2017

Hegewisch Marsh Section 506 Great Lakes Fishery & Ecosystem Restoration Study

Detailed Project Report & Environmental Assessment

30 Day Agency & Public Review Document

Chicago District, U.S. Army Corps of Engineers
Chicago Park District
April 2017

EXECUTIVE SUMMARY

The Chicago Park District (CPD) holds many natural areas within the Chicago City limits, many in which have remnant habitats that exemplify the Chicago Region. The CPD has in turn requested that the Chicago District, U.S. Army Corps of Engineers (USACE) to initiate a study under the Section 506 WRDA 2000, Great Lakes Fishery and Ecosystem Restoration (GLFER) authority that would determine the feasibility of restoring important migratory bird and wildlife habitat at the Hegewisch Marsh natural area.

This Detailed Project Report and Integrated Environmental Assessment documents whether or not a project is warranted for Federal participation based on a feasibility level assessment of estimated costs, potential benefits, and possible environmental impacts of various alternatives, all of which follow the United States Army Corps of Engineers (USACE) planning and policy guidelines. The main purpose of this report is to recommend a plan, including consideration of the No Action Plan, for ecological restoration of the Hegewisch Marsh. The need is to restore aquatic and buffering habitats and address invasive species issues in order for Hegewisch Marsh to provide important habitat for amphibians, reptiles, and migratory birds within a highly industrialized area.

Hegewisch Marsh is a ~131 acre natural area located on the south side of Chicago. The site is bounded to the north by 130th Street, to the east by Torrence Avenue, to the south by USACE property (T.J. O'Brien Lock and Controlling Works), and to the west by the Calumet River (T37N, R14E, S36). The natural area is owned in part by the CPD, Metropolitan Water Reclamation District of Greater Chicago (MWRDGC) and USACE, and managed by the CPD. The USACE owns 1.8 acres along the southern edge of the site, and has an access road leading to the T.J. O'Brien Lock and Controlling Works.

Historically, the Hegewisch Marsh natural area was most likely dominated by marsh and wet prairie/savanna riparian to the Calumet River. By the late 1800s, much of these communities in the Calumet Region were converted to urban or industrial use, and agriculture to a lesser degree. Although historic native plant community types and seed banks were eliminated from the site, there are relatively healthy patches of native community types that have formed. These patches are currently persisting, but are under pressure from other highly altered opportunistic plant communities that impose pressure on hydrology and nonnative plant infestation. Human induced disturbances to the remaining natural processes at Hegewisch Marsh include fire suppression, altered hydrology and hydroperiod, and increased colonization of invasive species. Based on site qualitative and quantitative investigations, and the study results above, the main problems at the Hegewisch Marsh in which the 506 Authority may address are as follows:

- Hydrogeomorphic conditions that limit native plant richness and abundance
- High abundance of invasive, water pumping trees, which reduce water levels and temporal longevity of vernal wetlands and hemi-marsh habitats
- Impaired connectivity for reptile and amphibians between Calumet River and Hegewisch Marsh due to bank configuration
- Impaired habitat patches due to invasive plant species dominance
- Lack of critical habitat for locally endangered and rare fauna
- Lack of high quality food source and resting habitat for migratory birds

Two (2) planning objectives were identified by the study team, including the non-Federal sponsor and various stakeholders, to address resource problems listed above:

Objective 1 – Reestablish Hydrogeomorphology to Support Natural Communities

This objective seeks to reestablish natural hydrogeomorphic structure and parameters to support wetland and riparian habitats within the Hegewisch Marsh natural area. Improvement is predicted via the increase in quality (FWP HSI (FQI)) of native plant communities.

Objective 2 – Eradicate Invasive Species from All Plant Communities

This objective seeks to reestablish native plant community richness and structure to support critical wetland and riparian habitats within the Hegewisch Marsh natural area. Improvement is predicted via the increase in quantity (acres of native plant dominance) and increase in quality (FWP HIS (FQI)) of native plant communities.

The PDT has identified the following planning constraints primarily to ensure the protection of existing natural resources and to avoid disturbing subsurface contamination:

- Avoid adverse affects to existing migratory bird and butterfly habitats
- Avoid adverse impacts to the few vernal pools that are functioning on site
- Avoid adverse impacts to surrounding functional hydrogeomorphology
- Minimize the removal of trees that are not considered to be highly invasive or having adverse affects on hydrology or native species
- Avoid adverse affects to animals by avoiding various contaminated patches (see Figure 4)
- Avoid/minimize disturbing contaminated soils by limiting earth moving to less than 12 inches deep

To achieve the study objectives and remedy ecosystem resource problems at Hegewisch Marsh, Eleven (11) measures were developed. One measure, the Groundwater Dam, was screened out prior to cost/benefit analysis due to violating planning constraints. Therefore, the viable ten (10) measures were input into the IWR Planning Suite to assess costs versus benefits. Each measure is also coupled with the No Action (FWOP) condition for consideration as well.

Code	Measure
WCS	Water Control Structure
BN	Bank Naturalization
VPa	Vernal Pool w/o (RS)
VPb	Vernal Pool w/ (RS)
RS	Ridge & Swale Creation
ER	Evapotranspiration Reduction
M	Marsh
WPa	Wet Prairie w/o (BN)
WPb	Wet Prairie w/ (BN)
W	Woodland

Based on habitat benefits versus cost inputs and planning criteria, the IWR Planning software generated seventeen (17) alternative combinations that were subsequently analyzed for cost effectiveness. Of these, eight (8) cost effective combinations were identified, which is inclusive of three (3) Best Buy Plans, which give the most benefits for the associated costs. The No Action plan is always deemed cost effective and a Best Buy Plan. Nine (9) alternative combinations were screened out as non-cost effective. An incremental cost analysis was performed on the following three (3) Best Buy Plan alternatives:

- Alternative Plan 1 – No Action
- Alternative Plan 2 – (BN) Bank Naturalization, (ER) Evapotranspiration Reduction, (WCS) Water Control Structure, (VPa) Vernal Pools, (W) Woodland, and (WPb) Wet Prairie
- Alternative Plan 3 – (BN) Bank Naturalization, (ER) Evapotranspiration Reduction, (WCS) Water Control Structure, (VPa) Vernal Pools, (W) Woodland, (WPb) Wet Prairie and (M) Marsh

When selecting a single alternative plan for recommendation from those that have been considered, the criteria used to select the NER plan include meeting the planning objectives, reasonably avoiding constraints and maximizing environmental benefits. Also, the alternative plan must pass tests of cost effectiveness/incremental cost analyses, significance of outputs, acceptability, completeness, efficiency, and effectiveness. The plan that reasonably maximizes net National Ecosystem Restoration benefits and is consistent with the Federal objective, authorities and policies, is identified as the NER/Preferred Plan. This study recommends that the NER/Preferred Plan to be Alternative Plan 3.

The implementation of all of the measures cohesively under Alternative Plan 3 would restore riverine fish habitat and side-stream marsh (1 acre), hemi-marsh (33.1 acres), wet prairie (21.5 acres), wet woodland (63.3 acres) and vernal pool (8.8 acres nested within the wet prairie and woodland habitats), all of which are riparian to the Calumet River. The implementation of these features is generally described as follows and according to the measures descriptions in Section 4.1. General construction activities and sequencing would include:

(1) Site Preparation – The first task would be to install safety fencing, signage 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. Instructive signage for workers would be set up as well to signify off limit work areas and site restrictions.

(2) Invasive Species Eradication – All invasive plant species would be physically and if need be, chemically eradicated from the planting zones. A “No Invasive Species Clearing” window between 01 March and 01 October was established via verbal coordination with the USFWS and the local birding community. All woody invasive species removed too small for snag habitat would be chipped into small pieces and spread over areas within Hegewisch Marsh.

(3) Geomorphic Contouring – Once targeted woody and invasive species are removed, bank and vernal pool would be graded to provide a suitable hydrology and micro topography for establishing native plant species. These areas will be contoured and all excess soils will be incorporated into the landscape within Hegewisch Marsh project site. Grading activities would be limited to less than 12 inches below surface grades to avoid past remediation, most of which can be accomplished by hand raking or small push tillers. Graded areas will be planted with seeds, plugs or shrubs and immediately stabilized to prevent erosion according to the plant community the work falls within. Large stones and woody debris gathered from the site would be placed on the side-stream marsh’s toe within the Calumet River during this step as well. Organic leaf litter compost and wood chips would be spread as needed within the plant community zones.

(4) Water Level Management – The purpose of the water level management plan is to support one of the primary objectives of the Hegewisch Marsh restoration project, i.e. to establish and maintain a hemi-marsh appropriate for wetland-dependent birds within a wetland historically supporting these species. Hemi-marsh is a type of wetland characterized by an interspersed mixture of emergent vegetation and open water, ideally approaching a ratio of 1:1 or approximately 50% emergent vegetation and 50% open water.

(5) Native Plant Community Establishment – Native plant communities of side-stream marsh, hemi-marsh, wet prairie, and wet woodland with interspersed vernal pools would be established over the remainder of the construction period. Planting lists are presented as Future With-Project Planting Lists located in Appendix A.

Zones would be seeded and planted with seed and live plugs. Live plug areas will require predatory control, primarily stringing and caging to prevent Canada Goose and Common Carp predation during the construction phase only.

(5) BMPs – Soil erosion and sediment control measures will be designed during design phase and will comply with local and federal environmental requirements. The minimum measures required at the project site may include:

- Hydroseeding, seeding, and mulching to stabilize disturbed areas
- Installation of silt fences around graded slopes and stockpile areas
- Protection of the ponds where grading occurs with silt fencing prevent sediments from traveling into the ponds
- Stabilizing construction entrances to limit soil disturbance at the ingress/egress from the site
- Installing erosion blanket over unprotected finished grades that are to be unplanted for at least two weeks

Recreational Features – Components of recreation are not proposed under this project.

An Environmental Assessment was completed for the proposed habitat restoration at the Hegewisch Marsh natural area in Chicago, Illinois. The Environmental Assessment has found that there would be no adverse effects resulting from implementation of the NER/Preferred Plan. A 30-day Agency and Public Review period will extend from 02 May 2017 to 02 June 2017. Agency and public review comments will be addressed and incorporated into the document as appropriate.

All significant aspects of the problems and opportunities as they relate to the Hegewisch Marsh natural area's resource problems have been considered. Those aspects include environmental, social, cultural, and economic effects, as well as engineering feasibility. The National Ecosystem Restoration (NER) Plan is Alternative Plan 3, which consists of restoring native plant and fauna communities within the Hegewisch Marsh natural area. The NER plan has a First Cost (FY 15) of approximately [redacted] (2015 price levels). This plan provides 2,921.3 net average annual habitat units over 118.9-acres of the natural area.

Finding of No Significant Impact
Hegewisch Marsh Section 506 GLFER Study

The U.S. Army Corps of Engineers Chicago District (Corps), has conducted an environmental analysis in accordance with the National Environmental Policy Act of 1969, as amended. The Corps assessed the effects of the following actions in the draft Detailed Project Report and Environmental Assessment, dated February 2017 which is incorporated herein by reference.

