amphibians, reptiles and other wildlife.

EO 11514 Protection and Enhancement of Environmental Quality – the Federal Government shall provide leadership in protecting and enhancing the quality of the Nation’s environment to sustain and enrich human life. Improving the quality of Northerly Island creates a healthier environment for humans via visually aesthetics of the numerous topographical features and corresponding native plant community types.

E.O. 11990 Protection of Wetlands – each agency shall provide leadership and shall take action to minimize the destruction, loss or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands. The project will both restore and increase the amount of wetland within the Northerly Island coastal zone. Lake, pond, marsh, and wet prairie habitat would increase from 0 to about 11.3-acres. These wetlands would be additionally protected and connected to about 28-acres of mesic prairie and savanna buffer.

EO 13186 Responsibilities of Federal Agencies to Protect Migratory Birds – federal agencies shall restore or enhance the habitat of migratory birds and prevent or abate pollution or detrimental alteration of the environment for migratory birds. This project will restore native lacustrine, marsh, prairie and savanna plant communities, thus providing forage and shelter to numerous migratory bird species, including water fowl and tropical migrants. This project lies within the only nationally significant portion of the Central Flyway, which is the Great Lakes Flyway.

E.O. 13112 Invasive Species – prevent the introduction of invasive species and provide for their control and to minimize the economic, ecological, and human health impacts that invasive species cause. Proposed measures for this project include the eradication of herbaceous invasive plant species. Aquatic project features would also provide for the exclusion of adult common carp, thusly preventing them from utilizing restored aquatic vegetation as a food and spawning ground.

Executive Order 13340 - identified the Great Lakes as a national treasure and defined a Federal policy to support local and regional efforts to restore and protect the Great Lakes ecosystem through the establishment of regional collaboration. A number of activities have been accomplished by Federal agencies working in partnership with state, tribal and local governments in response to the Executive Order. The USACE has been a major participant in these activities. The Executive Order established the Great Lakes Interagency Task Force. The Task Force worked with the governors of the eight Great Lakes states, mayors, and tribal leaders to establish the Great Lakes Regional Collaboration. The initial goal of the Collaboration

was to develop a “strategy for the protection and restoration of the Great Lakes” within 1 year. The Collaboration developed the strategy by using teams consisting of 1,500 stakeholders for the following eight priority issues identified by the Great Lakes governors and mayors with items in bold relative to this project:

- | | |
|--------------------------------------|-----------------------------------|
| 1. Toxic contaminants | 5. Contaminated sediments/AOCs |
| 2. Non-point source pollution | 6. Indicators/information |
| 3. Coastal health | 7. Sustainable development |
| 4. Habitat/species | 8. Invasive species |

Public Recognition

Public recognition means that some segment of the general public recognizes the importance of an environmental resource, as evidenced by people engaged in activities that reflect an interest or concern for that particular resource. Such activities may involve membership in an organization, financial contributions to resource-related efforts, and providing volunteer labor and correspondence regarding the importance of the resource.

The Millennium Reserve Initiative – is aimed at reinvesting in the ecology, culture and economy of the Calumet Region. The Millennium Reserve Initiative (MR) is part of President Obama’s America’s Great Outdoors Initiative to reconnect Americans, especially children, to America’s rich outdoor treasures, build upon public, private, and tribal priorities for conservation and recreation lands, and use science-based management practices to restore and protect our lands and waters for future generations. The Northerly Island 506 project is within the designated area of the Millennium Reserve and would contribute 40 additional acres of natural area that is readily available to the public for passive recreation.

The MR will initially focus on transforming the Calumet region of Chicago into a one-of-a-kind public destination with over 15,000 acres of open space. It honors our cultural and industrial past, while protecting and restoring natural ecosystems and supporting healthy and prosperous communities. The Calumet Core Reserve will be a catalyst to promote economic growth by providing a framework to leverage existing resources and new resources in partnership between the 44 government agencies, community groups, and advocacy organizations. Expanding and leveraging the power of these partnerships best prepares our region to achieve the three main goals of the MR:

1. Improving the Environment by:
 - a. Managing and restoring the 6,000 acres of natural areas that contain important high-quality biological communities and support over 20 rare plants and 40 rare animal species.
 - b. Completing and connecting 53 miles of trails and wildlife corridors throughout the area, and promoting public access and recreational opportunities.
 - c. Expanding and connecting natural areas and habitats in a system of Green Infrastructure.
2. Improving the Economy by:
 - a. Modernizing the Illinois International Port District and creating thousands of new jobs.
 - b. Creating a destination region for tourists and visitors, which will create jobs in a newly developed tourism industry.
 - c. Increasing property values for home owners near the Reserve and the over \$2 billion per year spent as a result of outdoor recreation in Illinois.

3. Improving the Community by:
 - a. Working with Michelle Obama's Let's Move Initiative to increase opportunities for kids to be physically active, and to create new opportunities for families to move together.
 - b. Reclaiming over 3,500 acres of underutilized lands and brownfields by using the innovative mud to parks/garden initiatives, renewable native biomass production, garden nurseries, organic farming, etc.
 - c. Connecting communities and people to their cultural, industrial and natural history through trails, interpretation and other creative opportunities.

Technical Recognition

Technical recognition means that the resource qualifies as significant based on its "technical" merits, which are based on scientific knowledge or judgment of critical resource characteristics. Whether a resource is determined to be significant may of course vary based on differences across geographical areas and spatial scale. While technical significance of a resource may depend on whether a local, regional, or national perspective is undertaken, typically a watershed or larger (e.g., ecosystem, landscape, or ecoregion) context should be considered. Technical significance should be described in terms of one or more of the following criteria or concepts: scarcity, representation, status and trends, connectivity, limiting habitat, and biodiversity.

Scarcity is a measure of a resource's relative abundance within a specified geographic range. Generally, scientists consider a habitat or ecosystem to be rare if it occupies a narrow geographic range (i.e., limited to a few locations) or occurs in small groupings. Unique resources, unlike any others found within a specified range, may also be considered significant, as well as resources that are threatened by interference from both human and natural causes.

Coastal wetlands around the Great Lakes have been identified as important resources that have been decimated by filling and grading to drain the land for human use. The coastal zone of southern rim of Lake Michigan, wetlands and other native plant communities have been severely degraded or removed. This project would reestablish critical submergent and emergent habitats that are extremely scarce for southern Lake Michigan.

Prairie and savanna have also been cleared from much of Northern Illinois since pre-settlement times to make way for roadways and urban development. The 28-acres of mesic prairie and savanna that buffer the proposed wetlands would make the wetland habitat that much more important, since life requisites of many amphibians, reptiles, and birds depend upon both wetland and buffering habitats at different times of their life history and the yearly cycle.

Representation is a measure of a resource's ability to exemplify the natural habitat or ecosystems within a specified range. The presence of a large number and percentage of native species, and the absence of exotic species, implies representation as does the presence of undisturbed habitat.

The Northerly Island 506 project area resides within coastal zone of Lake Michigan in Illinois. This area was typically covered with savanna, prairie and wetland swales of wet prairie, meadow and marsh. The project area currently exemplifies these habitat types and in several areas still has the floristic composition to be representative of the regions natural history. This

project would help increase the areas of these habitat types, preserve intact remnant parcels, and increase the floristic quality overall.

Status and Trends of the Northerly Island 506 project area may be classified as non-functional in biological, physical and chemical parameters. Although the peninsula is not natural, great potential for establishing structural aquatic habitat conditions exists. Reestablishing hydrology would allow for the additional acres of marsh, wet and mesic prairie and savanna habitats to be increased within the Chicago Region.

Connectivity is impaired between the lake itself and nearshore habitats at Northerly Island. Currently, lake species such as turtles and mud puppies, and migratory birds, have plenty of open lake habitat, but do not have access to coastal wetlands and other diverse plant communities. These species would utilize these new established habitats for reproduction, foraging and refugia.

Limiting Habitat exists within the Northerly Island study area. Vital spawning habitat for species that require vegetation and small fishes that require harbor areas would be restored with implementing proposed features. Currently, lake species such as fish, turtles and mud puppies, and migratory birds, have plenty of open lake habitat, but do not have access to coastal wetlands and other diverse plant communities. These species would utilize these new established habitats for reproduction, foraging and refugia.

Budget Guidance

The purpose of the Northerly Island 506 restoration project is to establish a more natural hydrology-geomorphology- vegetation interaction to resemble that of its natural structure and function. The project would also remove invasive plant species and replant with native species of regional genotype. The USACE has criteria for selecting projects for implementation with the following criteria and numerical scores being assigned to a project based upon the site meeting the requirements identified in the Corps Budget guidance:

- Habitat Scarcity – Score of 25/25
- Connectivity - Score of 25/25
- Special Status Species – Score of 5/10
- Hydrologic Character – Score of 15/20
- Geomorphic Condition – Score of 10/20
- Plan Recognition – Score of 10/10
- Self Sustaining – Score of 20/20
- Nationally Significant - Yes
- Regionally Significant – Yes

3.6.2 – Acceptability, Completeness, Effectiveness and Efficiency

Acceptability, completeness, effectiveness, and efficiency are the four evaluation criteria specified the USACE uses in the screening of alternative plans. Alternatives considered in any planning study, not just ecosystem restoration studies, should meet minimum subjective standards of these criteria in order to qualify for further consideration and comparison with other plans.

Acceptability

An ecosystem restoration plan should be acceptable to state and Federal resource agencies and local governments. There should be evidence of broad-based public consensus and support for the plan. A recommended plan must be acceptable to the non- Federal cost-sharing partner. However, this does not mean that the recommended plan must be the locally preferred plan.

Alternative 5 coincides with the conceptual designs provided by the Chicago Park District. This plan is most congruent with the desired future conditions of the Northerly Island's southern area, in which a cline of historic Chicago area natural communities would be exemplified. Alternatives 2 – 5 provide some of these habitat types, but taking stakeholder and non-Federal sponsor needs into consideration indicates that the most diverse habitat mosaic possible would be the most acceptable to the public.

Completeness

A plan must provide and account for all necessary investments or other actions needed to ensure the realization of the planned restoration outputs. This may require relating the plan to other types of public or private plans if these plans are crucial to the outcome of the restoration objective. Real estate, operations and maintenance, monitoring, and sponsorship factors must be considered. Where there is uncertainty concerning the functioning of certain restoration features and an adaptive management plan has been proposed it must be accounted for in the plan.

Alternative 5 is the most complete alternative that would establish a hydrogeomorphic landscape conducive to a mosaic of diverse habitats. This would provide for all coastal organisms and not a select few, such as Alternative 2 would only provide for those species that use wet prairie, mesic prairie and savanna for part of their life history. This alternative would also be complete in terms of public plans to establish the Millennium Reserve and meets objectives for establishing migratory bird habitat within the Great Lakes portion of the Central Flyway.

Effectiveness

An ecosystem restoration plan must make a significant contribution to addressing the specified restoration problems or opportunities (i.e. restore important ecosystem structure or function to some meaningful degree). The problems identified under this investigation and the alternatives that address them follow:

Lack of a natural mosaic and gradient of submerged to upland coastal habitats: Addressed by Alternatives 5 and for the most part by Alternative 4.

Fragmentation of local habitat patches: Addressed by Alternatives 3, 4 and 5, but maximized by Alternative 5.

Overabundance of unnatural conditions that promote invasive species success: Addressed by Alternatives 2 and 3 to a certain degree; addressed more so by Alternative 4; maximized by Alternative 5.

Lack of rich coastal plant communities: There is a successive increase in coastal plant community species richness starting from Alternative 2 and progressing through Alternative 5, with Alternative 5 maximizing the effectiveness of addressing this problem.

Lack of rare and sensitive coastal plant and animal species: There is a successive increase in providing for species that are rare and conservative starting from Alternative 2 and progressing through Alternative 5, with Alternative maximizing the effectiveness of addressing this problem.

Lack of critical habitat for locally endangered and rare fauna: Only Alternatives 4 and 5 provides critical habitat for locally imperiled species, with Alternative 5 maximizing the effectiveness of addressing this problem.

Lack of migratory bird resting and forage habitats: There is a successive increase in quantity and diversity of coastal migratory bird habitat starting from Alternative 2 and progressing through Alternative 5, with Alternative 5 maximizing the effectiveness of addressing this problem.

Efficiency

An ecosystem restoration plan must represent a cost-effective means of addressing the restoration problem or opportunity. It must be determined that the plan's restoration outputs cannot be produced more cost effectively by another agency or institution.

The cost effectiveness of the array of alternatives was analyzed using IWR-Plan software. As identified, Alternatives 1-5 are all deemed "cost effective" and "best buy" plans in terms of costs per benefit. The observable break point in the Incremental Cost Analysis is going from Alternative 3 to Alternative 4, which is the addition of the pond, which is the projects most important feature in terms of being the central aquatic feature and providing critical inlet habitat for mudpuppy and other shallow littoral species. Based on the scope of the recommended alternative and the total project cost, the Section 506 Authority administered by the USACE is the most suitable means for implementing the project out of other Federal and state programs. There are currently no other agencies or institutions with both the capability to plan, design, fund, administer contracts and monitor ecosystem restoration projects of this type.

3.6.3 – Risk and Uncertainty

When the costs and outputs of alternative restoration plans are uncertain and/or there are substantive risks that outcomes will not be achieved, which may be the case, the selection of a recommended alternative becomes more complex. It is essential to document the assumptions made and uncertainties encountered during the course of planning analyses. Restoration of some types of ecosystems may have relatively low risk. For example, removal of drainage tiles to restore hydrology to a wetland area. Other activities may have higher associated risks such as restoration of coastal marsh in an area subject to hurricanes. When identifying the NER plan,

the associated risk and uncertainty of achieving the proposed level of outputs must be considered. For example, if two plans have similar outputs but one plan costs slightly more, according to cost effectiveness guidelines, the more expensive plan would be dropped from further consideration. However, it might be possible that, due to uncertainties beyond the control or knowledge of the planning team, the slightly more expensive plan will actually produce greater ecological output than originally estimated, in effect qualifying it as a cost effective plan. But without taking into account the uncertainty inherent in the estimate of outputs, that plan would have been excluded from further consideration.

Complete eradication of invasive species always presents a certain level of risk and uncertainty as the chances of reinvasion are likely to occur without proper management, increasingly so when native species have not yet established. Measures that alleviate altered soil chemistry legacies consist of increasing organic carbon of the soils that will activate microbial processes. In order to ameliorate the unnatural soil conditions of the site for proper biogeochemical cycling, a soil amendment consisting of leaf compost will be incorporated into the top 6" of soil during late summer or early fall. Incorporating a soil amendment will decrease bulk density and increase soil organic matter, while enhancing microbial communities and stimulating vegetative diversity. These would alleviate the invasibility of the ecosystem, should lessen the risk and uncertainty associated with invasive species removal.

Native plantings also have an associated risk of not establishing due to a variety of unforeseen events. Predation from herbivorous animals and insects is a possibility and can be reasonably estimated based on baseline surveys of the existing flora and fauna. However, weather also plays a large role in the establishment success of new plantings. Periods of drought or early frost may alter the survival percentage of plantings. Although historical records can help to predict the best possible location and timing of new plantings, single unforeseen events may lead to failure. To mitigate these risks, planting over several years, overplanting and/or adaptive management and monitoring may be incorporated into the overall plan. In addition, climate change in the years to come may play a role in impacting the project outcome. Increased temperatures or rainfall may lead to changes in the ecosystem of the project area; however, Lake Michigan primarily drives the weather in the Chicagoland area and may partly mitigate climate change concerns.

Project analyses including the HTRW analysis and Geotechnical analysis identified limited information on subsurface conditions within the project site especially in the southeastern portion where substantial excavation is proposed. Consequently additional subsurface information will be obtained prior to the completion of the feasibility report to fill in the data gaps to confirm the subsurface conditions are comprised of suitable material; thereby reducing the risk and uncertainty associated with HTRW and geotechnical suitability related to the excavation of these fill materials used to build Northerly Island in the past century. If not confirmed, the results of the subsurface investigation and management of resulting risks can be addressed in this section of the final report.

3.7 – Selection of the National Ecosystem Restoration Plan

When selecting a single alternative plan for recommendation from those that have been considered, the criteria used to select the NER plan include all the evaluation criteria discussed above. Selecting the NER plan requires careful consideration of the plan that meets planning

objectives and constraints and reasonably maximizes environmental benefits while passing tests of cost effectiveness and incremental cost analyses, significance of outputs, acceptability, completeness, efficiency, and effectiveness. Additional factors to consider include the following items.

Partnership Context

This restoration project was planned in cooperation with the Chicago Park District. Also, as the Section 506 authority intends, the recommended plan would restore and preserve ecosystems in congruence with the Council on Lakes Committee. This restoration project makes a significant contribution to regional, national, and international programs that include the North American Waterfowl Management Plan, Lake-wide Management Plans, and the Coastal Zone Management Plan. This plan included an opportunity for open comment to ensure all stakeholder parties have had equal contribution.

Reasonableness of Costs

All costs associated with a plan were considered, and tests of cost effectiveness and incremental cost analysis have been satisfied for the alternatives analyzed. The cost estimates were based on current ecosystem restoration projects of the like that are in construction.

Having established confidence in the estimated implementation costs, the remaining test of reasonableness is to assess the value of the resource to be improved based on the cost to implement the improvement. The importance of the Great Lakes in terms of habitat and human uses has been documented through numerous sources. The importance of the Great Lakes to the nation was reiterated through Executive Order 13340.

Non-monetary values associated with the Northerly Island restoration project include a variety of ecological benefits. The project will provide important stop-over habitat for birds traveling along the Central Flyway; a migratory route recognized as nationally significant by the Audubon Society. In addition, the native habitat types planned will benefit native resident species. A variety of aquatic species such as fish, macroinvertebrates, and amphibians will greatly benefit through the addition of important foraging, refuge, and spawning habitat. The restoration of Northerly Island will significantly increase the ecological integrity of the surrounding area and is well worth the investment.

The NER/Preferred Plan

The plan that reasonably maximizes net national ecosystem restoration benefits, consistent with the Federal objective, is identified as the NER plan. Thus, the plan that maximizes net NER benefits and has shown great merit in the trade-off analysis is Alternative 5. This NER Plan is considered as the Preferred Plan for direct, indirect and cumulative effects assessment under NEPA in the following Chapter.

CHAPTER 4 – ENVIRONMENTAL ASSESSMENT

This chapter involves identification of direct environmental effects to current conditions stemming from any of the proposed alternatives if they were to be implemented. All sections denoted with an asterisk are pertinent to the Environmental Assessment.

4.1 – Need & Purpose

The purpose of the recommended alternative is to remedy habitat degradation issues and return stability in terms of hydrogeomorphology. One crucial component that is important to ecosystem integrity and integrates both aquatic and riparian or buffer habitat, is wetlands. Historically, Chicago's coastal zone was a lush mix of vast wetlands with prairie and savanna islands. While restoring wetlands within the Chicago city limits to their historical conditions is unlikely, reestablishing wetland and associated buffer plant communities on small expanses of land would provide critical habitat for a number of organisms. These patches of wetland would serve as an important refuge for migrant and resident bird species, as well as a variety of aquatic organisms (fish, amphibians, aquatic insects, etc.). The restoration, enhancement, and protection of critical wetland habitat in the Great Lakes ecosystem would provide an ecological benefit that is supported by the GLFER program. The main problems at Northerly Island are as follows:

- Lack of a natural mosaic and gradient of submerged to upland coastal habitats
- Fragmentation of local habitat patches
- Overabundance of unnatural conditions that promote invasive species success
- Lack of rich coastal plant communities
- Lack of rare and sensitive coastal plant and animal species
- Lack of critical habitat for locally endangered and rare fauna
- Lack of migratory bird resting and forage habitats

4.2 – Alternatives Considered

Five (5) alternative plans, including the No Action Plan, were considered for study implementation. Alternative 5 is the Preferred Plan since it maximizes ecosystem restoration and is holistic in terms of required plant communities that are directly connected to aquatic features of the pond and lake. See Section 3.1 for Measure details, which make up the Alternative Plans below:

1. No Action
2. Geomorphic Contouring w/ Wet Prairie, Mesic Prairie & Savanna
3. Geomorphic Contouring w/ Emergent Marsh, Wet Prairie, Mesic Prairie & Savanna
4. Geomorphic Contouring w/ Pond, Emergent Marsh, Wet Prairie, Mesic Prairie & Savanna
5. Geomorphic Contouring w/ Lacustrine, Pond, Emergent Marsh, Wet Prairie, Mesic Prairie & Savanna (Preferred Plan)

4.3 – The Affected Environment

The affected environment is described in detail in Chapter 3 – Inventory & Forecasting. Naturally, this area was once the bottom of Lake Michigan within the littoral zone. After creation

of the peninsula as part of Daniel Burnham's plan in 1925, the island became a small airport in 1946. The parcel is owned by the CPD and the southern portion of the island was planted for the most part with native grasses and turf grass to ensure the site would not become infested with non-native weeds. Currently, no wetland or natural habitats are found within the study area. The lack of surficial hydrology and topography diversity makes it difficult to establish native coastal and wetland vegetation.

4.4 – Direct & Indirect Effects of the Preferred Plan

4.4.1 – Physical Resources

Climate

The minor scale of the preferred plan would not be able to affect the regional climate. The increase in acreage of natural plant communities would increase evapotranspiration in a minor way, but still not great enough to affect weather patterns or rainfall within the region. No significant adverse effects will result from implementing the preferred plan are expected.

Air Quality

The project site is surrounded by an area of high boat and vehicle use that are all fossil fuel powered. The preferred plan would cause only minor and temporary increases in exhaust emissions from machinery and equipment during construction. Ecological prescribed burning must comply with all state and local permitting and control requirements.

Water Quality

The preferred plan would not adversely affect the water quality of Lake Michigan. Natural substrates that would be used for fill material below the OHW include clean boulders, limestone flags, sand, gravel and silt. The silt is to replicate the natural plant bed material found along the coast of Lake Michigan. There are no expected quantifiable changes in water quality parameters around Northerly Island. The addition of a corridor between the pond and Lake Michigan will not impact water quality either, because there is already an ongoing exchange of water between the groundwater of the Island and Lake Michigan. All of the proposed features would ultimately further provide water quality improvements.

Geology & Glacial Stratigraphy

Northerly Island is manmade and does not possess any natural geologic features. The preferred plan would not have any effects on geology or glacial stratigraphy.

Soils

Northerly Island is manmade and does not possess any natural soils. An amalgam of top soil fill and concrete debris that resides upon lake sands currently makes up the fill material profile of the site. To properly restore specific plant communities, soil amendments would be implemented as described in the measures and preferred alternative, which are primarily

organic leaf litter and sand. The preferred plan would not have any effects on geology or glacial stratigraphy.

Fluvial Geomorphology & Topography

Northerly Island is manmade and does not possess any naturally occurring rivers or streams, thusly fluvial geomorphology would not be affected. Topography would be manipulated to achieve the proper hydrogeomorphic setting for the proposed native plant communities. The preferred plan would not have any effects on natural landscapes within the project area.

Land Cover, Hydrology & Hydraulics

Northerly Island is manmade and does not possess any naturally occurring land cover types, wetlands or streams. Topography would be manipulated to achieve the proper hydrogeomorphic setting for the proposed native plant communities. The preferred plan would not have any affects on the local hydrology or coastal hydraulics.

4.4.2 – Ecological Resources

General Study Area Habitat

The project area encompasses 40-acres of the southern end of Northerly Island, including shallow water areas within Burnham Harbor. The current habitat types that exist are very limited. Restoration of the island will add habitat types, creating a diverse ecosystem for organisms to thrive in. An increase in ecological integrity is expected of the restoration as it will increase species diversity throughout the island. The preferred plan would not have any adverse effects on the current habitat.

Plant Communities

The preferred plan would not have significant effects on any beneficial plant communities of Northerly Island. Currently, the island consists of mowed grass and patches of degraded mesic prairie. Native species for each habitat type will be planted in corresponding hydrogeomorphic zones that would restore proper ecological function to the site. The diverse plant communities found in each habitat type will further provide important niches for a variety of resident and migratory insect and bird species.

Macroinvertebrates

The preferred plan would not have significant effects on the macroinvertebrate communities of Northerly Island. The addition of the pond habitat and enhancement of the lacustrine littoral zone will benefit aquatic macroinvertebrate assemblages. The pond will provide ideal interstitial spacing within the cobble substrate and macrophytes for cover. Since many macroinvertebrates are larval forms of many terrestrial insects and require emergent vegetation for reproductive purposes, the addition of the emergent marsh will further propagate abundances within the project area.

Fishes

The preferred plan would not have significant effects on fish communities surrounding Northerly Island. The preferred plan would provide effective habitat for a many important game and non-game species that depend on submerged and emergent macrophytes for specific characteristics of their life histories. Many fish species of Southern Lake Michigan require submerged and emergent macrophytes for spawning purposes. These areas also serve as important nursing habitat for many juvenile species of fish. In turn, predatory fish will be attracted to the area as a result of increased prey abundance. Therefore, fishes near the project area will greatly benefit from the proposed plan and may further perpetuate fish abundances to adjacent areas.

Amphibians & Reptiles

The preferred plan would not have significant effects on amphibian and reptile communities of Northerly Island. Information regarding reptiles and amphibian species currently in the project area is very limited, most likely due to the limited amount of habitat to be sampled. However, the surrounding lake is known to have a significant population of the state threatened salamander, the mudpuppy. The pond substrate will specifically be design to cater to mudpuppy by creating ideal habitat for forage and refuge. In addition, a variety of turtles will be attracted to the created wetland for foraging and reproductive purposes. Some snakes common to urban development (i.e. garter snake, *Thamnophis sirtalis*) will be attracted to the restored savanna and prairie habitats, too. Overall reptiles and amphibians will benefit from the preferred plan.

Resident & Migratory Birds

The preferred plan would not have significant effects on resident or migratory bird communities of Northerly Island. Northerly Island is located within the Central Flyway, which is nationally recognized as an important route for many migratory and birds. Approximately 253 species of resident and migratory birds have been spotted on or near Northerly Island. The preferred plan will continue to attract many migratory and resident birds. It is also likely, that more species will be recruited to the area due to the increased habitat diversity proposed. Both resident and migratory birds are expected to greatly benefit from the preferred plan due to the increased habitat types that will provide more niches for species.

Mammalian Community

The preferred plan would not have significant effects on small mammal communities of Northerly Island. Small to medium-bodied mammals are typical of urban environments. The lack of a corridor for terrestrial mammals will limit the benefits to the mammalian community. However, the new habitat types would provide a great foraging and refuge habitat for species like raccoons, squirrels, rabbits, opossum, muskrat, small mice and voles. A significant benefit for urban dwelling mammals is expected from the preferred plan.

Threatened & Endangered Species

The preferred plan would not have significant effects on threatened or endangered species within or around Northerly Island. The preferred plan is designed to increase critical habitat for the state threatened mudpuppy and banded killifish. Substrate used in the pond and lacustrine

littoral zone will be ideal habitat for mudpuppy. Similarly, the pond will provide important macrophyte structure needed by the banded killifish for spawning purposes. In addition to aquatic life, the increase habitat types will greatly benefit state listed bird species (Plate1). Twelve species of state threatened and endangered species have been observed on or near Northerly Island. Therefore, the preferred plan would provide a positive benefit for both threatened and endangered species.

The U.S. Fish and Wildlife website has been consulted for the distribution of federally listed species (17-February-2012). Appropriate USACE staff has reviewed the project along with the species list and no adverse effects to state or federally listed species would occur.

4.4.3 – Cultural Resources

Archaeological & Historical Properties

The preferred plan would have no adverse impacts on archaeological or historic properties. The project area is manmade land. Clearance has been provided by the Illinois Historic and Preservation Agency (letter dated February 8, 2012). Native American groups having an historic cultural interest in northeast Illinois have been consulted (letters dated January 27, 2012). The Kickapoo tribe of Kansas has responded and provided clearance (letter dated February 16, 2012).

Social Properties

The preferred plan will not have any adverse impacts on the area's social properties.

Recreational Activities

The preferred plan would have no adverse impacts on recreational activities at the Northerly Island. Short term impediments to recreational activities will occur during first and second years of construction. After all physical restoration features are implement after the second year, this portion of the park could be open to the public for passive recreation once again.

Hazardous, Toxic & Radioactive Waste (HTRW) Analysis

As discussed more fully in section 2.4.1, the preferred plan would not cause adverse impacts through disturbing HTRW materials at Northerly Island. Although some soil samples from the project site exceed TACO residential soil cleanup objectives for PAHs, the use of the project site will not be residential. The TACO objectives for the PAHs exceeded at the site are based on values for the ingestion exposure route, with an assumed 350 days/year exposure to the material. It is therefore believed that the residential criteria are exceedingly conservative for the protection of human health at the project site. IEPA also defines background PAH concentrations that are representative of soils in Chicago, which may be used as an alternative to residential closure values. When the soil samples are averaged, these background levels are not exceeded. Because earthwork proposed for this ecosystem restoration project would involve significant redistribution of material on the site, it is likely soils will be greatly homogenized, and use of average values is therefore appropriate. Based on this evaluation, the soil at the site has PAH concentrations that are typical of ambient Chicago conditions. In

addition, the soil sampling results were also compared to threshold and benchmark soil values given in the Calumet Area Ecotoxicology Protocol (attachment to Appendix C) to assess the potential risk to wildlife and other ecological receptors posed by the existing level of PAHs at the project site. Although two of the twelve soil samples exceeded the threshold values of at least one PAH by small margins, the average concentrations of PAHs from the twelve samples were all below threshold levels. As previously mentioned, the use average values is appropriate, because the earthwork proposed for this project will likely result in soils that are greatly homogenized. No sample exceeded benchmark values. The Ecotox Protocol states that areas with chemical concentrations below threshold values are not expected to need rehabilitation to protect the habitat's receptors, and therefore, no further action is needed. Thus, the PAH levels in soils at Northerly Island will not result in ecological impacts.

Although the groundwater sample that was collected on the project site exceeded the TACO Class I Groundwater Remediation Objective for PAHs for potable water, no potable water wells exist or are planned to be installed at the site. The Ecotoxicology Protocol discussed above does not provide comparison values for groundwater quality, but it does have standards for surface water. As discussed in more detail in Section 2.4.1, the groundwater sample results do exceed one of the Ecotox surface water benchmark standards. However, we believe that it is of limited to no value to compare a ground water sample to a surface water standard due to a variety of natural intervening factors. While groundwater infiltration will initially be a primary source of water into the pond and wetland areas created by the project, it is not valid to assume the resulting surface water quality would be comparable to that of the groundwater. Once brought to the surface and opened to the atmosphere, the PAH compounds present in the groundwater will be broken down by a variety of natural processes including volatilization, photodegradation, biodegradation, and oxidation. Furthermore, surface waters created at the project site will be significantly affected by clean rainfall and Lake Michigan water inputs. Because of the variability of these factors, it is not possible to mathematically predict surface water quality at the site based on existing groundwater data. Considering these numerous natural processes will act to reduce PAH concentrations in surface waters, it is believed that groundwater quality will not pose a threat to biological receptors at the project site. In addition, because there is already ongoing an ongoing exchange between the site groundwater and Lake Michigan, no additional impact to Lake Michigan will occur due to the surface water corridor connection to the pond. Based on the analysis above, the preferred plan will not result in HTRW-related adverse impacts to the environment.

The plan for construction is to achieve a zero balance of cut and fill, in order to eliminate disposal costs associated with these materials. Due to Illinois Clean Construction & Demolition Debris (CCDD) requirements, materials may not be acceptable for off-site reuse based on debris content. Although existing data indicates the material has concentrations of anthropogenic compounds less than the metropolitan background, the CCDD regulations also require environmental testing before removal to ensure the material meets this standard. If any excess material is required to be removed from the site and does not meet the CCDD requirements, the material would be required to be landfilled.

Additional soil borings are planned to be conducted to confirm the soil conditions in the area of excavation. The soil borings would include field identification of soil type, as well as screening for the presence of volatile compounds by use of a photoionization detector (PID). If these

borings reveal unexpected soil conditions that will have an HTRW-related impact to the project, the HTRW investigation will be revised at that time.

Project analyses including the HTRW analysis and Geotechnical analysis identified limited information on subsurface conditions within the project site especially in the southeastern portion where substantial excavation is proposed. Existing boring information only contained three data points in area to be excavated (one data point in the excavation area and two data points adjacent to it). Therefore typical representativeness and completeness standards for chemical data are insufficient to adequately address risk and uncertainty. Consequently additional subsurface information will be obtained prior to the completion of the feasibility report to fill in the data gaps to confirm the subsurface conditions are comprised of suitable material; thereby reducing the risk and uncertainty associated with HTRW and geotechnical suitability related to the excavation of these fill materials used to build Northerly Island in the past century. If not confirmed, the results of the subsurface investigation and management of resulting risks can be addressed in this section of the final report.

Environmental Justice

Executive Order 12898 (environmental justice) requires that, to the greatest extent practicable and permitted by law, and consistent with the principles set forth in the report on the National Performance Review, each Federal agency make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations in the United States and its territories and possessions, the District of Columbia, the Commonwealth of Puerto Rico, and the Commonwealth of the Mariana Islands.

The preferred plan would not cause any adverse human health effects or environmental effects on minority populations.

4.4.4 – 17 Points of Environmental Quality

The 17 points are defined by Section 122 of Rivers, Harbors & Flood Control Act of 1970 (P.L. 91-611) from (ER 1105-2-240 of 13 July 1978). Effects to these points are discussed as follows:

Noise – Any of the alternative plans would cause minor and temporary increases in noise levels beyond the current conditions. The minor noise effects would stem from machinery utilized for grading plant community topography, placing materials, removing concrete, and removal of trees and brush. Long term, significant effects in terms of noise is not expected.

Displacement of People – Any of the alternative plans would not displace local residents since this is an isolated public parcel.

Aesthetic Values – Any of the alternative plans would not reduce the aesthetic values of the Northerly Island. Temporary deteriorations in aesthetics would occur from herbicide application to stands of invasive species, temporary storage of debris piles, and graded areas of the new wetlands before native vegetation has established. These effects on aesthetics are minor and temporary as native plant species would sufficiently cover the ground after the first growing

season. The removed foreign debris, removed invasive species and restored plant communities would provide an increase in aesthetic values. This would be visually evident by a diverse mix of native wildflowers and grasses that would also attract new fish and wildlife species that would otherwise not be present without this restoration project.