Alternative Plan 3 was selected as the National Ecosystem Restoration (NER) Plan, which consists of the following measures: (BN) Bank Naturalization, (ER) Evapotranspiration Reduction, (WCS) Water Control Structure, (VPa) Vernal Pools, (W) Woodland, (WPb) Wet Prairie and (M) Marsh. The implementation of all of the measures cohesively under Alternative Plan 3 would restore riverine fish habitat and side-stream marsh (1 acre), hemi-marsh (33.1 acres), wet prairie (21.5 acres), wet woodland (63.3 acres) and vernal pool (8.8 acres nested within the wet prairie and woodland habitats), all of which are riparian to the Calumet River. The implementation of these features totals about 118.9 acres.

In addition to the "no action" alternative, 17 alternatives with varying levels of ecosystem outputs and costs were evaluated. Alternative 3 was identified as the National Ecosystem Restoration Plan and is the environmentally Preferred Plan, which would provide approximately 118.9-acres of high quality native habitat. All practicable means to avoid and minimize adverse environmental effects have been incorporated into the recommended plan. The Preferred Plan would not result in any impacts to federally-listed threatened or endangered species or their designated critical habitat, would have no impact to sites listed on or eligible for inclusion on the National Register of Historic Places, and would not adversely affect any wetlands or water of the U.S., nor any important wildlife habitat.

Technical and environmental criteria used in the formulation of alternative plans were those specified in the ER 1105-2-100 Planning Guidance Notebook, Appendix E. All applicable laws, executive orders, regulations, and local government plans were considered in the evaluation of the alternatives. It is my determination that the recommended plan does not constitute a major federal action that would significantly affect the human environment; therefore, preparation of an Environmental Impact Statement is not required.

Date: _____ _____

Christopher T. Drew
Colonel, U.S. Army
District Commander

HEGEWISCH MARSH
CHICAGO, ILLINOIS

DETAILED PROJECT REPORT AND ENVIRONMENTAL ASSESSMENT

April 2017

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Appendix F: Geotechnical Analyses
Appendix G: Real Estate (Intentional Exclusion)
Appendix H: Monitoring Plan

List of Acronyms

DO	Dissolved Oxygen
DPR	Detailed Project Report
EOP	Environmental Operating Principals
EX	Existing Conditions
FCSA	Feasibility Cost Sharing Agreement
FONSI	Finding of No Significant Impact
FQA	Floristic Quality Assessment
FQI	Floristic Quality Index
FWOP	Future Without Project Conditions
GIS	Geographic Information System
GLFER	Great Lakes Fishery & Ecosystem Restoration
IDNR	Illinois Department of Natural Resources
IEPA	Illinois Environmental Protection Agency
NEPA	National Environmental Policy Act
PMP	Project Management Plan
RCRA	Resource Conservation and Recovery Act
SHPO	State Historic Preservation Office
TCLP	Toxicity Characteristic Leaching Procedure
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
WRDA	Water Resources Development Act

CHAPTER 1 – Introduction

1.1 Report Structure

This report presents the results of an ecosystem restoration feasibility study for Hegewisch Marsh located on the southeast side of Chicago, Cook County, Illinois. This Detailed Project Report (DPR) presents the assessment of ecological conditions and potential plans to restore important migratory bird, fish and wildlife habitat within a highly urbanized environment. This report also presents historic and current site conditions, and forecasts future without and future with project conditions for the Hegewisch Marsh. This report also provides a recommended plan for restoring habitat at the Hegewisch Marsh.

The report contains the following chapters and appendices:

Chapter 1 – *Introduction*: introduces the project and provides a description of the study area and a summary of relevant studies and projects completed

Chapter 2 – *Inventory of Study Area and Forecasting:* contains an inventory or description of the study area which includes an assessment of pertinent historic, current and future without project conditions

Chapter 3 – *Problems and Opportunities:* discusses the problems within the study area, potential opportunities to remedy them, a study goal, restoration objectives and limiting constraints

Chapter 4 – *Plan Formulation and Evaluation:* discusses how plans have been formulated, presents the cost effectiveness and ecological benefits of each alternative, and discusses the evaluation process used to identify the National Ecosystem Restoration (NER) plan and select a recommended plan

Chapter 5 – *Environmental Assessment:* provides a description of potential impacts, both negative and positive, to cultural, ecological and physical resources within the surrounding environment and their significance.

Chapter 6 – *Plan Implementation*: discusses construction sequencing, monitoring and adaptive management, project costs and cost sharing responsibilities

Chapter 7 – *Recommendation:* provides the District Commander's recommendation for implementation of an ecosystem restoration plan

Appendix A: Draft FONSI, 404/401 and Coordination
Appendix B: Civil Design
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Appendix G: Real Estate (Intentional Exclusion)
Appendix H: Monitoring Plan

1.2 Study Authority

GREAT LAKES FISHERY & ECOSYSTEM RESTORATION (SECTION 506 WRDA 2000, as amended)

(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.

(2) 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 & Need

The Chicago Park District (CPD) holds many natural areas within the Chicago City limits, many of which have remnant habitats that exemplify the historic ecology of the Chicago Region. The CPD has in turn requested that the Chicago District, USACE initiate a study under the Section 506 WRDA 2000, Great Lakes Fishery and Ecosystem Restoration (GLFER) authority to ascertain the feasibility of restoring important migratory bird and wildlife habitat at the Hegewisch Marsh natural area.

The Detailed Project Report documents whether or not a project is warranted for Federal participation based on a feasibility level assessment of estimated costs, potential benefits, and possible environmental impacts of various alternatives, all of which follow the United States Army Corps of Engineers (USACE) planning and policy guidelines. The main purpose of the DPR is to recommend a plan, including consideration of the No Action Plan, for ecological restoration of the Hegewisch Marsh. The need is to restore aquatic and buffering habitats and address invasive species issues in order for Hegewisch Marsh to provide important habitat for amphibians, reptiles, and migratory birds within a highly industrialized area. If an alternative is found to be worth the investment, the next steps include approval of the decision document, signing of a Project Partnership Agreement (PPA) and development of a contract set of Plans and Specifications (P&S) and project implementation. The non-Federal sponsor is the Chicago Park District (CPD).

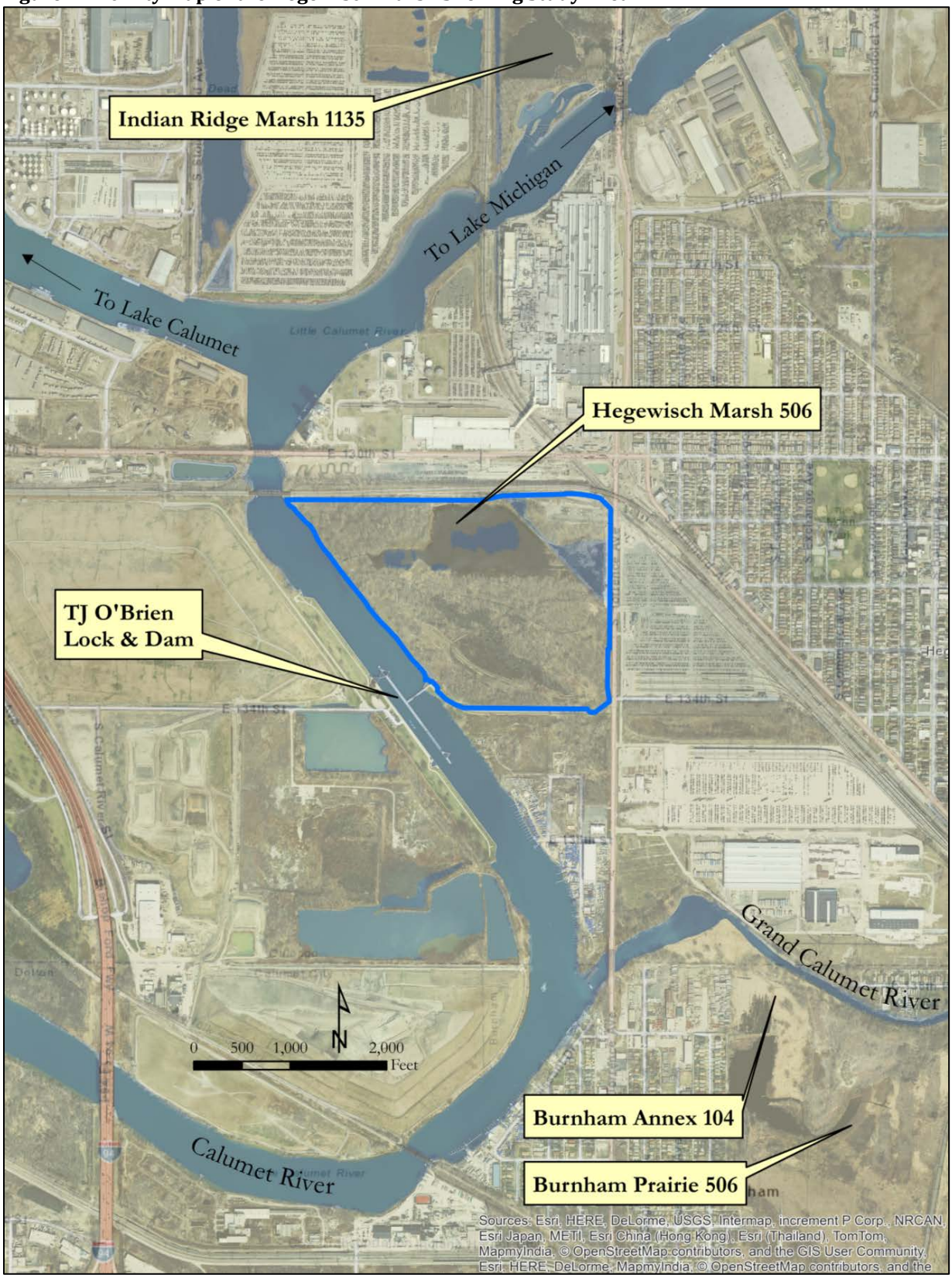
1.4 Study Area

Hegewisch Marsh is a 131-acre natural area located on the south side of Chicago (Figure 1) and is owned in part by the CPD, Metropolitan Water Reclamation District of Greater Chicago (MWRDGC) and USACE, and managed by the CPD. The site is bounded to the north by 130th Street, to the east by Torrence Avenue, to the south by USACE property (Timothy O'Brien Lock and Dam), and to the west by the Calumet River (**Figure 2**) (T37N, R14E, S36). The U.S. Army Corps of Engineers also owns 1.8

acres along the southern edge of the site, and has an access road leading to the Thomas J. O'Brien Lock and Dam.

Figure 1: Location of Study Area within the Chicago Region

Figure 2: Vicinity Map of the Hegewisch Marsh Showing Study Area



1.5 Prior Studies & Projects

This section summarizes the studies, reports and nearby projects that were already completed on Hegewisch Marsh prior to the initiation of this study.