Community Cohesion – Any of the alternative plans would not disrupt community cohesion, but provide restored open space for community activities.

Desirable Community Growth – Any of the alternative plans would not adversely affect community growth and would potential attract people to a more aesthetically pleasing area based on project restoration measures.

Desirable Regional Growth – Any of the alternative plans would not adversely or beneficially affect regional growth.

Tax Revenues – Any of the alternative plans would not adversely or beneficially affect tax revenues.

Property Values – Any of the alternative plans would not have adverse effects on property values, but has the potential to increase surrounding land values since the aesthetics would improve to do project restoration measures.

Public Facilities – Any of the alternative plans would not adversely affect public facilities of the Chicago Park District or Northerly Island. The project area is designated by the Chicago Park District to become natural area. All active recreational activities are planned for the northern portion of the park.

Public Services – Any of the alternative plans would not adversely or beneficially affect public services.

Employment – Any of the alternative plans would not adversely affect employment and would temporarily increase employment during construction activities.

Business and Industrial Activity – Any of the alternative plans would not adversely or beneficially affect local commerce.

Displacement of Farms – Any of the alternative plans would not adversely affect farmland since restoration areas do not occur on agricultural fields.

Man-made Resources – Any of the alternative plans would not adversely or beneficially affect man-made resources.

Natural Resources – The No Action Alternative allows for the continued degradation of native species, rare communities, and significant habitats. The NER Plan would not adversely affect natural resources, but improve them greatly.

Air –The preferred plan would cause only minor and temporary increases in exhaust emissions from machinery and equipment during construction. Ecological prescribed burning must comply with all state and local permitting and control requirements.

Water – As discussed previously, any of the alternative plans would not adversely affect water quality; however, riparian, wetland basin and instream restoration features are expected to improve dissolved oxygen and provide substrate for denitrifying bacteria.

4.5 – Cumulative Effects

Consideration of cumulative effects requires a broader perspective than examining just the direct and indirect effects of a proposed action. It requires that reasonably foreseeable future impacts be assessed in the context of past and present effects to important resources. Often it requires consideration of a larger geographic area than just the immediate “project” area. One of the most important aspects of cumulative effects assessment is that it requires consideration of how actions by others (including those actions completely unrelated to the proposed action) have and will affect the same resources. In assessing cumulative effects, the key determinant of importance or significance is whether the incremental effect of the proposed action will alter the sustainability of resources when added to other present and reasonably foreseeable future actions.

Cumulative environmental effects for the proposed ecosystem restoration project were assessed in accordance with guidance provided by the Council on Environmental Quality (CEQ) and U.S. Environmental Protection Agency (USEPA 315-R-99-002). This guidance provides an eleven-step process for identifying and evaluating cumulative effects in NEPA analyses.

The overall cumulative impact of the proposed Northerly Island ecosystem restoration project is considered to be beneficial environmentally, socially, and economically. The restoration of approximately 40-acres of the manmade peninsula would provide an important piece of habitat and refuge for a variety of species in an urban landscape. The habitat mosaic that is planned would provide several niches for species to thrive among, increasing ecological integrity through species diversity.

4.5.1 – Scope of Cumulative Effects Analysis

Through this environmental assessment, the cumulative effects issues and assessment goals are established, the spatial and temporal boundaries are determined, and the reasonably foreseeable future actions are identified. Cumulative effects are assessed to determine if the sustainability of any of the resources is adversely affected with the goal of determining the incremental impact to key resources that would occur should the proposal be permitted.

The spatial boundary for the assessment has been broadened to consider watershed effects. The spatial boundary being considered is normally in the general area of the proposed ecological restoration; however, the area may be expanded on a case-by-case basis if some particular resource condition necessitates broadening the boundary. For this analysis, the spatial boundary includes the Northerly Island and a buffering radius of about 1.5-miles.

Three temporal boundaries were considered:

- Past –1830s because this is the approximate time that the landscape was in its natural state, a vast prairie/wetland/woodland mosaic.
- Present – 2012 when the decision is being made on the most beneficial ecological restoration
- Future – 2062, the year used for determining project life end, although the ecological restoration should last until a geologic event disturbs the area.

Projecting the reasonably foreseeable future actions is difficult. The proposed action (ecosystem restoration) is reasonably foreseeable; however, the actions by others that may affect the same resources are not as clear. Projections of those actions must rely on judgment as to what are reasonable based on existing trends and where available, projections from qualified sources. Reasonably foreseeable does not include unfounded or speculative projections. Some future projections were taken from watershed and specific studies generated for the general Waukegan area. In this case, reasonably foreseeable future actions include:

- Use of the northern portion of the Northerly Island as active recreation
- Future aquatic ecosystem improvements around the Northerly Island
- Continued application of environmental requirements such as those under the Clean Water Act

4.5.2 – Cumulative Effects on Resources

Physical Resources

Cumulatively there are no adverse effects expected to the physical resources on and around Northerly Island. The island is made of fill that consists of mostly sand and riprap; therefore the geology, soils, hydrology, etc were not naturally created. Also, physical resources would only be manipulated on the peninsula itself or on the manmade rubble mound in Burnham Harbor. The preferred plan would naturalize the site's hydrogeomorphology to restore a landscape indicative of the presettlement Chicago Region. The project will ameliorate soils for each habitat type, improving the soil structure and composition of the project area. Similarly, the topography of the project area will be manipulated using these ameliorated soils. Overall, the cumulative impacts of the soils and topography of the study area will be beneficial to the human environment, water resources, and the ecosystem sustainability. The water quality in Southern Lake Michigan is considered to be very good. The proposed project would provide further natural filtration via the addition of the emergent marsh and macrophytes in the littoral lacustrine zone. The cumulative effects on water quality are expected to have a significant benefit to the human environment, water resources, and ecosystem sustainability.

Aquatic Resources

Cumulatively there are no adverse effects expected to the aquatic resources on and around Northerly Island. Northerly Island is a manmade peninsula in Southern Lake Michigan in an urban landscape that was once dominated by wetland habitat. Many aquatic species require wetlands for a variety of life history characteristics; including foraging, spawning, and refuge. The urbanization of the Chicagoland area has diminished many of the necessary wetland

habitats that these aquatic species need. The addition of the pond and emergent marsh on Northerly Island will greatly benefit the surrounding aquatic resources. It will provide important spawning and foraging habitat for a number of fish species as well as the state threatened mudpuppy. The wetland habitat will act as an attractant to many fish species and may increase recruitment to the surrounding areas. The cumulative future actions will greatly improve the aquatic resources and have great benefits to the human environment, water resources, and ecosystem sustainability.

Cultural & Historic Resources

Cumulatively there are no adverse effects expected to the cultural and historic resources on and around Northerly Island. Clearance has been provided by the Illinois Historic and Preservation Agency (letter dated February 8, 2012). Native American groups having an historic cultural interest in northeast Illinois have been consulted (letters dated January 27, 2012). The Kickapoo tribe of Kansas has responded and provided clearance (letter dated February 16, 2012). The project area has been used for a variety of functions including an airport and the current use as a passive recreational green space. As a green space, Northerly Island attracts urban residents for hiking, biking, bird watching, and fishing opportunities. The future action plans will enhance these opportunities by creating a more natural environment and creating habitat that is more conducive for bird and fish species. The cumulative effects would enhance the landscape and benefit human life by providing a natural habitat mosaic for people to experience and escape the city life.

Aesthetic Values

The current aesthetic value of Northerly Island is very minimal. The degraded prairie habitat that currently exists on the island is surrounded by mowed lawn speckled with a variety of invasive species. However, the project site provides a very aesthetic view of the city. Additional habitat types consisting of native vegetation will significantly increase the aesthetic value of the island by providing a more natural escape from the city. The view of the city skyline will not be disrupted. The future proposed actions will greatly benefit the surrounding community via the enhancement in aesthetics.

Public Facilities

Restoration of the Northerly Island will provide an enhanced outdoor experience for the surrounding community. The Educational potential of the restoration project is exceptional. The Chicago Park District, John G. Shedd Aquarium, Field Museum, and Adler Planetarium are likely to benefit from the restoration through educational and monitoring opportunities. There are no recreational features proposed under this project. The Chicago Park District's planned passive recreational features for the southern end of the Island are incongruence with restoring coastal habitat. These include walking trails, vista points and low impacting camping.

4.5.3 – Cumulative Effects Summary

The overall cumulative benefits of the Northerly Island restoration plan are positive. Benefits to the environmental, social, and economic sectors of the surrounding community are likely to occur. Social benefits will include increased educational and recreation opportunities for the

local community. As more people visit Northerly Island, the local economy will see increased spending at local gas stations and shops. However, the most important benefit is that to the local environment, especially macroinvertebrates, fish, the mud puppy and migratory birds. It is expected increased habitat types will cause observable increases in ecological integrity and biodiversity, adding to the already valuable region.

5.3 Compliance with Environmental Statutes

The plans presented in this integrated Environmental Assessment are in compliance with appropriate statutes, executive orders and memoranda including the Natural Historic Preservation Act of 1966; the Endangered Species Act of 1973; the Fish and Wildlife Coordination Act; Executive Order 12898 (environmental justice); Executive Order 11990 (protection of wetlands); Executive Order 11988 (floodplain management); and the Rivers and Harbors Act of 1899. The potential project is in compliance with the Clean Air Act; the Clean Water Act, and the National Environmental Policy Act of 1969.

5.3.1 Environmental Justice EO12898

To the greatest extent practicable and permitted by law, and consistent with the principles set forth in the report on the National Performance Review, each Federal agency shall make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations in the United States and its territories and possessions, the District of Columbia, the Commonwealth of Puerto Rico, and the Commonwealth of the Mariana Islands. The preferred plan would not have any adverse effects to any human being.

5.3.2 Clean Air Act

Due to the small scale, short duration and relatively unpolluted nature of the restoration project, it is assumed that the project is below the de minimis level of PM 100 tons per year. As a reference, other USACE projects that are much grander in scale and earthwork have GCA well below the PM 100 tons per year.

5.3.3 Section 401 & 404 of the Clean Water Act

A Section 404 analysis was completed for the preferred plan and is located in Appendix F. Features addressed by the 404 include the fill materials for the Lacustrine Littoral zone measure where cobble, gravel, sand and clean silts would be placed to mimic natural lake substrates. No adverse effects were determined.

Section 401 Water Quality Certification for the Lacustrine Littoral zone measure would be applied for once a set of 100% construction drawings are complete. There is no reason to expect this permit would not be received since the materials being used are inert and clean, and the feature itself would improve water quality via aquatic macrophyte and bacterial functions.

5.3.4 USFWS Coordination

Coordination with the USFWS commenced with a project scoping letter dated 27 January 2012. This environmental assessment identified the preferred ecological restoration plan was determined to have “no effects” on Federally endangered species or their habitats. It is anticipated that upon review of this document, the USFWS would preclude the need for further consultation on the Northerly Island Section 506 restoration project as required under Section 7 of the Endangered Species Act of 1973, as amended. The intent of the NER Plan is to aid in the overall restoration of the Lake Michigan coastal ecosystem, inclusive of threatened and endangered species. Coordination is documented in Appendix F.

5.3.5 State of Illinois Historic Preservation Act

Pursuant to Section 106 of the National Historic Preservation Act (16 U.S.C. § 4701) and 36 C.F.R. Part 800, the staff of the Illinois State Historic Preservation Officer (Illinois SHPO) has conducted an analysis of the materials dated 27 January 2012 and 07 February 2012. Based upon the documentation available, the staff of the Illinois SHPO has not identified any historic buildings, structures, districts, or objects listed in or eligible for inclusion in the National Register of Historic Places within the probable area of potential effects. Thusly, the SHPO has no objection to the work being performed under the NER Plan. All areas affected by ground disturbance under this project have already been previously disturbed; thusly an archaeological survey is unnecessary. This is in congruence with the SHPO letter dated 08 February 2012, which is located in Appendix F.

5.3.6 Finding of No Significant Impact (FONSI)

A FONSI was signed on ___ July 2012 after a 30-day public review was completed with a finding of no significant environmental effects. An Environmental Assessment was completed for the proposed measures at the Northerly Island restoration project which found no significant adverse effects to the resources on site. A 30-day Public Review period was held from 07 June 2012 to 07 July 2012 for the Environmental Assessment. There were ____ responses from state and federal agencies on the project. The proposed project is expected to be in full compliance with the National Environmental Policy Act, the Endangered Species Act, the Fish and Wildlife Coordination Act, the National Historic Preservation Act, the Clean Air Act, Sections 401 and 404 of the Clean Water Act, and the Corps of Engineer’s regulations.

CHAPTER 4 – DESCRIPTION OF THE RECOMMENDED PLAN

5.1 – Plan Components

The National Ecosystem Restoration (NER) Plan is the recommended plan, which is Alternative 5 (Plate 04). This alternative consists of six (measures): (LL) Lacustrine Littoral, (C) Geomorphic Contouring, (P) Pond, (EM) Emergent Marsh, (WP) Wet Prairie, (MP) Mesic Prairie and (S) Savanna. All of these community types would have been represented within the pre-settlement coastal zone within the Chicago Region. The implementation of these features is generally described as follows and according to the measures descriptions in Section 3.1. A detailed set of plans & specifications would be created if approval of this Detailed Project Report (DPR) is granted.

Site Preparation – The first task would be to install safety fencing and other safety features in order to keep the public out of the site during heavy construction. Staging areas and access roads would be demarcated. All surficial infrastructure and ornaments would need to be removed and discarded or stockpiled and saved depending on the CDP's needs and desires. The contractor may perform subsurface investigations as necessary to determine valuable materials for reuse and unusable debris for confinement or disposal if they want additional information as that provided by the soil borings collected in area of excavation for the pond.

Geomorphic Contouring – Once the site is ready for grading, the geomorphic features would be created. This grading would establish the hydrologic regime according to the particular native plant community the contours delimit. Test pits would be excavated during construction to classify material for reuse as surficial material or to be buried. All unsightly material that is not suitable for growing plants on or habitat would be reburied sufficiently beneath the mesic prairie and savanna plant communities; since these two community types would not be affected by conglomerate materials. About 260,000 cubic yards will be pushed around the site to achieve design contours.

Substrate / Amendment Placement – Pond and lake substrates would be placed as soon as grading is complete. About 6,600 cubic yards of mixed sand and alluvial gravels would be placed in a 1' thick layer within the pond. It is expected for emergent vegetation to creep down into some of the pond slopes to further stabilize the pond banks. Limestone flags would be used as mudpuppy habitat in the bottom of the pond around 4' deep and in areas along the bank where stabilization enforcement may be need. The mouth of the pond, where it connects to the lake, would also have a galvanized steel mesh fence that will rise just above the water line to prevent large invasive species such as common carp and non-native Salmonids from entering the pond ecosystem.

Materials for the Lacustrine Littoral (LL) feature would be placed by small barge. The jersey barriers would be set up first as a retaining wall, then back-filled with a band natural rounded cobbles for lithophilic spawners and a band of sandy silt for submergent macrophyte establishment that are both 1" thick. A temporary (5-year) adult common carp barrier (fence/net) would be placed around this area to prevent uprooting the young macrophytes prior to establishing.

Once grading is complete, to ameliorate the unnatural soil conditions of the site for proper biogeochemical cycling, a soil amendment consisting of leaf compost will be incorporated into the top 6" of soil for emergent marsh and wet prairie communities. Incorporating a soil amendment will decrease bulk density and increase soil organic matter, while enhancing microbial communities and stimulating vegetative diversity.

Native Plant Community Establishment – The finishing touch of the project would be to establish native plant communities over the remainder of the construction period. These communities would be located according to the new hydrogeomorphology, soils and substrates established by the previous steps. The complete planting list may be viewed on Plate 05. Once in the 2nd year of restoration and the initial seeding complete, the site may be open back to the public since very few activities would be occurring, which are considered low impact. These include spot herbicide application and planting native plugs, which are very similar to home gardening activities.

Recreational Features – Components of recreation are not proposed under this project. The CPD has coordinated their passive recreational feature plans which include signage, mowed pathways, small board walks, and a small one acre mowed camping zone. None of these features would affect expected ecosystem benefits.

5.2 – Plans & Specifications

During the design phase, a detailed set of plans and specifications will be fashioned in order to solicit and award a construction contract. Also, prior to finalization of the plans and specifications, assurance will be made that all areas to be prepared by the non-Federal sponsor shall be in compliance with ER 1165-2-132, Federal, State, and local regulations. A schedule, quality control plan, and labor estimate was fashioned along the FS QCP for the plans and specifications phase; if approval is granted to this project, the QCP would continue to be followed.

5.3 – Real Estate

The current non-Federal LERRDs credit is estimated based on the gross appraisal in Appendix D, Real Estate, which is \$10,000.

5.4 – Operation and Maintenance

The O&M costs of the project are estimated to total an annual cost of \$7,500 with a 4.875% interest rate over 50 years. Slope maintenance includes the addition of stone or soil in certain areas that experienced minor erosion. Natural plant community maintenance includes the prevention of non-native and exotic species colonization and the addition of native species overtime. A detailed O&M Manual containing all the duties will be provided to the non-Federal sponsor after construction is closed out.

5.5 – Monitoring Plan

Section 2039 of WRDA 2007 directs the Secretary to ensure that when conducting a feasibility study for a project (or a component of a project) for ecosystem restoration that the

recommended project includes a plan for monitoring the success of the ecosystem restoration. Within a period of ten years from completion of construction of an ecosystem restoration project, monitoring shall be a cost-shared project cost.

A five year monitoring plan following completion of construction will be implemented for Northerly Island (Appendix E). The USACE, Chicago District will conduct monitoring to determine the success of the project. The primary goal of the Northerly Island project is restore lacustrine, coastal wetland, and other coastal plant habitats in support of Great Lakes fishes, amphibians, reptiles, and migratory bird species. Baseline data for current conditions on Northerly Island are detailed in the DPR. The following specific objectives were established for monitoring the effectiveness of this project:

- Improve native fish species richness, evenness, and diversity. Shannon- Wiener Index will be used to determine diversity and evenness.
 - Target richness= **≥15**
 - Target evenness= **≥ 0.7**
 - Target diversity= **≥ 1.9**
- Improve macroinvertebrate species richness, evenness, and diversity. Target values are hard to determine since no baseline data is available. Instead we will track the progression of these indices through time.
- Improve native plant species richness and assemblage structure as measured by coefficient of conservatism of the Chicago Region Floristic Quality Index: Target Overall Mean C Score = **≥5**.
- Eradicate / reduce the presence of non-native and invasive species: Target Invasive Species Eradication Percentage = **<1% Areal Coverage**.

5.6 – Division of Responsibilities

As established in PL99-662, as amended, project costs are shared with the non-Federal sponsor in accordance with project outputs. The Chicago Park District has agreed to serve as the local cost-sharing sponsor for the Northerly Island 506 Great Lakes Fishery & Ecosystem Restoration project. The cost-sharing requirements and provisions will be formalized with the signing of the Project Partnership Agreement (PPA) between the local sponsor and USACE prior to initiation of contract award activities. In this agreement, the local sponsor will agree to pay 35 percent of the total project costs. Based on the cost sharing requirements, the total project cost and pertinent cost-sharing information for the restoration project are summarized in Tables 6 and 7.

Table 6 – Total Project Cost*.
INTENTIONALLY REMOVED

*All costs input from the Certified TPC by the Walla Walla Cost TCX on 05 April 2012 except LERRDs which were derived from the Real Estate Plan Appendix D; includes 24% contingency

Table 7 – Cost Sharing Breakout in 1000's*.
INTENTIONALLY REMOVED

*All costs input from the Certified TPC by the Walla Walla Cost TCX on 05 April 2012 except LERRDs which were derived from the Real Estate Plan Appendix D; includes 24% contingency

Responsibilities

Federal - The estimated Federal cost share of the project is about \$ [REDACTED]. The USACE would accomplish the plans and specifications phase, which includes additional design studies and plans and specifications, contract for construction, overall supervision during construction, prepare an operation and maintenance manual, and participate in a portion of the post construction monitoring.

Non-Federal Responsibilities - Prior to initiation of the design phase, the Federal Government and the non-Federal sponsor will execute a PPA. The LERRDs and OMRR&R of the project will be the responsibility of the non-Federal sponsors for the proposed project. The estimated non-Federal share of the total first cost of the project is about \$ [REDACTED] and will be covered by LERRDs credit of \$ [REDACTED] and a cash contribution of \$ [REDACTED]. In addition to the total first cost, the feasibility level operations and maintenance costs of the project are estimated to total an annual cost of \$ [REDACTED]. The non-Federal sponsors shall, prior to implementation, agree to perform the following items of local cooperation:

1. Provide 35 percent of the separable project costs allocated to environmental restoration as further specified below
 - a) Provide the non-Federal share of all complete planning and design work upon execution of the PCA
 - b) Provide all lands, easements, and rights-of-way, including suitable borrow and dredged or excavated material disposal areas, and perform or ensure the performance of all relocations determined by the government to be necessary for the construction and O&M of the project
 - c) Provide or pay to the government the cost of providing all features required for the construction of the project
 - d) Provide, during construction, any additional costs as necessary to make its total contribution equal to 35 percent of the separable project costs allocated to environmental restoration

2. Contribute all project costs in excess of the USACE implementation guidance limitation of \$10,000,000
3. For so long as the project remains authorized, operate, maintain, repair, replace, and rehabilitate the completed project or the functional portion of the project at no cost to the government in accordance with applicable federal and state laws and any specific directions prescribed by the government
4. Give the government a right to enter, at reasonable times and in a reasonable manner, upon land that the local sponsor owns or controls for access to the project for the purpose of inspection and, if necessary, for the purpose of completing, operating, maintaining, repairing, replacing, or rehabilitating the project
5. Assume responsibility for operation, maintenance, repair, replacement, and rehabilitation (OMRR&R) of the project or completed functional portions of the project, including mitigation features, without cost to the government in a manner compatible with the project's authorized purpose and in accordance with applicable federal and state laws and specific directions prescribed by the government in the OMRR&R manual and any subsequent amendments thereto
6. Comply with Section 221 of Public Law (P.L.) 91-611, Flood Control Act of 1970, as amended, and Section 103 of the WRDA of 1986, as amended, which provides that the Secretary of the Army shall not commence the construction of any water resource project or separable element thereof until the nonfederal sponsor has entered into a written agreement to furnish its required cooperation for the project or separable element
7. Hold and save the United States free from damages due to construction of or subsequent maintenance of the project except those damages due to the fault or negligence of the United States or its contractors
8. Keep and maintain books, records, documents, and other evidence pertaining to costs and expenses incurred pursuant to the project to the extent and in such detail as will properly reflect total project costs
9. Perform or cause to be performed such investigations for hazardous substances that are determined necessary to identify the existence and extent of any hazardous substances regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 *U.S. Code* 9601 through 9675, that may exist in, on, or under lands, easements, or rights-of-way necessary for the construction, and O&M of the project, except that the nonfederal sponsor shall not perform investigations of lands, easements, or rights-of-way that the government determines to be subject to navigation servitude without prior written direction by the government
10. Assume complete financial responsibility for all necessary cleanup and response costs for CERCLA-regulated material located in, on, or under lands, easements, or rights-of-way that the government determines necessary for the construction and O&M of the project
11. To the maximum extent practicable, conduct OMRR&R of the project in a manner that will not cause liability to arise under CERCLA
12. Prevent future encroachment or modifications that might interfere with proper functioning of the project
13. Comply with the applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, P.L. 91-646, as amended in Title IV of the Surface Transportation and Uniform Relocation Assistance Act of 1987, P.L. 100-17, and the uniform regulation contained in Part 24 of Title 49, *Code of Federal Regulations* (CFR), in acquiring lands, easements, and rights-of-way for construction and subsequent O&M of the project, and inform all affected persons of applicable benefits, policies, and procedures in connection with said acts
14. Comply with all applicable federal and state laws and regulations, including Section 601 of Title VI of the Civil Rights Act of 1964, P.L. 88-352, and Department of Defense Directive 5500.11 issued pursuant thereto and published in 32 CFR, Part 300, as well as Army Regulation 600-7 entitled "Non-Discrimination on the Basis of Handicap in Programs and Activities Assisted or Conducted by the Department of the Army"

15. Provide 35 percent of that portion of the total cultural resource preservation, mitigation, and data recovery costs attributable to environmental restoration that are in excess of 1 percent of the total amount authorized to be appropriated for environmental restoration
16. Do not use federal funds to meet the nonfederal sponsor's share of total project costs unless the federal granting agency verifies in writing that the expenditure of such funds is expressly authorized by statute

Financial Capability of Sponsor

In accordance with regulation ER1105-2-100, Appendix D, where the non-Federal sponsor's capability is clear, as in the instances where the sponsor has sufficient funds currently available or has a large revenue base and a good bond rating, the statement of financial capability need only provide evidence of such. The non-Federal sponsor is committed to its specific cost share of the Design & Implementation (D&I) Phase, and expresses willingness to share in the costs of construction to the extent that can be funded.

CHAPTER 6 – RECOMMENDATION

I have considered all significant aspects of the problems and opportunities as they relate to the project resource problems of Northerly Island. Those aspects include environmental, social, and economic effects, as well as engineering feasibility.

I recommend Alternative 5, which consists of establishing a diverse coastal habitat mosaic at Northerly Island. The recommended plan has a total project cost of approximately \$ [REDACTED] (2012 price levels). This plan provides 205 net average annual habitat units over 40-acres of coastal zone. All costs associated with the restoration and preservation of the Northerly Island ecosystem has been considered.

Frederic A. Drummond Jr.
Colonel, U.S. Army
District Commander

MEMORANDUM FOR CELRC-PM-PM (Buczak)**SUBJECT: HTRW and non-HTRW Report for Northerly Island Restoration GLFER**

1. Enclosed is the HTRW investigation report for the Northerly Island Restoration Great Lakes Fishery and Ecosystem Restoration (GLFER) Section 506 project. The investigation was performed as part of the Planning and Design Analysis phase of the project. The investigation was based on a database research, review of historical images and existing information, and a site visit. All work was performed between February and June 2012. The significant findings and necessary actions recommended in this investigation are summarized below.
2. Review of a Database Search identified several LUSTs directly adjacent to the project site. Investigations related to the "Signature Flight Support" jet fuel LUST revealed LUST-related contamination was confined to the immediate tank bed area, which is located outside the project work limits, and as such, this LUST does not post a concern to the project.
3. Existing soil samples have been concluded to show low concentrations of the polycyclic aromatic hydrocarbons (PAHs) typically found in urban areas. Although many of these samples exceeded TACO residential closure objectives for certain PAHs, the average concentrations in these samples were less than the metropolitan background concentration for the City of Chicago, and as such represent the typical conditions and not any particular source of contamination. These samples were also compared to Calumet Area Ecotoxicology Protocol, and found to be protective of biological receptors at the site. These samples only represent a portion of the project site, but there is very low risk that other portions of the project site contain significantly greater concentrations of contaminants due to the fact that no contaminant sources are located on the remaining portions of the site. Existing soil borings indicate small amounts of debris and deleterious materials are intermixed with soils at the site.
4. The plan for construction is to achieve a zero balance of cut and fill, in order to eliminate disposal costs associated with these materials. Due to Illinois CCDD requirements, materials may not be acceptable for off-site reuse based on debris content. Although existing data indicates the material has concentrations of anthropogenic compounds less than the metropolitan background, the CCDD regulations also require environmental testing before removal to ensure the material meets this standard. If any excess material is required to be removed from the site and does not meet the CCDD requirements, the material would be required to be landfilled.
5. Additional soil borings are planned to be conducted to confirm the soil conditions in the area of excavation. The soil borings would include field identification of soil type, as well as screening for the presence of volatile compounds by use of a photoionization

detector (PID). If these borings reveal unexpected soil conditions that will have an HTRW-related impact to the project, this HTRW investigation will be revised at that time.

6. No environmental site assessment can wholly eliminate uncertainty regarding the potential for recognized environmental conditions associated with a project area. Performance of the environmental site assessment is intended to reduce, but not eliminate, uncertainty regarding the potential for recognized environmental conditions in connection with a project area, while recognizing time and cost constraints.
7. If there are any questions regarding this HTRW investigation, please contact Jennifer Raber at (312) 846-5504, jennifer.r.raber@usace.army.mil.

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JAY A. SEMMLER, P.E.
Chief, Hydraulic & Environmental
Engineering Section

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**HAZARDOUS, TOXIC, AND RADIOACTIVE WASTE (HTRW) AND
NON-HTRW INVESTIGATION**

**NORTHERLY ISLAND RESTORATION GREAT LAKES FISHERY AND
ECOSYSTEM RESTORATION (GLFER) PROJECT, SECTION 506
CHICAGO, IL**

Hydraulic and Environmental Engineering Section (TS-DH)
U.S. Army Corps of Engineers, Chicago District

June 2012

**HAZARDOUS, TOXIC, AND RADIOACTIVE WASTE (HTRW) AND NON-HTRW
INVESTIGATION
NORTHERLY ISLAND RESTORATION GLFER**

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INTRODUCTION

The purpose of this report is to discuss the Phase I Environmental Site Assessment for the Northerly Island Restoration Great Lakes Fishery and Ecosystem Restoration (GLFER), Section 506 project. This report identifies Recognized Environmental Conditions (RECs) and presents appropriate measures to resolve the issues. The methods used in performing the investigation are described in detail. Conclusions and recommendations regarding potential impacts due to RECs associated with the project sites are provided.

AUTHORITY

Engineer Regulation (ER) 1165-2-132, Hazardous, Toxic, and Radioactive Waste (HTRW) Guidance for Civil Works projects, requires that a site investigation be conducted as early as possible to identify and evaluate potential HTRW problems. According to ER 1165-2-132, non-HTRW issues that do not comply with the federal, state, and local regulations should be discussed in the HTRW investigation along with HTRW issues. Therefore, HTRW and non-HTRW issues identified are discussed in this report.

The Phase I Environmental Site Assessment (ESA) presented in this report was conducted during the feasibility phase of the project and was performed at the level of detail required for a Reconnaissance Phase investigation. As stated in the ER 1165-2-132, an initial assessment as appropriate for a Reconnaissance Study should be conducted as a first priority for projects with no prior HTRW consideration. If the initial assessment indicates the potential for HTRW, testing, as warranted, and analysis similar to a Feasibility Study should be conducted prior to proceeding with the project design.

GUIDANCE

Supplemental guidance was provided by the Standard Practice for Environmental Assessments: Phase I Environmental Site Assessment Process (Designation: E 1527-05) prepared by the American Society for Testing of Materials (ASTM). The guidance defines a standard of good commercial and customary practice for conducting an environmental site assessment of a parcel of property; the goal of the process established by this practice is to identify Recognized Environmental Conditions (RECs) through a records review, site visit, interviews, and report preparation. This report followed many of the ASTM E 1527-05 guidelines but not to the same level of detail described by the ASTM E 1527-05 guidance.

Hazardous, Toxic, and Radioactive Waste

The objective of ER 1165-2-132 is to outline procedures to facilitate early identification and appropriate consideration of HTRW problems.

Non-Hazardous, Toxic, and Radioactive Waste

According to ER 165-2-132, non-HTRW environmental issues that do not comply with federal, state and local regulations should be discussed in the HTRW investigation along with HTRW issues. For example, solid waste is a non-HTRW issue considered. Petroleum releases from Leaking Underground Storage Tanks (LUSTs) are not considered HTRW, but are regulated under the Illinois Administrative Code (IAC), Title 35, Part 731 - Underground Storage Tanks, Part 732 - Petroleum Underground Storage Tanks, and Part 742 - Tiered Approach to Corrective Action Objectives (TACO). These sites have the potential to impose environmental hazards. Non-HTRW problems identified during the investigation are also discussed in this report, along with resolutions and/or recommendations for resolving the issue.

LAWS AND REGULATIONS

Federal

The definition of HTRW according to ER 1165-2-132, page 1, paragraph 4(a) is as follows: “Except for dredged material and sediments beneath navigable waters proposed for dredging, for purposes of this guidance, HTRW includes any material listed as a ‘hazardous substance’ under the Comprehensive Environmental Response, Compensation and Liability Act, 42 U.S.C. 9601 et seq (CERCLA). (See 42 U.S.C. 9601(14).) Hazardous substances regulated under CERCLA include ‘hazardous wastes’ under Sec. 3001 of the Resource Conservation and Recovery Act, 42 U.S.C. 6921 et seq; ‘hazardous substances’ identified under Section 311 of the Clean Air Act, 33 U.S.C. 1321, ‘toxic pollutants’ designated under Section 307 of the Clean Water Act, 33 U.S.C. 1317, ‘hazardous air pollutants’ designated under Section 112 of the Clean Air Act, 42 U.S.C. 7412; and ‘imminently hazardous chemical substances or mixtures’ on which EPA has taken action under Section 7 of the Toxic Substance Control Act, 15 U.S.C. 2606; these do not include petroleum or natural gas unless already included in the above categories. (See 42 U.S.C. 9601(14).)”

As stated in the definition of hazardous substance in the Environmental Statutes, 1988 Edition, the term does not include petroleum, including crude oil or any fraction thereof, which is not otherwise specifically listed or designated as a hazardous substance under the definition. Underground Storage Tanks (USTs) are federally regulated under 40 CFR Part 280, which includes technical standards and corrective action requirements for owner and operators of USTs.

State

The Illinois State regulations were examined to determine which regulations governed the state specific hazardous waste disposal, release, and cleanup requirements. Illinois regulates USTs under Illinois Administrative Code, Title 35, Subtitle G, Chapter I, Subchapter D, Part 731, Underground Storage Tanks. The definition of a regulated substance under this regulation means any “hazardous substance” or “petroleum.” Hazardous substance UST is defined as an UST system that contains a “hazardous substance,” or any mixture of “hazardous substances” and

“petroleum” which is not a petroleum UST system. Petroleum UST means any UST system that contains petroleum or a mixture of petroleum with minimal quantities of other regulated substances. Owners and operators of petroleum or hazardous substance UST systems must comply with the requirements of Part 731 except for USTs excluded under Section 731.110(b) and UST systems subject to RCRA corrective action requirements under 35 Ill. Adm. Code 724.200, 724.296, 725.296 or 725 Subpart G.