1.5.1 Reports & Studies

- Camp Dresser and McKee, Inc. (CDM). August 26, 2008. Memorandum RE: Hegewisch Marsh Summary of Previous Environmental Investigations.
- Carrow, Conibear and Associates, Ltd. (CCA). 2002. Phase I Environmental Site Assessment, Vacant land - 134th and Torrence Avenue.
- GSG Consultants. 2011. Delineation Report Hegewisch Marsh
- GSG Consultants. 2011. Delineation Report Addendum Hegewisch Marsh
- GSG Consultants. 2011. Hegewisch Marsh Soil Remediation Project, Project Specifications.
- GSG Consultants. 2011. Final Lead Hotspot Remedial Strategy Recommendation, Hegewisch Marsh.
- Conservation Design Forum. 2009. Hegewisch Marsh Ecological Rehabilitation 2009 Monitoring Report. Prepared for Chicago Department of Environment.
- Conservation Land Stewardship (CLS). 2008. Project Report Summary Hegewisch Marsh Restoration Project NCWC Phase I, January 2007 to October 2008
- Earth Tech, Inc. 2001. Phase I Environmental Site Assessment, Hegewisch Marsh.
- Earth Tech, Inc. 2002. Phase I Environmental Site Assessment Addendum, Hegewisch Marsh.
- Marcisz, Walter. 2012. Water Level Management Recommendations for Hegewisch Marsh and Other Calumet Sites. Prepared for Chicago Park District.
- Tetra Tech EM Inc. 2003. Soil Sampling Report, 130th Street and Torrence Avenue.
- Tetra Tech EM Inc., Land and Water Resources Inc., and Terry Guen Design Associates Inc. 2006. Hegewisch Marsh Site Plan. Prepared for Chicago Department of Environment.
- Tetra Tech EM, Inc. 2006. Phase I Environmental Site Assessment, Hegewisch Marsh-Southwest Parcel, 134th Street and Calumet River.
- Tetra Tech EM, Inc. 2006. Hegewisch Marsh Status Report, Additional Soil, Sediment, Vegetation, and Macroinvertebrate Sampling Results for the 100-Acre Parcel.
- Tetra Tech EM, Inc. 2006. Hegewisch Marsh Status Report – Addendum Earthworm Bioaccumulation Study and Food Chain Model Assessment of Potential Risks to Site Receptors for the 100-Acre Parcel.

- Tetra Tech EM, Inc. 2007. Hegewisch Marsh Status Report, Additional Soil Screening and Sampling for the 100-Acre Parcel.
- Tetra Tech EM, Inc. 2007. Phase II Environmental Site Assessment Report, Hegewisch Marsh-17-Acre Parcel, November 2007 Sampling Summary.
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1.5.2 Nearby Federal Projects

Thomas J. O'Brien Lock and Dam – The T.J. O'Brien Lock and Controlling Works is 326.0 miles above the confluence of the Illinois River with the Mississippi river at Grafton, Illinois. It is approximately 35 miles upstream of the Lockport Lock and Dam, in the southeastern portion of Chicago. The T.J. O'Brien Lock and Controlling Works is located at the entrance to Lake Michigan in Chicago. The facility is a unit of the Illinois Waterway System and is one of eight such facilities between Chicago and Versailles, IL. It is composed of a navigational lock, fixed dam, and controlling works. The T.J. O'Brien Lock and Controlling Works is a low-lift sector gate lock. It provides a maximum lift of five feet for traffic passing from Lake Michigan to the Calumet River. The lock chamber is 1,000-feet long by 110-feet wide. The dam is 296.75 feet long. The controlling works consist of four large vertical slide gates (10 feet square) located near the center of the dam to regulate water flow. There are also two sets of sector gates weighing 216 tons each at both the river and lake ends. These are unique on the Illinois Waterway and; consequently, there is no need for tunnels in the lock walls. The T.J. O'Brien Lock and Controlling Works controls the movement of water between Lake Michigan and the Calumet River while maintaining navigation. The lock and dam are used for flood control and waterway flushing, and also function as components of the diversion control system. The Hegewisch Marsh Section 506 project would have no influence upon this project; however, the regulation of water levels by this lock and dam will be considered for plant community restoration components.

Powderhorn Lake and Prairie 506 – This study is being conducted by the USACE and the Forest Preserve District of Cook County under the Section 506 GLFER. The project is currently in the feasibility phase and is investigating restoration measures for geomorphic features, hydrology, fish and wildlife habitat and native plant community restoration. This project would benefit from additional naturalized habitats connecting to and surrounding the site.

Wolf Lake, IL 506 – This study is being conducted by the USACE and the Illinois Department of Natural Resources under the Section 506 GLFER. The project is currently in the feasibility phase and is

investigating restoration measures for geomorphic features, hydrology, fish and wildlife habitat and native plant community restoration. This project would benefit from additional naturalized habitats connecting to and surrounding the site. This study is separated from the Indiana portion of Wolf Lake, which is adjacent to the Wolf Lake completed project in Indiana, with the boundary being the Indiana/Illinois Stateline.

Burnham Prairie Annex Engineering Research Design Center Aquatic Weed Control Program – This USACE project is in the process of controlling and managing invasive plant species and establishing native plant communities at Burnham Prairie Annex to restore the ecological integrity of the project area. Restoring native plant communities within the site will serve as a demonstration project by implementing site-specific measures, in the form of an Invasive Species Control and Management Plan (ISCMP), for the control of aquatic and other invasive plant species within the Burnham Prairie Annex project area. The ISCMP was developed by the USACE Engineering Research and Development Center (ERDC) and the USACE, Chicago District. Burnham Prairie Annex is currently overrun with monotypic stands of invasive species, predominantly common reed (*Phragmites australis* ssp. *australis*) and reed canary grass (*Phalaris arundinacea*). High quality communities with healthy populations of conservative species exist within the adjacent Burnham Prairie Nature Preserve and are threatened from degraded conditions found within the proposed project area. The invasive species control and native planting at Burnham Prairie Annex will also help restore floodplain habitat adjacent to the Grand Calumet River.

Burnham Prairie Section 506 – This project is being implemented by the USACE and the Forest Preserve District of Cook County under the Section 506 GLFER. The project is currently in construction and is showing great success within the restored ridge and swale and marsh hydrogeomorphic features. This project would benefit from additional naturalized habitats connecting to and surrounding the site.

Indian Ridge Marsh 1135 – This project is being implemented by the USACE and Chicago Park District under the Section 1135 WRDA 1986, Restoration of Environmental Quality. The project is currently in construction and is showing great success within the naturalized marsh, pond, and prairie habitats. This project would benefit from additional naturalized habitats connecting to and surrounding the site.

Wolf Lake, IN 206 – This project was implemented by the USACE and Hammond, IN, Park District under the Section 206 WRDA 1996 Aquatic Ecosystem Restoration. Construction was completed in April 2010, which restored lake, submerged aquatic vegetation, wet prairie and marsh habitats. The project is currently in the monitoring phase and has shown great success in providing needed habitats for fishes and migratory water fowl and water birds. This project is separated from the Illinois portion of Wolf Lake, which is adjacent to the Wolf Lake study in Illinois, by the Indiana/Illinois Stateline.

CHAPTER 2 – INVENTORY OF STUDY AREA AND FORECASTING

This step of the planning process is to develop an inventory and forecast of critical resources (physical, demographic, economic, social, etc.) relevant to the problems and opportunities under consideration in the planning area. This information is used to define and characterize the problems and opportunities. A quantitative and qualitative description of these resources is made, for both current and future conditions, and is used to define existing and future without-project conditions. Existing (EX) conditions are those at the time the study is conducted. The forecast of the future without-project (FWOP) condition reflects the conditions expected during the 50-year period of analysis. The future without-project condition provides the basis from which alternative plans are formulated and impacts are assessed. Since impact assessment is the basis for plan evaluation, comparison and selection, clear definition and full documentation of the without-project condition are essential. Gathering information about historic and existing conditions requires an inventory. Gathering information about potential future conditions requires forecasts, which should be made for selected years over the period of analysis to indicate how changes in economic and other conditions are likely to have an impact on problems and opportunities. Information gathering and forecasts will most likely continue throughout the planning process. Chapter 2 contains the following information:

- An inventory of relevant historic conditions,
- An inventory of relevant current conditions and the studies that have been completed to identify those conditions, and
- A forecast of future without-project conditions.

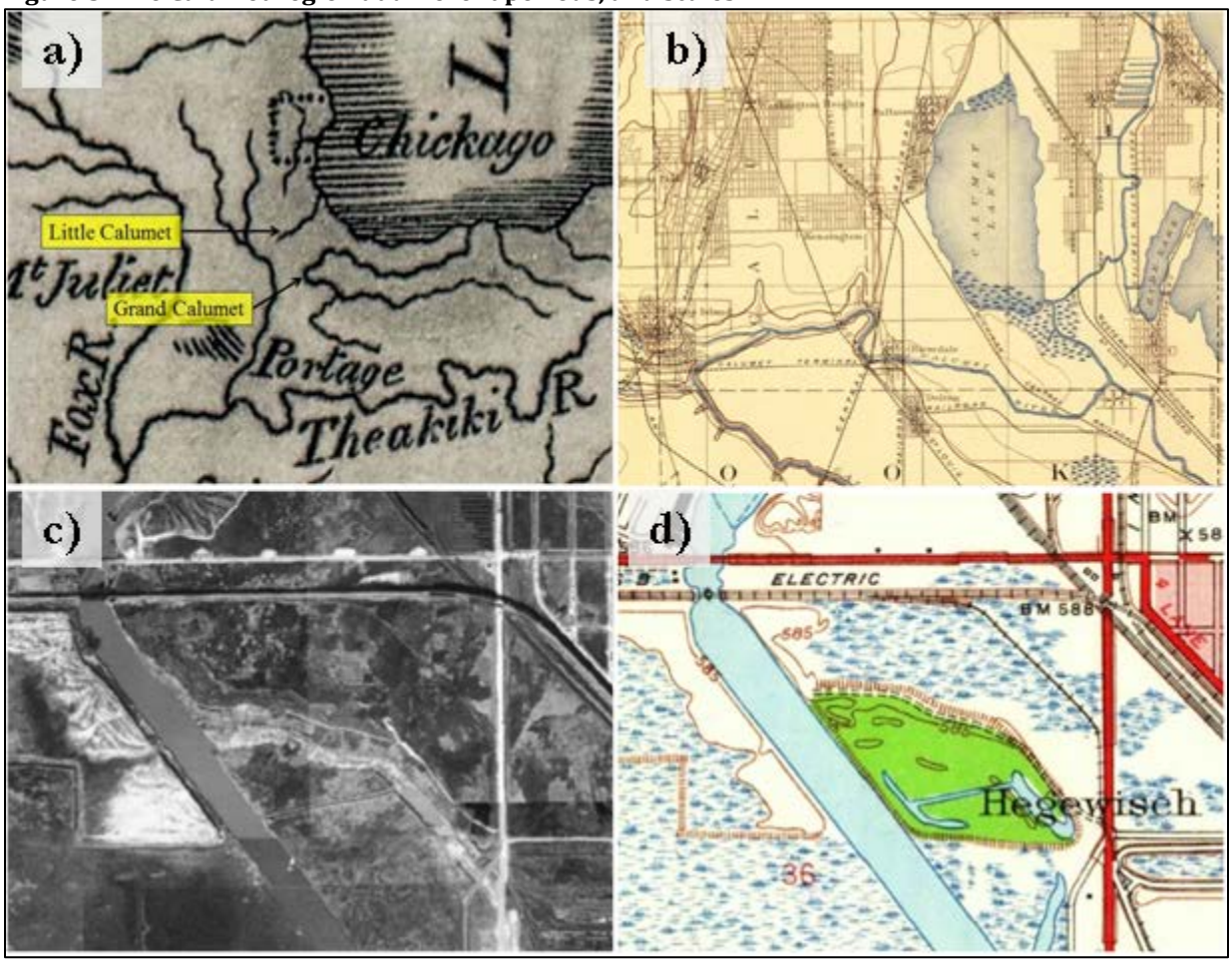
2.1 Historic Conditions and Considerations