SITE DESCRIPTION

The Northerly Island Restoration project site is located in Cook County, Illinois on the shore of Lake Michigan (see Figure 1). The site is a man-made peninsula owned by the Chicago Park District. The site is located to the south of Chicago’s “Museum Campus”, and provides protection to Burnham Harbor located to the west. The entirety of Northerly Island is approximately 91 acres, and the current restoration site footprint is located on the southern 40 acres of the peninsula (see Figure 2). This portion of the peninsula primarily consists of open space with native and non-native plants, some trees, and a paved path, although several remnant buildings are also present from the site’s previous use as an airport.

Figure 1: Northerly Island Restoration Vicinity Map

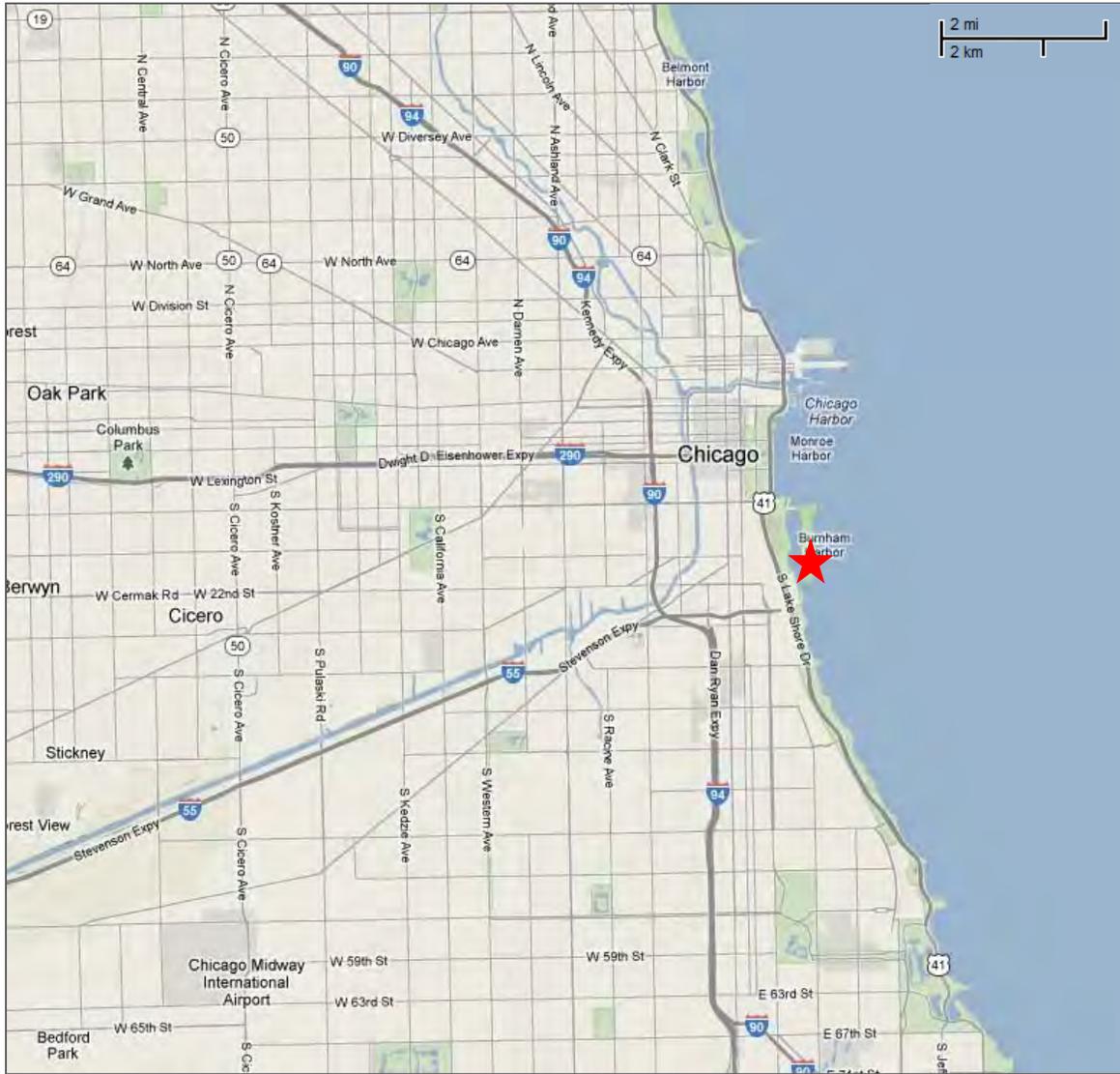
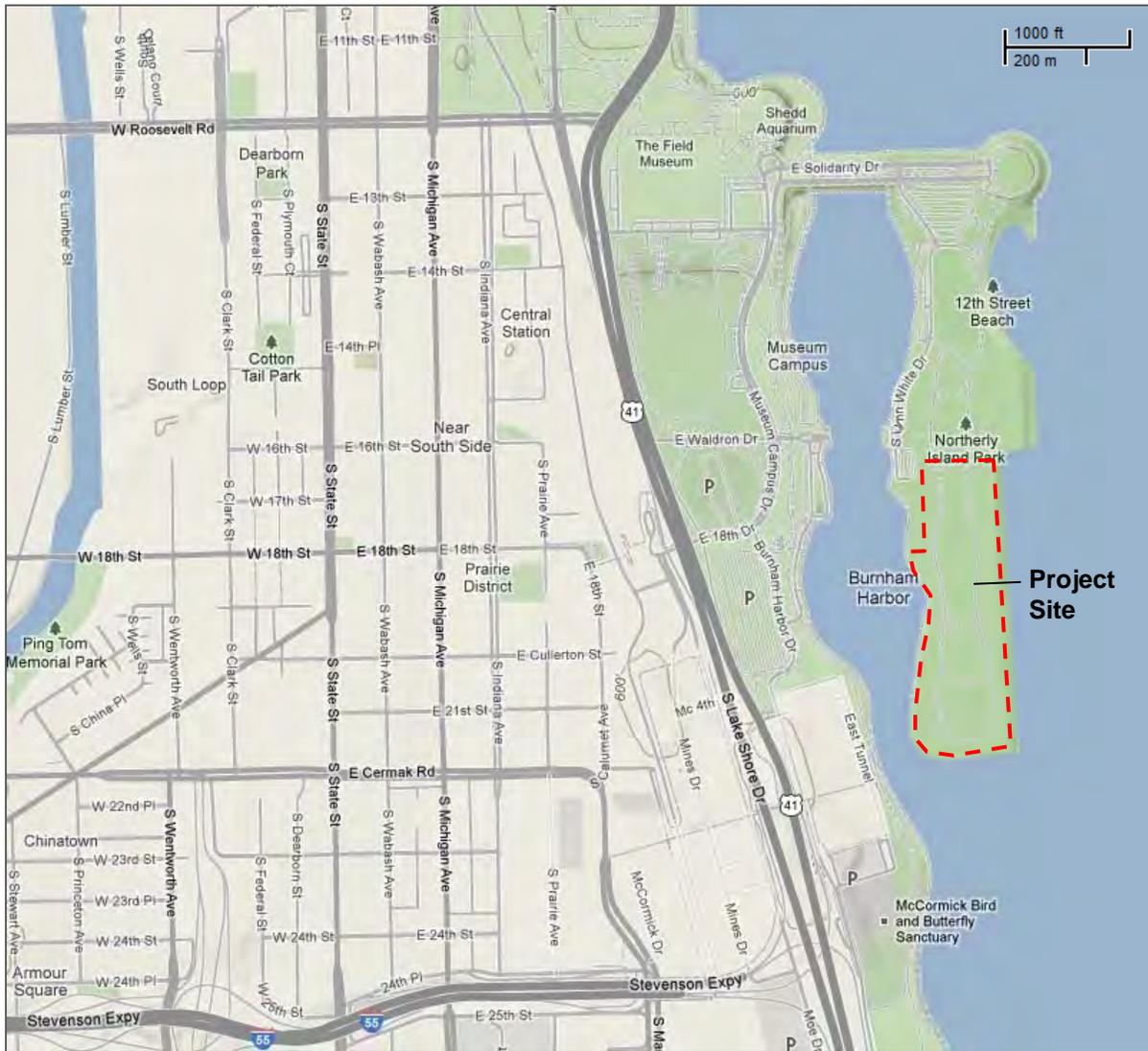


Figure 2: Northerly Island Restoration Project Site Location Map



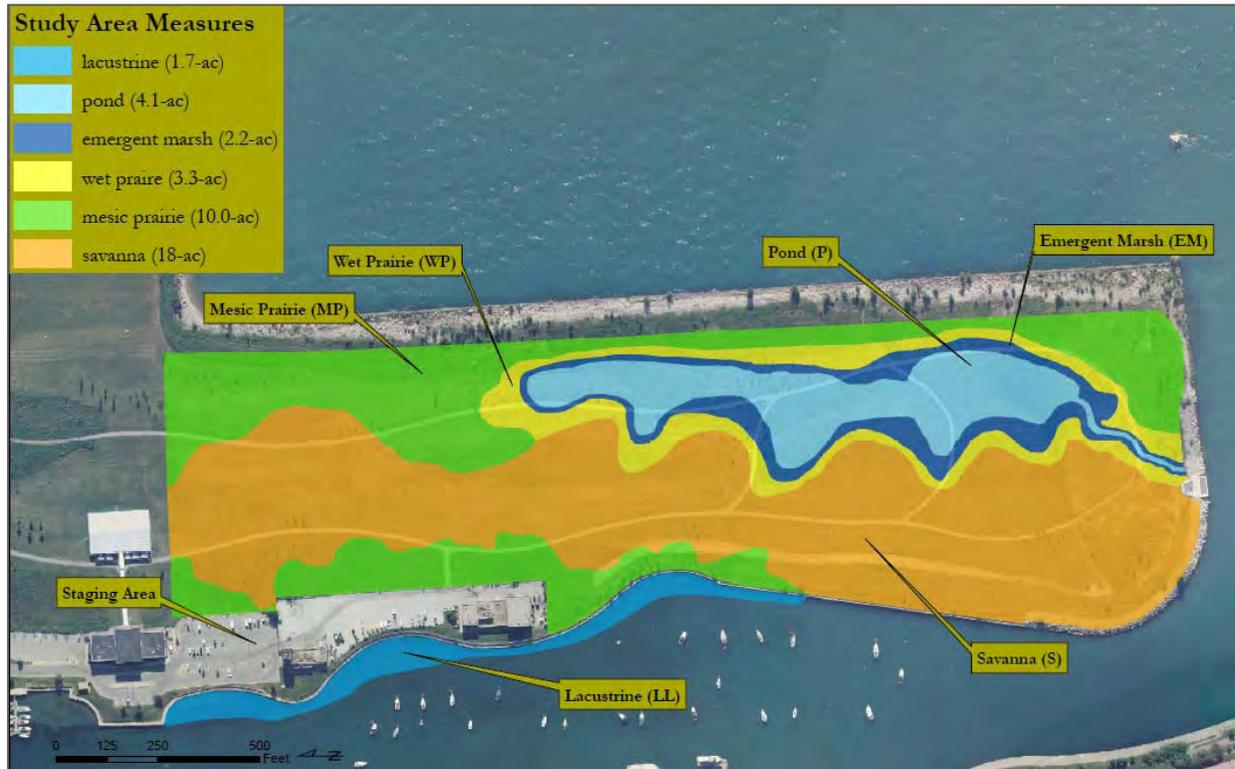
PROJECT DESCRIPTION

The Northerly Island Restoration project is intended to restore lacustrine, coastal wetland, and other coastal plant communities in support of Great Lakes fishes, amphibians, reptiles, and migratory bird species. The methods proposed to be used in completing this restoration include:

- Add a pond with deeper holes and fringing wetlands to create lacustrine habitat heterogeneity.
- Provide connectivity from the wetland to Lake Michigan to allow proper access by native fish.
- Establish a screen to minimize the migration of invasive species into the wetland habitat.
- Eradicate non-native plant species.
- Plant native coastal plant species.

The final proposed site layout is shown in Figure 3.

Figure 3: Proposed Site Layout



GENERAL METHODS

This assessment relies primarily on the location of regulated sites within the immediate vicinity of the project area identified in the database search, a review of existing information and historical images, and information gathered during a site visit. The following sections contain information that was gathered in accordance with ER 1165-2-132. The information was obtained from:

- Review of existing [historical](#) information.
- Review of historical aerial photographs, topographic maps, and Sanborn maps provided by EDR.
- Database search performed by Environmental Data Resources, Inc. (EDR)
- [Review of existing environmental data.](#)
- Observations made during a site visit on March 22, 2012.

REVIEW OF EXISTING INFORMATION

Information gathered by PM-PL for the project Environmental Assessment (EA) was reviewed to gain an understanding of the history of the site. According to this information, Northerly Island is a completely artificial man-made island created by the deposition of clean lake sand dumped

within a crib placed in Lake Michigan. The design for Northerly Island was included in Daniel Burnham's 1909 "Plan of Chicago", but construction did not begin until 1920, finishing in 1925. Briefly utilized as parkland, the island served as the site of the 1933-1934 "Century of Progress: World's Fair." Plans to locate an airport on the island were proposed after the fair, and in the early 1940's approximately 26 acres were added to the southern end of the island for the airport runways. The airport, Meigs Field, operated from 1946 until 2002 when it was closed by the city. The runways and most airport-related structures were later demolished. Since then, the island has been converted to open green space by the Chicago Park District.

REVIEW OF HISTORICAL AERIALS, TOPOS, AND SANBORNS

Historical aerial photographs, USGS topographic maps, and Sanborn fire insurance maps of the site were obtained from EDR for review and comparison. EDR provided aerial photographs from the years 1952, 1963, 1972, 1983, 1988, 1994, 1999, 2005, and 2007, topographic maps from the years 1901, 1929, 1953, 1963, and 1998, and Sanborn maps from 1933, 1988, 1990, 1992, 2002, and 2004.

The 1933 Sanborn map showed the location of buildings and structures for the World's Fair, all of which have since been removed from the project site.

Topographic maps showed how the southern end of the island was expanded southward and eastward to create Meigs Field in the 1940's (see Figures 4-5). Material to be excavated for pond construction will be taken only from the later-constructed portion of the island.

Aerials photographs of Meigs Field (see Figure 6) showed several airport buildings to be located on the western edge of the island, some of which have since been removed. Airplanes parked along the western edge of the island as well. The airport runway was located in the area where pond excavation is planned to occur.

The Yacht Club building on the west bank of the island (north of the airport) appears to have been constructed between 1952 and 1963. Almost no boat moorings were seen in the harbor in the 1952 aerial, but there was a steady increase in boat mooring capacity over the years of the aerial photographs.

Figures 4 – 5: 1929, 1953 Topographic Maps

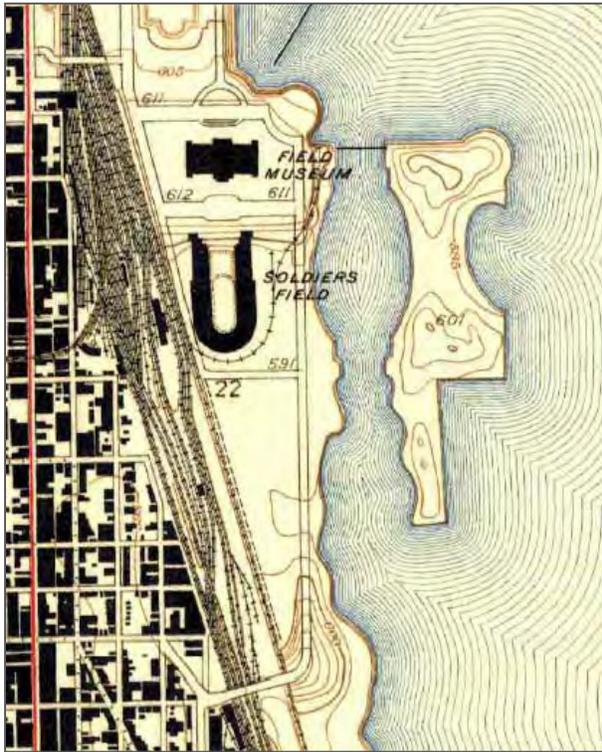


Figure 6: 1999 Aerial Photograph, Meigs Field



DATABASE SEARCH

A search of available environmental records was conducted utilizing the services of Environmental Database Resources, Inc. (EDR). EDR searched federal and state databases using

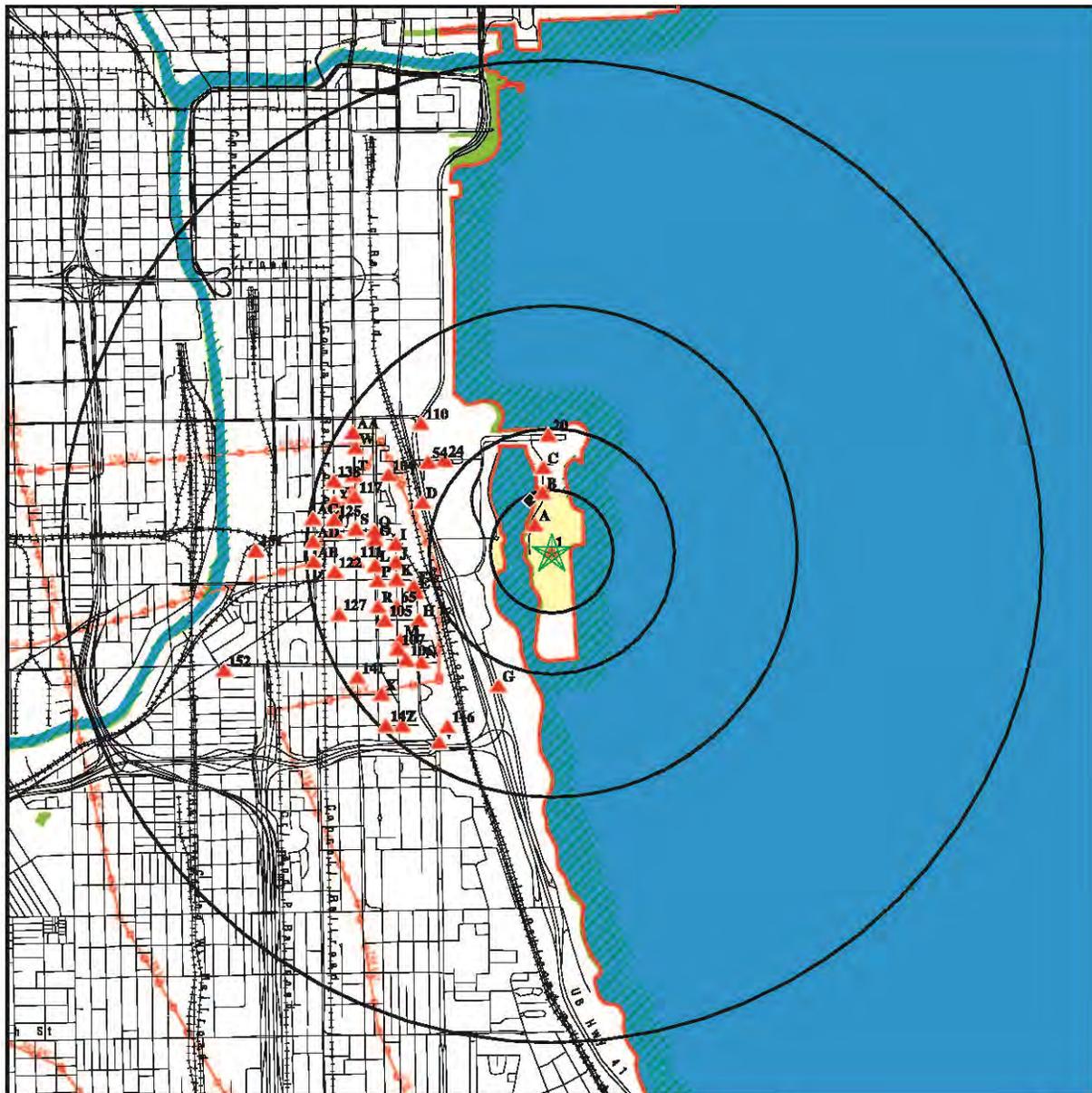
the minimum search distances issued in the ASTM E 1527-00 guidelines. Table 1 notes the recommended ASTM search distance for federal and state databases. The search was centered roughly on the middle of the Northerly Island peninsula, and all radii were expanded by ½ mile to cover the entire 1-mile long peninsula. Although this project only involves work on the southern half of Northerly Island, future projects are anticipated to involve the northern half as well, and may utilize this database search in their HTRW investigations. Database search tools on IEPA’s website were also used to gain additional information for results returned in the EDR search, and a FOIA request was submitted to IEPA for detailed information on potential sites of concern.

Table 1: Minimum Search Distance for Federal and State Database Searches

Database	Approximate Minimum Search Distance (mi)
Federal NPL Site List	1.0
Federal CERCLIS List	0.5
Federal CERCLIS NFRAP site list	Property and Adjoining Properties
Federal RCRA CORRACTS Facilities List	1.0
Federal RCRA non-CORRACTS TSD Facilities List	0.5
Federal RCRA Generators List	Property and Adjoining Properties
Federal ERNS List	Property Only
State Equivalent NPL	1.0
State Equivalent CERCLIS	0.5
State Landfill/Solid Waste Disposal Site Lists	0.5
State LUST Lists	0.5
State registered UST List	Property and Adjoining Properties

The EDR overview map displaying the project area and the search results are given in Figure 7. A great number of sites were returned in the database search, however, the majority of these are located inland from Northerly Island. Sites not located on the peninsula itself are hydrologically disconnected from the project site, and therefore are not considered to be a concern. The inland search results were briefly reviewed for sites that may have been incorrectly mapped, but were otherwise disregarded from further investigation. Additional “orphan” sites were returned by the search, but were not mapped due to poor or inadequate address information. These site locations were verified using online maps, and none were found to be located on the Northerly Island peninsula.

Figure 7: EDR Overview Map



- ★ Target Property
- ▲ Sites at elevations higher than or equal to the target property
- ◆ Sites at elevations lower than the target property
- ▲ Manufactured Gas Plants
- 🚚 National Priority List Sites
- 🏠 Dept. Defense Sites
- 🏠 Indian Reservations BIA
- 📏 County Boundary
- ⚡ Power transmission lines
- 🛢️ Oil & Gas pipelines from USGS
- 🌊 100-year flood zone
- 🌊 500-year flood zone
- 🌿 National Wetland Inventory

This report includes Interactive Map Layers display and/or hide map information. The legend includes only those icons for the default map view.

<p>SITE NAME: Northerly Island ADDRESS: S Lynn White Dr Chicago IL 60605 LAT/LONG: 41.8596 / 87.6085</p>	<p>CLIENT: U.S. Army Corps of Engineers CONTACT: Jennifer Faber INQUIRY #: 3259952.2s DATE: February 16, 2012 2:01 pm</p>
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CERCLIS

The Comprehensive Environmental Response, Compensation, and Liability, Information System (CERCLIS) contains data on any potential hazardous waste site that has been reported by states, municipalities, private companies, or private persons pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). The CERCLIS database indicates the stages of evaluation and remediation that have been completed for any given site. The CERCLIS database includes the National Priority List (NPL), which identifies over 1,200 sites for priority cleanup under the Superfund program, and the CERCLIS-No Further Remedial Action Planned (NFRAP) List, which includes a listing of sites that have been removed from CERCLIS, for various reasons.

The database search located three CERC-NFRAP sites within the search distance. However, none of the three were located on the Northerly Island peninsula, and therefore are not considered in greater detail for this investigation.

RCRIS

The Resource Conservation and Recovery Information System (RCRIS) lists sites which generate, transport, store, and/or dispose of hazardous waste defined by the Resource Conservation and Recovery Act (RCRA). The RCRIS database includes the RCRA Corrective Action Report (CORRACTS) that identifies hazardous waste handlers with RCRA corrective action activity, RCRA treatment, storage, and disposal facilities (TSDFs), RCRA conditionally exempt small quantity generators (CESQGs), RCRA small quantity generators (SQGs), RCRA large quantity generators (LQGs), and RCRA non-generators (NonGen) that do not presently generate hazardous waste.

The database search located one RCRA-CORRACTS facility, sixteen RCRA-SQG facilities, eighteen RCRA-CESQG facilities, and nine RCRA-NonGen facilities within the search distance. Of these, four facilities were located on the Northerly Island peninsula, and are summarized in Table 2 below. There were no violations reported for these facilities. All four facilities also appeared in the FINDS database. The Burnham Park Yacht Club and Chicago Park District sites also appeared in the HWAR (Hazardous Waste Annual Report) database discussed later in this report. The Signature Flight Support and Burnham Park Yacht Club sites also appeared in the LUST database, and are discussed in greater detail later in this report. The Chicago Fire Department site was mapped at a location just under ¼ mile north of the project site. However, the historical Sanborn maps indicated the Fire Department had a building to the south of the Airport Terminal Building, which would be located directly west of the project site. Regardless, none of these sites appear to pose any RCRA-related concern for the project, as they have received no RCRA violations.

Table 2: RCRIS Search Results

Database	Map ID	Site Name	Proximity to Site (Address)	Status
NonGen, FINDS, LUST	A3	Signature Flight Support	Directly west (15 th St and Lakefront)	Former LQG; No violations
SQG, FINDS	B14	Chicago Fire Dept Meigs Field	Directly west (1500 S Lynn White Dr)	No violations
NonGen, FINDS, HWAR, UST, LUST	B12	Burnham Park Yacht Club	<¼ mile north (1500 S Linn White Dr)	Former LQG; No violations
SQG, FINDS, HWAR	C17	Chicago Park District	¼ mile north (1400 S Lynn White Dr)	No violations

ERNS

The Emergency Response Notification System (ERNS) database lists information on reported releases of oil and hazardous substances. The database search located no ERNS sites within the search distance.

SSU

The Illinois EPA's State Sites Unite (SSU) is the state-equivalent CERCLIS list. These sites may or may not have already been listed on the federal CERCLIS list. The State Response Action Program database identifies the status of all sites under the responsibility of the SSU. The database search located three SSU sites within the search distance. However, none of the three were located on the Northerly Island peninsula, and therefore are not considered in greater detail for this investigation.

SWF/LF

The IEPA records the state's Solid Waste Facilities/Landfill sites (SWF/LF). These sites may be active or inactive facilities or open dumps that failed to meet RCRA Subtitle D Section 4004 criteria for solid waste landfills or disposal sites. The database search located no SWF/LF sites within the search distance.

LUST/UST

The Illinois State Fire Marshall maintains a listing of registered underground storage tanks (UST), as required by RCRA Subtitle I. The Illinois Environmental Protection Agency maintains a listing of leaking underground storage tank reports (LUST). The database search located 35 UST, 43 LUST, and one LUST TRUST facility within the recommended search distances. Of these, five UST and four LUST sites were located on the Northerly Island peninsula. Two LUSTs listed as "City of Chicago Airport" were mapped on the peninsula, but further investigation revealed these were actually located at O'Hare Airport. These facilities are summarized in Table 3. All other facilities were excluded from further investigation.

Table 3: UST/ LUST Search Results

Database	Map ID	Site Name	Proximity to Site (Address)	Status
LUST, RCRA-NonGen, FINDS	A2-3	Signature Flight Support	Directly west (15 th St & Lakefront)	1 jet fuel tank leak 1993, high priority
LUST	A7	City of Chicago	Directly west? (15 th & Lake Michigan, Meigs Field)	1 fuel oil leak reported 1992; no evidence of leak found
UST	A8	Butler Aviation – Meigs Field	Directly west? (15 th & Lakefront)	7 USTs removed
UST	1	Northerly Island – Maintenance Building	Directly west? (1521 S Linn White Dr)	3 USTs removed, 1 out of service
UST	A6	City of Chicago Department of Aviation	Directly west? (1521 S Lynn White Dr)	1 UST removed, 1 currently in use?
LUST	10	City of Chicago, Meigs Field Terminal Bldg	Directly north (15 th St at Lake Michigan)	Other petro leak reported 1998 NFA/NFR: 9/17/1999
UST, LUST, RCRA-NonGen, FINDS, HWAR	B11	Burnham Park Yacht Club	<¼ mile north (1500 S Linn White Dr)	1 gasoline leak reported 1990; 5 USTs removed
UST	D23	Dept Aviation Meigs Field	Unknown (1500 S Lake Shore Dr)	1 UST removed

Signature Flight Support LUST

This site has had several different LUST reports involving seven USTs located at the site. These USTs were located in a tank bed south of the terminal building, on the western edge of the island (see Figure 8 in the following section). A LUST was first reported at this facility in January 1992. Much of the same information for the City of Chicago LUST described below was also returned for this site, under the name City of Chicago Department of Aviation. The tanks appear to have been somehow jointly operated and/or maintained. However, a second LUST was reported in August 1993, due to a jet fuel tank piping leak. Upon discovery of this leak, approximately 2 cubic yards of gravel were removed from the release area, and the lines were repaired and satisfactorily pressure tested. All USTs were later removed in February 1999.

Site assessments in 1994 and 2001 revealed that petroleum-related compounds (certain BTEX and PAHs) were present in the tank bed area soils and groundwater above TACO objectives. Two 2002 investigations analyzed background samples collected on Northerly Island. The PNAs benzo(a)anthracene, benzo(a)pyrene, and benzo(k)fluoranthene exceeded the cleanup objectives for Class I groundwater, but because both sample results were identical at sample locations greater than 500’ apart, the investigation concluded, “the groundwater beneath the site is assumed to be impacted from the construction materials used to create the peninsula, and not from a point source.” Background soil samples were collected and reviewed, and the average of the sample results for five PNA constituents, benzo(a)anthracene, benzo(b)fluoranthene,

benzo(a)pyrene, indeno(1,2,3-cd)pyrene, and dibenz(a,h)anthracene, exceeded the Tier 2 cleanup objective. Soil samples collected during UST excavation and subsequent subsurface investigations contain PNAs within the same order of magnitude or lower than those in background soil samples in both shallow and deep soils. The analysis concluded that PNAs are a result of fill and construction materials used to form the peninsula and not a result of a release from the UST system. Benzene, however, was found in concentrations above the Tier 2 cleanup objective for the ingestion exposure route only in the tank bed area. It was not above the cleanup objective in background samples, indicating the benzene exceedance was a result of the LUST.

A permanent asphalt or concrete cap over the UST basin was proposed as an engineered barrier to eliminate the benzene ingestion exposure route. However, following the closure of Meigs Field Airport and transfer of the site to the Chicago Park District, the District explained in a 2005 letter that a paved cap would not fit with their long-term plans for the site, and a permanent solution would be delayed until the end of 2007. In the meantime, the excavation was backfilled to grade and the property was isolated by an 8-foot chain-link fence to prevent public access. This portion of the site remains fenced off today, and was excluded from the project work limits in order to avoid issues involving remediation for this open LUST. As background soil and groundwater samples were not found to be impacted by the LUST, excavation and earthwork associated with the project should not be impacted [by this site. Further discussion of soil and groundwater conditions at the site is included in a later section of this report, "Review of Existing Environmental Data"](#).

City of Chicago LUST

A LUST was reported in May 1992 at the City of Chicago Fire Department facility at Meigs Field. The report was made when a #2 heating oil UST failed a tightness test. In response, the tank was emptied and soil was excavated to expose the top of the tank and product/vent piping. This revealed no visual or olfactory evidence of a leak, and it was concluded that a piping malfunction was the likely cause of the failed test. All piping was then replaced and the system was upgraded to current standards, including electronic tank monitoring equipment, in December 1992. The city reported that the tank has been in compliance since then. A request was made to IEPA in 2002 to issue a NFR letter for this tank, as no evidence of a leak was found after the initial report, but IEPA declined this request, indicating that soil sampling must be conducted to determine whether the surrounding soils have been impacted above remediation objectives. Based on the given documentation indicating no leak could be found, it would appear this LUST does not pose a risk to the project. However, the report detailing response actions noted that the native soil type encountered during excavation was "sand and rubber (landfill)". Although rubber was not noted in borings taken for the Signature Flight Support LUST, this finding is consistent with other various landfill materials found in borings throughout the site.

City of Chicago, Meigs Field Terminal Building LUST

This site reported a leak of "other petroleum" from a UST in 1998. The site is presumed to be located at the airport terminal building directly to the north of the project site. The site was given NFA/NFR status in 1999, and is therefore not anticipated to be a concern to the project.

Burnham Park Yacht Club LUST

An underground gasoline tank leak was discovered and reported in May 1990, apparently while testing the tank for leaks. The tank had been previously tested in fall of 1989, and no leaks were found at that time. Once the leak was detected, all fuel was removed from the tank. A letter indicated that there was no “visible surface or below ground release” from the tank, but it is unclear whether any underground investigation occurred, or if this observation was based on what could be seen from the surface. The last recorded correspondence, dated July 1990, indicated the Yacht Club was delayed in producing required documentation for the leak, but contractors had been contacted regarding cleanup actions. Due to the apparently small scale of this leak, the amount of time since the leak first occurred, and the proximity from excavation planned at the project site, it is believed there is a low risk of this LUST impacting the project.

Other USTs

The Butler Aviation, Northerly Island Maintenance Building, and City of Chicago Department of Aviation USTs are presumed to be located adjacent to the project site based on their addresses and the layout of buildings at Meigs Field. All but two of these USTs are reported to have been removed without any report of leaks. Of the remaining USTs, one 2000 gallon diesel fuel tank at the Northerly Island Maintenance Building has been taken out of service but not removed. The other UST, an 800 gallon diesel fuel tank at the City of Chicago Department of Aviation was still listed as being in service as of 2008. Based on the locations of former airport facilities and structures, it is believed these tanks are located outside the project limits, if they still exist. These USTs were flagged for investigation during the site visit, to determine whether these remaining USTs may be visible from the surface. The Department of Aviation Meigs Field site has a Lake Shore Drive address, but may be located on site as well. The one UST at this site has been removed, and poses no concern.

Site Remediation Programs

The Site Remediation Program (SRP) database lists all voluntary remediation projects administered through the pre-notice site clean-up program (1989 to 1995) and the site remediation program (1996 to present). The Brownfields database lists sites that have received grants under the Illinois Municipal Brownfields Redevelopment Grant Program for site investigation and cleanup activities. The search of these databases located nineteen sites within the search distance. However, none of these were located on the Northerly Island peninsula, and therefore are not considered in greater detail for this investigation.

FINDS

The FINDS database (facility index system/facility registry system) contains facility information and pointers to other sources that contain more detail. The EDR report includes the following FINDS databases in the report: PCS (Permit Compliance System), AIRS (Aerometric Information Retrieval System), DOCKET (Enforcement Docket used to manage and track information on civil judicial enforcement cases for all environmental statutes), FURS (Federal Underground Injection Control), C-DOCKET (Criminal Docket System used to track criminal enforcement actions for all environmental statutes), FFIS (Federal Facilities Information System), STATE (Statement Environmental Laws and Statues), and PADS (PCB Activity Data System). Seven FINDS were reported within a half mile of the project site. However, all

FINDS sites were also in RCRA or UST/LUST databases, and are discussed in greater detail in those sections of the report.

Other Databases

Various other databases are searched that include supplemental information to the above databases, including but not limited to: CERCLA consent decrees, National Priority list deletions, Nuclear Regulatory Commission’s database of sites possessing radioactive materials, Superfund Liens, PCB Activity Database, Department of Defense sites, Toxic Chemical Release Inventory, FIFRA/TSCA tracking system, oil and gas pipelines, electric transmission lines, sensitive receptors, flood zone data, and the national wetlands inventory. The search of these databases returned one IL NIPC (Northeast Planning Commission Solid Waste Landfill Inventory) site within one mile, eight sites with engineering controls within one mile, seven sites with institutional controls within one mile, four HWAR (Hazardous Waste Annual Report) sites within one half mile, two EDR Historical Auto Stations within 0.75 miles, and three EDR Historical Cleaners within 0.75 miles of the project site. Of these, three sites were located on the Northerly Island peninsula; all others were not considered in detail for this investigation. Two of the listings, the Burnham Park Yacht Club and Chicago Park District HWAR sites appeared in RCRA databases discussed earlier in this report; the HWAR database listings did not provide any additional information on hazardous waste activities at the sites. One remaining site, Chicago DOT, is in the HWAR database only. Few details were given regarding this site’s listing, but it does not appear to pose a concern to the project due to its distance from the site and limited risk of other nearby HWAR sites. See Table 4 for a summary of the facility information.

Table 4: Other Search Results

Database	Map ID	Site Name	Proximity to Site (Address)	Status
HWAR	20	Chicago DOT	½ mile north (700 E Solidarity Dr)	Entered 2008; no additional details found

Former Gunsite Listing

An IEPA Bureau of Land listing not included in the EDR search was found while searching IEPA online databases for information on other sites. This site was listed as “Meigs Field, Northerly Island,” and “Gun Site Area - Former” in 2001. USACE was listed as the operator. USACE, Louisville District was contacted for additional information on this site, and a 2005 Site Review report was provided explaining the history and status of the site. The Northerly Island Gunsite was a part of the Anti-Aircraft Artillery (AAA) Gunsite Program during the Korean War. The U.S. Government leased approximately 5 acres of land north of Meigs Field from the Chicago Park District between 1951 and 1954. The gunsite is located approximately 1000 feet north of the project site, in the current location of the Charter One Pavillion. The site contained four AAA guns and at least one magazine structure. All aboveground features were razed following termination of the lease. It is not believed any ordnance was left or buried on the site, and no shells have been found in any of the twenty Chicago Gunsites. A 1995 DERP FUDS

Inventory Project Report concluded no remediation projects exist for the site, and no further action was required. The 2005 site review indicated a “No Defense Action” is warranted as well. Following a 2005 site review by USACE, Louisville District, the property was determined to not have any potential hazard, and was closed for further work. The Former Gunsite FUDS does not pose any risk to the project.

REVIEW OF EXISTING ENVIRONMENTAL DATA

During this HTRW investigation, existing environmental data were examined in order to determine expected soil and groundwater conditions and risk of contamination at the site. This information was then used to determine whether a Phase II investigation or other measures were warranted for the project. Twelve soil and one groundwater sample were collected from locations on the project site during past investigations related to the Signature Flight Support LUST discussed above. The LUST location is outside the project limits. The samples were collected in 2002 by the parties responsible for the LUST, and were analyzed for BTEX and PAHs. Documentation of the sampling was obtained from IEPA. These samples had been collected to compare soil and groundwater conditions surrounding the LUST to soil conditions in more remote locations of the site which were unimpacted, in order to determine appropriate remedial actions for the LUST. The sampling results showed that some of these background samples exceeded the corresponding TACO soil and groundwater cleanup objectives for several PAHs. The investigation concluded that these elevated levels of PAHs were a result of the fill and construction materials used to create the manmade peninsula.

The environmental soil samples mentioned above were located towards the center of the peninsula, at approximately 60' intervals along a straight line beginning at the northern end of the project site (see Figure 8, below). The sample results were compared to TACO residential remediation objectives, Chicago background soil concentrations, and Threshold and Benchmark Open Space Reserve values given in the Calumet Area Ecotoxicology Protocol. TACO residential remediation objectives are based on human health criteria, and are the most stringent standards out of an array of objectives developed for various property uses. The TACO objectives for the five PAHs exceeded at the site are based on values for the ingestion exposure route, with an assumed 350 days/year exposure to the material. However, future use of the site will not be residential in nature; rather, human exposure will be limited to construction workers during project construction, and periodic exposure to site maintenance personnel and short-term visitors to the site. It is therefore believed that the residential criteria are exceedingly conservative for the protection of human health at the project site, and TACO residential remediation objectives are not applicable for determination of human health risks associated with the site. IEPA also defines background PAH concentrations that are representative of soils in Chicago, which may be used as an alternative to residential closure values. PAHs are released into the environment primarily due to combustion or burning of fuels such as oil, coal, or wood. As a result, automobiles, planes, and power generation have greatly contributed to the widespread presence of these chemicals in urban environments. The Threshold and Benchmark Open Space Reserve values were used to determine the potential for impacts to ecological receptors, and are discussed in greater detail below.

The twelve soil sample results, an average, and the four comparison values for the five PAHs with TACO exceedances are shown in the Table 5, below. This data shows that while a fair portion of these samples exceed TACO residential closure objectives, few are above Chicago background levels. All exceedances above background are by a small margin. When the twelve samples are averaged, background levels are not exceeded. Because earthwork proposed for this ecosystem restoration project would involve excavation and redistribution of material on various locations of the site by heavy construction equipment, it is likely soils will be greatly homogenized, and use of average values is therefore appropriate in this evaluation. Based on this existing sampling data, it was concluded that fill materials at the site have PAH concentrations that are typical of ambient Chicago conditions. The levels of PAHs observed in these samples do not indicate that the fill material used to construct Northerly Island poses an HTRW risk to the project.

The twelve soil sampling results were also compared to threshold and benchmark soil values given in the Calumet Area Ecotoxicology Protocol to assess the potential risk to wildlife and other ecological receptors posed by the existing level of PAHs at the project site. This Ecotox Protocol was developed and is supported by an assembly of agencies, including USEPA, USFWS, Illinois EPA, Illinois DNR, as well as several local agencies. It was created for the specific purpose of providing appropriate standards and guidance for cleanup and ecological rehabilitation of potentially contaminated properties in the Calumet Area. The standards were designed to ensure the health of plants and animals of the Calumet Area on sites where historical environmental pollutants are a concern. The “Calumet area” as defined in the protocol is a 20-square mile area on Chicago’s far southeast side, which has plans for future ecological rehabilitation and conversion of lands to open space reserves. Although the Northerly Island project site is not within the boundaries of the Calumet Area, the protocol is applicable to this project, based on the natural divisions of the Calumet Region. The protocol takes into account both point source industrial discharges, and indirect urban pollution sources such as atmospheric deposition and stormwater runoff. Therefore, the type of habitat restoration activity planned for Northerly Island is the precise type of situation this protocol was developed for. Threshold values are defined as concentrations believed protective of ecological receptors in the Calumet Area, derived from toxicity studies that identified no observable adverse-effect levels. Benchmark values are defined as concentrations expected to impact ecological receptors in the Calumet area, derived from toxicity studies that identified lowest observable adverse effect levels. Although two of the twelve samples exceeded the threshold values of at least one PAH by small margins, the average concentrations of PAHs from the twelve samples were all below threshold levels. No sample exceeded benchmark values. The Ecotox Protocol states that areas with chemical concentrations below threshold values are not expected to need rehabilitation to protect the habitat’s receptors, and therefore, no further action is needed. This information was the basis for the determination that PAH levels in soils at Northerly Island will not pose an ecological risk to the proposed project.

Table 5: Soil Sampling Results (mg/kg)

PAH	Reference Value	Environmental Samples Collected on Project Site												Average
	TACO Residential	1	2	3	4	5	6	7	8	9	10	11	12	
Benzo(a)anthracene	0.9	0.532	0.826	0.731	1.09	0.316	0.115	0.068	1.42	0.206	0.061	0.716	0.0087	0.50748
Benzo(b)fluoranthene	0.9	0.524	0.922	0.639	1.1	0.222	0.087	0.038	2	0.107	0.04	0.82	0.011	0.5425
Benzo(a)pyrene	0.09	0.785	1.01	0.926	1.68	0.336	0.129	0.064	1.47	0.211	0.052	0.601	0.015	0.60658
Indeno(1,2,3-cd)pyrene	0.9	0.505	0.703	0.619	1.08	0.18	0.066	0.031	0.782	0.068	0.029	0.601	0.029	0.39108
Dibenz(a,h)anthracene	0.09	0.105	0.224	0.124	0.265	0.051	0.02	0.02	0.175	0.02	0.02	0.174	0.02	0.1015
	TACO Background	1	2	3	4	5	6	7	8	9	10	11	12	Average
Benzo(a)anthracene	1.1	0.532	0.826	0.731	1.09	0.316	0.115	0.068	1.42	0.206	0.061	0.716	0.0087	0.50748
Benzo(b)fluoranthene	1.5	0.524	0.922	0.639	1.1	0.222	0.087	0.038	2	0.107	0.04	0.82	0.011	0.5425
Benzo(a)pyrene	1.3	0.785	1.01	0.926	1.68	0.336	0.129	0.064	1.47	0.211	0.052	0.601	0.015	0.60658
Indeno(1,2,3-cd)pyrene	0.86	0.505	0.703	0.619	1.08	0.18	0.066	0.031	0.782	0.068	0.029	0.601	0.029	0.39108
Dibenz(a,h)anthracene	0.2	0.105	0.224	0.124	0.265	0.051	0.02	0.02	0.175	0.02	0.02	0.174	0.02	0.1015
	Ecotox Threshold	1	2	3	4	5	6	7	8	9	10	11	12	Average
Benzo(a)anthracene	--	0.532	0.826	0.731	1.09	0.316	0.115	0.068	1.42	0.206	0.061	0.716	0.0087	0.50748
Benzo(b)fluoranthene	1	0.524	0.922	0.639	1.1	0.222	0.087	0.038	2	0.107	0.04	0.82	0.011	0.5425
Benzo(a)pyrene	11.3	0.785	1.01	0.926	1.68	0.336	0.129	0.064	1.47	0.211	0.052	0.601	0.015	0.60658
Indeno(1,2,3-cd)pyrene	1	0.505	0.703	0.619	1.08	0.18	0.066	0.031	0.782	0.068	0.029	0.601	0.029	0.39108
Dibenz(a,h)anthracene	--	0.105	0.224	0.124	0.265	0.051	0.02	0.02	0.175	0.02	0.02	0.174	0.02	0.1015
	Ecotox Benchmark	1	2	3	4	5	6	7	8	9	10	11	12	Average
Benzo(a)anthracene	--	0.532	0.826	0.731	1.09	0.316	0.115	0.068	1.42	0.206	0.061	0.716	0.0087	0.50748
Benzo(b)fluoranthene	10	0.524	0.922	0.639	1.1	0.222	0.087	0.038	2	0.107	0.04	0.82	0.011	0.5425
Benzo(a)pyrene	113	0.785	1.01	0.926	1.68	0.336	0.129	0.064	1.47	0.211	0.052	0.601	0.015	0.60658
Indeno(1,2,3-cd)pyrene	10	0.505	0.703	0.619	1.08	0.18	0.066	0.031	0.782	0.068	0.029	0.601	0.029	0.39108
Dibenz(a,h)anthracene	--	0.105	0.224	0.124	0.265	0.051	0.02	0.02	0.175	0.02	0.02	0.174	0.02	0.1015

Highlighted sample concentrations are above reference value

TACO Residential values are Tier 1 Soil Remediation Objectives for Residential Properties (35 IAC 742, Appendix B, Table A)

TACO Background values are Concentrations of Polynuclear Aromatic Hydrocarbon Chemicals in Chicago Background Soils (35 IAC 742, Appendix A, Table H)

Ecotox Threshold values are concentrations believed protective of ecological receptors in the Calumet Area, derived from toxicity studies that identified no observable adverse-effect levels (Calumet Area Ecotoxicology Protocol Table A-1)

Ecotox Benchmark values are concentrations expected to impact ecological receptors in the Calumet area, derived from toxicity studies that identified lowest observable adverse effect levels (Calumet Area Ecotoxicology Protocol, Table A-3)

The groundwater sample that was collected on the project site exceeded the TACO Class I Groundwater Remediation Objective for four PAHs (see Table 6, below). Because the Class I groundwater standard was developed for potable water resources, and no potable water wells exist or are planned to be installed at the site, the slight exceedances above these values do not appear to pose a concern for the project. These slight exceedances also do not pose a risk for construction workers who may have incidental dermal contact with the groundwater. The Calumet Area Ecotoxicology Protocol discussed above does not provide comparison values for groundwater quality, and does not give any specific guidance to ensure groundwater is protective of ecological receptors. While groundwater infiltration will initially be a primary source of water into the pond and wetland areas created by the project, it is not valid to assume the resulting surface water quality would be comparable to that of the groundwater. Once brought to the surface and opened to the atmosphere, the PAH compounds present in the groundwater will be broken down by a variety of natural processes including volatilization, photodegradation, biodegradation, and oxidation. Furthermore, surface waters created at the project site will be highly affected by clean rainfall and Lake Michigan water inputs. Because of these factors, it is

not possible to mathematically predict surface water quality at the site based on existing groundwater data. Considering these numerous natural processes will act to reduce PAH concentrations in surface waters, it is believed that groundwater quality will not pose a threat to biological receptors at the project site. Also, considering soils at the site meet the protective standards of the Ecotox Protocol, it is reasonable to infer that the underlying groundwater quality is similarly acceptable, despite the fact that no relevant standard of comparison exists for groundwater. As discussed above, the PAH compounds present in both the soil and groundwater at the site are ubiquitous in urban environments such as the city of Chicago due to their constant inputs by common sources such as automobile and airplane exhaust. The finding that groundwater at Northerly Island exceeds TACO Class I potable water standard for these ubiquitous compounds is not indicative of any unusual or elevated environmental risk or concern. Considering the above, it is not believed that groundwater quality at the project site poses an environmental concern.

Table 6: Groundwater Sampling Results (ug/L)

PAH	Reference Value	Sampling Location
	TACO Class I GW	Groundwater
Benzo(a)anthracene	0.13	1.4
Benzo(a)pyrene	0.2	2
Benzo(b)fluoranthene	0.18	0.88
Benzo(k)fluoranthene	0.17	1.17

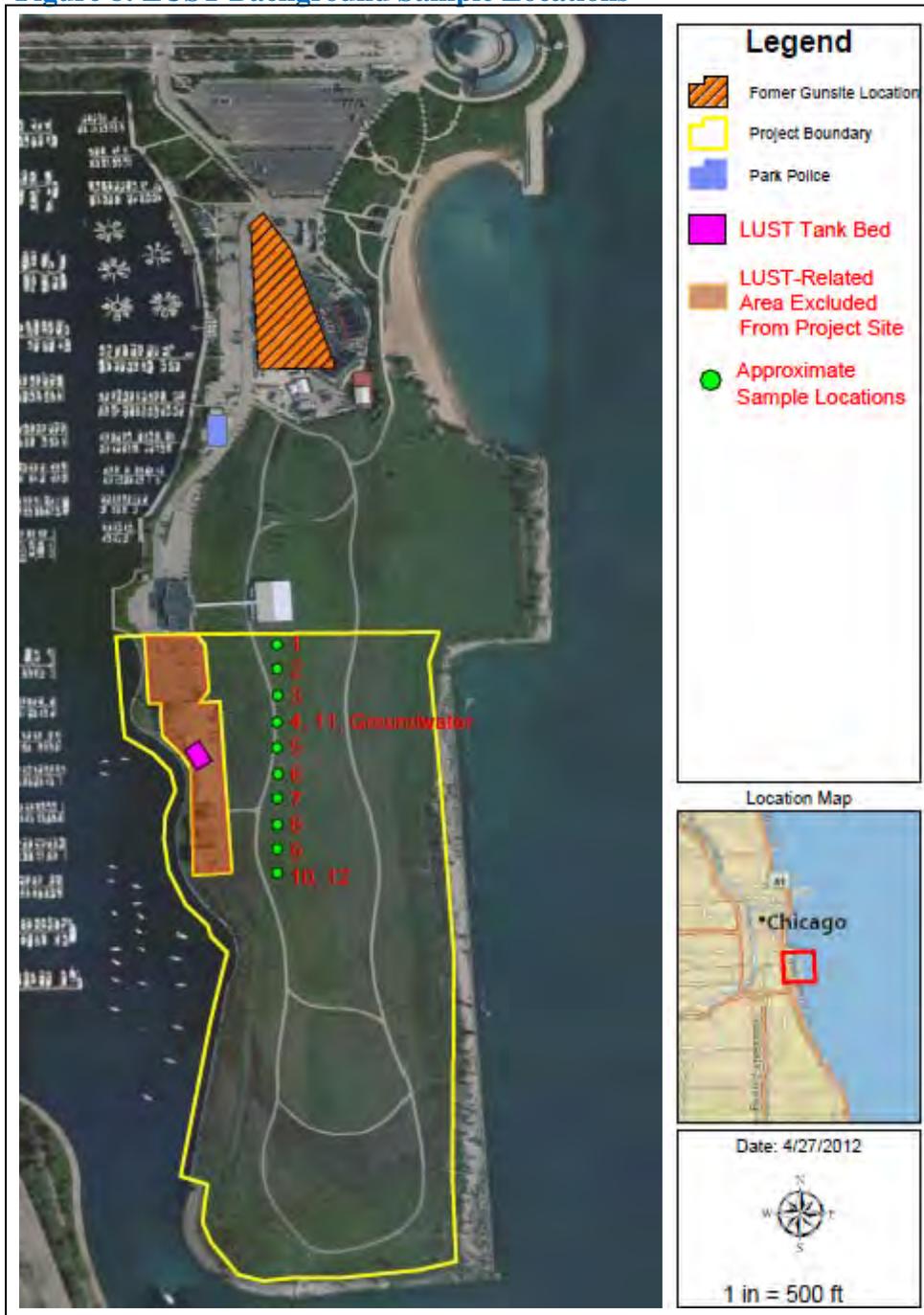
Highlighted sample concentrations above reference value

Notes on Reference Values:

TACO Class I GW values are for Potable Resource Groundwater (35 IAC 742, Appendix B, Table E)

Based on the information detailed above, it is believed that soils and groundwater at the Northerly Island project site do not pose an HTRW concern in terms of liability, human health and safety, or ecological health. However, it is acknowledged that the existing sampling data represents only a portion of the site. Since these samples were taken close to the only identified source of pollution, the Signature Flight Support LUST, it is significant that only low background concentrations of anthropogenic compounds were found. This finding indicates that there is a very low risk of finding actionable levels of pollution elsewhere on the project site, since there are no other known sources.

Figure 8: LUST Background Sample Locations



Soil boring logs were included in multiple LUST site investigation reports, as well as descriptions of soil composition. In the immediate vicinity of the tank beds, it was reported, “Subsurface geology underlying the site area consisted of two units--1) a gravelly sand, and 2) an unstratified mixture of sandy, silty clay with discontinuous sand lenses and trace amounts of plant matter, clay-tile, and glass.” Some borings also encountered pockets of brick and rock fragments, foundry slag and foundry sand. **No large quantities of deleterious materials were encountered.** The area that is to be excavated for pond creation is located on the portion of

Northerly Island that was constructed in the '40s, whereas all investigations associated with this LUST are located in the older portions of the site. Therefore, this material may not be representative of soils encountered in pond excavation, but it is possible similar materials may exist throughout the site.

Three additional soil borings were taken for Meigs Field, from locations along the centerline of the island (these borings are discussed in further detail in the Geotechnical Appendix of this report). These were taken from the more recently constructed portions of the island, where all excavation is planned to occur during project construction. These borings showed soils to consist of sand, clay, silty clay, and gravel. Small quantities of brick and asphalt were noted in the upper layer of these borings, which is consistent with prior site use. Based on these existing data, it is believed there is very little risk of encountering significant amounts of slag or other unacceptable or HTRW materials during project construction.

There does not appear to be a risk of encountering large quantities of deleterious materials during excavation, although no HTRW investigation can completely eliminate this risk. Because the earthwork quantities have been balanced, it is anticipated that all soils will be reused on site, and any large debris or other deleterious materials found to be buried on site will be re-interred as part of the project. This strategy will eliminate hauling and disposal costs associated with potential unexpected materials. If unforeseen hazardous waste were to be encountered during construction, this would be treated as a differing site condition in the contract and all appropriate steps would be taken to remove the waste, as is standard contingency for construction contracts.

Illinois has enacted stringent Clean Construction and Demolition Debris (CCDD) regulations relating to the testing and disposal of fill material that require the landfilling of demolition and construction debris, and also includes extensive soil testing requirements for the off-site reuse of "non native" materials. Although no soils or other existing materials are planned to be removed or disposed of off-site, in the event any materials are needed to be removed, the materials would be subject to testing and potential landfilling if the materials include debris and/or concentrations of anthropogenic compounds in concentrations greater than the metropolitan background. However, as mentioned above, concentrations of PAHs in soils are less than metropolitan background concentrations, and therefore would likely meet the definition of clean fill based on chemical criteria.

To confirm the soil conditions in the area of excavation, USACE Chicago District may conduct soil borings. The soil borings would include field identification of soil type, as well as screening for the presence of volatile compounds by use of a photoionization detector (PID). If staining or high PID levels indicate contamination of the soils, chemical analyses would be conducted to determine the level of contamination present. The extent of debris materials would also be noted, since that material will be reburied on site. If extensive debris/deleterious fill is found, the project plan would be adjusted to require off-site disposal (landfilling) of that material. Although soil borings would provide additional information on the project area, at this time it is concluded that there is sufficient existing data to demonstrate a low risk of encountering recognized environmental conditions on this project site.

SITE VISIT

A site visit was conducted on 22 March 2012. The purpose of the visit was to acquaint environmental engineering personnel with the site, follow up on possible concerns identified in the database search, and detect any other potential recognized environmental concerns (RECs).

The database search revealed two USTs that are reportedly still in place near the project site, at Northerly Island Maintenance Building and City of Chicago Department of Aviation. No sign of these USTs was found during the site visit. These USTs are likely located in the fenced-off storage area described below, and do not pose a concern to the project.

The area where the LUST tank bed was located is currently fenced off and used by the city for storage. Various recycling trucks, recycling bins, barrels for hot coals, and other equipment and machinery were located in this area (see Figure 9). Despite the many waste receptacles, the area was generally clean and well-kept, and did not appear to pose any risk to the project.

Exposed soil from a recently installed underground electrical line along the western bank of the island was examined to determine the composition of fill material at the site. The soil was intermixed with many bricks, brick shards, small rocks, pieces of asphalt, few glass pieces, and various debris (see Figure 10 below). No slag or other potentially contaminated materials were observed. This type of fill material was seen on both the originally constructed and more recently constructed areas of the island.

The eastern and southeastern banks of the island were found to be covered with large chunks of asphalt and concrete, large stones, and scattered steel rods and rebar (see Figure 11 below). It is unknown how much, if any, of this material may have originated from demolition of Meigs Field Airport. No barrels, tanks, or other signs of RECs were observed. These areas are currently excluded from the project site, and therefore should not pose an environmental risk to the project.

Planning team members had indicated that following the demolition of Meigs Field Airport, runway material was piled at the site and covered to create a hill. A large hill was located on the southern end of the island, and is believed to be the hill in question. No asphalt or other runway materials were visible on the surface. Proper disposal in accordance with Illinois Clean Construction and Demolition Debris (CCDD) regulations will be required for any runway material to be removed offsite from this hill during construction.

Figure 9: Former LUST tank bed area



Figure 10: Typical soil composition in exposed area along western bank



Figure 11: Eastern bank of island



FINDINGS AND CONCLUSIONS

In order to generate an HTRW report for the Northerly Island Restoration GLFER Project, four methods were employed. Findings of these investigation methods are summarized as follows:

- **Review of Existing [Historical Information](#)**
Review of existing site information indicated Northerly Island is a completely artificial man-made island created by the deposition of clean lake sand dumped within a crib placed in Lake Michigan. The island was constructed in 1920-1925, and expanded in the early 1940s. Meigs Field airport operated on the site from 1946 until 2002.
- **Review of Historical Images**
Historical aerial photographs, USGS topographic maps, and Sanborn fire insurance maps of the site were obtained from Environmental Data Resources (EDR). These images generally reflected changes in land use over the years consistent with the existing information review.
- **Database Review**
Review of a database search provided by Environmental Data Resources (EDR) identified several LUSTs directly adjacent to the project site. Investigations related to the “Signature Flight Support” jet fuel LUST were reviewed and revealed LUST-related contamination was confined to the immediate tank bed area, located outside the project work limits. No other significant issues were identified in the database review.

- **Review of Existing Environmental Data**

Soil samples have been concluded to show low concentrations of the polycyclic aromatic hydrocarbons (PAHs) typically found in urban areas. Although many of these samples exceeded TACO residential closure objectives for certain PAHs, the average concentrations in these samples were less than the metropolitan background concentration for the City of Chicago, and as such represent the typical conditions and not any particular source of contamination. These samples were also compared to Calumet Area Ecotoxicology Protocol, and found to be protective of biological receptors at the site. These samples only represent a portion of the project site, but there is very low risk that other portions of the project site contain significantly greater concentrations of contaminants due to the fact that no contaminant sources are located on the remaining portions of the site.

Existing soil borings indicate small amounts of debris and deleterious materials are intermixed with soils at the site. The plan for construction is to achieve a zero balance of cut and fill, in order to eliminate disposal costs associated with these materials. Due to Illinois CCDD requirements, materials may not be acceptable for off-site reuse based on debris content. Although existing data indicates the material has concentrations of anthropogenic compounds less than the metropolitan background, the CCDD regulations also require environmental testing before removal to ensure the material meets this standard. If any excess material is required to be removed from the site and does not meet the CCDD requirements, the material would be landfilled.

Additional soil borings are planned to be conducted to confirm the soil conditions in the area of excavation. The soil borings would include field identification of soil type, as well as screening for the presence of volatile compounds by use of a photoionization detector (PID). If these borings reveal unexpected soil conditions that will have an HTRW-related impact to the project, this HTRW investigation will be revised at that time.

- **Site Visit**

A site visit revealed no additional RECs at the project site. Soils at the site were intermixed with brick, stone, and other various debris, but no potentially contaminated materials were observed. A large hill was observed on the southern end of the site, which is believed to contain demolished runway materials from the former Meigs Field Airport.

No investigation can wholly eliminate uncertainty regarding the potential for encountering an REC associated with a project area. Performance of this investigation is intended to reduce, but not eliminate, uncertainty regarding the potential for encountering an REC in connection with a project area. As a result of this HTRW analysis, TS-DH has concluded that there is sufficient information to demonstrate that the work proposed for the Northerly Island Restoration site has little potential for encountering an REC.

REFERENCES

- 35 Illinois Administrative Code. Environmental Regulations for the State of Illinois.
- American Society for Testing of Materials. Publication E 1527-00. Standard Practice for Environmental Assessments: Phase I Environmental Site Assessment Process.
- Calumet Ecotoxicology Roundtable Technical Team. Calumet Area Ecotoxicology Protocol. June 2007.
- Department of the Army. U.S. Army Corps of Engineers. ER 1165-2-132. Hazardous, Toxic, and Radioactive Waste (HTRW) Guidance for Civil Works Projects. June 1992.
- U.S. Army Corps of Engineers, Louisville District. Former Northerly Island Gunsite, Chicago, Illinois, FUDS Site NO. E05IL332300, Site Review, Final, Revision 1. 2005.

Northerly Island

Section 506 Great Lakes Fishery & Ecosystem Restoration

Appendix E - Monitoring & Adaptive Management Plan



Chicago District, GL-ECO-CX



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Introduction

Section 2039 of WRDA 2007 directs the Secretary of the Army to ensure, that when conducting a feasibility study for a project (or component of a project) under the Corps ecosystem restoration mission, that the recommended project includes a monitoring plan to measure the success of the ecosystem restoration and to dictate the direction adaptive management should proceed, if needed. This monitoring and adaptive management plan shall include a description of the monitoring activities, the criteria for success, and the estimated cost and duration of the monitoring as well as specify that monitoring will continue until such time as the Secretary determines that the success criteria have been met.

Section 2039 of WRDA 2007 also directs the Corps to develop an adaptive management plan for all ecosystem restoration projects. The adaptive management plan must be appropriately scoped to the scale of the project. The information generated by the monitoring plan will be used by the District in consultation with the Federal and State resources agencies and the MSC to guide decisions on operational or structural changes that may be needed to ensure that the ecosystem restoration project meets the success criteria.

An effective monitoring program is necessary to assess the status and trends of ecological health and biota richness and abundance on a per project basis, as well as to report on regional program success within the United States. Assessing status and trends includes both spatial and temporal variations. Gathered information under this monitoring plan will provide insights into the effectiveness of current restoration projects and adaptive management strategies, and indicate where goals have been met, if actions should continue, and/or whether more aggressive management is warranted.

Monitoring the changes at a project site is not always a simple task. Ecosystems, by their very nature, are dynamic systems where populations of macroinvertebrates, fish, birds, and other organisms fluctuate with natural cycles. Water quality also varies, particularly as seasonal and annual weather patterns change. The task of tracking environmental changes can be difficult, and distinguishing the changes caused by human actions from natural variations can be even more difficult. This is why a focused monitoring protocol tied directly to the planning objectives needs to be followed.

This Monitoring and Adaptive Management Plan describes the existing habitats and monitoring methods that could be utilized to assess projects. By reporting on environmental changes, the results from this monitoring effort will be able to evaluate whether measurable results have been achieved and whether the intent of Section 506 Great Lakes & Fisheries Ecosystem Restoration are being met.

Guidance

The following documents provide distinct Corps policy and guidance that are pertinent to developing this monitoring and adaptive management plan:

- a. Section 2039 of WRDA 2007 Monitoring Ecosystem Restoration

(a) In General - In conducting a feasibility study for a project (or a component of a project) for ecosystem restoration, the Secretary shall ensure that the recommended project includes, as an integral part of the project, a plan for monitoring the success of the ecosystem restoration.

(b) Monitoring Plan - The monitoring plan shall--

(1) include a description of the monitoring activities to be carried out, the criteria for ecosystem restoration success, and the estimated cost and duration of the monitoring; and

(2) specify that the monitoring shall continue until such time as the Secretary determines that the criteria for ecosystem restoration success will be met.

(c) Cost Share - For a period of 10 years from completion of construction of a project (or a component of a project) for ecosystem restoration, the Secretary shall consider the cost of carrying out the monitoring as a project cost. If the monitoring plan under subsection (b) requires monitoring beyond the 10-year period, the cost of monitoring shall be a non-Federal responsibility.

- b. USACE. 2009. Planning Memorandum. Implementation Guidance for Section 2039 of the Water Resources Development Act of 2007 (WRDA 2007) - Monitoring Ecosystem Restoration
- c. USACE. 2000. ER 1105-2-100, Guidance for Conducting Civil Works Planning Studies. Washington D.C.
- d. USACE. 2003a. ER 1105-2-404. Planning Civil Work Projects under the Environmental Operating Principles. Washington, D.C.

General Monitoring Objectives

As presented in "Guidance on Monitoring Ecosystem Restoration Project" on 12 January 2010, the following are general project monitoring objectives:

- To determine and prioritize needs for ecosystem restoration
- To support adaptive management of implemented projects
- To assess and justify adaptive management expenditures
- To minimize costs and maximize benefits of future restoration projects
- To determine "ecological success", document, and communicate it
- To advance the state of ecosystem restoration practice

Project Area Description

Naturally, this area was once the bottom of Lake Michigan within the littoral zone. After creation of the peninsula as part of Daniel Burnham's plan in 1925, the island became a small airport in 1946. In 2002 the parcel was obtained by the CPD and the southern portion of the island was planted for the most part with native grasses and turf grass to ensure the site would not become infested with non-native weeds.

Currently, no wetland or natural habitats are found within the study area. The lack of surficial hydrology and topography diversity makes it difficult to establish native coastal and wetland vegetation.

Habitat Trends Triggering Restoration

This project aims to remedy adverse trends of:

- Establishment of invasive species
- Loss of effective fish habitat
- Loss of important habitat types such as wetlands and riparian prairie and savanna
- Loss of conservative plant, fish, and amphibian species
- Loss of biodiversity and ecological integrity

Restoration Design Overview

Implementation of the preferred plan will greatly improve the ecosystem conditions of Northerly Island. The addition of several native habitat types will increase biodiversity and the integrity of the surrounding environment. The plan selected in the Detailed Project Report is the most environmentally and economically justifiable that will address the adverse trends of Northerly Island. Specific elements of the proposed plan are:

- Remove invasive plant species
- Excavate a pond to promote wetland and aquatic biodiversity
- Enhance littoral zone habitat with cobble and macrophyte additions
- Ameliorate soils throughout the island to promote new habitat types
- Riparian plant community restoration of marsh, wet prairie, mesic prairie, and oak savanna

Monitoring Components

Monitoring Plan Goals & Objectives

The primary goal of the Northerly Island project is restore lacustrine, coastal wetland, and other coastal plant habitats in support of Great Lakes fishes, amphibians, reptiles, and migratory bird species. Baseline data for current conditions on Northerly Island are detailed in the DPR. The following specific objectives were established for monitoring the effectiveness of this project:

- Improve native fish species richness, evenness, and diversity. Shannon- Wiener Index will be used to determine diversity and evenness (See below for equation explanation).
 - Target richness= **≥15**
 - Target evenness= **≥ 0.7**
 - Target diversity= **≥ 1.9**
- Improve macroinvertebrate species richness, evenness, and diversity. Target values are hard to determine since no baseline data is available. Instead we will track the progression of these indices through time.