2.1.1 – History of Site

Over the past 200 years, what we know today as Hegewisch Marsh has been significantly altered. It was once part of an extensive system of marsh wetlands that extended across the southern lake plain. The marsh was located just south of Lake Calumet, and drained north through what was then the Little Calumet River into Lake Michigan near South Chicago. The Grand Calumet River was located south of Hegewisch Marsh, first flowing to the west, then looping around northwards near present day Blue Island. A 1795 map of the Northwest Territories indicates there was no apparent surface water connection between the two drainages (**Figure 3a**). However by 1812, a map drawn by General William Hull of Illinois waterways indicated that a portage channel had been cut between the Little Calumet and Grand Calumet rivers, presumably by “Indian traders”. This channel ran through Hegewisch Marsh and was gradually deepened and renamed the Calumet River; while that portion of the Grand Calumet downstream of the Calumet River was re-named the Little Calumet since it was now taking most of that flow (**Figure 3b**). In 1938, that portion of the Calumet River bisecting Hegewisch Marsh was filled in to redirect the channel south (**Figure 3c**). At various times since, clay fill and rubble has been added to the marsh, initially from the former Calumet River channel on to the south (**Figure 3d**).

Currently, most of the area that was built up with fill has been colonized and dominated by invasive trees: cottonwoods, green ash, black willows, and buckthorn scattered in pockets. A portion of the original marsh remains, bounded by fill to the south, north, and west, the South Shore line and fill to the north, and South Torrence Avenue to the east. Most of the marsh floor consists of natural sediments.

Figure 3: The Calumet region at different periods, and scales.



Clockwise from upper left, a) 1795 Northwest Territories map, with the Little Calumet and Grand Calumet rivers labeled with insets, b) 1888 USGS map, c) 1938 aerial photograph, and d) 1952 USGS map.

2.1.2 HTRW Investigation

USACE conducted an initial Phase I Environmental Site Assessment (ESA) in accordance with ASTM E-1527-13. According to ER 1165-2-132, non-HTRW environmental issues that do not comply with federal, state, and local regulations should be discussed in the HTRW evaluation along with HTRW issues. The ESA identified HTRW and non-HTRW issues at the project site. The HTRW assessment included in **Appendix E** summarizes previous investigations, provides a general description of past land use and recognized environmental concerns (RECs), summarizes data collected from multiple phase II sampling events, provides a review of State and Federal regulated sites near the project area, and addresses the human health and ecological risks at the site. Two RECs have been identified in the project area:

- Previous ESAs suggest the Calumet River underwent significant changes in the project area after 1937 when it is was declared unnavigable, at which time it was straightened, widened and moved. Fill materials generated from the channel construction were placed in adjacent marsh areas. Meandering portions of the Calumet River that flowed in southern portions of Hegewisch Marsh were filled to direct the Calumet River south. Due to the industrial nature of the land use adjacent to the river at the time, any sediment dredged from the Calumet River or fill material subsequently deposited in the marsh were presumed contaminated.

- There is a history of fly dumping on the site.

Phase II ESAs conducted on-site between 2002 and 2007 by various entities confirmed the presence of elevated concentration of metals in soils at the site. The City of Chicago conducted an environmental remediation project at Hegewisch Marsh in three areas identified as containing high concentrations of metals (remediation areas are shown in **Appendix E-Figure 11**). In addition the city removed debris deposited through historic illegal dumping, including seven cars, ten ton of tires, 160 ton of construction debris, and eighteen ton of miscellaneous refuse from the site. The soil remedial activities were limited to three areas where lead and chromium concentrations in the soils exceed the site specific Tier 3 human health risk value approved for use at the site by the Illinois Environmental Protection Agency (IEPA) and other Federal and State agencies part of the Calumet Ecotox Management and Technical Team. The Calumet Ecotox Management and Technical teams are established in Calumet Open Space Reserve (COSR) Ecotox Protocol, a framework establish by Federal, State, and Local agencies for investigating ecotoxicological risks and defining standards for rehabilitation that address ecological health within the Calumet area open spaces.

A simplified conceptual site model for the USACE project area is provided in **Figure 4**. The model was used to guide the formulation process for the restoration study. The proposed conceptual site plan addresses potential risk identified by removing from consideration for the project, those areas that represent a high risk. As shown in Figure 4, the truss storage area and Zone C have been removed from the USACE project and will be restored by others. The Phase I ESA conducted as part of the feasibility study recommended the removal of Zones A and B from the USACE project limits as well. Further delineation during subsequent project phases will refine the areas (Zone B) to be excluded from the project, to ensure that USACE avoids areas that represent a potentially higher risk of future liability. Removing Zones A – C and portions of D from the project footprint does not compromise the potential project benefits, since the bulk of the continuous habitat is still intact and habitat benefits will be realized from the restoration of the majority of the site. The proposed removal of Zones A – C and portions of D from the project footprint is cost effective, since no work will be done on the removed areas and no federal dollars will be committed to those areas. The proposed conceptual site plan addresses risk mitigation for USACE while maintaining project benefits.

As discussed in the HTRW Appendix, additional sampling is required in Zone B to determine the western and eastern boundary of lead contamination above the Tier 3 human health risk remedial objective. Outside of the areas removed from the project, USACE planning efforts to restore habitat and increase species diversity and abundance at the site through surficial soil disturbance and plantings can be conducted without imposing unnecessary ecological risk. No additional site specific assessments are recommended to address ecological risks in the future. The maximum soil disturbance must be limited to within one-foot of existing grade to reduce the potential human health or ecological risks associated with significant earthwork and/or grade changes at the site. All excavated materials must be reused on-site. In addition, measures to prevent erosion and prevent migration of materials off-site should be implemented during construction, including dust control practices, soil erosion and sediment controls and site-specific storm water pollution prevention plan (SWPPP) to include silt fence, gravel ingress/egress, tire washing, and other BMPs as necessary. Contract shall require construction of geotextile lined gravel lay down areas for contractor staging and storage.

The Phase I ESA also recommends that the Chicago Park District design and install natural barriers in Zones A and B to discourage site users from entering those portion of the site in accordance with IEPA recommendations. The Phase I ESA also recommended that the Park District implement enforcement measures to prevent future fly dumping on-site.

2.1.3 – Plan Formulation Guidelines

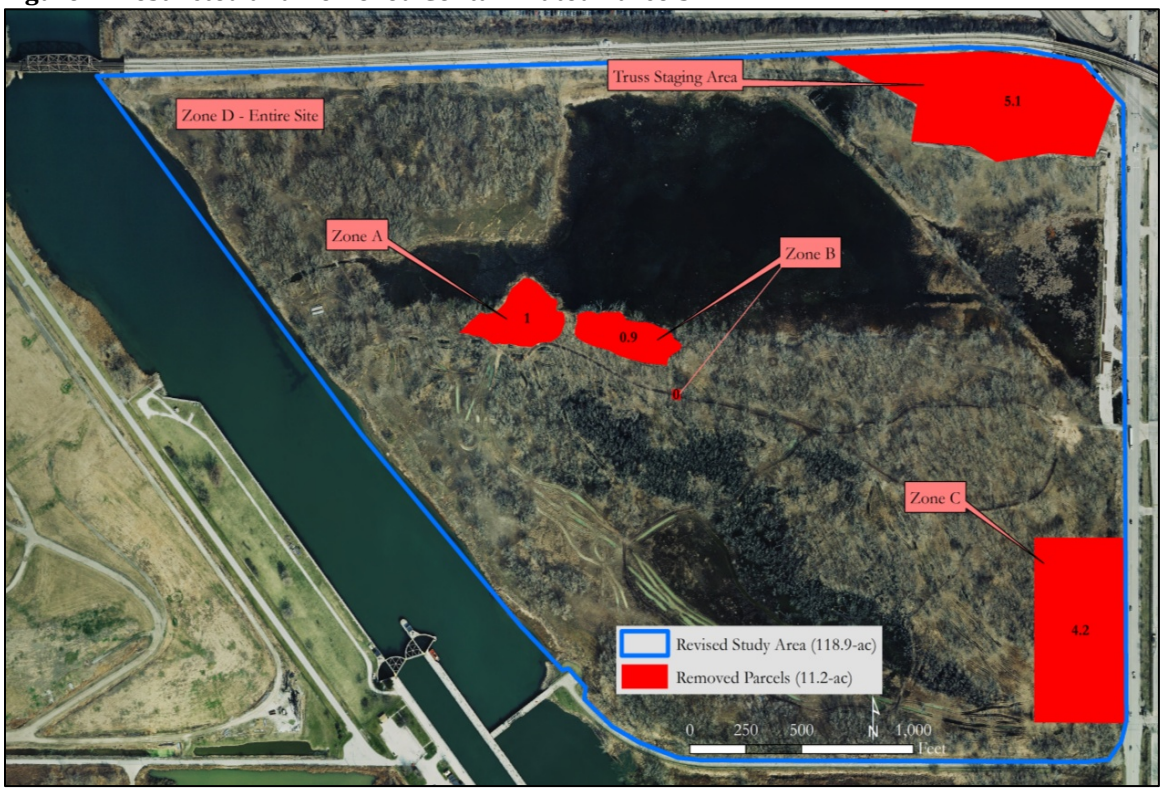
Based on site history, contamination, filling and HTRW Analysis and recommendations, the following guidelines would be followed in order to have a policy compliant project under the USACE Section 506 Program. The 28 October 2016 Memorandum for the Supplemental analysis of HTRW issues with Hegewisch Marsh ecosystem restoration project provides guidance and affirmation to the plan formulation processes conducted under this Feasibility Study. **Figure 4** depicts the Zones discussed below.

Zone A – No USACE restoration activities were pursued for this zone. Removed from study area.

Zone B –No USACE restoration activities were pursued for this zone. Removed from study area.

Zone C – No USACE restoration activities were pursued for this zone. Removed from study area.