- Improve native plant species richness and assemblage structure as measured by coefficient of conservatism of the Chicago Region Floristic Quality Index: Target Overall Mean C Score = **≥5**
- Eradicate / reduce the presence of non-native and invasive species: Target Invasive Species Eradication Percentage = **<1% Areal Coverage**

In order to evaluate the overall effectiveness of the project and to determine if the specific objectives are met, the following Monitoring Plan is proposed, and includes several basic monitoring components: fish community, macroinvertebrate community, and riparian vegetation. All components will be monitored as specified below, once prior to the project and over the course of five years following completion of the project.

Macroinvertebrate and Fish Communities

Macroinvertebrates will be collected concurrently with fish samples, according to Illinois River Watch Protocols (IDNR 2000). Shannon-Wiener diversity index will be used to calculate species richness and evenness within the wetland and littoral habitats. Samples will be taken four times per year from the pond and littoral habitat to follow species diversity through time.

No Indices of Biotic Integrity (IBI) are currently developed for Southern Lake Michigan. Therefore, species richness, evenness, and diversity will be calculated using the Shannon-Wiener index. Species richness is simply the count of the number of native species present. The Shannon-Wiener diversity index is defined as:

where s = number of species, and p_i = proportion of the total samples represented by the i th species (Kwak and Peterson 2007). The value rarely exceeds 5 and the value is specific to the region being sampled. Similar to macroinvertebrates, no baseline for the pond will be established the diversity will be tracked through time. Evenness is a function of the above diversity index and is defined as:

The combination of species diversity and evenness can provide a look into the functionality of the ecosystem and will help qualitatively assess the fish and macroinvertebrates assemblages.

Riparian Plant Communities

Evaluation of riparian vegetation will be done using the Floristic Quality Assessment Index (FQA) and native plant richness, as described in the PDA. In short, the FQA is a measure of overall environmental quality based on the presence or absence of certain plant species. Plant species that are assigned a coefficient of conservatism of 5 to 10 are considered to be indicative of less human mediated disturbance and a higher level of functionality. As the area stabilizes after restoration measures are complete, the number of higher conservative plant species that become established will increase. Communities that have an average mean coefficient of conservatism of between 3 to 5 are considered to be fair quality. This is a good estimate of the

future quality of the area based on the current plant community and 'good' quality natural sites in the surrounding areas. The overall number of native plant species is expected to increase dramatically as well, helping to increase the overall biodiversity of the area.

Other Communities

Ancillary data will be collected on other assemblages too. During fish and macroinvertebrate collections, time will be spent searching for reptiles and amphibians within the project area. In addition, bird counts and species list provided by the Bird Conservation Network will be examined for changes in bird abundances and species.

Sampling Stations

Transects will be established within the pond and littoral zones for fish and macroinvertebrates. Riparian vegetation will be surveyed and analyzed by both a roaming and stratified random transect survey. Each habitat type will be analyzed separately.

Reference Site Discussion

No reference site is deemed necessary; improvements will be judged from site current conditions.

Sampling/Survey Frequency

Fish and Macroinvertebrate Communities

Monitoring will occur four times a year during each season of winter, spring, summer, and fall. The monitoring should continue for five years.

Riparian Plant Communities

Plant monitoring would occur between June and August of each year of monitoring activities. Sampling would occur once a year. The total monitoring period will be 5-years.

Birds, Reptiles, and Amphibians

Field notes will be taken during fish, macroinvertebrates, and riparian surveys on any observed birds, reptiles, or amphibians. The Bird Conservation Network will be utilized for their database of bird counts and species.

Data Analysis

Habitat Fish and Macroinvertebrate Communities

The information gathered through the monitoring plan will be used to demonstrate species colonization and effects of restoration. Parameters calculated will be displayed graphically to show trends through time. Some simple statistics to demonstrated seasonal and yearly

differences will be investigated. If the trend begins to decrease, adaptive management actions will be taken.

Riparian Plant Communities

The information generated through sampling the plant community would be used to indicate the trend in overall condition of the area. The FQA mean coefficient of conservatism is expected to increase each year. If the FQA analysis indicates a decrease in condition, adaptive management actions may be taken to increase the score for the following sampling year.

Monitoring Responsibilities

The US Army Corps of Engineers will be responsible for monitoring of fish, macroinvertebrates, riparian plants, reptiles, and amphibians. US Army Corps of Engineers will utilize the Bird Conservation Network’s database for monitoring bird abundances and species .

Monitoring Costs & Funding Schedule

Tasks	Year 1	Year 2	Year 3	Year 4	Year 5	Total
Fish and Inverts	\$7,000	\$7,000	\$7,000	\$7,000	\$7,000	\$35,000
Riparian Plants	\$2,600	\$2,600	\$2,600	\$2,600	\$2,600	\$13,000
Birds	\$560	\$560	\$560	\$560	\$560	\$2,800
Final Report	n/a	n/a	n/a	n/a	5,000.00	\$5,000
Total	\$10,160	\$10,160	\$10,160	\$10,160	\$15,160	\$55,800

Reporting Results

A yearly monitoring summary report would be drafted by the USACE that briefly summarizes the data collected and determines if adaptive management is needed. A final monitoring report would be drafted that details the outcomes of the restoration project.

Contact Information

Fish and Inverts

Nicholas A. Barkowski
 US Army Corps of Engineers, Chicago District
 111 N. Canal St., Suite 600
 Chicago, IL 60606
 312-846-5578
 Nicholas.A.Barkowski@usace.army.mil

Riparian Plants

Robbie Sliwinski
Botanist / Restoration Ecologist
US Army Corps of Engineers, Chicago District
111 N. Canal St., Suite 600
Chicago, IL 60606
312-846-5486
Robbie.Sliwinski@usace.army.mil

Adaptive Management

Adaptive management needs for this project are minimal and currently not foreseen needs are apparent. However, changes would be planned, approved and implemented if expectations are not being met.

Northerly Island

Section 506 Great Lakes Fishery & Ecosystem Restoration

Appendix F – Correspondence, 404b1, FONSI



Chicago District, GL-ECO-CX



REPLY TO
ATTENTION OF

DEPARTMENT OF THE ARMY
CHICAGO DISTRICT, U.S. ARMY CORPS OF ENGINEERS
111 NORTH CANAL STREET
CHICAGO IL 60606-7206

Planning Branch
Environmental Formulation Section

Kenneth Westlake, Chief
Environmental Review Branch
U.S. EPA ME-19J
77 West Jackson
Chicago, IL 60604

27 JAN 2012

Dear Mr. Westlake:

The Chicago District is preparing a National Environmental Policy Act (NEPA) document on impacts of an ecosystem restoration project in the City of Chicago, Cook County, Illinois. As part of the scoping process the Chicago District would appreciate your comments. A map of the project area is enclosed.

The Northerly Island Project area is comprised of 40 acres at the south end of Northerly Island. This restoration project will include the creation of fish habitat though the addition of a pond with connectivity to Lake Michigan, the creation of fringe wetlands, removal of non-native invasive plants, and the planting of native plant species.

I am particularly interested in your comments regarding impacts to aquatic habitat and threatened or endangered species. Please comment within 30 days, marking your reply to the attention of Mr. Peter Bullock, U.S. Army Corps of Engineers, 111 North Canal Street, Suite 600, Chicago, Illinois 60606. Questions may be directed to Mr. Bullock at 312/846-5587, or at peter.y.bullock@usace.army.mil. Your assistance is appreciated.

Sincerely,

151

Susanne J. Davis, P. E.
Chief of Planning Branch

Enclosure

1/26/12
Bullock PM-PL-E
01/26/12
Veraldi PM-PL-E
1/26/12
Fleming PM-PL-E
Buczak PM-PM *JCB 26 Jan 12*
Davis PM-PL *SJD 26 Jan 12*



Illinois Department of Natural Resources

One Natural Resources Way Springfield, Illinois 62702-1271
<http://dnr.state.il.us>

Pat Quinn, Governor
Marc Miller, Director

Office of Water Resources, Michael A. Bilandic Building, 160 N. LaSalle Street, Suite #S-700,
Chicago, IL 60601 Phone: 312/793-3123 Fax: 312/793-5968

February 1, 2012

Mr. Peter Bullock
U.S. Army Corps of Engineers
111 N. Canal Street, Suite 600
Chicago, IL 60606

RE: Restoration of Northerly Island in Lake Michigan in the City of Chicago

Dear Mr. Bullock:

Thank you for the letter dated January 27, 2012 concerning the above referenced project. According to the letter and attached plans, part of the proposed restoration may include work in Lake Michigan. If that is the case, then an Illinois Department of Natural Resources/Illinois Environmental Protection Agency joint permit will be required.

If you have any questions feel free to contact me at (312) 793-5947 or james.casey@illinois.gov.

Sincerely,

James P. Casey
Lake Michigan Management Section

JC:cp

Bullock, Peter Y LRC

From: Nellie Cadue [nellie.cadue@ktik-nsn.gov]
Sent: Thursday, February 16, 2012 11:05 AM
To: Bullock, Peter Y LRC
Subject: Northerly Island Project

Mr. Bullock:

The Kickapoo Tribe in Kansas has no concern with the proposed restoration project in the City of Chicago, Cook County, IL. Should there be an inadvertent discovery of human remains and/or cultural artifacts, please contact the State Archaeologist, SHPO and our tribe.

Nellie Cadue-KTIK Land Office

1107 Goldfinch Road

Horton, KS 66439

Phone 785-486-9636 Ext. 3

Fax: 785-486-2445

Email: nellie.cadue@ktik-nsn.gov <<mailto:nellie.cadue@ktik-nsn.gov>>

Kickapoo Tribe in Kansas

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**Illinois Historic
Preservation Agency**

1 Old State Capitol Plaza • Springfield, Illinois 62701-1512 • www.illinois-history.gov

Cook County
Chicago
Northerly Island, south end
COEC
Ecosystem restoration

PLEASE REFER TO: IHPA LOG #003013012

January 31, 2012

Susanne Davis
Department of the Army
Chicago District, Corps of Engineers
111 N. Canal St.
Chicago, IL 60606-7206

Dear Ms. Davis:

Thank you for requesting comments from our office concerning the possible effects of the project referenced above on cultural resources. Our comments are required by Section 106 of the National Historic Preservation Act of 1966 (16 USC 470), as amended, and its implementing regulations, 36 CFR 800: "Protection of Historic Properties".

The project area has not been surveyed and may contain prehistoric/historic archaeological resources. Accordingly, a Phase I archaeological reconnaissance survey to locate, identify, and record all archaeological resources within the project area will be required. This decision is based upon our understanding that there has not been any large scale disturbance of the ground surface (excluding agricultural activities) such as major construction activity within the project area which would have destroyed existing cultural resources prior to your project. If the area has been heavily disturbed prior to your project, please contact our office with the appropriate written and/or photographic evidence.

The area(s) that need(s) to be surveyed include(s) all area(s) that will be developed as a result of the issuance of the federal agency permit(s) or the granting of the federal grants, funds, or loan guarantees that have prompted this review.

Enclosed you will find an attachment briefly describing Phase I surveys and a list of archaeological contracting services. THE IHPA LOG NUMBER OR A COPY OF THIS LETTER SHOULD BE PROVIDED TO THE SELECTED PROFESSIONAL ARCHAEOLOGICAL CONTRACTOR TO ENSURE THAT THE SURVEY RESULTS ARE CONNECTED TO YOUR PROJECT PAPERWORK.

If you have further questions, please contact Joe Phillippe at 217/785-1279.

Sincerely,

Anne E. Haaker
Deputy State Historic
Preservation Officer

Enclosure

Bullock, Peter Y LRC

From: Bullock, Peter Y LRC
Sent: Tuesday, February 07, 2012 12:02 PM
To: 'Haaker, Anne'
Subject: Northerly Island IHPA Log #003013012 (UNCLASSIFIED)

Classification: UNCLASSIFIED
Caveats: NONE

Classification: UNCLASSIFIED
Caveats: NONE

Northerly Island Eco restoration
IHPA Log #003013012

Anne:

In response to your letter of January 31, 2012, I've included some additional information concerning the planned Northerly Island project. I believe an archaeological survey is unnecessary for this project.

Northerly Island is a completely artificial man-made island created between 1920-1925 by the deposition of fill dumped within a wooden crib placed in Lake Michigan. In the early 1940's because of needed additional land for the proposed airport runways, approximately 26 acres were added to the southern end of the island.

The project area is comprised of approximately the southern half of Northerly Island. Although the design for Northerly Island was included in Daniel Burnham's 1909 "Plan of Chicago", construction did not begin until 1920 and finish in 1925. Briefly utilized as parkland, the island served as the site of the 1933-1934 "Century of Progress: World's Fair. Plans to locate an airport on the island were proposed in 1935 after the worlds' fair, but World War II and a unsuccessful proposal by Chicago to locate the future United Nations Headquarters on Northerly Island delayed airport construction until 1946. The airport was named Meigs Field after local newspaper publisher and aviation booster Merrill C. Meigs. Meigs Field operated as Chicago's lakefront airport from 1946 until 2002 when it was closed by the city. Late the runways and most airport related structures were demolished. Since then the island has been converted to open green space by the Chicago Park District.

This project is focused on upgrading the passive use southern portion of parkland on Northerly Island.

Peter Y. Bullock
Archaeologist
USACE
CELRC-PM-PL-E
312-846-5587
FAX 312-886-2891



Illinois Historic Preservation Agency

1 Old State Capitol Plaza • Springfield, Illinois 62701-1512 • www.illinois-history.gov

Cook County
Chicago

PLEASE REFER TO: IHPA LOG #003013012

Northerly Island, south end
COEC
Ecosystem restoration

February 8, 2012

Peter Bullock
Department of The Army
U.S. Army Corps of Engineers
Chicago District
111 North Canal Street, Suite 600
Chicago, IL 60606

Dear Mr. Bullock:

We have reviewed the documentation submitted for the referenced project(s) in accordance with 36 CFR Part 800.4. Based upon the information provided, no historic properties are affected. We, therefore, have no objection to the undertaking proceeding as planned.

Please retain this letter in your files as evidence of compliance with section 106 of the National Historic Preservation Act of 1966, as amended. This clearance remains in effect for two (2) years from date of issuance. It does not pertain to any discovery during construction, nor is it a clearance for purposes of the Illinois Human Skeletal Remains Protection Act (20 ILCS 3440).

If you are an applicant, please submit a copy of this letter to the state or federal agency from which you obtain any permit, license, grant, or other assistance.

Sincerely,

Anne E. Haaker
Deputy State Historic
Preservation Officer

c: Susanne Davis, Department of the Army

PRELIMINARY SECTION 404(B)(1) EVALUATION

Northerly Island Restoration Section 506 Cook County, Illinois

March 2012

I. Project Description

a. Location

The study area is a 91-acre manmade peninsula located on the southwestern shore of Lake Michigan in Chicago, Illinois (Figure 01). It is located south of the Adler Planetarium and provides protection to Burnham Harbor from Lake Michigan wave action. The restoration would primarily occur on the south side of the island and encompass approximately 45-acres of land (Figure 02). From 1947 to 1996 the island was home to a small airport known as Meigs Field. Today, the northern end of the island is occupied by a music venue: the Charter One Pavilion. Although the body of land is unnatural, Northerly Island's unique location and vicinity within Lake Michigan provides an ecological refuge to a variety of organisms in an otherwise urban environment. Restoration of the site will aid in the preservation of coastal habitat and species.

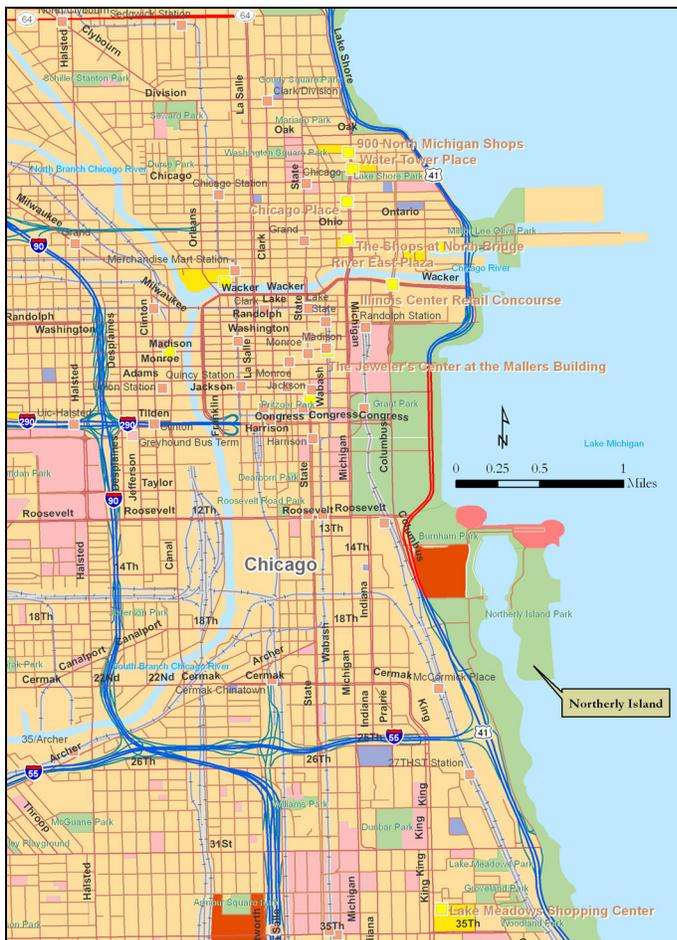


Figure 1 – Vicinity map of Northerly Island located in downtown Chicago, Illinois.



Figure 2 – Current conditions of the Northerly Island study area.

b. General Description

The recommended plan includes the following measures:

- Restoration of lacustrine littoral zone. This measure will provide increased habitat for both lithophilic (stone loving) spawners and those fish species that spawn on submerged vegetation. Currently, the western side of Northerly Island has a long continuous rubble mound shelf that consists of riprap, cobble, gravel, and boulders along the revetment wall. Implementation will include the placement of a low cost retaining wall (e.g. jersey barriers) near the edge of the rubble mound shelf. Riprap will be covered with a foot of glacially derived gravel and cobble that will extend towards the shoreline for about 1/3 of the distance. Rounded boulders and flat slate rocks will be stacked to create mudpuppy habitat on top of the newly placed stone shelf. A mixture of sand and silt will also be placed from the gravel/cobble line inland to the revetment. Aquatic macrophytes such as eel grass (*Vallisneria americana*) and pondweeds (*Potamogeton* spp.) will be planted to create submerged to emergent habitat structure. Finally, a temporary adult common carp barrier (fence) will be placed around this area to prevent uprooting of the young macrophytes prior to establishment by non-native aquatic species.
- Restoration of hydrogeomorphic heterogeneity. Implementation of this measure will include grading of the entire site to achieve different hydrologic conditions in order to establish coastal plant communities. The lowest point of the contouring will be the bottom of the pond habitat, which at its deepest point will be 4-feet below the Ordinary High Watermark (OHW). The pond will then grade into emergent marsh, which will have 6" of standing water. The topography will then grade from marsh to wet prairie. The wet prairie surface elevation will be flush with the OHW. The mesic prairie and savanna will have different elevations of groundwater, depending on site contouring.

- Restoration of pond habitat. Implementation of this measure will include the creation of an approximately 4-acre pond with varying depths that will provide an array of habitat types for fishes and other aquatic life. Excavated materials from the pond will be used to re-contour the project area accordingly. The bottom of the pond will be covered in a mixture of sand, gravel, cobble, and boulder substrates that will provide increased habitat for aquatic species. In addition, large flat slate rocks will be strategically placed to promote establishment of the state threatened mudpuppy (*Necturus maculosus*). In addition to the pond, an approximately 1 to 2 feet deep corridor will be created to connect the pond to Lake Michigan. The mouth of the corridor will have galvanized mesh fence sitting just below the water line to prevent large invasive species such as common carp (*Cyprinus carpio*) and non-native salmonids from entering the pond ecosystem.
- Restoration of emergent marsh habitat. This measure seeks to restore approximately 3-acres of emergent marsh habitat around the perimeter of the pond and lacustrine corridor described above. The unnatural soil conditions prohibiting the creation of emergent marsh habitat will be ameliorated with a soil amendment prior to planting. The amendment will consist of leaf compost that will be incorporated into the top 6-inches of soil at a rate of 62 short tons per acre. Live plugs of native emergent species will then be planted in this area. Spot herbicide application will occur as needed to control the establishment of any invasive and/or non-native plant species.
- Restoration of wet prairie habitat. Implementation of this measure will include the restoration of approximately 7-acres of wet prairie habitat throughout Northerly Island. Geomorphic contouring of the site will occur and elevation of the soil will be set at the OHW. Unnatural soil conditions will be ameliorated with a soil amendment consisting of leaf compost that will be incorporated into the top 6-inches of soil at a rate of 45 short tons per acre. This will be followed by seeding and planting of plugs of native wet prairie species. Spot herbicide application will occur as needed to control the establishment of any invasive and/or non-native plant species.
- Restoration of mesic prairie habitat. Implementation of this measure will include the restoration of approximately 10-acres of mesic prairie habitat that will occur at elevations slightly higher than that of the wet prairie habitat. Seed and live plugs of native mesic wet prairie plants will be planted in this area and spot herbicide application will occur as needed to control the establishment of any invasive and/or non-native plant species.
- Restoration of savanna habitat. Implementation of this measure will include the restoration of approximately 18-acres of savanna habitat, much of which will sit atop elevated hills and slopes created as part of the geomorphic contouring measure. A diverse seed mix of native savanna plants will be applied to these areas as well as the planting of native oaks and a variety of shrubs. The addition of savanna habitat will promote native species establishment, increase habitat diversity, and provide critical resting and foraging habitat for migratory birds; while the slopes of the savanna may provide nesting habitat for several Lake Michigan turtle species.

c. Authority and Purpose

This study is authorized under Section 506 of the Water Resources Development Act (WRDA) of 2000. Authority is given to plan, design, and construct projects to restore the fishery, ecosystem, and beneficial uses of the Great Lakes. Projects are justified by ecosystem benefits alone, while considering affects to public health, safety, economic benefits, recreational or any combination of these.

The Chicago Park District (CPD) has requested that the Chicago District, US Army Corps of Engineers (USACE) initiate a Feasibility Study (FS) under the Section 506 Great Lakes Fishery and Ecosystem Restoration authority to ascertain the feasibility of restoration features to restore critical aquatic and migratory bird habitat. This FS has evaluated the feasibility and environmental effects of manipulating topography and subsurface hydrology in an effort to restore coastal habitat. The scope of this study addresses the issues of local habitat patches fragmentation, native submergent to upland plant community diversity and structure, invasive species, and native species richness. This FS assessed and identified problems and opportunities, identified and evaluated measures, and recommends and designs the most cost effective feasible solution to the ecological problems currently existing within the area of study.

Prior to European settlement, the Lake Michigan coastal zone, in which Northerly Island resides, was one of the most diverse ecosystems in Cook County, Illinois. The vast expanse of wetlands that were left behind by glacial movement and the recession of ancient Lake Chicago included marsh, wet prairie, and wet savanna. First trading and industry, and then the onset of agriculture modified many of the plant communities unique to the area. Ultimately, the City of Chicago was erected and in turn obliterated the natural geomorphology, topography, and associated plant communities. The southern portion of Northerly Island was the primary focus for this study, which also included the lake on the southern boundary of the study area.

d. Proposed Fill Material

1) General Characteristics

Fill material consists of:

- Glacially derived cobble and gravel will be used to cover and extend past the riprap revetment; creating more naturalistic habitat for macroinvertebrate and fish species.
- Fill materials used to conceal the riprap revetment will be free from the presence of environmental contaminants and will contain less than 5% fines.
- Commercially purchased fine sand or silty sand will be used to create a proper substrate for the planting of aquatic macrophytes in the lacustrine littoral zone.
- Fill materials used to create the lacustrine littoral habitat will be free from the presence of environmental contaminants.
- Large (3'x3') limestone flags for mudpuppy habitat.

2) Quantity

- Approximately 600 cubic yards of glacially derived cobble and gravel will be required to cover the riprap revetment. Placed 1" thick.
- Approximately 1000 cubic yards of commercially obtained fine sand or silty sand will be required to create the lacustrine littoral zone. Placed 1" thick.
- 12 – 15 limestone flags for mudpuppy habitat.
- In addition, approximately 2,500 feet of precast concrete Jersey barrier would be need to act as a retaining wall on the existing rubble mound revetment to hold in the cobbles and sand. A chain-link fence will be needed to temporarily block large fish from entering the habitat area until the young macrophytes establish. The fence would be attached to the Jersey barriers for easy removal.

3) Source

- Glacial cobble, gravel and limestone flag material for the riprap revetment will be clean, inert materials obtained from a commercial supplier.
- Sand substrate for the lacustrine littoral habitat will be clean, inert materials obtained from a commercial supplier.

e. Proposed Discharge Site

1) Location

The proposed fill activity would occur along the northwestern edge of the project area located in Burnham Harbor. The project study area location is within Jackson Park, Section 22, Township 39 North, Range 14 East in Cook County, Illinois (USGS 1998).

2) Size, Type, and Habitat

The Northerly Island project area consists of 40 acres located on the southern portion of the island. The majority of the island currently consists of a failing mesic prairie and 1.7 acres of the project area is a littoral zone consisting of unnatural rip rap. The littoral zone will have natural cobble, gravel, and sand added to the area to allow macrophytes to flourish and give native fish suitable spawning habitat.

3) Timing and Duration of Discharge

Construction of Northerly Island project restoration features may begin as early as fall 2012 and may end as early as fall 2017. Placement of the glacial cobble and gravel revetment cover is expected to require 1-2 weeks, while planting and placing of the temporary protective fence for the lacustrine littoral habitat is expected to require an addition 1-2 weeks.

f. Placement Method

Cobble, gravel, and sand will likely be brought to the project site by truck or barge and will be placed into position using light weight machinery and may be finely adjusted by hand or with handheld tools.

II. Factual Determinations

a. Physical Substrate Determinations

1) Substrate Elevation and Slope

The study area does not have any fluvial geomorphic features. Topography of the island is flat, with a surface elevation of 586 ft.

2) Sediment Type

The underlying regional bedrock is Silurian-age dolomite, most likely of the Niagaran Series (Willman 1971). This rock resulted from marine deposition when all of northeastern Illinois and much of the neighboring Great Lakes region was the floor of a tropical sea from about 440 to 410 million years ago.

Naturally, the soils within the Chicago Lakeplain consisted of poorly drained clays, silts, sands, and gravels. However, Northerly Island is manmade and does not possess naturally occurring soils. The fill material primarily consists of clays, loams and sand fill. Foreign debris occurs on the site as well, chiefly consisting of cement and asphalt chunks that have been used as *ad hoc* erosion control.

3) Material Movement

There would be no significant movement of fill material after construction. Materials selected for establishment of the riprap façade and lacustrine littoral habitat would be sized properly to withstand wave turbulence. This placement is on the inside of Burnham Harbor which is protected from all storm and wave surges. Also, the Jersey barriers would retain this material to maintain a flat shelf.

4) Physical Effects on Benthos

Existing benthos directly beneath where the cobble, gravel, flat slate rocks, sand, and silt would be placed would temporarily be covered, but the area is so small it would have insignificant effects on the macroinvertebrate population. Effects to the benthic invertebrate assemblage would be positively enhanced with the restoration of the lacustrine littoral zone. Minor impacts during construction are necessary to create overall improved conditions for benthic invertebrates. There are no significant adverse effects expected.

5) Other Effects

There would be no other significant substrate impacts.

6) Actions Taken to Minimize Impacts

No special measures would be taken to minimize the temporary or long-term impacts on physical substrates associated with the proposed activity since this project is both beneficial to ecology and water quality.

b. Water Circulation, Fluctuation, and Salinity Determinations

1) Water

The proposed fill activity would have no significant negative impacts to water chemistry, water clarity, color, odor, taste, dissolved gas levels, nutrients, or increased eutrophication as a result. Natural substrates that would be used for fill material below the OHW include clean boulders, limestone flags, sand, gravel, and silt. The silt is to replicate the natural plant bed material found along the coast of Lake Michigan. Quantifiable changes in water quality parameters around Northerly Island are not expected with implementation of the project; however, all of the proposed features would ultimately further provide water quality improvements.

2) Current Patterns and Circulation

Northerly Island is manmade and does not possess any naturally occurring rivers or streams thusly local hydrology and coastal hydraulics would not be impacted. There are no significant adverse effects expected.

3) Normal Water Level Fluctuations

Northerly Island is manmade and does not possess any naturally occurring rivers or streams; therefore, the proposed fill activity would have no impact on normal water level fluctuations.

4) Salinity Gradients

Not applicable to freshwater environments.

5) Actions Taken to Minimize Impacts

No special measures would be taken to minimize the temporary impacts on water circulation and fluctuation associated with the proposed activity.

c. Suspended Particulate/Turbidity Determinations

1) Expected Changes in Suspended Particulates and Turbidity in Vicinity of Fill

There would be minor increases in suspended particulates and turbidity levels in the immediate area of the proposed fill activity during construction, most likely of which are less than any given summer thunderstorm.

2) Effects on Chemical and Physical Properties of Water Column

There would be negligible effects to light penetration and dissolved oxygen levels during construction. There are no known toxic metals, organics, or pathogens in the construction area. The placement of clean fill will not introduce metal, organic, or pathogens to the project area. Aesthetics would be improved in the long-term after instream habitat heterogeneity is established in the channel.

3) Effects on Biota

Only beneficial effects on aquatic biota are expected to result from the restoration activities and minor increase in turbidity or suspended particulates associated with the proposed fill is most likely less than that of a summer thunderstorm event.

4) Actions Taken to Minimize Impacts

Material will be carefully placed during days of minimal wave action to prevent sedimentation and disturbance of the surrounding habitat.

d. Contaminant Determination

The proposed fill material would not introduce any new contaminants into Lake Michigan, or release any significant amounts of existing contaminants (if any are present) through bottom disturbance in the construction zone.

e. Aquatic Ecosystem and Organism Determinations

1) Effects on Plankton

Only beneficial affects to planktonic organisms are expected.

2) Effects on Benthos

Refer to section II.a.4)

3) Effects on Nekton

Fish eggs and larvae would not be smothered by the proposed fill activity since the anticipated construction activities will occur during non-reproductive or rearing seasons. Fish and other free-swimming organisms will tend to avoid the construction area; the construction area will be used again by those organisms soon after construction ends and overall species richness is expected to increase.

4) Effects on Aquatic Food Web

Beneficial improvements to the food web are expected, due to expected increases in macroinvertebrate richness and abundance.

5) Effects on Aquatic Sites

- a) Sanctuaries and Refuges – none present; no significant impact
- b) Wetlands – increase in hydrophytic vegetation
- c) Mud Flats – none present; no significant impact
- d) Vegetated Shallows – increase in submergent aquatic macrophytes
- e) Coral Reefs – not applicable to freshwater environments
- f) Riffle and Pool Complexes – none present; no significant impact

6) Threatened and Endangered Species

Based on the nature and objectives of this project, to restore habitat, the US Army Corps of Engineers and the U.S. Fish and Wildlife Service has coordinated that the proposed ecological restoration project would not *affect* any Federal or State listed species. There is potential for restoring habitat for species that may use if present, or are attracted to the areas after restoration activities are complete. A 5-year monitoring plan that was developed in conjunction with the Feasibility Study and Integrated Environmental Assessment would take note if this were the case.

7) Other Wildlife

No other wildlife would be significantly impacted by the proposed activity.

8) Actions Taken to Minimize Impacts

General construction scheduling and sequencing would minimize impacts to reproducing macroinvertebrates and fishes.

f. Proposed Discharge Site Determinations

1) Mixing Zone Determination

A mixing zone is not applicable to this project as no violation of applicable water quality standards is expected during construction.

2) Determination of Compliance with Applicable Water Quality Standards

The proposed activity would not cause significant or long-term degradation of water quality within Lake Michigan and would comply with all applicable water quality standards.

3) Potential Effects on Human use Characteristics

No significant impacts to municipal and private water supplies, water-related recreation, aesthetics, recreational, or commercial fisheries are expected. No known National Parks, National and Historic Monuments, National Seashores, Wilderness Areas, Research Sites, and Similar Preserves are present. There are no significant adverse effects expected.

g. Cumulative Effects on the Aquatic Ecosystem

The proposed project would restore aquatic habitat structure and function. There are no significant adverse effects expected.

h. Secondary Effects on the Aquatic Ecosystem

No significant impacts on the Lake Michigan ecosystem are expected as a result of the proposed activity.

III. Findings of Compliance with the Restrictions on Discharge

- a. No adaptation of the Section 404(b)(1) guidelines was made for this evaluation.
- b. No practical alternatives are available that produce fewer adverse aquatic impacts than the proposed plan.
- c. The proposed project would comply with applicable water quality standards.
- d. The project is in compliance with applicable Toxic Effluent Standards under Section 307 of the Clean Water Act; with the Endangered Species Act of 1973; with the National Historic Preservation Act of 1966; and with the Marine Protection, Research, and Sanctuaries Act of 1972.
- e. The proposed fill activity would have no significant adverse impact on human health or welfare, including municipal and private water supplies, recreational and commercial fisheries, plankton, fish, shellfish, or wildlife communities (including community diversity, productivity, and stability), special aquatic sites, or recreational, aesthetic, and economic values.
- f. Typical erosion control measures would be taken to minimize construction impacts other than selection of the least environmentally damaging construction alternative.
- g. On the basis of the Guidelines, the proposed site for the discharge of fill material is specified as complying with the requirements of these guidelines with the inclusion of appropriate and practical conditions to minimize pollution or adverse impacts to the aquatic ecosystem.

Date _____

Susanne J. Davis, P.E.
Chief of Planning Branch

Finding of No Significant Impact

Northerly Island Ecosystem Restoration (GLFER 506)

Background

The Study area is a 91-acre manmade peninsula found on the shores of Lake Michigan in Chicago, Illinois. It is located south of the Adler Planetarium and provides protection to Burnham Harbor from Lake Michigan storms. The restoration would primarily occur on the south side of the island and encompass approximately 45-acres of land. From 1947-1996 the island was home to a small airport known as Meigs Field. Today, the northern end of the island is occupied by a music venue: the Charter One Pavilion. Northerly Island's unique location and vicinity within Lake Michigan provides an ecological refuge to a variety of organisms in an otherwise urban environment.

One crucial component that is important to ecosystem integrity and integrates both aquatic and riparian or buffer habitat, is wetlands. Historically, Chicago's shoreline was lush with vast expanses of wetlands. While restoring wetland in Chicago to their historical conditions is unlikely, converting small expanses of land into wetlands will provide critical habitat for a number of organisms. These patches of wetland would serve as an important refuge for migrant and resident bird species, as well as a variety of aquatic organisms (fish, amphibians, aquatic insects, etc.). The restoration, enhancement, and protection of critical wetland habitat would provide an ecological benefit that is supported by the GLFER program. The main problems at Northerly Island are as follows:

- Lack of a natural mosaic and gradient of submerged to upland coastal habitats
- Fragmentation of local habitat patches
- Overabundance of unnatural conditions that promote invasive species success
- Lack of rich coastal plant communities
- Lack of rare and sensitive coastal plant and animal species
- Lack of critical habitat for locally endangered and rare fauna
- Lack of migratory bird resting and forage habitats

Brief Summary of the EA & Preferred Plan

The environmental assessment identified the direct, indirect and cumulative effects of a set of measures that were part of five (5) alternatives plans including the No Action plan. The National Ecosystem Restoration (NER) preferred plan is Alternative 5.

The NER Preferred Plan

The National Ecosystem Restoration (NER) Plan is the preferred plan, which is Alternative 5. This alternative consists of six (measures): (LL) Lacustrine Littoral, (C) Geomorphic Contouring, (P) Pond, (EM) Emergent Marsh, (WP) Wet Prairie, (MP) Mesic Prairie and (S) Savanna. All of these community types would have been represented within the pre-settlement coastal zone within the Chicago Region. The implementation of these features is generally described as follows and according to the measures descriptions in Section 3.1. A detailed set of plans & specifications would be created if approval of this Detailed Project Report (DPR) is granted.

Site Preparation – The first task would be to install safety fencing and other safety features in order to keep the public out of the site during heavy construction. Staging areas and access roads would be

demarcated. All surficial infrastructure and ornaments would need to be removed and discarded or stockpiled and saved depending on the CDP's needs and desires.

Geomorphic Contouring – Once the site is ready for grading, the geomorphic features would be created. This grading would establish the hydrologic regime according to the particular native plant community the contours delimit. All unsightly material that is not suitable for growing plants on or habitat would be reburied sufficiently beneath the mesic prairie and savanna plant communities; since these two community types would not be affected by subsurface concrete pieces.

Substrate / Amendment Placement – Pond and lake substrates would be placed as soon as grading is complete. Sand and gravels would be placed in a 1" thick layer within the pond. It is expected for emergent vegetation to creep down into some of the pond slopes to further stabilize the pond banks. Limestone flags would be used as mudpuppy habitat in the bottom of the pond around 4" deep and in areas along the bank where stabilization enforcement may be need. The mouth of the pond, where it connects to the lake, would also have a galvanized steel mesh fence that will sit just below the water line to prevent large invasive species such as common carp and non-native Salmonids from entering the pond ecosystem.

Materials for the Lacustrine Littoral (LL) feature would be placed by small barge. The jersey barriers would be set up first as a retaining wall, then back-filled with a band natural rounded cobbles for lithophilic spawners and a band of sandy silt for submergent macrophyte establishment that are both 1" thick. A temporary (5-year) adult common carp barrier (fence/net) would be placed around this area to prevent uprooting the young macrophytes prior to establishing.

Once grading is complete, to ameliorate the unnatural soil conditions of the site for proper biogeochemical cycling, a soil amendment consisting of leaf compost will be incorporated into the top 6" of soil for emergent marsh and wet prairie communities. Incorporating a soil amendment will decrease bulk density and increase soil organic matter, while enhancing microbial communities and stimulating vegetative diversity.

Native Plant Community Establishment – The finishing touch of the project would be to establish native plant communities over the remainder of the construction period. These communities would be located according to the new hydrogeomorphology, soils and substrates established by the previous steps. The complete planting list may be viewed on Plate 05. Once in the 2nd year of restoration and the initial seeding complete, the site may be open back to the public since very few activities would be occurring, which are considered low impact. These include spot herbicide application and planting native plugs, which are very similar to home gardening activities.

Recreational Features – Components of recreation are not proposed under this project. The CPD has coordinated their passive recreational feature plans which include signage, mowed pathways, small board walks, and a small one acre mowed camping zone. None of these features would affect expected ecosystem benefits.

Discussion of Environmental Compliance

The preferred plan presented is in compliance with appropriate statutes and executive orders including the Endangered Species Act of 1973 as amended; the Fish and Wildlife Coordination Act of 1934 as amended; Executive Order 12898 (Environmental Justice); Executive Order 11990 (Protection of Wetlands); Executive Order 11988 (Floodplain Management); and the Rivers and Harbors Act of

1899, as amended; the Clean Air Act of 1970 as amended and the National Environmental Policy Act of 1969 as amended.

Environmental Justice EO12898

To the greatest extent practicable and permitted by law, and consistent with the principles set forth in the report on the National Performance Review, each Federal agency shall make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations in the United States and its territories and possessions, the District of Columbia, the Commonwealth of Puerto Rico, and the Commonwealth of the Mariana Islands. The preferred plan would not have any adverse effects to any human being.

Clean Air Act

Due to the small scale, short duration and relatively unpolluted nature of the restoration project, it is assumed that the project is below the de minimis level of PM 100 tons per year. As a reference, other USACE projects that are much grander in scale and earthwork have GCA well below the PM 100 tons per year.

Section 401 & 404 of the Clean Water Act

A Section 404 analysis was completed for the preferred plan and is located in Appendix F. Features addressed by the 404 include the fill materials for the Lacustrine Littoral zone measure where cobble, gravel, sand and clean silts would be placed to mimic natural lake substrates. No adverse effects were determined.

Section 401 Water Quality Certification for the Lacustrine Littoral zone measure would be applied for once a set of 100% construction drawings are complete. There is no reason to expect this permit would not be received since the materials being used are inert and clean, and the feature itself would improve water quality via aquatic macrophyte and bacterial functions.

USFWS Coordination

Coordination with the USFWS commenced with a project scoping letter dated 27 January 2012. This environmental assessment identified the preferred ecological restoration plan was determined to have "no effects" on Federally endangered species or their habitats. It is anticipated that upon review of this document, the USFWS would preclude the need for further consultation on the Northerly Island Section 506 restoration project as required under Section 7 of the Endangered Species Act of 1973, as amended. The intent of the NER Plan is to aid in the overall restoration of the Lake Michigan coastal ecosystem, inclusive of threatened and endangered species. Coordination is documented in Appendix F.

State of Illinois Historic Preservation Act

Pursuant to Section 106 of the National Historic Preservation Act (16 U.S.C. § 4701) and 36 C.F.R. Part 800, the staff of the Illinois State Historic Preservation Officer (Illinois SHPO) has conducted an analysis of the materials dated 27 January 2012 and 07 February 2012. Based upon the documentation available, the staff of the Illinois SHPO has not identified any historic buildings,

structures, districts, or objects listed in or eligible for inclusion in the National Register of Historic Places within the probable area of potential effects. Thusly, the SHPO has no objection to the work being performed under the NER Plan. All areas affected by ground disturbance under this project have already been previously disturbed; thusly an archaeological survey is unnecessary. This is in congruence with the SHPO letter dated 08 February 2012, which is located in Appendix F

Public Interest

An Environmental Assessment (EA) was prepared for the project and sent to Federal, State and local agencies along with the general public for review. A 30-day Public Review period was held from ___ April 2012 to ___ May 2012 for the Environmental Assessment. Significant comments from the Federal, State or local agencies or the public were not received.

Conclusion

In accordance with the National Environmental Policy Act of 1969 and Section 122 of the River and Harbor and Flood Control Act of 1970, the U.S. Army Corps of Engineers (USACE) has assessed the environmental impacts associated with this project. The purpose of this EA is to evaluate the impacts that would be associated with the restoration of the southern 40-acres of the Northerly Island. The proposed project has been determined to be in full compliance with the appropriate statutes, executive orders and USACE regulations.

The assessment process indicates that this project would not cause significant effects on the quality of the human environment. The assessment process indicates that this project would have only beneficial impacts upon the ecological, biological, social, cultural, or physical resources of this area, and would provide environmental benefits to the Lake Michigan coastal zone and the Great Lakes as a whole. The findings indicate that that the proposed action is not a major Federal action significantly affecting the quality of the human environment. Therefore, I have determined that an Environmental Impact Statement (EIS) is not required.

Frederic A. Drummond Jr. Date: _____
Colonel, U.S. Army
District Commander

**GREAT LAKES FISHERY & ECOSYSTEM RESTORATION
(GLFER)**

NORTHERLY ISLAND

GEOTECHNICAL APPENDIX G

U.S. Army Corps of Engineers, Chicago District
Geotechnical & Survey Section

June 7, 2012

GEOTECHNICAL APPENDIX

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ATTACHMENTS

- Attachment 1: Overall Subsurface Plan and Profile
- Attachment 2: Chicago Shoreline Soil Boring Logs
- Attachment 3: Meigs Field Soil Boring Logs
- Attachment 4: NRCS Soil Map

GEOTECHNICAL APPENDIX

INTRODUCTION

1. The Great Lakes Fishery & Ecosystem Restoration (GLGER) was authorized in Section 506 of the Water Resources Development Act of 2000. The purpose is to restore fishery, ecosystem, and beneficial uses of the Great Lakes in cooperation with non-Federal interests. This specific project is located on Northerly Island, south of Adler Planetarium and east of Soldier Field in Chicago, Illinois.
2. The proposed project will modify the existing topography to allow for lake, wetland, prairie, savanna, and woodland communities. It will also add topsoil, remove invasive plant species, and plant native community types.

Project Background

3. Northerly Island is a 91-acre manmade peninsula built in the 1920's and 30's. It was used for the 1933 World's Fair and an airport called Meigs Field was constructed in 1946. Meigs Field was demolished and removed in 2006. Northerly Island is currently owned by the Chicago Park District and is covered with grassland and several walking paths. Figure 1 shows the current state as of 2011 while Figure 2 shows Northerly Island before Meigs Field was removed. The general area of the proposed project is circled in red.



Figure 1. Location of Project Site with 2011 Aerial



Figure 2. 2002 Aerial Showing Meigs Field

GEOLOGY

4. The geology of the Chicago area is largely a consequence of a series of continental glacial advances and retreats. During the most recent glaciation, the Wisconsin Episode, the area was covered by several thousand feet of ice of the Lake Michigan Lobe. The area had been covered with surficial deposits up to 300 feet thick that were deposited by glaciers and higher level stages of Lake Michigan. Bedrock typically consists of sedimentary dolomitic limestone, dolomite shale, and sandstone. The uppermost bedrock unit is the Silurian Niagran series consisting of dolomitic limestone. The bedrock is generally not exposed in Chicago, except in quarries and local outcroppings, as the rock is typically covered by glacial drift. In addition to these natural processes, the Chicago lakefront has been extensively modified during the last 150 years from man-made structures and filling operations.

5. Most of the overburden soils were originally deposited by the Lake Michigan Lobe ice sheet or were deposited as lake-bottom and near-shore deposits of the ancient Lake Chicago or its ancestors. Glacial and lacustrine processes resulted in the deposition of three types of materials; recent deposits of fluvial and eolian sand, lacustrine silt and clay, and till-related deposits. The thickness of the overburden soils generally ranges from 70 to 90 feet. The majority of the glacial deposits are of the Wedron Formation which includes till-related deposits and gravel, sand and silt. The till consists of gray silty clay with localized silt seams. Borings indicate the till increases in strength with depth and varies from 15 to 40 feet in thickness.

6. Recent deposits consisting of silty sand or clean, poorly graded sand sediments have been deposited in the near shore area as a result of erosion or littoral drift processes. During the past 100 years the primary source of sediment is bluff erosion caused in part by ice drift. Other sediments range from lacustrine or glacial fluvial sediments of the Equality Formation to eolian sediments of the Parkland Sand. These sediments consist of shore or shallow water lacustrine deposits, commonly found in ridges defining former spits and beaches.

7. Manmade features have also affected the formation of the Chicago Shoreline, as piers, jetties, and breakwaters diverted and trapped the littoral sand. The lake bottom is a dynamic environment within 12 miles of the shore with currents induced by storm waves transporting fine sand and silt. This process causes a patchy, continually changing distribution of sediments overlying the till base.

LOCAL GEOLOGY

8. Northerly Island was created by filling an offshore area of Lake Michigan in the 1920's and 1930's. It is assumed that the island was created by dredging the surrounding lake, although other sources are possible as documentation was not available.

9. Several existing soil boring logs were available from previous explorations on and near Northerly Island. Eight borings were completed in 1994 and 1996 for the USACE Chicago Shoreline project. Four of these borings were completed on the northern portion of Northerly Island land and four were completed east of the island in the water. Additionally, two separate investigations were completed in 1995 and 2001 for Meigs Field which include a total of 11 soil borings. Six of these are located on the east-central portion, one is on the west-central portion, and four are along the north-south centerline. The soil boring logs are located in Attachments 2 and 3 of this Appendix. The locations of the borings are shown in Attachment 1 and Figure 3, below.



Figure 3. Previous Soil Boring Locations (see Attachment 1 for larger map)

10. Each soil boring completed on land encountered a varying amount of fill. These fill soils consisted of mostly soft to very stiff silty clay and silt with several layers of loose to medium stiff sand, silty sand, and gravel. Several soil borings noted concrete, bricks, and cinders within the fill soils. Of the borings completed within the proposed job area, the deleterious material is noted in the top 5 feet. Beneath the fill soils, the land borings encountered varying amounts of soft to medium stiff silty clay and loose sand. At deeper depths, the borings encountered medium dense sand and silt, very soft to hard silty clay, and loose clayey sand. The borings terminated between 17 and 105 feet below grade.

11. All four soil borings completed off shore did not encounter fill material. CB-3-5-94 encountered about 3 feet of silty sand at the lake bottom. Beneath this material and at the lake bottom of the other locations, soft to firm clay was encountered to the termination depths of 17 to 21-½ feet below the bottom of the lake. There are a few sand, silt, and gravel seams noted in the clay material.

12. Additionally, a soils map developed by the Natural Resources Conservation Service is provided in Attachment 4. This map identifies the soils at Northerly Island as Psamments, Orthents, and Urban Land-Orthents. Orthents are at the southern tip, while Urban Land-Orthents are at the northern tip. These suborders are all part of the greater Entisols order. Entisols are defined as alluvial, sandy soils that do not show any profile development because they are very young. Orthents are commonly on recent erosional surfaces while Psamments are usually nearly bare sands.

SUMMARY AND CONCLUSIONS

13. In the current plan, the slopes for the proposed pond are 5H: 1V, with the tallest slope at 8 feet tall. There are no structural or engineered features that require quantitative soil properties. However, it is anticipated that deleterious materials such as concrete, bricks, etc. may be encountered during the excavation of the proposed pond. Soil borings B-1 and B-2 (1995) were completed within this pond area, which encountered varying amounts of cinders and brick mixed with clay, sand and gravel within the top 5 feet of the subsurface. As stated in the project plan, any deleterious materials encountered will be moved to areas receiving fill and buried.

14. Eight additional soil borings will be completed in the excavation area to better quantify any unsuitable materials present in the subsurface. The resulting soil boring logs can then be provided in the plans and specifications so that contractors bidding on the job can supply more accurate bids on the excavation work.

15. Groundwater is likely to be encountered near Lake Michigan level. Since both the soil borings and soil survey indicate sandy materials are present, the groundwater will likely seep into any excavation completed near the lake level. The bottom elevation of the proposed pond is about 574 NAVD88, while the current lake level is about 579 NAVD. Therefore, groundwater is anticipated.

GEOTECHNICAL APPENDIX G

Attachment 1



NORTHERLY ISLAND SOIL BORING MAP

U.S. Army Corps
of Engineers
Chicago District



Legend

 Soil Boring

Location Map



DISCLAIMER - While the United States Army Corps of Engineers, (hereinafter referred to as USACE) has made a reasonable effort to insure the accuracy of the maps and associated data, it should be explicitly noted that USACE makes no warranty, representation or guaranty, either express or implied, as to the content, sequence, accuracy, timeliness or completeness of any of the data provided herein. The USACE, its officers, agents, employees, or servants shall assume no liability of any nature for any errors, omissions, or inaccuracies in the information provided regardless of how caused. The USACE, its officers, agents, employees or servants shall assume no liability for any decisions made or actions taken or not taken by the user of the maps and associated data in reliance upon any information or data furnished here. By using these maps and associated data the user does so entirely at their own risk and explicitly acknowledges that he/she is aware of and agrees to be bound by the disclaimer and agrees not to present any claim or demand of any nature against the USACE, its officers, agents, employees or servants in any form whatsoever for any damages of any nature whatsoever that may result from or may be caused in any way by the use of the maps and associated data.

Soil Boring Map of Existing Subsurface Investigations

GEOTECHNICAL APPENDIX G

Attachment 2

DRILLING LOG		DIVISION	INSTALLATION		SHEET 1	
		NORTH CENTRAL	CHICAGO DISTRICT		OF 1 SHEETS	
1. PROJECT CHICAGO SHORELINE EROSION - REACH 3			10. SIZE AND TYPE OF BIT 3-7/8" DRAG BIT			
2. LOCATION (Coordinates or Station) 698306 E 1895049 N (feet)			11. DATUM FOR ELEVATION SHOWN (TBM or MSL) LOW WATER DATUM (LWD)			
3. DRILLING AGENCY FUGRO-McCLELLAND			12. MANUFACTURER'S DESIGNATION OF DRILL FALING 250 (TRUCK-MOUNTED)			
4. HOLE NO. (As shown on drawing title and file number) CB-3-2-94			13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 5	UNDISTURBED 3	
5. NAME OF DRILLER DAVID FENDLEY			14. TOTAL NUMBER CORE BOXES N/A			
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.			15. ELEVATION GROUND WATER 2.4 LWD (LAKE LEVEL)			
7. THICKNESS OF OVERBURDEN 19.5 FT			16. DATE HOLE	STARTED 21 MAY 94	COMPLETED 21 MAY 94	
8. DEPTH DRILLED INTO ROCK 0 FT			17. ELEVATION TOP OF HOLE -21.1 LWD (23.5' WATER DEPTH)			
9. TOTAL DEPTH OF HOLE 19.5 FT			18. TOTAL CORE RECOVERY FOR BORING N/A %			
			19. SIGNATURE OF INSPECTOR <i>David H. ...</i>			
ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
-21.1' LWD			(CL) CLAY, Gray, Soft to Firm -with a few gravel and coarse sand -shell hosh and gravel to 0.3'	24/24	1	Std. Penetration Test Blows NS = No Sample WOP = Weight of Pipe WOH = Weight of Hammer
	1				1A	
	2		Q = 0.3 ksf (cp = 11 psi), DD = 87 pcf @ 1.6' w = 36% @ 1.6' w = 34% @ 2'		NS	
	3			0/18	NS	-Sample not recovered due to gravel borehole
	4				NS	
	5				NS	
	6		w = 34% @ 6.5'	18/18	3	
	7				NS	
	8		-with silt pockets at 8'	16/18	4	
	9		w = 37% @ 8.8'		NS	
	10				NS	
	11			24/24	5	3" ø thin-walled tube sample
	12				5A	
	13		Tor = 0.5 ksf @ 12' PP = 0.5 ksf, 0.4 ksf @ 12' w = 20% @ 12'	12/18	6	
	14				NS	
	15		-with a few claystone fragments below 15'		NS	ABBREVIATIONS
	16		w = 25% @ 16.5'	18/18	7	w = Water Content DD = Dry Density PL = Plastic Limit LL = Liquid Limit
	17				NS	G _s = Specific Gravity Q = Unconsolidated-Undrained cp = Confining Pressure
	18		Q = 0.4 ksf (cp = 24 psi), DD = 101 pcf @ 19.1' w = 27% @ 19.1' Tor = 0.7 ksf @ 19.5' PP = 0.5 ksf, 0.6 ksf @ 19.5'	24/24	8	Unc = Unconfined Compression Tor = Torvone PP = Pocket Penetrometer
	19		w = 26% @ 19.5' (19.5')		8A	
-40.6' LWD			COMPLETION DEPTH = 19.5'			

DRILLING LOG		DIVISION	INSTALLATION		SHEET 1		
		NORTH CENTRAL	CHICAGO DISTRICT		OF 1 SHEETS		
1. PROJECT CHICAGO SHORELINE EROSION - REACH 3			10. SIZE AND TYPE OF BIT 3-7/8" DRAG BIT				
2. LOCATION (Coordinates or Station) 698347 E 1894173 N (feet)			11. DATUM FOR ELEVATION SHOWN (TBM or MSL) LOW WATER DATUM (LWD)				
3. DRILLING AGENCY FUGRO-McCLELLAND			12. MANUFACTURER'S DESIGNATION OF DRILL FALLING 250 (TRUCK-MOUNTED)				
4. HOLE NO. (As shown on drawing title and file number) CB-3-3-94			13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN		DISTURBED 6		
					UNDISTURBED 2		
5. NAME OF DRILLER DAVID FENDLEY			14. TOTAL NUMBER CORE BOXES N/A				
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.			15. ELEVATION GROUND WATER 2.6 LWD (LAKE LEVEL)				
7. THICKNESS OF OVERBURDEN 19.0 FT			16. DATE HOLE STARTED 21 MAY 94				
8. DEPTH DRILLED INTO ROCK 0 FT			17. ELEVATION TOP OF HOLE -20.9 LWD (23.5' WATER DEPTH)				
9. TOTAL DEPTH OF HOLE 19.0 FT			18. TOTAL CORE RECOVERY FOR BORING N/A %				
			19. SIGNATURE OF INSPECTOR <i>Greg D. H...</i>				
ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OF SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g	
-20.9' LWD			(CL) CLAY, Gray, Fine, Soft to Firm -with a few gravel, coarse sand, and claystone fragments -fine brown sand to 0.2' w = 37% @ 1.1'	13/18	1	Std. Penetration Test Blows NS = No Sample WOP = Weight of Pipe WOH = Weight of Hommer	
	1					NS	
	2					NS	
	3				18/18	2	
	4			w = 32% @ 4'		NS	
	5					NS	
	6				24/24	3	3" ø thin-walled tube sample PUSH
	7			Q = 0.3 ksf (cp = 14 psi), DD = 87 pcf @ 6.6' w = 39% @ 6.6' Tor = 0.4 ksf @ 7' PP = 0.5 ksf, 0.3 ksf @ 7' w = 16% @ 7'		3A	
	8			-with many gravel at 7' w = 33%, LL = 45%, PL = 19% @ 8.6'	13/18	4	WOH 1 1
	9					NS	
	10					NS	ABBREVIATIONS
	11			-with silt seams at 11' w = 23% @ 11.5'	18/18	5	w = Water Content DD = Dry Density PL = Plastic Limit LL = Liquid Limit Weight of pipe
	12					NS	G _s = Specific Gravity Q = Unconsolidated-Undrained cp = Confining Pressure
	13			-with gravel seam at 13.5'	18/18	6	Unc = Unconfined Compression Tor = Torvane PP = Pocket Penetrometer WOP 1-12"
	14			w = 21%, G _s = 2.69 @ 14'		NS	
	15					NS	
	16				24/24	7	3" ø thin-walled tube sample PUSH
	17			Tor = 0.6 ksf @ 17' PP = 0.5 ksf, 0.5 ksf @ 17' w = 25% @ 17'		7A	
	18					NS	
	19		w = 27% @ 19' (19.0)	18/18	8	3 4 5	
	19		COMPLETION DEPTH = 19.0 FT		NS		
-39.9' LWD							

DRILLING LOG		DIVISION	NORTH CENTRAL		INSTALLATION		CHICAGO DISTRICT		SHEET 1 OF 1 SHEETS		
1. PROJECT CHICAGO SHORELINE EROSION - REACH 3					10. SIZE AND TYPE OF BIT 3-7/8" DRAG BIT						
2. LOCATION (Coordinates or Station) 698367 E 1893268 N (feet)					11. DATUM FOR ELEVATION SHOWN (TBM or MSL) LOW WATER DATUM (LWD)						
3. DRILLING AGENCY FUGRO-McCLELLAND					12. MANUFACTURER'S DESIGNATION OF DRILL FAILING 250 (TRUCK-MOUNTED)						
4. HOLE NO. (As shown on drawing title and file number) CB-3-4-94					13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN		DISTURBED 6		UNDISTURBED 2		
5. NAME OF DRILLER DAVID FENDLEY					14. TOTAL NUMBER CORE BOXES N/A						
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.					15. ELEVATION GROUND WATER 2.4 LWD (LAKE LEVEL)						
7. THICKNESS OF OVERBURDEN 17.0 FT					16. DATE HOLE		STARTED 21 MAY 94		COMPLETED 21 MAY 94		
8. DEPTH DRILLED INTO ROCK 0 FT					17. ELEVATION TOP OF HOLE -22.6 LWD (25' WATER DEPTH)						
9. TOTAL DEPTH OF HOLE 17.0 FT					18. TOTAL CORE RECOVERY FOR BORING N/A %						
					19. SIGNATURE OF INSPECTOR <i>[Signature]</i>						
ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)					
-22.6' LWD			(CL) CLAY, Gray, Soft to Firm -with a few gravel and coarse sand -with silt seams and packets to 6' w = 35% @ 1.5'	18/18	1	Std. Penetration Test Blows NS = No Sample WOP = Weight of Pipe WOH = Weight of Hammer					
	1										
	2				NS						
	3		-with a few small shell fragments at 3'	18/18	2						
	4		w = 30%, LL = 37%, PL = 20%, -200 = 89% @ 4'								
	5				NS						
	6		w = 28% @ 6'	18/18	3						
	6		w = 25% @ 6.5'		4						
	7				NS						
	8		-firm to stiff 7.5'-9'								
	9		Q = 1.2 ksf (cp = 17 pci), DD = 96 pcf, w = 30% @ 8.9' Tor = 0.9 ksf @ 9.2' PP = 0.8 ksf, 0.6 ksf @ 9.2' w = 29% @ 9.2'	21/24	5	3" @ Thin-Walled Tube Sample PUSH					
	9				5A						
	9				NS						
	10				NS						
	11		w = 32% @ 11.5'	18/18	6						
	12				NS						
	13					3" @ Thin-Walled Tube Sample PUSH					
	14		Q = 0.5 ksf (cp = 21 psi), 0.7 ksf (cp = 32 psi), 0.8 ksf (cp = 42 psi) @ 14.2' DD = 93 pcf @ 14.2' Tor = 0.7 ksf @ 14.5' PP = 0.6 ksf, 0.5 ksf @ 14.5' w = 31% @ 14.5'	24/24	7						
	14				7A						
	15				NS						
	16		w = 33% @ 16.7'	14/18	8	ABBREVIATIONS w = Water Content DD = Dry Density PL = Plastic Limit LL = Liquid Limit					
	16				NS						
	17		COMPLETION DEPTH = 17 FT (17.0')			C _s = Specific Gravity Q = Unconsolidated-Undrained cp = Confining Pressure Unc = Unconfined Compression Tor = Torvane PP = Pocket Penetrometer					
-39.6' LWD											
	18										
	19										

DRILLING LOG			DIVISION	INSTALLATION	SHEET 1	
			NORTH CENTRAL	CHICAGO DISTRICT	OF 2 SHEETS	
1. PROJECT CHICAGO SHORELINE EROSION - REACH 3			10. SIZE AND TYPE OF BIT 3-7/8" DRAG BIT			
2. LOCATION (Coordinates or Station) 698397 E 1892415 N (feet)			11. DATUM FOR ELEVATION SHOWN (TBM or MSL) LOW WATER DATUM (LWD)			
3. DRILLING AGENCY FUGRO-McCLELLAND			12. MANUFACTURER'S DESIGNATION OF DRILL FAILING 250 (TRUCK-MOUNTED)			
4. HOLE NO. (As shown on drawing title and file number) CB-3-5-94			13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED 8 UNDISTURBED 2			
5. NAME OF DRILLER DAVID FENDLEY			14. TOTAL NUMBER CORE BOXES N/A			
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.			15. ELEVATION GROUND WATER 2.6 LWD (LAKE LEVEL)			
7. THICKNESS OF OVERBURDEN 21.5 FT			16. DATE HOLE STARTED 21 MAY 94 COMPLETED 21 MAY 94			
8. DEPTH DRILLED INTO ROCK 0 FT			17. ELEVATION TOP OF HOLE -17.9 LWD (20.5' WATER DEPTH)			
9. TOTAL DEPTH OF HOLE 21.5 FT			18. TOTAL CORE RECOVERY FOR BORING N/A %			
			19. SIGNATURE OF INSPECTOR <i>David H. ...</i>			
ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OF SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
-17.9' LWD	1		(SM) SAND, Gray, Fine, Silty -with a few gravel and shell fragments -200 = 36% @ 1'	12/18	1	Std. Penetration Test Blows NS = No Sample
	2		w = 25% @ 3' (3.0')		NS	-set casing to 1.5 ft below lakebed
-20.9' LWD	3		(CL) CLAY, Gray, Soft to Firm -with a few gravel and coarse sand w = 33%, LL = 43%, PL = 18% @ 3.8'	15/18	2	
	4				3	
	5				NS	
	6		w = 34% @ 6.5'	18/18	4	
	7				NS	
	8				5	3" ϕ Thin-Walled Tube Sample
	9		G = 0.4 ksf (cp = 15 psi), DD = 90 pcf, w = 35% @ 9.1' Tor = 0.8 ksf @ 9.5' PP = 0.8 ksf, 0.6 ksf @ 9.5' w = 33% @ 9.5'		5A	
	10				NS	
	11		-with shale seams at 11' w = 17% @ 11.3'	16/18	6	-Lost circulation at 10'. Add 5' casing (total depth 6.5' below lakebed)
	12				NS	
	13				7	3" ϕ Thin-Walled Tube Sample
	14		-with many gravel at 14' Tor = 0.8 ksf @ 14.5' PP = 0.8 ksf @ 14.5' w = 14% @ 14.5'		7A	
	15				NS	ABBREVIATIONS
	16		w = 28% @ 16.1'	13/18	8	w = Water Content DD = Dry Density PL = Plastic Limit LL = Liquid Limit
	17				NS	G _s = Specific Gravity Q = Unconsolidated-Undrained cp = Confining Pressure
	18			18/18	9	Unc = Unconfined Compression Tor = Torvane PP = Pocket Penetrometer
	19		w = 26% @ 19'		NS	
-37.9' LWD						

DRILLING LOG		DIVISION NORTH CENTRAL	INSTALLATION CHICAGO DISTRICT		SHEET 2 OF 2 SHEETS	
1. PROJECT CHICAGO SHORELINE EROSION - REACH 3			10. SIZE AND TYPE OF BIT 3-7/8" DRAG BIT			
2. LOCATION (Coordinates or Station) 698397 E 1892415 N (feet)			11. DATUM FOR ELEVATION SHOWN (TBM or MSL) LOW WATER DATUM (LWD)			
3. DRILLING AGENCY FUGRO-McCLELLAND			12. MANUFACTURER'S DESIGNATION OF DRILL FAILING 250 (TRUCK-MOUNTED)			
4. HOLE NO. (As shown on drawing title and file number) CB-3-5-94			13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN		DISTURBED 8	
5. NAME OF DRILLER DAVID FENDLEY			14. TOTAL NUMBER CORE BOXES		N/A	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.			15. ELEVATION GROUND WATER		2.6 LWD (LAKE LEVEL)	
7. THICKNESS OF OVERBURDEN 21.5 FT			16. DATE HOLE		STARTED 21 MAY 94 COMPLETED 21 MAY 94	
8. DEPTH DRILLED INTO ROCK 0 FT			17. ELEVATION TOP OF HOLE -17.9 LWD (20.5' WATER DEPTH)			
9. TOTAL DEPTH OF HOLE 21.5 FT			18. TOTAL CORE RECOVERY FOR BORING N/A %			
19. SIGNATURE OF INSPECTOR <i>[Signature]</i>						
ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (drilling time, water loss, depth of weathering, etc., if significant) g
-37.9' LWD	21	//	(CL) CLAY, Gray, Soft to Firm -with a few gravel and coarse sand w. = 21% @ 21.5' (21.5')	18/18	10	2 4 4
-39.4' LWD	22		COMPLETION DEPTH = 21.5'			
	23					
	24					
	25					

DRILLING LOG		DIVISION North Central	INSTALLATION Chicago	SHEET OF 6 SHEETS 1
1. PROJECT Chicago Shoreline Erosion - L5235.D0		10. SIZE AND TYPE OF BIT 3 1/4" I.D. HSA		
2. LOCATION (Coordinates or Station) N 1894803 E 1181241		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) IGLD1985		
3. DRILLING AGENCY Patrick Drilling		12. MANUFACTURER'S DESIGNATION OF DRILL CME 55 TM		
4. HOLE NO. (As shown on drawing title and file number) CS3-6-96		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 41	UNDISTURBED 2
5. NAME OF DRILLER Jerry Copak		14. TOTAL NUMBER CORE BOXES 0		
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED 0.0 DEG. FROM VERT.		15. ELEVATION GROUND WATER -31.1		
7. THICKNESS OF OVERBURDEN 105.0		16. DATE HOLE STARTED MAY 3 96 COMPLETED MAY 4 96		
8. DEPTH DRILLED INTO ROCK 0.0		17. ELEVATION TOP OF HOLE 21.5		
9. TOTAL DEPTH OF HOLE 105.0		18. TOTAL CORE RECOVERY FOR BORING N/A %		
		19. SIGNATURE OF INSPECTOR <i>[Signature]</i>		