Figure 4: Restricted and Removed Contaminated Parcels



Zone D – Project study areas includes all acres outside of Zones A, B, C and Truss Staging Area. Zone D contains reduced levels of contamination that suggest habitat restoration would increase species diversity and abundance at the site; where minor grading through surficial soil disturbance and plantings can be conducted without imposing unnecessary ecological risk in accordance with the Calumet Open Space Reserve (COSR) Ecotox Protocol. The Ecotox Protocol is a framework established by Federal, State, and Local agencies for investigation ecotoxicological risks and defining standard for rehabilitation that address ecological health within the Calumet area. The COSR Ecotox Protocol allows for site-specific assessments if screening levels are exceeded. Vegetation sampling, macroinvertebrate sampling, earthworm bioassays, and a simultaneously extracted metals/acid volatile sulfide (AVS/SEM) analysis were completed by TTEMI. The additional sampling suggested metals in sediments are bound to AVS

and organic carbon, which makes these metals unavailable. Vegetation, macroinvertebrate sampling, and the earthworm bioassay, completed to address bioaccumulation, suggested that no significant toxicity from metals or pesticides is expected in the project area. USACE formulation of ecosystem restoration measures within this zone would be restricted to less than 1-foot deep of earth disturbance if grading techniques are required to achieve appropriate hydrogeomorphology.

Truss Storage Area: No USACE restoration activities were pursued for this zone. Removed from study area.

Based on the removed areas highlighted in red on **Figure 4**, the revised study area for plan formulation is 118.9acres.

2.2 Physical Resources

2.2.1 Geology, Glacial Stratigraphy and Soils

Geology and Glacial Stratigraphy

The Hegewisch Marsh site is part of the Equality Formation and is situated within the Carmi Member and sandwiched between two fingers of the Dolton Member. These two members often seamlessly grade vertically into each other. The Carmi Member is dominantly silt with clay and sand lenses. The Dolton Member consists primarily of sands and gravels. Much of the area surrounding Hegewisch Marsh was extremely modified for industrial and residential purposes; therefore these two geologic features may have been impacted via excavation and mixing by these past activities.

Soils

The Hegewisch Marsh resides in an area that was unmapped for soils by the Natural Resource Conservation Service (NRCS) due to the industrialized nature of the south Chicago area. All natural soils have been removed from the site for borrow or mixed during past activities. There are extensive portions of the site that are covered with a clay cap and several inches of clean topsoil for planting purposes.

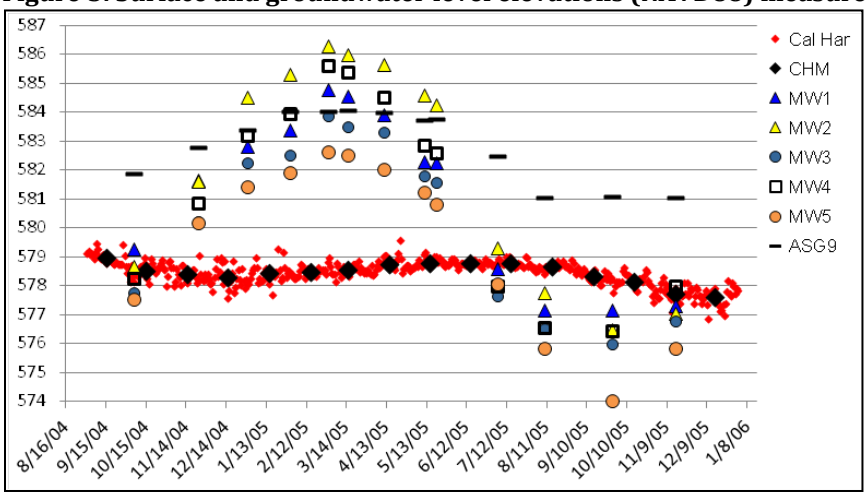
2.2.2 Hydrogeology

Surface water levels in the marsh basin and meadow areas were logged continuously between October 6, 2004 and November 15, 2005. It was determined that surface water in the marsh rose from an October 2004 low of 581.4-ft to 584.0-ft in February 2005. Marsh water levels remained near 584 ft through April 2005, after which levels began falling until surface water was entirely lost from the basin in late July 2005. Other than short periods of recharge associated with rain events, the smaller west basin remained empty through the second half of the water year. Water elevations in the surface pool to the south followed a nearly identical pattern, at a higher perched elevation, until drying in early August 2005.

To study the underlying soil groundwater levels, four soil boring logs measured groundwater levels on 13 dates during the monitoring period at each of these sites plus a fifth reading from an existing well. It was found that the five groundwater levels followed a qualitatively similar pattern to surface water levels, rising through early March 2005, then falling through October and showing slight recovery by mid-November 2005 (**Figure 5**). It was found that groundwater levels in some wells were up to two feet higher than in the adjacent marsh between January and May 2005, and that readings varied spatially from two up to 3.5 feet in elevation, both findings suggesting poor hydrologic connectivity and perching throughout the area. Of particular interest was a comparison between groundwater levels in Hegewisch

Marsh and the Calumet River surface water elevation, which was higher than nearly all groundwater measurements collected after May 2005.

Figure 5: Surface and groundwater level elevations (NAVD88) measured at or near Hegewisch Marsh



It was concluded that the entire site is underlain with a sand lens that is hydrologically contiguous with the Calumet River and that groundwater is being lost through this sand lens to the southwest and into the river (water is flowing downhill). This dynamic primarily explains the seasonal loss of both groundwater and marsh surface water, assuming that surface water percolates into the groundwater and is eventually lost to the river. This is corroborated by previous data collected from a nearby groundwater well, and that Hegewisch Marsh resides within the Carmi Member, which is riddled with clay and sand lenses. It is almost certain that most marsh water is lost in this manner, at least to the surface elevation of the adjacent Calumet River. The conclusion that surface water and groundwater is being entirely lost to the river is not entirely consistent with groundwater levels falling below the river surface water level throughout much of the study period however. This suggests that conductance in or out of the site is relatively slow, and that groundwater losses must be coupled with another dynamic. Extensive filling and mixing of the site's soils and upper layers of the geologic member could of enhanced evaporation straight from the soils. Also, and more probable, is the high abundance of phreatic plants (deep water pumping plants), such as Cottonwood (*Populus deltoides*) and Green Ash (*Fraxinus pennsylvanica*) that are playing a role in reversing groundwater gradients back towards the marsh. The evapotranspiration pumping by these invasive plants is greater than the amount of water needed to wet the surface and fully recharged groundwater expression, especially in dry years with little or no precipitation recharge.

2.3 Ecological Resources

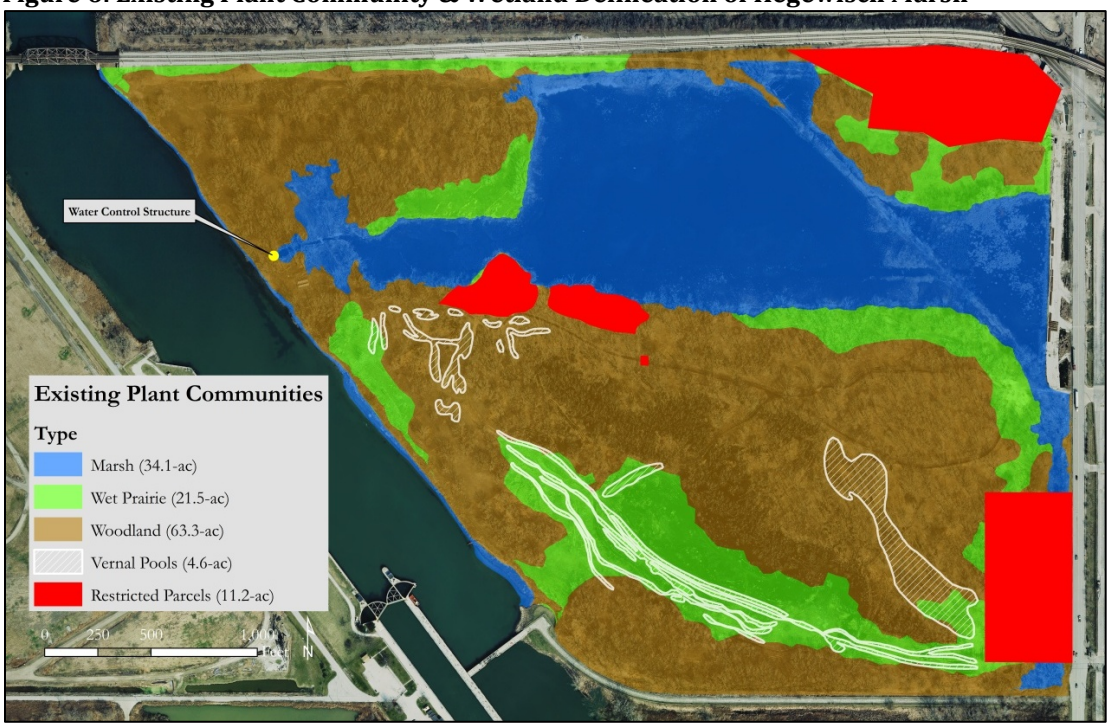
This section presents the current conditions for those ecological/biological resources that would be affected by a project should a feasible solution to the ecosystem problems be recommended. When looking at the plants and animals that have been identified at the site, present contamination has minimal to no effect, whereas habitat structure does. There are no signs of plants or animals being affected by contamination.

2.3.1 Existing Plant Communities

Three habitat types currently exist at the Hegewisch Marsh: (1) Marsh, which includes the large hemi-marsh and the side-stream marsh along the Calumet River; (2) Woodland, which is inclusive of vernal pools; and (3) Wet Prairie, which serves as transition habitat between marsh and woodland habitats, also

inclusive of vernal pools (**Figure 6**). Quantitative plant monitoring was completed by Chicago District botanists during the 2014 growing season in which twenty (20) quadrats were surveyed for species composition, richness and relative coverage per plant community type. This information was input into the Floristic Quality Assessment (FQA) program to derive HSI values for existing (EX) and Future Without-Project Conditions (FWOP). All detailed plant monitoring data and FQA results are provided in **Appendix A**. The photos provided are all taken from Hegewisch Marsh, showing the difference between healthy and degraded patches of habitat.

Figure 6: Existing Plant Community & Wetland Delineation of Hegewisch Marsh



Marsh

There are two types of marsh within the study area, Hemi-Marsh and Side-Stream Marsh. The large hemi-marsh has no passable connection for fish or animals with the Calumet River and currently is configured as an isolated basin. The water elevations are controlled by a structure and pump system recently installed by the CPD (**Photo 1**). The Side-Stream Marsh has surface water connection with the Calumet River all year long; the hydrology here is stable due to the T.J. O'Brien Lock and Controlling Works fixing water elevations.