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) g
19.9	1.6	[Cross-hatched legend symbol]	Black silty CLAY to clayey silt, trace coarse to fine sand, trace coarse to fine gravel, medium plasticity, moist -FILL- CL	9/18"	AU-1 0.0 1.0 SS-2A/B 1.0 2.5	2.0" split-spoon samples were obtained using a 140 lb. hammer falling 30" Water level 52.8' below ground surface in auger immediately after drilling. 3/5/17 SS-2A: qu = 2.0*tef Stone caught in spoon
18.9	2.6		Medium dense gray coarse GRAVEL, trace coarse to fine sand, poorly graded, dry -FILL- GP			
17.0	4.5		Very stiff brown and black silty CLAY to clayey silt, trace coarse to fine sand, trace coarse to fine gravel, medium plasticity, moist -FILL- CL	12/18"	SS-3A/B 3.5 5.0	7/15/16 SS-3A: qu = 3.0*tef
16.2	5.3		Dense brown coarse to fine SAND and fine gravel, well graded, dry -FILL- SW			
13.7	7.8		Medium dense black and gray coarse to fine GRAVEL and coarse to fine sand, little silt, well graded, dry -FILL- GM	12/18"	SS-4 6.0 7.5	14/10/7
			Medium dense to loose brown coarse to fine SAND and coarse to fine gravel, some clay, well graded, moist -FILL- SC	12/18"	SS-5 8.5 10.0	3/5/6
			Saturated at 11.0'.	12/18"	SS-6 11.0 12.5	2/1/2
				12/18"	SS-7 13.5 15.0	17/7/3
6.2	15.3		Soft gray silty CLAY, trace coarse to fine sand, trace coarse to fine gravel, high plasticity, wet -FILL- CH	15/18"	SS-8 16.0 17.5	2/2/2 qu < 0.5*tef
3.7	17.8		Stiff brown silty CLAY, trace coarse to fine sand, trace coarse to fine gravel, medium plasticity, wet -FILL- CL	18/18"	SS-9 18.5 20.0	2/3/3 qu = 2.0*tef

DRILLING LOG		DIVISION North Central	INSTALLATION Chicago	SHEET 2
1. PROJECT Chicago Shoreline Erosion - L5235.D0		10. SIZE AND TYPE OF BIT 3 1/4" I.D. HSA		
2. LOCATION (Coordinates or Station) N 1894803 E 1181241		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) IGLD1985		
3. DRILLING AGENCY Patrick Drilling		12. MANUFACTURER'S DESIGNATION OF DRILL CME 55 TM		
4. HOLE NO. (As shown on drawing title and file number) CS3-6-96		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 41	UNDISTURBED 2
5. NAME OF DRILLER Jerry Copak		14. TOTAL NUMBER CORE BOXES 0		
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED 0.0 DEG. FROM VERT.		15. ELEVATION GROUND WATER -31.1		
7. THICKNESS OF OVERBURDEN 105.0		16. DATE HOLE STARTED MAY 3 96	COMPLETED MAY 4 96	
8. DEPTH DRILLED INTO ROCK 0.0		17. ELEVATION TOP OF HOLE 21.5		
9. TOTAL DEPTH OF HOLE 105.0		18. TOTAL CORE RECOVERY FOR BORING N/A %		
		18. SIGNATURE OF INSPECTOR <i>John M. ...</i>		

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) g
0.4	21.1		Stiff brown silty CLAY, trace coarse to fine sand, trace coarse to fine gravel, medium plasticity, wet -FILL- CL	18/18"	SS-10A/B 21.0 22.5	1/2/3 SS-10A: qu = 1.5 * tef SS-10B: qu = 0.5 * tef
			Soft grey silty CLAY, trace coarse to fine sand, trace coarse to fine gravel, medium plasticity, wet CL	18/18"	SS-11 23.5 25.0	1/2/2 qu < 0.5 * tef Water level 24.7' below ground surface in auger on 5/4/96 at 8:20 a.m.
				24/24"	3T-12 28.0 28.0	Pushed 3" Shelby tube Torvane = 0.42 tef qu < 0.5 * tef Dry density = 98.1 pcf qu = 0.5 tef LL = 33 PL = 18
				18/18"	SS-13 28.5 30.0	2/3/5 qu < 0.5 * tef
				18/18"	SS-14 31.0 32.5	WOH/2/2 qu < 0.5 * tef
				18/18"	SS-15 33.5 35.0	2/3/4 qu < 0.5 * tef
-14.9	36.4		Medium dense grey coarse to fine SAND, little silty clay, trace fine gravel, poorly graded, saturated SC	18/18"	SS-16A/B 36.0 37.5	5/5/8 SS-16A: qu < 0.5 * tef SS-16B: Sand = 85% Fines = 13% Gravel = 2%
				18/18"	SS-17 38.5 40.0	4/7/11

DRILLING LOG		DIVISION North Central	INSTALLATION Chicago	SHEET OF 6 SHEETS 3
1. PROJECT Chicago Shoreline Erosion - L5235.D0		10. SIZE AND TYPE OF BIT 3 1/4" I.D. HSA		
2. LOCATION (Coordinates or Station) N 1894803 E 1181241		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) IGLD1985		
3. DRILLING AGENCY Patrick Drilling		12. MANUFACTURER'S DESIGNATION OF DRILL CME 55 TM		
4. HOLE NO. (As shown on drawing title and file number) CS3-6-96		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN 41	DISTURBED 2	UNDISTURBED 2
5. NAME OF DRILLER Jerry Copak		14. TOTAL NUMBER CORE BOXES 0		
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED 0.0 DEG. FROM VERT.		15. ELEVATION GROUND WATER -31.1		
7. THICKNESS OF OVERBURDEN 105.0		16. DATE HOLE MAY 3 96	STARTED MAY 3 96	COMPLETED MAY 4 96
8. DEPTH DRILLED INTO ROCK 0.0		17. ELEVATION TOP OF HOLE 21.5		
9. TOTAL DEPTH OF HOLE 105.0		18. TOTAL CORE RECOVERY FOR BORING N/A %		
		19. SIGNATURE OF INSPECTOR <i>John M. Kunkamp</i>		

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) g
-19.0	40.5		Medium dense gray coarse to fine SAND, little silty clay, trace fine gravel, poorly graded, saturated			
			SC	18/18*	SS-18 41.0 42.5	WOH/2/3 qu < 0.5*tef
			CL			
			Soft to medium stiff gray silty CLAY, trace coarse to fine sand, trace coarse to fine gravel, medium plasticity, wet			
				18/18*	SS-19 43.5 45.0	1/2/2 qu < 0.5*tef
				18/18*	SS-20 46.0 47.5	1/1/2 qu < 0.5*tef
				18/18*	SS-21 48.5 50.0	WOH/2/2 qu < 0.5*tef
				18/18*	SS-22 51.0 52.5	WOH/1/2 qu < 0.5*tef
				18/18*	SS-23 53.5 55.0	3/5/5 qu < 0.5*tef
				24/24*	3T-24 56.0 58.0	Pneum 3" Shelby tube Torvane = .32tef qu < 0.5*tef Dry density = 104.1 pcf LL = 38 PL = 21
				18/18*	SS-25 58.5 60.0	3/2/4 qu < 0.5*tef

DRILLING LOG		DIVISION North Central	INSTALLATION Chicago	SHEET OF 6 SHEETS 4
1. PROJECT Chicago Shoreline Erosion - L5235.D0			10. SIZE AND TYPE OF BIT 3 1/4" I.D. HSA	
2. LOCATION (Coordinates or Station) N 1894803 E 1181241			11. DATUM FOR ELEVATION SHOWN (TBM or MSL) IGLD1985	
3. DRILLING AGENCY Patrick Drilling			12. MANUFACTURER'S DESIGNATION OF DRILL CME 55 TM	
4. HOLE NO. (As shown on drawing title and file number) CS3-6-96			13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED: 41 UNDISTURBED: 2	
5. NAME OF DRILLER Jerry Copak			14. TOTAL NUMBER CORE BOXES 0	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED 0.0 DEG. FROM VERT.			15. ELEVATION GROUND WATER -31.1	
7. THICKNESS OF OVERBURDEN 105.0			16. DATE HOLE STARTED: MAY 3 96 COMPLETED: MAY 4 96	
8. DEPTH DRILLED INTO ROCK 0.0			17. ELEVATION TOP OF HOLE 21.5	
9. TOTAL DEPTH OF HOLE 105.0			18. TOTAL CORE RECOVERY FOR BORING N/A %	
			19. SIGNATURE OF INSPECTOR <i>John Mockenamp</i>	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) g
			Soft to medium stiff gray silty CLAY, trace coarse to fine sand, trace coarse to fine gravel, medium plasticity, wet CL			
			18/18"	SS-26 61.0 62.5	4/4/5 qu = 0.5*tef	
			18/18"	SS-27 83.5 85.0	4/3/5 qu < 0.5*tef	
			18/18"	SS-28 68.0 67.5	2/3/4 qu = 0.5*tef	
			18/18"	SS-29 88.5 70.0	3/3/4 qu < 0.5*tef	
-49.0	70.5			Stiff brown silty CLAY, little coarse to fine sand, little coarse to fine gravel, medium plasticity, wet CL		
-50.5	72.0	18/18"		SS-30A/B 71.0 72.5	8/11/11 SS-30A: qu = 1.5*tef Dry density = 118.4	
		Medium dense fine GRAVEL, some coarse to fine sand, poorly graded, saturated GP				
-52.7	74.2		Hard to very stiff gray silty CLAY, trace coarse to fine sand, trace coarse to fine gravel, low plasticity, moist CL			
			18/18"	SS-31A/B 73.5 75.0	10/15/16 SS-31B: qu > 4.5*tef	
			18/18"	SS-32 78.0 77.5	12/18/22 qu = 4.5*tef	
			18/18"	SS-33 78.5 80.0	6/19/23 qu = 2.75*tef	
			1" sand seam at 79.8'.			

DRILLING LOG		DIVISION North Central	INSTALLATION Chicago	SHEET OF 6 SHEETS 5
1. PROJECT Chicago Shoreline Erosion - L5235.D0		10. SIZE AND TYPE OF BIT 3 1/4" I.D. HSA		
2. LOCATION (Coordinates or Station) N 1894803 E 1181241		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) IGLD1985		
3. DRILLING AGENCY Patrick Drilling		12. MANUFACTURER'S DESIGNATION OF DRILL CME 55 TM		
4. HOLE NO. (As shown on drawing title and file number) CS3-6-96		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 41	UNDISTURBED 2
5. NAME OF DRILLER Jerry Copak		14. TOTAL NUMBER CORE BOXES 0		
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED 0.0 DEG. FROM VERT.		15. ELEVATION GROUND WATER -31.1		
7. THICKNESS OF OVERBURDEN 105.0		16. DATE HOLE	STARTED MAY 3 96	COMPLETED MAY 4 96
8. DEPTH DRILLED INTO ROCK 0.0		17. ELEVATION TOP OF HOLE 21.5		
9. TOTAL DEPTH OF HOLE 105.0		18. TOTAL CORE RECOVERY FOR BORING N/A %		
		19. SIGNATURE OF INSPECTOR <i>John Mochlenburg</i>		

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) g
-59.0	80.5		Hard to very stiff gray silty CLAY, trace coarse to fine sand, trace coarse to fine gravel, low plasticity, moist CL			
			Medium dense gray and black clayey SILT, trace coarse to fine sand, wat to saturated ML	18/18"	SS-34 81.0 82.5	8/10/15
			Very dense, moist at 83.5'	18/18"	SS-35 83.5 85.0	12/29/33
-64.0	85.5		Hard gray silty CLAY, little coarse to fine sand, trace fine gravel, low plasticity, moist CL	18/18"	SS-36 86.0 87.5	24/35/48 qu > 4.5 * tef
				18/18"	SS-37 88.5 90.0	23/38/42 qu > 4.5 * tef
-69.0	90.5		Hard gray silty CLAY, trace coarse to fine sand, low plasticity, moist CL	18/18"	SS-38 91.0 92.5	14/23/35 qu > 4.5 * tef
				18/18"	SS-39 93.5 95.0	15/24/29 qu > 4.5 * tef
				18/18"	SS-40 96.0 97.5	35/48/53 qu > 4.5 * tef
			Silty clay to clayey silt at 99.0'	12/18"	SS-41 98.5 100.0	27/35/50 qu > 4.5 * tef

DRILLING LOG		DIVISION North Central		INSTALLATION Chicago		SHEET OF 6 SHEETS 6	
1. PROJECT Chicago Shoreline Erosion - L5235.D0				10. SIZE AND TYPE OF BIT 3 1/4" I.D. HSA			
2. LOCATION (Coordinates or Station) N 1894803 E 1181241				11. DATUM FOR ELEVATION SHOWN (TBM or MSL) IGLD1985			
3. DRILLING AGENCY Patrick Drilling				12. MANUFACTURER'S DESIGNATION OF DRILL CME 55 TM			
4. HOLE NO. (As shown on drawing title and file number) CS3-6-96				13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN		DISTURBED 41	UNDISTURBED 2
5. NAME OF DRILLER Jerry Copak				14. TOTAL NUMBER CORE BOXES 0			
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED 0.0 DEG. FROM VERT.				15. ELEVATION GROUND WATER -31.1		16. DATE HOLE STARTED MAY 3 96 COMPLETED MAY 4 96	
7. THICKNESS OF OVERBURDEN 105.0				17. ELEVATION TOP OF HOLE 21.5			
8. DEPTH DRILLED INTO ROCK 0.0				18. TOTAL CORE RECOVERY FOR BORING N/A %			
9. TOTAL DEPTH OF HOLE 105.0				19. SIGNATURE OF INSPECTOR <i>John Moellenkamp</i>			
ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) g	
-78.8	00.3		Medium dense gray clayey SILT, trace coarse to fine sand, saturated	ML	18/18"	SS-42 101.0 102.5	6/10/19
-81.5	03.0		Hard gray silty CLAY, little coarse to fine sand, trace fine gravel, low plasticity, moist	CL	16/18"	SS-43 103.5 105.0	21/32/35 qu > 4.5*tef
-83.5	05.0		Trace limestone chips at 104.5'				
			End of Boring at 105.0'				Borehole backfilled with cuttings immediately after drilling.

DRILLING LOG		DIVISION North Central	INSTALLATION Chicago	SHEET OF 4 SHEETS 1
1. PROJECT Chicago Shoreline Erosion - L5235.D0		10. SIZE AND TYPE OF BIT 3 1/4" I.D. HSA		
2. LOCATION (Coordinates or Station) N 1894813 E 1181639		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) IGLD1985		
3. DRILLING AGENCY Patrick Drilling		12. MANUFACTURER'S DESIGNATION OF DRILL CME 55 TM		
4. HOLE NO. (As shown on drawing title and file number) CS3-7-96		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 28	UNDISTURBED 3
5. NAME OF DRILLER Jerry Copak		14. TOTAL NUMBER CORE BOXES 0		
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED 0.0 DEG. FROM VERT.		15. ELEVATION GROUND WATER -7.9		
7. THICKNESS OF OVERBURDEN 75.0		16. DATE HOLE	STARTED MAY 2 96	COMPLETED MAY 2 96
8. DEPTH DRILLED INTO ROCK 0.0		17. ELEVATION TOP OF HOLE 21.6		
9. TOTAL DEPTH OF HOLE 75.0		18. TOTAL CORE RECOVERY FOR BORING N/A %		
		19. SIGNATURE OF INSPECTOR <i>Mark Hochstetler</i>		

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) g	
		[Hatched Pattern]	Very stiff black silty CLAY to clayey silt, trace coarse to fine sand, medium plasticity, moist -FILL- CL		AU-1 0.0 1.0	2.0" split-spoon samples were obtained using a 140 lb. hammer falling 30"	
					12/18"	SS-2 1.0 2.5	6/7/7 qu = 2.5 * tef
17.8	3.8			Medium dense brown silty coarse to fine SAND, trace coarse to fine gravel, well graded, dry -FILL- SM		12/18" SS-3A/B 3.5 6.0	8/11/8 SS-3A: qu = 2.5 * tef
16.3	6.3			Loose black coarse to fine SAND, trace coarse to fine gravel, trace silty clay, well graded, dry -FILL- SW/SC		12/18" SS-4 6.0 7.5	6/4/4 Sand = 82% Gravel = 10% Fines = 8%
12.7	8.9			Medium stiff grey silty CLAY, trace coarse to fine sand, trace coarse to fine gravel, medium plasticity, moist -FILL- CL		12/18" SS-5A/B 8.5 10.0	3/2/3 qu = 1.0 * tef
					12/18"	SS-6 11.0 12.5	1/2/2 qu = 0.5 * tef Dry density = 115.1 pcf
					12/18"	SS-7 13.5 15.0	2/2/4 qu = 1.0 * tef
					12/18"	SS-8 16.0 17.5	2/3/3 qu = 1.0 * tef
3.8	17.8			Soft grey silty CLAY, trace coarse to fine sand, trace coarse to fine gravel, medium plasticity, wet CL		18/18" SS-9 18.5 20.0	2/2/3 qu = 0.5 * tef

DRILLING LOG		DIVISION North Central	INSTALLATION Chicago	SHEET OF 4 SHEETS 3
1. PROJECT Chicago Shoreline Erosion - L5235.D0		10. SIZE AND TYPE OF BIT 3 1/4" I.D. HSA		
2. LOCATION (Coordinates or Station) N 1894813 E 1181639		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) IGLD1985		
3. DRILLING AGENCY Patrick Drilling		12. MANUFACTURER'S DESIGNATION OF DRILL CME 55 TM		
4. HOLE NO. (As shown on drawing title and file number) CS3-7-96		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN 28	DISTURBED 3	UNDISTURBED 3
5. NAME OF DRILLER Jerry Copak		14. TOTAL NUMBER CORE BOXES 0		
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED 0.0 DEG. FROM VERT.		15. ELEVATION GROUND WATER -7.9	16. DATE HOLE MAY 2 96	STARTED COMPLETED MAY 2 96
7. THICKNESS OF OVERBURDEN 75.0		17. ELEVATION TOP OF HOLE 21.6		
8. DEPTH DRILLED INTO ROCK 0.0		18. TOTAL CORE RECOVERY FOR BORING N/A %		
9. TOTAL DEPTH OF HOLE 75.0		19. SIGNATURE OF INSPECTOR <i>York MacLennan</i>		

ELEVATION e	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) g
			Loose gray clayey fine SAND, saturated SC			
				18/18"	SS-18 41.0 42.5	2/1/1
-21.4	43.0		Soft gray silty CLAY, trace coarse to fine sand, trace coarse to fine gravel, medium plasticity, wet CL	18/18"	SS-19 43.5 45.0	1/2/2 qu < 0.5 * tef
				12/18"	SS-20 46.0 47.5	2/1/2 qu < 0.5 * tef
				12/18"	SS-21 48.5 50.0	4/5/3 qu < 0.5 * tef
				18/18"	SS-22 51.0 52.5	WOH/2/2 qu < 0.5 * tef
				3/18"	SS-23 53.5 55.0	3/3/5 qu < 0.5 * tef Stone in spoon blocking sample
				18/18"	SS-24 56.0 57.5	WOH/2/3 qu < 0.5 * tef
				18/18"	SS-25 58.5 60.0	3/3/4 qu < 0.5 * tef
-38.4	60.0					

DRILLING LOG		DIVISION North Central	INSTALLATION Chicago	SHEET OF 4 SHEETS 4
1. PROJECT Chicago Shoreline Erosion - L5235.D0			10. SIZE AND TYPE OF BIT 3 1/4" I.D. HSA	
2. LOCATION (Coordinates or Station) N 1894813 E 1181639			11. DATUM FOR ELEVATION SHOWN (TBM or MSL) IGLD1985	
3. DRILLING AGENCY Patrick Drilling			12. MANUFACTURER'S DESIGNATION OF DRILL CME 55 TM	
4. HOLE NO. (As shown on drawing title and file number) CS3-7-96			13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED: 28 UNDISTURBED: 3	
5. NAME OF DRILLER Jerry Copak			14. TOTAL NUMBER CORE BOXES 0	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED 0.0 DEG. FROM VERT.			15. ELEVATION GROUND WATER -7.9	
7. THICKNESS OF OVERBURDEN 75.0			16. DATE HOLE STARTED: MAY 2 96 COMPLETED: MAY 2 96	
8. DEPTH DRILLED INTO ROCK 0.0			17. ELEVATION TOP OF HOLE 21.6	
9. TOTAL DEPTH OF HOLE 75.0			18. TOTAL CORE RECOVERY FOR BORING N/A %	
			19. SIGNATURE OF INSPECTOR <i>Yael Mochlenberg</i>	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) g	
		CL	Medium stiff gray silty CLAY, trace coarse to fine sand, trace coarse to fine gravel, medium plasticity, wet				
			0/24"		3T-26 61.0 63.0	Pushed 3" Shelby tube	
			24/24"		3T-27 63.0 66.0	Pushed 3" Shelby tube Torvane = 0.8t _{sf} qu = 0.75*t _{sf} Dry density = 101.2 pcf LL = 40 PL = 19	
			18/18"		SS-28 66.0 67.5	3/3/4 qu = 0.75*t _{sf}	
			18/18"		SS-29 68.5 70.0	3/3/4 qu = 0.75*t _{sf}	
-48.9	70.5			Hard gray silty CLAY, little coarse to fine sand, trace coarse to fine gravel, low plasticity, moist			
					18/18"	SS-30 71.0 72.5	20/26/29 qu > 4.5*t _{sf}
				18/18"	SS-31 73.5 76.0	25/27/19 qu > 4.5*t _{sf}	
-53.4	75.0		End of Boring at 75.0'.				

DRILLING LOG		DIVISION North Central	INSTALLATION Chicago	SHEET OF 4 SHEETS 1
1. PROJECT Chicago Shoreline Erosion - L5235.D0		10. SIZE AND TYPE OF BIT 3 1/4" I.D. HSA		
2. LOCATION (Coordinates or Station) N 1894947 E 1182208		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) IGLD1985		
3. DRILLING AGENCY Patrick Drilling		12. MANUFACTURER'S DESIGNATION OF DRILL CME 55 TM		
4. HOLE NO. (As shown on drawing title and file number) CS3-8-96		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 28	UNDISTURBED 3
5. NAME OF DRILLER Jerry Copak		14. TOTAL NUMBER CORE BOXES 0		
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED 0.0 DEG. FROM VERT.		15. ELEVATION GROUND WATER -6.1		
7. THICKNESS OF OVERBURDEN 75.0		16. DATE HOLE STARTED MAY 1 196 COMPLETED MAY 1 196		
8. DEPTH DRILLED INTO ROCK 0.0		17. ELEVATION TOP OF HOLE 22.4		
9. TOTAL DEPTH OF HOLE 75.0		18. TOTAL CORE RECOVERY FOR BORING N/A %		
		19. SIGNATURE OF INSPECTOR <i>John M. ...</i>		

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) g	
			Soft to very stiff black clayey SILT to silty clay, trace coarse to fine sand, trace coarse to fine gravel, medium plasticity, moist		AU-1 0.0 1.0	2.0" split-spoon samples were obtained using a 140 lb. hammer falling 30"	
			-FILL- CL	12/18"	SS-2 1.0 2.5	2/3/3 qu < 0.5 * tef	
				12/18"	SS-3 3.5 5.0	4/2/3 qu = 2.0 * tef	
				12/18"	SS-4 6.0 7.5	6/4/1 qu = 3.0 * tef	
				12/18"	SS-5 8.5 10.0	2/4/5 qu = 1.5 * tef	
12.1	10.3			Loose clayey coarse to fine SAND and coarse to fine gravel, well graded, saturated			
10.9	11.5			-FILL- SW	12/18"	SS-6A/B 11.0 12.5	5/5/3 qu = 2.0 * tef
				Stiff gray silty CLAY, trace coarse to fine sand, trace coarse to fine gravel, medium plasticity, wet			
				-FILL- CL	15/18"	SS-7 13.5 15.0	1/3/4 qu = 1.5 * tef
7.0	15.4			Soft to medium stiff gray silty CLAY, trace coarse to fine sand, trace coarse to fine gravel, medium plasticity, wet			
			CL	18/18"	SS-8 16.0 17.5	1/1/2 qu = 0.5 * tef	
				18/18"	SS-9 18.5 20.0	2/1/3 qu < 0.5 * tef	
2.4	20.0						

DRILLING LOG		DIVISION North Central	INSTALLATION Chicago	SHEET 2 OF 4 SHEETS
1. PROJECT Chicago Shoreline Erosion - L5235.D0		10. SIZE AND TYPE OF BIT 3 1/4" I.D. HSA		
2. LOCATION (Coordinates or Station) N 1894947 E 1182208		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) IGLD1985		
3. DRILLING AGENCY Patrick Drilling		12. MANUFACTURER'S DESIGNATION OF DRILL CME 55 TM		
4. HOLE NO. (As shown on drawing title and file number) CS3-8-96		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 28	UNDISTURBED 3
5. NAME OF DRILLER Jerry Copak		14. TOTAL NUMBER CORE BOXES 0		
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED 0.0 DEG. FROM VERT.		15. ELEVATION GROUND WATER -6.1	16. DATE HOLE STARTED MAY 1 96 COMPLETED MAY 1 96	
7. THICKNESS OF OVERBURDEN 75.0		17. ELEVATION TOP OF HOLE 22.4		
8. DEPTH DRILLED INTO ROCK 0.0		18. TOTAL CORE RECOVERY FOR BORING N/A %		
9. TOTAL DEPTH OF HOLE 75.0		19. SIGNATURE OF INSPECTOR <i>Yout Moshlenkayz</i>		

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) g
			Soft gray silty CLAY, trace coarse to fine sand, trace coarse to fine gravel, medium plasticity, moist CL			
				24/24"	3T-10 21.0 23.0	Pushed 3" Shelby tube Torvane = 0.45tef qu = 0.75*tef Dry density = 97.1 pcf qu = 0.7tef LL = 48 PL = 21 Specific gravity = 2.72
				18/18"	SS-11 23.5 25.0	2/1/3 qu < 0.5*tef
				18/18"	SS-12 28.0 27.5	2/2/3 qu < 0.5*tef
				18/18"	SS-13 28.5 30.0	2/2/2 qu < 0.5*tef Water level 28.5' below ground surface in auger on 5/2/96 at 8:20 a.m.
				15/18"	SS-14 31.0 32.5	4/8/5 qu < 0.5*tef
				9/18"	SS-15 33.5 35.0	3/5/5 qu < 0.5*tef
				6/18"	SS-16 36.0 37.5	4/8/5 qu < 0.5*tef
-16.6	39.0		Medium dense gray clayey fine SAND, saturated SC		SS-17A/B 38.5 40.0	2/8/5 SS-17A: qu < 0.5*tef SS-17B: Sand = 83% Fines = 13%

DRILLING LOG		DIVISION North Central	INSTALLATION Chicago	SHEET 3 OF 4 SHEETS
1. PROJECT Chicago Shoreline Erosion - L5235.D0		10. SIZE AND TYPE OF BIT 3 1/4" I.D. HSA		
2. LOCATION (Coordinates or Station) N 1894947 E 1182208		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) IGLD1985		
3. DRILLING AGENCY Patrick Drilling		12. MANUFACTURER'S DESIGNATION OF DRILL CME 55 TM		
4. HOLE NO. (As shown on drawing title and file number) CS3-8-96		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 28	UNDISTURBED 3
5. NAME OF DRILLER Jerry Copak		14. TOTAL NUMBER CORE BOXES 0		
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED 0.0 DEG. FROM VERT.		15. ELEVATION GROUND WATER -6.1		
7. THICKNESS OF OVERBURDEN 75.0		16. DATE HOLE STARTED MAY 1 96 COMPLETED MAY 1 96		
8. DEPTH DRILLED INTO ROCK 0.0		17. ELEVATION TOP OF HOLE 22.4		
9. TOTAL DEPTH OF HOLE 75.0		18. TOTAL CORE RECOVERY FOR BORING N/A %		
		19. SIGNATURE OF INSPECTOR <i>John Mochlenkamp</i>		

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) g	
			Medium dense gray clayey fine SAND, saturated SC			Gravel = 4%	
			18/18"	SS-18 41.0 42.5	7/7/6		
			18/18"	SS-19 43.5 45.0	7/7/3		
-23.1	45.5			Very soft to soft gray silty CLAY, trace coarse to fine sand, trace coarse to fine gravel, medium plasticity, wet CL	18/18"	SS-20 46.0 47.5	2/2/3 qu < 0.5* tef
			18/18"	SS-21 48.5 50.0	2/1/3 qu < 0.5* tef		
			18/18"	SS-22 51.0 52.5	2/2/3 qu < 0.5* tef		
			18/18"	SS-23 53.5 55.0	2/2/3 qu < 0.5* tef		
			18/18"	SS-24 56.0 57.5	1/2/2 qu = 0.5* tef		
			18/18"	SS-25 58.5 60.0	3/3/2 qu < 0.5* tef Dry density = 97.4 pcf qu = 0.1 tef LL = 36 PL = 19		

DRILLING LOG		DIVISION North Central	INSTALLATION Chicago	SHEET 4
1. PROJECT Chicago Shoreline Erosion - L5235.D0		10. SIZE AND TYPE OF BIT 3 1/4" I.D. HSA		
2. LOCATION (Coordinates or Station) N 1894947 E 1182208		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) IGLD1985		
3. DRILLING AGENCY Patrick Drilling		12. MANUFACTURER'S DESIGNATION OF DRILL CME 55 TM		
4. HOLE NO. (As shown on drawing title and file number) CS3-8-96		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 28	UNDISTURBED 3
5. NAME OF DRILLER Jerry Copak		14. TOTAL NUMBER CORE BOXES 0		
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED 0.0 DEG. FROM VERT.		15. ELEVATION GROUND WATER -6.1	16. DATE HOLE STARTED MAY 1 96	COMPLETED MAY 1 96
7. THICKNESS OF OVERBURDEN 75.0		17. ELEVATION TOP OF HOLE 22.4		
8. DEPTH DRILLED INTO ROCK 0.0		18. TOTAL CORE RECOVERY FOR BORING N/A %		
9. TOTAL DEPTH OF HOLE 75.0		19. SIGNATURE OF INSPECTOR <i>York Muehlenberg</i>		

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) g
			Very soft to soft gray silty CLAY, trace coarse to fine sand, trace coarse to fine gravel, medium plasticity, wet			
			CL			
				0/24"	3T-28 61.0 63.0	Pushed 3" Shelby tube
				22/24"	3T-27 63.0 65.0	Pushed 3" Shelby tube Torvane = 0.30 tef qu = 0.5 * tef LL = 39 PL = 18 Dry density = 102.4 pcf
				18/18"	SS-28 66.0 67.5	WOH/3/4 qu < 0.5 * tef LL = 38 PL = 20 Dry density = 99.8 pcf qu = 0.4 tef
				18/18"	SS-29 68.5 70.0	3/3/4 qu = 0.5 * tef
				18/18"	SS-30 71.0 72.5	2/2/2 qu = 0.5 * tef
-51.6	74.0		Hard gray sandy CLAY, low plasticity, moist			
			CL			
-52.6	75.0		End of Boring at 75.0'.			