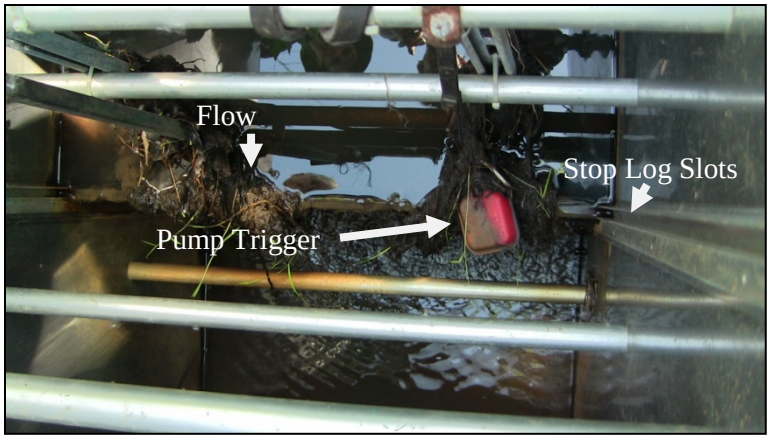


Photo 1: Control Structure with Stop Logs and Solar Powered Pump

Hemi-Marsh – Native species richness is limited to four (4) species only, which exemplifies a highly degraded habitat. The native species that are present, but sparse in abundance and coverage include American Water-Plantain (*Alisma subcordatum*), Wooly Sedge (*Carex pellita*), Rice Cut Grass (*Leersia oryzoides*), and Hard-Stem Club-Rush (*Schoenoplectus acutus*). **Photo 2** shows how the hemi-marsh should look with large patches of open water and small islands of emergent vegetation. **Photo 3** shows invasion and domination by Common Reed (*Phragmites australis*) and hybrid Cattail (*Typha x glauca*). The current condition calculated for the Marsh habitat is a Mean C value of 3.0, with an FQI value of 7.35 (see Section 2.5 for FQA description).

Photo 2: Relatively Healthy Patch of Hemi-Marsh

Photo 3: Highly Degraded Patch of Hemi-Marsh with Cattail and Common Reed

Side-Stream Marsh – The side stream marsh along the Calumet River is a monotypic stand of Common Reed (**Photo 4**). The density of the reeds excludes many species of fish and birds from utilizing this once important habitat. Section 2.3.3 identifies all the native fishes that could utilize the side-stream marsh if it were healthy.

Photo 4: Highly Degraded Side-Stream Marsh with Common Reed

Wet Prairie

The wet prairie quadrats average a native species richness of twenty-one (21) species, but when considering the conservatism of the native species present, species composition still exemplifies a highly degraded habitat. The most conservative native species that are present are of moderate conservatism quality (C=5 or 6), and are sparse in abundance and coverage. These few are limited to Cut-Leaf Water-Horehound (*Lycopus americanus*), Prairie Groundsel (*Packera plattensis*), Wand Panic Grass (*Panicum virgatum*), Marsh Mermaidweed (*Proserpinaca palustris*), Hard-Stem Club-Rush (*Schoenoplectus acutus*), Mad Dog Skullcap (*Scutellaria lateriflora*), White Heath American-Aster (*Symphyotrichum ericoides*). Invading non-native species include Purple Loosestrife (*Lythrum salicaria*), Reed Canary Grass (*Phalaris arundinacea*), and Common Reed (*Phragmites australis*). **Photo 5** shows a relatively healthy patch of wet prairie, whereas **Photo 6** shows invasion and domination by Green Ash (*Fraxinus pennsylvanica*) and Reed Canary Grass. The current condition calculated for the Wet Prairie habitat is a Mean C value of 3.0, with an FQI value of 15.0.

Photo 5: Relatively Healthy Wet Prairie Patch

Photo 6: Highly Degraded Wet Prairie Patch with Green Ash and Reed Canary Grass Invasion

Woodland

The woodland quadrats average a native species richness of 31 species, but when considering the conservatism of the native species present, species composition still exemplifies a highly degraded habitat. The most conservative native species that are present are of a higher conservatism quality (C =7 or 8), and are sparse in abundance and coverage. These are Hairy Pagoda Plant (*Blephilia hirsuta*), White Grass (*Leersia virginica*), Long-Sepal Beardtongue (*Penstemon calycosus*) and Golden Alexanders (*Zizia aurea*). Moderately conservative (C=5) native species that are present and are sparse in abundance and coverage are Hairy Woodland Brome (*Bromus pubescens*), Cut-Leaf Water-Horehound (*Lycopus americanus*), Cup Plant (*Silphium perfoliatum*), Yellow Indian Grass (*Sorghastrum nutans*), and White Heath American-Aster (*Symphyotrichum ericoides*). Invading non-native species include Queen Anne's Lace (*Daucus carota*), White Sweet-Clover (*Melilotus alba*), Parsnip (*Pastinaca sativa*), Kentucky Bluegrass (*Poa pratensis*), European Buckthorn (*Rhamnus cathartica*), and Common Dandelion (*Taraxacum officianale*). The remaining species are considered low quality, native weeds. **Photo 7** shows a relatively healthy patch of woodland, whereas **Photo 8** shows invasion and domination by a weedy understory and European Buckthorn. The current condition calculated for the Woodland habitat is a Mean C value of 2.5, with an FQI value of 15.3.

Photo 7: Relatively Healthy Patch of Wet Woodland with Cardinal Flower

Photo 8: Highly Degraded Patch of Woodland with Over Dense Canopy and Buckthorn Invasion

Vernal Pools

Vernal pools are specific hydrogeomorphic features that are nested within two of the habitat types at Hegewisch Marsh, which are the wet prairie and woodland communities. Floristic inventories of the wet prairie and woodland capture the quality of these, which is primarily dictated by the geomorphic configuration and hydroperiod longevity. There are healthy vernal pools (**Photo 9**) and unhealthy vernal pools (**Photo 10**).

Photo 9: Healthy Woodland Vernal Pool with Natural Geomorphology and Hydroperiod Longevity

Photo 10: Highly Degraded Vernal Pool with Poor Geomorphology and Short Hydroperiod

2.3.2 Aquatic Macroinvertebrates

Detailed scientific inventory and identification of aquatic and terrestrial macroinvertebrates has not been accomplished to date by USACE or others at Hegewisch Marsh. Several aquatic macroinvertebrate species were observed by USACE biologists during site visits, however. Species were numerous including those that are easily visible and identifiable, such as Damselflies (Zygoptera), Dragonflies (Anisoptera), Darners (Aeshnidae), Water Boatman (Corixidae), and Giant Waterbug (Belostomatidae) (**Photo 11**). These were particularly abundant in those vernal pools that have the ability to sustain native aquatic macrophytes such as Mermaid Weed and American Water Plantain.

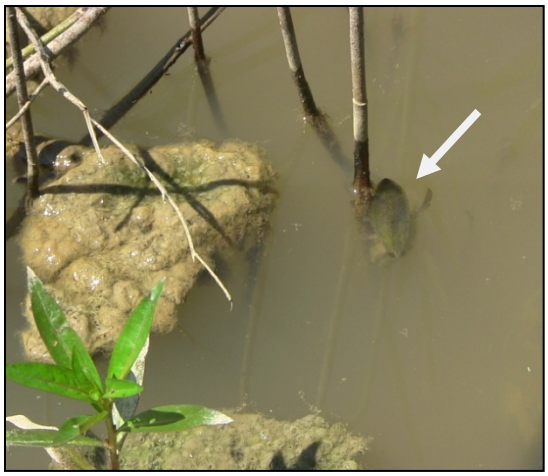


Photo 11: Giant Water Bug (Belostomatidae) and Mermaid Weed, Vernal Pool at Hegewisch Marsh.

2.3.3 Fishes

The Hegewisch Marsh has surface water separation from the Calumet River even during flood events. There are currently no fish present within the Hegewisch Marsh proper or in vernal pools; however, there is a mixed native and non-native assemblage of fishes that occur in the adjacent Calumet River, Lake Calumet complex and Lake Michigan. Any aquatic restoration features that could be restored along the Calumet River would have benefits to the list of native fishes presented in Table 1. Non-native fishes present within the vicinity of Hegewsich Marsh include Alewife (*Alosa pseudoharengus*), Goldfish (*Carassius auratus*), Grass Carp (*Ctenopharyngodon idella*), Common Carp (*Cyprinus carpio*), Oriental

Weatherfish (*Misgurnus anguillicaudatus*), White Perch (*Morone americana*), Round Goby (*Neogobius melanostomus*), Coho Salmon (*Oncorhynchus kisutch*), Rainbow Trout (*Oncorhynchus mykiss*), Chinook Salmon (*Oncorhynchus tshawytscha*), Rainbow Smelt (*Osmerus mordax*), and Brown Trout (*Salmo trutta*).

Table 1: Fishes Observed Near Hegewisch Marsh (1878 - 2010), Chicago Region Fish Database

Species	Common Name	Status	Side Stream Marsh Use
Ambloplites rupestris	Rock Bass		hunting
Ameiurus melas	Black Bullhead		forage/spawning
Ameiurus natalis	Yellow Bullhead		forage/spawning
Aplodinotus grunniens	Freshwater Drum		forage/spawning
Carpiodes carpio	River Carpsucker		forage
Carpiodes cyprinus	Quilback		forage
Catostomus catostomus	Longnose Sucker	ST	no effect
Catostomus commersonii	White Sucker		forage
Cottus bairdii	Mottled Sculpin		no effect
Cyprinella spiloptera	Spotfin Shiner		forage/spawning
Esox americanus	Grass Pickerel		hunt/estuary
Etheostoma exile	Iowa Darter	ST	forage/spawning/estuary
Etheostoma nigrum	Johnny Darter		forage/spawning/estuary
Fundulus diaphanus	Banded Killifish	ST	forage/spawning/estuary
Fundulus dispar	Northern Starhead Topminnow	Extirpated	forage/spawning/estuary
Hybognathus nuchalis	Silvery Minnow	Extirpated	forage/spawning/estuary
Ichthyomyzon castaneus	Chestnut Lamprey	Extirpated	metamorphosis
Ichthyomyzon unicuspis	Silver Lamprey	Extirpated	metamorphosis
Ictalurus punctatus	Channel Catfish		hunting
Ictiobus bubalus	Smallmouth Buffalo		forage/spawning/estuary
Ictiobus niger	Black Buffalo		forage/spawning/estuary
Labidesthes sicculus	Brook Silverside		forage/spawning/estuary
Lepomis cyanellus	Green Sunfish		no effect
Lepomis gibbosus	Pumpkinseed		forage/spawning/estuary
Lepomis humilis	Orangespotted Sunfish		forage/spawning/estuary
Lepomis macrochirus	Bluegill		no effect
Lepomis peltastes	Northern Longear Sunfish	Extirpated	forage/spawning/estuary
Micropterus dolomieu	Smallmouth Bass		hunting
Micropterus salmoides	Largemouth Bass		hunting/spawning/estuary
Morone chrysops	White Bass		hunting
Morone mississippiensis	Yellow Bass		no effect
Moxostoma macrolepidotum	Shorthead Redhorse		forage
Notemigonus crysoleucas	Golder Shiner		forage/spawning/estuary
Notropis atherinoides	Emerald Shiner		forage
Notropis buchanani	Ghost Shiner	Rare	forage/spawning/estuary
Notropis hudsonius	Spottail Shiner		forage
Notropis stramineus	Sand Shiner		forage
Noturus gyrinus	Tadpole Madtom		forage/spawning/estuary