DRILLING LOG		DIVISION North Central	INSTALLATION Chicago	SHEET 1 OF 4 SHEETS
1. PROJECT Chicago Shoreline Erosion - L5235.D0		10. SIZE AND TYPE OF BIT 3 1/4" I.D. HSA		
2. LOCATION (Coordinates or Station) N 1894398 E 1182283		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) IGLD1985		
3. DRILLING AGENCY Patrick Drilling		12. MANUFACTURER'S DESIGNATION OF DRILL CME 55 TM		
4. HOLE NO. (As shown on drawing title and file number) CS3-9-96		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 26	UNDISTURBED 2
5. NAME OF DRILLER Jerry Copak		14. TOTAL NUMBER CORE BOXES 0		
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED 0.0 DEG. FROM VERT.		15. ELEVATION GROUND WATER -6.7		
7. THICKNESS OF OVERBURDEN 67.5		16. DATE HOLE	STARTED APR 30 96	COMPLETED MAY 1 96
8. DEPTH DRILLED INTO ROCK 0.0		17. ELEVATION TOP OF HOLE 12.3		
9. TOTAL DEPTH OF HOLE 67.5		18. TOTAL CORE RECOVERY FOR BORING N/A %		
		19. SIGNATURE OF INSPECTOR <i>Yosh Mochlenkamp</i>		

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) g	
10.8	1.5		Loose brown silty coarse to fine SAND, well graded, dry -FILL- SM		AU-1 0.0 1.0	2.0" split-spoon samples were obtained using a 140 lb. hammer falling 30"	
					12/18"	SS-2 1.0 2.5	3/4/6
8.1	4.2		Medium stiff brown to black silty CLAY, trace coarse to fine sand, low plasticity, moist -FILL- CL				
					12/18"	SS-3 3.5 5.0	5/9/9 qu=4.0*tf
			Very stiff black clayey SILT, trace coarse to fine sand, trace coarse to fine gravel, medium plasticity, moist -FILL- ML				
					18/18"	SS-4 6.0 7.5	5/6/4 qu>4.5*tf
3.7	8.6		Medium dense brown silty coarse to fine SAND, well graded, saturated SM				
					14/18"	SS-5 8.5 10.0	6/8/6
1.9	10.4		Soft gray silty CLAY, trace coarse to fine sand, trace coarse to fine gravel, medium plasticity, wet CL				
					12/18"	SS-6 11.0 12.5	1/1/2 qu=0.5*tf
					15/18"	SS-7 13.5 15.0	1/1/2 qu=0.5*tf
					18/18"	SS-8 16.0 17.5	1/4/6 qu=0.5*tf
			1" sand seam at 17.3'				
					18/18"	SS-9 18.5 20.0	1/2/6 qu<0.5*tf Water level 19.0' below ground surface in auger on 5/1/96 at 8:20 a.m.
			2" sand seam at 18.5'				

DRILLING LOG		DIVISION North Central	INSTALLATION Chicago	SHEET OF 4	2 SHEETS
1. PROJECT Chicago Shoreline Erosion - L5235.D0			10. SIZE AND TYPE OF BIT 3 1/4" I.D. HSA		
2. LOCATION (Coordinates or Station) N 1894398 E 1182283			11. DATUM FOR ELEVATION SHOWN (TBM or MSL) IGLD1985		
3. DRILLING AGENCY Patrick Drilling			12. MANUFACTURER'S DESIGNATION OF DRILL CME 55 TM		
4. HOLE NO. (As shown on drawing title and file number) CS3-9-96			13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED: 26 UNDISTURBED: 2		
5. NAME OF DRILLER Jerry Copak			14. TOTAL NUMBER CORE BOXES 0		
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED 0.0 DEG. FROM VERT.			15. ELEVATION GROUND WATER -6.7		
7. THICKNESS OF OVERBURDEN 67.5			16. DATE HOLE STARTED APR 30 96 COMPLETED MAY 1 96		
8. DEPTH DRILLED INTO ROCK 0.0			17. ELEVATION TOP OF HOLE 12.3		
9. TOTAL DEPTH OF HOLE 67.5			18. TOTAL CORE RECOVERY FOR BORING N/A %		
			19. SIGNATURE OF INSPECTOR <i>Mark Mankin</i>		

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) g
-8.9	21.2		Soft gray silty CLAY, trace coarse to fine sand, trace coarse to fine gravel, medium plasticity, wet CL	20/24*	3T-10 21.0 23.0	Pushed 3" Shelby tube Sand = 57% Fines = 43%
			Medium dense to loose gray clayey coarse to fine SAND, poorly graded, saturated SP			
				18/18*	SS-11 23.6 26.0	1/1/2
				18/18*	SS-12 26.0 27.5	1/2/2 Sand = 85% Fines = 9% Gravel = 6%
				12/18*	SS-13 28.6 30.0	3/6/6
				18/18*	SS-14 31.0 32.5	WOH/3/3
-20.7	33.0		Soft gray silty CLAY, trace coarse to fine sand, trace coarse to fine gravel, medium plasticity, wet CL	18/18*	SS-16 33.6 35.0	2/2/2 qu = 0.5*tsf
				18/18*	SS-18 36.0 37.5	2/1/1 qu < 0.5*tsf
				18/18*	SS-17 38.5 40.0	1/2/2 qu < 0.5*tsf

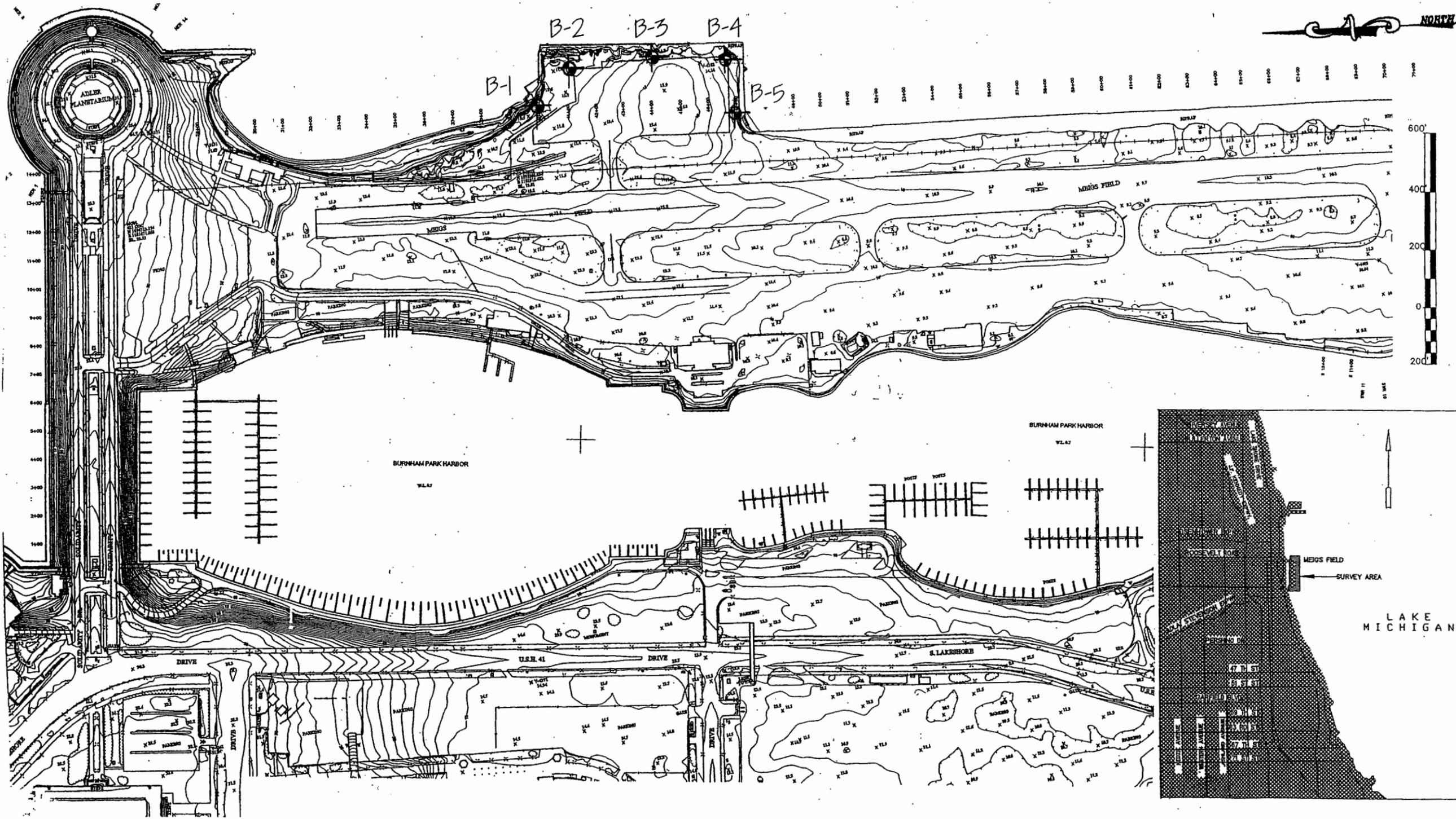
DRILLING LOG		DIVISION North Central	INSTALLATION Chicago	SHEET OF 4 SHEETS 3
1. PROJECT Chicago Shoreline Erosion - L5235.D0		10. SIZE AND TYPE OF BIT 3 1/4" I.D. HSA		
2. LOCATION (Coordinates or Station) N 1894398 E 1182283		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) IGLD1985		
3. DRILLING AGENCY Patrick Drilling		12. MANUFACTURER'S DESIGNATION OF DRILL CME 55 TM		
4. HOLE NO. (As shown on drawing title and file number) CS3-9-96		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 26	UNDISTURBED 2
5. NAME OF DRILLER Jerry Copak		14. TOTAL NUMBER CORE BOXES 0		
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED 0.0 DEG. FROM VERT.		15. ELEVATION GROUND WATER -6.7	16. DATE HOLE STARTED APR 30 96	COMPLETED MAY 1 96
7. THICKNESS OF OVERBURDEN 67.5		17. ELEVATION TOP OF HOLE 12.3		
8. DEPTH DRILLED INTO ROCK 0.0		18. TOTAL CORE RECOVERY FOR BORING N/A %		
9. TOTAL DEPTH OF HOLE 67.5		19. SIGNATURE OF INSPECTOR <i>John Mocklenkamp</i>		

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) g
		[Hatched Legend Box]	Soft gray silty CLAY, trace coarse to fine sand, trace coarse to fine gravel, medium plasticity, wet CL			
			18/18"	SS-18 41.0 42.5	2/2/3 qu < 0.5 * tef	
			18/18"	SS-19 43.5 45.0	3/2/3 qu < 0.5 * tef	
-33.2	46.5		Medium stiff gray silty CLAY, some coarse to fine sand, trace coarse to fine gravel, medium plasticity, wet CL			
			12/18"	SS-20 46.0 47.5	3/5/5 qu = 0.5 * tef	
			18/18"	SS-21 48.5 50.0	3/4/4 qu = 0.75 * tef	
			24/24"	3T-22 51.0 53.0	Pushed 3" Shelby tube Torvane = 0.45 tef qu = 1.0 * tef LL = 32 PL = 18 Dry density = 112.8 pcf qu = 1.1 tef	
			18/18"	SS-23 53.5 55.0	2/3/2 qu = 0.75 * tef	
			18/18"	SS-24 56.0 57.5	3/3/3 qu = 0.5 * tef	
			18/18"	SS-25 58.5 60.0	2/3/3 qu = 0.5 * tef	

DRILLING LOG		DIVISION North Central		INSTALLATION Chicago		SHEET OF 4 SHEETS 4	
1. PROJECT Chicago Shoreline Erosion - L5235.D0				10. SIZE AND TYPE OF BIT 3 1/4" I.D. HSA			
2. LOCATION (Coordinates or Station) N 1894398 E 1182283				11. DATUM FOR ELEVATION SHOWN (TBM or MSL) IGLD1985			
3. DRILLING AGENCY Patrick Drilling				12. MANUFACTURER'S DESIGNATION OF DRILL CME 55 TM			
4. HOLE NO. (As shown on drawing title and file number) CS3-9-96				13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN		DISTURBED 26	UNDISTURBED 2
5. NAME OF DRILLER Jerry Copak				14. TOTAL NUMBER CORE BOXES 0			
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED 0.0 DEG. FROM VERT.				15. ELEVATION GROUND WATER -6.7		16. DATE HOLE STARTED APR 30 96 COMPLETED MAY 1 96	
7. THICKNESS OF OVERBURDEN 67.5				17. ELEVATION TOP OF HOLE 12.3			
8. DEPTH DRILLED INTO ROCK 0.0				18. TOTAL CORE RECOVERY FOR BORING N/A %			
9. TOTAL DEPTH OF HOLE 67.5				19. SIGNATURE OF INSPECTOR <i>John Mocklenburg</i>			
ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) g	
		[Hatched Legend]	Medium stiff to soft gray silty CLAY, some coarse to fine sand, trace coarse to fine gravel, medium plasticity, wet CL				
			18/18" SS-26 61.0 62.5			3/3/3 qu = 0.5* <i>tf</i>	
			18/18" SS-27 63.5 65.0			2/2/6 qu < 0.5* <i>tf</i>	
-54.2	68.5		15/18" SS-28A/B 66.0 67.5			1/8/20 SS-28A: qu < 0.5* <i>tf</i> SS-28B: qu = 3.0* <i>tf</i>	
-55.2	67.5		Very stiff gray silty CLAY, some coarse to fine sand, little coarse to fine gravel, medium plasticity, wet CL				
End of Boring at 67.5'							

GEOTECHNICAL APPENDIX G

Attachment 3



LEGEND

OBA
O'BRIEN & ASSOCIATES, INC.
 CONSULTING ENGINEERS
 1235 E. DAVIS ST./ARLINGTON HTS., IL 60005
 (708) 473-3900 • FAX (708) 473-6376

REVISIONS					
ZONE	REV	DESCRIPTION	DATE	APPROVED	

**Meigs Field Aircraft Apron
 East & South Shoreline Improvements
 Chicago, Illinois**

Soil Boring Location Diagram

SIZE B	REV. 1	OBA Job No. 00420	DRAWN BY CKB	APPROVED BY DOB
SCALE: As Shown		DATE: 3-31-01	SHEET: 1 OF 1	



**O'BRIEN & ASSOCIATES, INC.
CONSULTING ENGINEERS**

1235 E. DAVIS ST./ARLINGTON HTS., IL 60005
(847)398-1441 * FAX(847) 398-2376

**STRUCTURE FOUNDATION
BORING LOG**

Sh 2 of 2

Project City of Chicago-Chicago Shoreline Protection Project

OBA JOB NO. 00420

Project 2: Melas Field Apron

Date 2-20-2001

Location xx

Bored By RH

Client Melas Field, Chicago, Illinois

Checked By DOB

BORING NO. B-1

Station XX
Offset XX

Blow Counts	R (in)	Qu (tsf)	W (%)	Surface Water Elev. N/A		Blow Counts	R (in)	Qu (tsf)	W (%)
				Groundwater Depth	11.0' WD				
...continued				-38.5					
2				SILTY CLAY-trace sand & gravel-gray-stiff (CL)		3		99.3	
2						5			
1		NP	48			7		1.25B	26
2						3		100.6	
2						5			
-55.0	2	NP	44		-68.0-80.0	6		1.4B	23
				End of Boring @ -80.0'					
				Hollow Stem Augers					
				CME Automatic Hammer					
2									
2									
2		NP	51						
2									
3									
-60.0	3	NP	69		-85.0				
				-49.0					
2									
1									
1		NP	32						
1									
2									
-65.0	2	NP	26		-90.0				
				-54.0					
1									
2									
3		0.5P	19						
				-58.5					
6									
11									
-70.0	16	1.75P	20		-95.0				
5			99.8						
10									
13		1.9B	23						
4			98.8						
8									
-75.0	7	1.4B	26		-100.0				

N-Standard Penetration Test (ASTM D-1586)
R-Recovery in inches
NR-No Recovery

ST-S Shelby Tube
VS-Vane Shear
NS-No Sample
NP-Non Plastic

Failure Type
B-Bulge Failure
S-Shear Failure
P-Penetrometer

Qu-Unconfined Compressive Strength (tsf)
W-Water Content, percent dry weight
NP-Non-Plastic
Unit wt. (pcf) noted in italics above w%



**O'BRIEN & ASSOCIATES, INC.
CONSULTING ENGINEERS**

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**STRUCTURE FOUNDATION
BORING LOG**

Sh 1 of 2

Project City of Chicago—Chicago Shoreline Protection Project
Project 2: Meigs Field Apron

OBA JOB NO. 00420

Location xx

Date 1-15-2001

Client Meigs Field, Chicago, Illinois

Bored By RH

Checked By DOB

BORING NO. B-2

Station XX
Offset XX

Ground Surface Elevation	Blow Counts	R (in)	Qu (tsf)	W (%)	Surface Water Elev. N/A Groundwater Depth 8.5' WD Groundwater Depth 9.0' AB After Hours	Blow Counts	R (in)	Qu (tsf)	W (%)
Ground Surface Elevation +11.5 CCD									
Black TOPSOIL +10.5									
SILTY CLAY—trace sand & gravel—brown & gray—very stiff (CL) Fill	3 3 5		3.25P	16		0 1 2		0.5P	23
+8.0									
Misc. Brick—very dense (Fill)	5 15					0 2			
-5.0									
Fine SAND—trace silt—gray—very loose to loose (SP)	50/3*		NP	22		3		NP	32
+5.5									
SILTY CLAY—trace to some sand, gravel & brick—gray—hard (CL) Fill	3 5 5		4.5P	17		0 1 0		NP	28
+3.0									
Fine SAND—trace gravel—gray—medium dense (SP)	3 8 5		NP	21		0 1 2		<0.25P	45
+0.5									
SILTY CLAY—trace sand & gravel—gray—very soft to soft (CL) Possible Fill	2 1 1		0.75P	23		1 0 1		<0.25P	40
-15.0									
SILTY CLAY—trace sand, gravel & organics—gray—medium stiff (CL) Wet	1 0 0 1		<0.25P	26		1 2 2		0.75P	28
-20.0									
SILTY CLAY—trace sand, gravel & organics—gray—medium stiff (CL) Wet	0 0 1		<0.25P	24		1 1 2		0.5P	30
-27.0									
Black SANDY FIBROUS PEAT (PT)	0 1 2		<0.25P	22		3 5 9		NP	76
-32.0									
SANDY SILT—trace gravel & organics—dark brown & gray—loose (ML/OL)	1 1 1		<0.25P	25		3 3 5		NP	72
-37.0									
SANDY SILT—trace gravel & organics—dark brown & gray—loose (ML/OL)	1 2 2		<0.25P	23		4 3 5		NP	41
-25.0									

N—Standard Penetration Test (ASTM D-1586)
R—Recovery in Inches
NR—No Recovery

ST—Shelby Tube
VS—Vane Shear
NS—No Sample
NP—Non Plastic

Failure Type
B—Bulge Failure
S—Shear Failure
P—Penetrometer

Qu—Unconfined Compressive Strength (tsf)
W—Water Content, percent dry weight
NP—Non-Plastic
Unit wt. (pcf) noted in Italics above w%



**STRUCTURE FOUNDATION
BORING LOG**

**O'BRIEN & ASSOCIATES, INC.
CONSULTING ENGINEERS**

1235 E. DAVIS ST./ARLINGTON HTS., IL 60005
(847)388-1441 * FAX(847) 388-2376

Sh 1 of 2

Project City of Chicago-Chicago Shoreline Protection Project

OBA JOB NO. 00420

Project 2: Melas Field Apron

Date 1-15-2001

Location xx

Bored By RH

Client Melas Field, Chicago, Illinois

Checked By DOB

BORING NO. B-3

Station XX
Offset XX

Ground Surface Elevation	Blow Counts	R (in)	Qu (tsf)	W (%)	Surface Water Elev. N/A Groundwater Depth 16.0' WD Groundwater Depth 78.0' AB After Hours	Borehole	Blow Counts	R (in)	Qu (tsf)	W (%)
+14.0 CCD										
5.0" ASPHALT +13.6										
CLAYEY SAND-trace to some gravel, brick & cinders-black-medium dense (Fill)	4 3 7		NP	19			0 0 0		<0.25F	22
+10.5										
SILTY CLAY-trace sand, gravel, cinders & brick-brown & gray-stiff to very stiff (CL) Fill	2 12 6		2.0P	19	Vane Shear Strength=0.47tsf	-30.0	VS		0.47	
+8.5										
SILTY CLAY-trace sand & gravel-gray-very soft (CL) Fill	1 2 7		1.5P	23	Fine to Medium SAND-some gravel, cinders & slag-brown & gray-medium dense (Fill) Wet		4 6 6		NP	39
-19.5										
SILTY CLAY-trace to some sand & gravel-gray-very soft (CL) Fill	2 5 5		2.0P	18	Fine SAND-trace gravel gray-medium dense (SP)	-35.0	4 5 6		NP	26
+3.5										
SILTY CLAY-trace sand & gravel-gray-very soft (CL) Fill	1 1 2		<0.25F	21	Fine SANDY CLAYEY SILT-trace gravel-gray-medium stiff (CL/ML)	-22.0	0 0 1		0.5P	29
+1.0										
SILTY CLAY-trace sand & gravel-gray-very soft to soft (CL) Fill			100.2							
-15.0	ST		0.31B	26	Vane Shear Strength=0.51tsf	-40.0	VS		0.51	
Vane Shear Strength=0.31tsf										
-27.0										
ORGANIC SANDY CLAYEY SILT-dark brown & black-loose (OL) Wet			0.31				2 2 2		0.5P	50
Vane Shear Strength=0.31tsf	-20.0	VS	0.31				3 2		0.75P	62
Sand Seams from -21.0' to -22.5'			100.0							
-34.5										
SILTY CLAY-trace sand & gravel-gray-very stiff (CL)							2 5 7		2.5P	23
Vane Shear Strength=0.21tsf	-25.0	VS	0.21							

N-Standard Penetration Test (ASTM D-1586)
R-Recovery in inches
NR-No Recovery

ST-Shelby Tube
VS-Vane Shear
NS-No Sample
NP-Non Plastic

Failure Type
B-Bulge Failure
S-Shear Failure
P-Penetrometer

Qu-Unconfined Compressive Strength (tsf)
W-Water Content, percent dry weight
NP-Non-Plastic
Unit wt. (pcf) noted in Italics above wX



**STRUCTURE FOUNDATION
BORING LOG**

**O'BRIEN & ASSOCIATES, INC.
CONSULTING ENGINEERS**

1235 E. DAVIS ST./ARLINGTON HTS., IL 60005
(847)398-1441 • FAX(847) 398-2376

Sh 1 of 2

Project City of Chicago-Chicago Shoreline Protection Project

OBA JOB NO. 00420

Project 2: Meigs Field Apron

Date 2-1-01

Location xx

Bored By RH

Client Meigs Field, Chicago, Illinois

Checked By DOB

BORING NO. B-5

Station XX
Offset XX

Ground Surface Elevation	Blow Counts	R (in)	Qu (tsf)	W (%)	Surface Water Elev. N/A Groundwater Depth 11.0' WD Groundwater Depth After Hours	Blow Counts	R (in)	Qu (tsf)	W (%)
+11.0 CCD									
Black CLAYEY TOPSOIL—some sand, gravel, brick & cinders—medium dense (Fill)	3				Vane Shear Strength=0.29tsf				101.4
	5				SILTY CLAY—trace sand & gravel—gray—soft (CL) Fill Wet	ST		0.31B	30
	6		NP	22					
+7.5					-17.5				
Drillers Note: Obstruction—possible brick or concrete	50/1"								
					SILTY SAND with Gravel & Cinders—gray—loose (Fill) Wet			NP	29
+5.0					-20.0				
	3								
	4								
SILTY CLAY—trace sand & gravel—gray—medium stiff to stiff (CL) Fill	4		1.75P	19	Fine SAND—trace silt—gray—very loose to loose (SP)			NP	22
	2								
	1								
-10.0	0		0.75P	20	-35.0			NP	26
+0.5									
	0								
SILTY CLAY—trace sand & gravel—gray—soft (CL) Fill Wet	0				Drillers Note: Blow In Sands at -36.0'				NS
	2		0.25P	28	-27.5				
-15.0	VS		0.33		-40.0			<0.25F	31
Vane Shear Strength=0.33tsf									
					SILTY CLAY—trace sand & gravel—gray—very soft to soft (CL) Wet				
	ST		0.39B	20				<0.25F	33
-20.0	VS		0.40		Vane Shear Strength=0.49tsf	-45.0	VS	0.49	
Vane Shear Strength=0.40tsf									
	ST		0.37	28				<0.25F	22
-25.0	VS		0.29		-50.0			<0.25F	27

N—Standard Penetration Test (ASTM D-1586)
R—Recovery in Inches
NR—No Recovery

ST— Shelby Tube
VS—Vane Shear
NS—No Sample
NP—Non Plastic

Failure Type
B—Bulge Failure
S—Shear Failure
P—Penetrometer

Qu—Unconfined Compressive Strength (tsf)
W—Water Content, percent dry weight
NP—Non-Plastic
Unit wt. (pcf) noted in Italics above %

LOG OF BORING NO. B-1

CLIENT				STATION AND OFFSET			
City of Chicago-Department of Aviation							
LOCATION				PROJECT DESCRIPTION			
Merrill C. Meigs Field Chicago, Illinois							
DEPTH BELOW GROUND SURFACE	SAMPLE NO.	TYPE SAMPLE	SAMPLE DISTANCE	SAMPLE RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY FC. LBS./FT. ³	UNCONSOLIDATED COMPRESSION STRENGTH TONS/FT. ²
							CALIBRATED PENETROMETER TONS/FT. ²
							1 2 3 4 5 6+
							WATER CONTENT %
							STANDARD "N" PENETRATION (BLOWS/FT.)
							10 20 30 40 50 60+
	1	SS			Black TOPSOIL-trace roots & cinders-loose (FILL)		
5.0	2	SS			Fine SAND-trace gravel-brown-loose (SP)		
	3	SS					
10.0	4	SS					
15.0	5	SS			Fine SAND-trace gravel-brown & gray-loose (SP)		
20.0	6	SS					
25.0	7	SS					
END OF BORING							

WATER LEVEL OBSERVATIONS	
W.L.	8.0' WD
W.L.	14.0' AB
W.L.	
W.L.	

O'BRIEN & ASSOCIATES, INC.
 Consulting Engineers
 ARLINGTON HEIGHTS, ILLINOIS
 (708) 568-1441

BORING STARTED	July 7, 1995
BORING COMPLETED	July 7, 1995
RIG	CME 55
FOREMAN	LH
DRAWN	KLC
APPROVED	DOB
JOB #	951BR
SHEET	1 OF 1

LOG OF BORING NO. B-3

CLIENT City of Chicago-Department of Aviation				STATION AND OFFSET			
LOCATION Merrill C. Meigs Field Chicago, Illinois				PROJECT DESCRIPTION			
DEPTH BELOW GROUND SURFACE	SAMPLE NO.	TYPE SAMPLE	SAMPLE DISTANCE	SAMPLE RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS./FT. ³	UNCONFINED COMPRESSIVE STRENGTH TONS/FT. ²
							CALIBRATED PENETROMETER TONS/FT. ²
							1 2 3 4 5 8 +
							WATER CONTENT %
							STANDARD "N" PENETRATION (BLOWS/FT.)
							10 20 30 40 50 60+
					GROUND SURFACE ELEVATION		
	1	SS			Misc. topsoil, sand, gravel, clay, cinders, roots & brick-med. dense (ML)		
	2	SS			Silty CLAY-trace sand, gravel & roots-brwn-very tough (CL) Possible FILL		
5.0	2a	SS					
	3	SS			SILT-some clay & sand-gray-stiff (ML) wet		
	4	SS			Silty CLAY-trace sand & gravel with sand lenses-gray-soft (CL) wet		
10.0							
	5	SS					
16.0							
	6	SS					
20.0							
	7	SS					
26.0							
	8	SS			Fine SAND-trace gravel-gray-loose (SP)		
30.0	8a	SS			Silty CLAY-trace sand & gravel-soft (CH) wet		

END OF BORING

WATER LEVEL OBSERVATIONS		O'BRIEN & ASSOCIATES, INC. Consulting Engineers ARLINGTON HEIGHTS, ILLINOIS (708) 398-1441	BORING STARTED July 7, 1995	
W.L.	28.5' WD		BORING COMPLETED July 7, 1995	
W.L.			RIG CME 65	FOREMAN LH
W.L.			DRAWN KLC	APPROVED DDB
W.L.			JOB # 95188	SHEET 1 OF 1

LOG OF BORING NO. B-4

CLIENT				STATION AND OFFSET					
City of Chicago-Department of Aviation									
LOCATION				PROJECT DESCRIPTION					
Marshall C. Heays Field Chicago, Illinois									
DEPTH BELOW GROUND SURFACE	SAMPLE NO.	TYPE SAMPLE	DESCRIPTION OF MATERIAL	UNCONFINED COMPRESSIVE STRENGTH TONS/FT. 2					
				CALIBRATED PENETROMETER TONS/FT. 2					
DEPTH BELOW GROUND SURFACE	SAMPLE NO.	TYPE SAMPLE	DESCRIPTION OF MATERIAL	WATER CONTENT %					
				STANDARD "N" PENETRATION (BLOWN/FT.)					
			GROUND SURFACE ELEVATION	10	20	30	40	50	60+
	1	SS	Clayey TOPSOIL-black & dark brown-loose (FILL)						
0.0	2	SS	Misc. sand, gravel, topsoil & brick-loose to med. dense (FILL)						
	3	SS	Fine SAND-trace gravel-brown-loose (SP)						
	4	SS	Sandy CLAY-trace gravel-gray-tough (CL)						
10.0			Fine SAND-trace gravel & clay-gray-loose (SP)						
	5	SS	Silty CLAY-trace sand & gravel-gray-soft (CL) wet						
15.0									
	6	SS	Sandy SILT-trace gravel & clay-gray-loose (NL)						
20.0									
	7	SS	Silty CLAY-trace sand & gravel-brown-tough (CL) wet						
25.0									
	8	SS	SAND & GRAVEL-trace clay-dark gray-loose (SW-GW)						
30.0									
	9	SS	Silty CLAY-trace sand & gravel-gray-soft (CL)						
35.0									
END OF BORING									
WATER LEVEL OBSERVATIONS				O'BRIEN & ASSOCIATES, INC. Consulting Engineers ARLINGTON HEIGHTS, ILLINOIS (708) 388-1441			BORING STARTED July 6, 1995		
W.L.	17.9 WD						BORING TERMINATED July 8, 1995		
W.L.							LOG ONE SS FOREMAN LH		
W.L.							DRAWN KLC APPROVED PMS		
W.L.				JOB # 86188 SHEET 1 OF 1					

LOG OF BORING NO. B-5

CLIENT City of Chicago—Department of Aviation				STATION AND OFFSET			
LOCATION Merrill C. Meigs Field Chicago, Illinois				PROJECT DESCRIPTION			
DEPTH BELOW GROUND SURFACE	SAMPLE NO.	TYPE SAMPLE	SAMPLE DISTANCE	SAMPLE RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LB./FT.	UNCONFINED COMPRESSIVE STRENGTH TONS/FT. ²
							CALIBRATED PENETROMETER TONS/FT. ²
							1 2 3 4 5 6+
							WATER CONTENT %
							STANDARD "N" PENETRATION (BLOWS/FT.)
							10 20 30 40 50 60+
					GROUND SURFACE ELEVATION		
					5' TOPSOIL		
	1	SS			Sandy TOPSOIL—trace sand, gravel, clay & cinders—dark brown—loose (FILL)		
5.0	2	SS			Silty CLAY—trace sand & gravel with shell fragments—brown—hard (CL) Apparent FILL		
	3	SS			Sandy CLAY—trace gravel with silt lenses—gray—tough (CL) wet		
10.0	4	SS			Silty CLAY—trace sand & gravel—gray—soft to stiff (CL-CH) wet		
15.0	5	SS					
20.0	6	SS					
25.0	7	SS					
	8	SS			FINE to med. SAND—trace gravel—dark gray—loose (SW)		
30.0	8a	SS			Silty CLAY—trace sand & gravel—gray—soft (CL) wet		

END OF BORING

WATER LEVEL OBSERVATIONS		O'BRIEN & ASSOCIATES, INC. Consulting Engineers ARLINGTON HEIGHTS, ILLINOIS (708) 308-1441	BORING STARTED July 6, 1995			
W.L.	25.0' WD		BORING COMPLETED July 6, 1995			
W.L.	25.0' AB		RIG	CME 68	FOREMAN	LH
W.L.			DRAWN	KLG	APPROVED	DOB
W.L.		JOB #	83186	SHEET	1 OF 1	

LOG OF BORING NO. 4-6					
CLIENT City of Chicago-Department of Aviation			STATION AND OFFSET		
LOCATION Merrill C. Meigs Field Chicago, Illinois			PROJECT DESCRIPTION		
DEPTH BELOW GROUND SURFACE	SAMPLE NO.	TYPE SAMPLE	SAMPLE DISTANCE	SAMPLE RECOVERY	DESCRIPTION OF MATERIAL
					GROUND SURFACE ELEVATION
					12.0' TOPSOIL
	1	SS			Silty CLAY-trace sand & gravel-brown very tough (MLL)
5.0	2	SS			Silty CLAY-trace sand & gravel-gray-tough (CL)
	3	SS			Silty CLAY-trace sand & gravel-gray-stiff (CL)
10.0	4	SS			Silty CLAY-trace sand & gravel-gray-stiff to tough (CL-Ch) wet
15.0	5	SS			
20.0	6	SS			
25.0	7	SS			
30.0	8	SS			
END OF BORING					

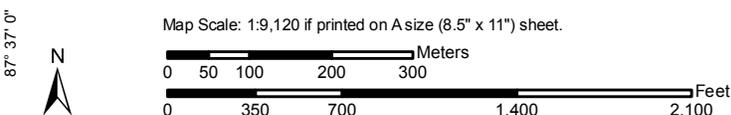
UNCOMFINED COMPRESSIVE STRENGTH TONS/FT. 2	○					
CALIBRATED PENETROMETER TONS/FT. 2	○					
WATER CONTENT %	●					
STANDARD "N" PENETRATION (BLOWS/FT.)	⊗					
	1	2	3	4	5	6+
	10	20	30	40	50	60+

WATER LEVEL OBSERVATIONS		O'BRIEN & ASSOCIATES, INC. Consulting Engineers ARLINGTON HEIGHTS, ILLINOIS (708) 388-1441	BORING STARTED	July 5, 1988	
W.L.	DRY		BORING COMPLETED	July 8, 1988	
W.L.			NO	CME 55	FOREMAN LM
W.L.			DRAWN	KLC	APPROVED DOR
W.L.		JOB #	86188	SHEET 1 OF 1	

GEOTECHNICAL APPENDIX G

Attachment 4

Soil Map—Cook County, Illinois



MAP LEGEND

Area of Interest (AOI)

 Area of Interest (AOI)

Soils

 Soil Map Units

Special Point Features

-  Blowout
-  Borrow Pit
-  Clay Spot
-  Closed Depression
-  Gravel Pit
-  Gravelly Spot
-  Landfill
-  Lava Flow
-  Marsh or swamp
-  Mine or Quarry
-  Miscellaneous Water
-  Perennial Water
-  Rock Outcrop
-  Saline Spot
-  Sandy Spot
-  Severely Eroded Spot
-  Sinkhole
-  Slide or Slip
-  Sodic Spot
-  Spoil Area
-  Stony Spot

 Very Stony Spot

 Wet Spot

 Other

Special Line Features

-  Gully
-  Short Steep Slope
-  Other

Political Features

 Cities

Water Features

 Streams and Canals

Transportation

-  Rails
-  Interstate Highways
-  US Routes
-  Major Roads
-  Local Roads

MAP INFORMATION

Map Scale: 1:9,120 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:12,000.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
 Web Soil Survey URL: <http://websoilsurvey.nrcs.usda.gov>
 Coordinate System: UTM Zone 16N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Cook County, Illinois
 Survey Area Data: Version 6, Nov 2, 2011

Date(s) aerial images were photographed: 7/30/2007

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Cook County, Illinois (IL031)			
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
392A	Urban land-Orthents, loamy, complex, nearly level	28.8	15.3%
800A	Psamments, nearly level	69.9	37.1%
807B	Orthents, loamy-skeletal, undulating	7.3	3.9%
Subtotals for Soil Survey Area		106.0	56.3%
Totals for Area of Interest		188.4	100.0%