Perca flavescens	Yellow Perch		forage/spawning/estuary
Percopsis omiscomaycus	Trout Perch	Rare	forage/spawning/estuary
Pimephales notatus	Bluntnose Minnow		forage/spawning/estuary
Pimephales promelas	Fathead Minnow		forage/spawning/estuary
Pomoxis annularis	White Crappie		forage/spawning/estuary
Pomoxis nigromaculatus	Black Crappie		forage/spawning/estuary
Pylodictis olivaris	Flathead Catfish		hunting
Rhinichthys cataractae	Longnose Dace		no effect
Umbra limi	Central Mudminnow		forage/spawning/estuary

SE = State Endangered; ST = State Threatened

2.3.4 Reptiles and Amphibians

There are currently no detailed or specific surveys for reptiles and amphibians within the Hegewisch Marsh. Due to the presence of marsh and surface waters throughout the site, this area would be prime habitat for amphibians, and in particular frogs, toads and salamanders. Common reptiles and amphibians observed by various biologists/naturalists and recorded by the CPD at the site include Snapping Turtle (*Chelydra serpentina*), Painted Turtle (*Chrysemys picta*), Red Ear Slider (*Trachemys scripta*), Softshell Turtle (*Apalone spinifera*), Common Garter Snake (*Thamnophis siratilis*), Northern Watersnake (*Nerodia sipedon*), Bullfrog (*Lithobates catesbeiana*), Northern Leopard Frog (*Lithobates pipiens*), and American Toad (*Bufo americanus*). Although not specifically observed from the site, it is probable that the Mudpuppy (*Necturus maculosus*), Tiger Salamander (*Ambystoma maculatum*) and Bluespotted Salamander (*Ambystoma laterale*) exist at the site. These two species are abundant in the area and seem to be tolerant to human activities. In the spring, homes adjacent to wetlands and forest preserves in the Calumet Region can experience subsurface drains becoming clogged with these species (*per observation*).

2.3.5 Birds

Resident and migratory birds have been recorded at Hegewisch Marsh by various ornithologists and credible bird watchers between 1987 and 2013. Table 2 provides the data obtained and curated by the Audubon Society, Chicago. One hundred and eighty five (185) of the three hundred (300) bird species (~62%) observed within the Chicago Region have been observed at Hegewisch Marsh.

Table 2: Resident & Migratory Birds Observed at Hegewisch Marsh (1987 – 2013)

Common Name	Scientific Name	Status		Common Name	Scientific Name	Status
Alder Flycatcher	*Empidonax alnorum*			Least Sandpiper	*Calidris minutilla*	
Alder/Willow Flycatcher	*Empidonax traillii*			Lesser Scaup	*Aythya affinis*	
American Bittern	*Botaurus lentiginosus*	SE		Lesser Yellowlegs	*Tringa flavipes*	
American Black Duck	*Anas rubripes*			Lincoln's Sparrow	*Melospiza lincolnii*	
American Coot	*Fulica americana*			Little Blue Heron	*Egretta caerulea*	SE
American Crow	*Corvus brachyrhynchos*			Louisiana Waterthrush	*Parkesia motcilla*	
American Goldfinch	*Carduelis tristis*			Magnolia Warbler	*Setophaga magnolia*	
American Kestrel	*Falco sparverius*			Mallard	*Anas platyrhynchos*	
American Redstart	*Setophaga ruticilla*			Marsh Wren	*Cistothorus palustris*	
American Robin	*Turdus migratorius*			Monk Parakeet	*Myiopsitta monachus*	
American Tree Sparrow	*Spizella arborea*			Mourning Dove	*Zenaida macroura*	
American Wigeon	*Anas americana*			Mourning Warbler	*Geothlypis philadelphia*	
American Woodcock	*Scolopax minor*			Mute Swan	*Cygnus olor*	
Bald Eagle	*Haliaeetus leucocephalus*			Nashville Warbler	*Oreothlypis ruficapilla*	
Baltimore Oriole	*Icterus galbula*			Neotropic Cormorant	*Phalacrocorax brasilianus*	
Bank Swallow	*Riparia riparia*			Northern Cardinal	*Cardinalis cardinalis*	

Barn Swallow	*Hirundo rustica*			Northern Flicker	*Colaptes auratus*	
Bay-breasted Warbler	*Setophaga castanea*			Northern Harrier	*Circus cyaneus*	SE
Bell's Vireo	*Vireo bellii*			Northern Parula	*Setophaga americana*	
Belted Kingfisher	*Megaceryle alcyon*			Northern Pintail	*Anas acuta*	
Black Tern	*Chlidonias niger*	SE		Northern Rough-winged Swallow	*Stelgidopteryx serripennis*	
Black-and-white Warbler	*Mniotilta varia*			Northern Shoveler	*Anas clypeata*	
Black-billed Cuckoo	*Coccyzus erythropthalmus*	ST		Northern Waterthrush	*Parkesia noveboracensis*	
Blackburnian Warbler	*Setophaga fusca*			Olive-sided Flycatcher	*Contopus cooperi*	
Black-capped Chickadee	*Poecile atricapillus*			Orange-crowned Warbler	*Oreothlypis celata*	
Black-crowned Night-Heron	*Nycticorax nycticorax*	SE		Orchard Oriole	*Icterus spurius*	
Blackpoll Warbler	*Setophaga striata*			Osprey	*Pandion haliaetus*	SE
Black-throated Blue Warbler	*Setophaga caerulescens*			Ovenbird	*Seiurus aurocapilla*	
Black-throated Green Warbler	*Setophaga virens*			Palm Warbler	*Setophaga palmarum*	
Blue Jay	*Cyanocitta cristata*			Pectoral Sandpiper	*Calidris melanotos*	
Blue-gray Gnatcatcher	*Polioptila caerulea*			peep sp.	*Calidris sp.*	
Blue-headed Vireo	*Virea solitarius*			Peregrine Falcon	*Falco peregrinus*	ST
Blue-winged Teal	*Anas discors*			Pied-billed Grebe	*Podilymbus podiceps*	
Bonaparte's Gull	*Chroicocephalus philadelphia*			Pine Siskin	*Cardielis pinus*	
Broad-winged Hawk	*Buteo platypterus*			Pine Warbler	*Setophaga pinus*	
Brown Creeper	*Certhia americana*			Purple Martin	*Progne subis*	
Brown Thrasher	*Toxostoma rufum*			Red-bellied Woodpecker	*Melanerpes carolinus*	
Brown-headed Cowbird	*Molothrus ater*			Red-breasted Nuthatch	*Sitta canadensis*	
Buff-breasted Sandpiper	*Tryngites subruficollis*			Red-eyed Vireo	*Vireo olivaceus*	
Bufflehead	*Bucephala albeola*			Red-headed Woodpecker	*Melanerpes erythrocephalus*	
Canada Goose	*Branta canadensis*			Red-tailed Hawk	*Buteo jamaicensis*	
Canada Warbler	*Cardellina canadensis*			Red-winged Blackbird	*Agelaius phoeniceus*	
Canvasback	*Aythya valisineria*			Ring-billed Gull	*Larus delawarensis*	
Cape May Warbler	*Setophaga tigrina*			Ring-necked Duck	*Aythya collaris*	
Caspian Tern	*Hydroprogne caspia*			Ring-necked Pheasant	*Phasianus colchicus*	
Cedar Waxwing	*Bombycilla cedrorum*			Rock Pigeon	*Columba livia*	
Chestnut-sided Warbler	*Setophaga pensylvanica*			Rose-breasted Grosbeak	*Pheucticus ludovicianus*	
Chimney Swift	*Chaetura pelagica*			Ross's Goose	*Chen rossi*	
Chipping Sparrow	*Spizella passerina*			Rough-legged Hawk	*Buteo lagopus*	
Cliff Swallow	*Petrochelidon pyrrhonota*			Ruby-crowned Kinglet	*Regulus calendula*	
Common Gallinule	*Gallinula galeata*			Ruby-throated Hummingbird	*Archilochus colubris*	
Common Grackle	*Quiscalus quiscula*			Ruddy Duck	*Oxyura jamaicensis*	
Common Merganser	*Mergus merganser*			Rusty Blackbird	*Euphagus carolinus*	
Common Nighthawk	*Chordeiles minor*			Sandhill Crane	*Grus canadensis*	
Common Yellowthroat	*Geothlypis trichas*			Savannah Sparrow	*Passerculus sandwichensis*	
Cooper's Hawk	*Accipiter cooperii*			Scarlet Tanager	*Piranga olivacea*	
Dark-eyed Junco	*Junco hyemalis*			Sedge Wren	*Cistothorus platensis*	
Double-crested Cormorant	*Phalacrocorax auritus*			Semipalmated Plover	*Charadrius semipalmatus*	
Downy Woodpecker	*Picoides pubescens*			Semipalmated Sandpiper	*Calidris pusilla*	
Eastern Bluebird	*Sialia sialis*			Sharp-shinned Hawk	*Accipiter striatus*	
Eastern Kingbird	*Tyrannus tyrannus*			Snowy Egret	*Egretta thula*	SE
Eastern Phoebe	*Sayornis phoebe*			Solitary Sandpiper	*Tringa solitaria*	
Eastern Towhee	*Pipilo erythrophthalmus*			Song Sparrow	*Melospiza melodia*	
Eastern Wood-Pewee	*Contopus virens*			Sora	*Porzana carolina*	
European Starling	*Sturnus vulgaris*			Spotted Sandpiper	*Actitis macularius*	
Field Sparrow	*Spizella pusilla*			Stilt Sandpiper	*Calidris himantopus*	
Fox Sparrow	*Passerella iliaca*			Swainson's Thrush	*Catharus ustulatus*	
Gadwall	*Ana strepera*			Swamp Sparrow	*Melospiza georgiana*	
Golden-crowned Kinglet	*Regulus satrapa*			Tennessee Warbler	*Oreothlypis peregrina*	
Golden-winged Warbler	*Vermivora chrysoptera*			Tree Swallow	*Tachycineta bicolor*	
Gray Catbird	*Dumetella carolinensis*			Turkey Vulture	*Cathartes aura*	
Gray-cheeked Thrush	*Catharus minimus*			Veery	*Catharus fuscescens*	
Great Blue Heron	*Ardea herodias*			Virginia Rail	*Rallus limicola*	
Great Crested Flycatcher	*Myiarchus crinitus*			Warbling Vireo	*Vireo gilvus*	
Great Egret	*Ardea alba*			White-breasted Nuthatch	*Sitta carolinensis*	
Great Horned Owl	*Bubo virginianus*			White-crowned Sparrow	*Zonotrichia leucophrys*	

Greater Yellowlegs	*Tringa melanoleuca*			White-eyed Vireo	*Vireo griseus*	
Green Heron	*Butorides virescens*			White-throated Sparrow	*Zonotrichia albicollis*	
Green-winged Teal	*Anas carolinensis*			Willow Flycatcher	*Empidonax traillii*	
gull sp.	Laridae sp.			Wilson's Snipe	*Gallinago delicata*	
Hairy Woodpecker	*Picoides villosus*			Wilson's Warbler	*Cardellina pusilla*	
Hermit Thrush	*Catharus guttatus*			Winter Wren	*Troglodytes hiemalis*	
Herring Gull	*Larus smithsonianus*			Wood Duck	*Aix sponsa*	
Hooded Merganser	*Lophodytes cucullatus*			Wood Thrush	*Hylocichla mustelina*	
Hooded Warbler	*Setophaga citrina*			Worm-eating Warbler	*Helmitheros vermivorum*	
House Finch	*Haemorhous mexicanus*			Yellow Warbler	*Setophaga petechia*	
House Sparrow	*Passer domesticus*			Yellow-bellied Flycatcher	*Empidonax flaviventris*	
House Wren	*Troglodytes aedon*			Yellow-bellied Sapsucker	*Sphyrapicus varius*	
Indigo Bunting	*Passerina cyanea*			Yellow-billed Cuckoo	*Coccyzus americanus*	
Killdeer	*Charadrius vociferus*			Yellow-crowned Night-Heron	*Nyctanassa violacea*	SE
King Rail	*Rallus elegans*	SE		Yellow-headed Blackbird	*Xanthocephalus xanthocephalus*	SE
Least Bittern	*Ixobrychus exilis*	ST		Yellow-rumped Warbler	*Setophaga coronata*	
Least Flycatcher	*Empidonax minimus*					

SE = State Endangered; ST = State Threatened

2.3.6 Mammals

Common mammals that are adapted to urban landscapes may occur within the project boundaries. These species include raccoon (*Procyon lotor*), thirteen-lined ground squirrel (*Spermophilus tridecemlineatus*), cottontail rabbit (*Sylvilagus flordianus*), gray squirrel (*Sciurus carolinensis*), fox squirrel (*Sciurus niger*), opossum (*Didelphis virginiana*), muskrat (*Ondatra zibethicus*), the North American beaver (*Castor canadensis*), White Tail Deer (*Odeocolis virginianus*), Coyote (*Canis latrans*), Feral Dogs (*Canis familiaris* var.) and Feral Cats (*Felis domesticus* var.). Although the presence of these species was not specifically documented from the Hegewisch Marsh site, these species are known to inhabit open natural and industrial parcels within the Calumet Region. White tail deer, coyote and muskrat were observed from the site by USACE biologists.

2.3.7 Threatened and Endangered Species

Federally-listed Threatened, Endangered, Proposed and Candidate Species were reviewed for the project area by the Chicago District (http://www.fws.gov/midwest/endangered/section7/index.html). The following federally listed species, status 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 gravely soil

Based on the information listed above and site assessments, federally endangered and threatened species or their critical habitats do not occur within the study area.

The Illinois Natural Heritage Database was queried on 11 June 2014 for important resource areas and State Listed Species. The IDNR EcoCAT Report, (project number 1412156) shows the following protected sites are within the vicinity of the Hegewisch Marsh: 130th Street Marsh INAI Site and Lake Calumet INAI Site. The EcoCAT Report also names the following State Listed Species that are known to occur within the potential project site's vicinity: Banded Killifish (*Fundulus diaphanus*), Blanding's Turtle (*Emydoidea blandingii*), Black-Crowned Night Heron (*Nycticorax nycticorax*), Common Moorhen (*Gallinula chloropus*), Little Blue Heron (*Egretta caerulea*), Peregrine Falcon (*Falco peregrinus*), Yellow-Crowned Night Heron (*Nyctanassa violacea*), Yellow-Headed Blackbird and (*Xanthocephalus xanthocephalus*). EcoCAT Report 1412156 may be found in **Appendix A**. State Listed species not identified on the EcoCAT Report but are known to occur in the vicinity of Hegewisch Marsh include Iowa Darter (*Etheostoma exile*), Mudpuppy (*Necturus maculosus*), American Bittern (*Botaurus lentiginosus*), Black Tern (*Chlidonias niger*), Black-Billed Cuckoo (*Coccyzus erythropthalmus*), King Rail (*Rallus elegans*), Least Bittern (*Ixobrychus exilis*), Northern Harrier (*Circus cyaneus*), Osprey (*Pandion haliaetus*), and Snowy Egret (*Egretta thula*).

2.4 Cultural and Architectural Environment

2.4.1 Archaeological and Historical Properties

There are no properties in the vicinity of Hegewisch Marsh currently listed on the National Register of Historic Properties. The closest listed property is a historic ship, AVR 661 (listed in 1980), last reported located in Calumet Harbor approximately 5 miles to the north, and the Ford Airport Hanger (listed in 1989) located at the Lansing Airport approximately 4 miles to the south. One structure approximately one quarter mile east of Hegewisch Marsh, the Mann Park Field House, is eligible for listing on the National Register. The City of Chicago has its own list of City Landmarks, none of which are located near Hegewisch Marsh.

<u>Summary of Native American Coordination</u>

The following Native American tribes were contacted by letter regarding the proposed ecosystem restoration project at Hegewisch Marsh. Tribes contacted by letter included Kickapoo Tribe of Oklahoma, Kickapoo of Kansas, Miami Tribe of Oklahoma, Citizen Potawatomi Nation, Forest County Potawatomi Executive Council, Nottawaseppi Huron Potawatomi Tribal Office, Hannahville Potawatomi Comm., Council, Pokagon Band of Band of Potawatomi Indians, and the Miami Nation in Indiana. No responses were received. Mailing list and coordination letters are provided in **Appendix A**.

2.4.2 Land Use History

Bypassed during the early farming era because of its poor drainage and swampy land, the first development in the Hegewisch neighborhood occurred when a number of railroads crossed the area in the 1850's. Adolph Hegewisch, president of U.S. Rolling Stock Company, laid out the town of Hegewisch as a planned ideal working man's community in 1883. By 1885 the community had a population of 500. The area was annexed to Chicago in 1889.

Steel mills and other industries were attracted to the region by the proximity to Lake Calumet and the Chicago Sanitary and Ship Canal. Immigrants moved into the area to work in the newly established industries. The steel mills in and around Hegewisch remained the mainstays of the community over the

next half century. Adjacent to the Bishop Ford Expressway (Interstate-94) and numerous railway lines, industry (including DMC, a major Midwest distributor of Ford automobiles since 1998) and nearby Indiana casinos now constitute the employment base for the residents of Hegewisch. This portion of Chicago is adjacent to Burnham and Calumet City to the south and west, and Hammond, Indiana to the east.

2.4.3 Social Setting

The Hegewisch neighborhood is located within the City of Chicago 16 miles SE of the Loop. The Hegewisch neighborhood has a racially and ethnically diverse population of 9,800 (2010). Median household income for Hegewisch is $43,655 (2013), and median home value is $71,500 (2013).

2.4.4 Recreation

The City of Chicago has an active summer youth program in conjunction with its extensive park system. Mann Park provides soccer and baseball facilities for the Hegewisch community including Beaubien Park Forest Preserve, Burnham Woods Forest Preserve, Powderhorn Lake, Wentworth Woods Forest Preserve, Wolf Lake, and the William F. Powers Conservation area provide large amount of preserved open space for outdoor sports including bird watching, hiking, picnicking, fishing and boating.

2.5 Habitat Quality Forecasting

The purpose of this study was to identify problems and corresponding solutions to address the altered and degraded ecosystem of Hegewisch Marsh. To calculate change in habitat quality, the level of habitat suitability was calculated by developing a Habitat Suitability Index (HSI). The HSI is an algebraic function that typically uses various habitat structure components as indicators, such as species richness and cover. One HSI that has been certified by the USACE's Center of Expertise for Ecosystem Restoration that reflects a plant community's quality is the Floristic Quality Assessment (FQA). This HSI was used to quantify Existing Ecological (EX) conditions, Future Without-Project conditions (FWOP) and Future With-Project (FWP) conditions for the Hegewisch Marsh study area. Plant communities are highly indicative of habitat quality for animals since plants are the secondary driver to ecosystem biodiversity. Plant communities are defined as a secondary driver to ecosystem structure and function because they respond to primary drivers of (a) hydrogeomorphic and soil conditions and (b) relay to tertiary drivers by providing structure, food, and cover for all fish and wildlife, both directly and in indirectly.

2.5.1 - Habitat Suitability Index

The Floristic Quality Assessment (FQA) is based on the Chicago Region's floristic coefficients of conservatism developed by Swink and Wilhelm (1979) and was approved for regional use by the USACE Ecosystem Planning Center of Expertise (ECO-PCX) and USACE Head Quarters. The FQA captures the effects of various scenarios on the quality of the plant community and was designed for use as an all inclusive method, not just a method to identify high quality sites. Quality, as used in this study, is an assessment of the degree to which native plant species are present within a defined area of land in order to provide habitat for native animals. Also, plants are exceptional indicators of short and long-term disturbance in terms of changes to the geomorphology, hydrology, soils and invasive species pressures. These plant community conditions reflect natural area quality and sustainability as well.

The Floristic Quality Index is calculated using FQA **Equation 1**. Baseline floristic quality was surveyed during the growing season of 2014 (see Section 2.3.1), which will serve as a comparison for predictions

of changes to the plant community based on alternative future scenarios. The prediction of the biological response would be driven by changes to a plant's habitat: geomorphology, hydrology, water, soil, and substrate, which is important for the sustainability of reestablished plant communities, and in turn, those animal species that are dependent upon them (see the Illinois Wild Flowers Home Page for faunal associations of native Illinois plants).

Equation 1

$$FQI = \bar{C}\sqrt{N}$$

Where:

FQI	=	Floristic Quality Index
$\bar{C}$	=	Sum of the Coefficient of Conservatism / # of Native Species
N	=	Total # of Native Species

2.6 Future Without-Project Conditions

Historically, the Hegewisch Marsh study area was most likely marsh and wet prairie/savanna that was part of the Lake Calumet complex. As described above in the historic and current conditions discussion, this area was ultimately transformed from natural habitat types to a dump site; however, soil conditions have been remediated recently that are capable of supporting the growth of native plants and animals. The CPD currently manages the site strictly for habitat purposes, along with small woodchip pathways for the public to utilize the site. These activities would continue as foreseen perpetually into the future without a Federal restoration project. There are no plans or indication of other groups further restoring the Hegewisch Marsh hydrology or plant communities to further increase habitat structure and native species richness and abundance. That being the case, the existing conditions (EX HSI) would be quite indicative of the Future Without-Project Conditions (FWOP HSI) since without a Federal project, the CPD would continue to maintain the small patches of habitat without expanding them. Also, there are various habitat patches that are degraded to an end point in terms of floristic structure and native diversity, such as the side-stream marsh and many vernal pools. Climate change is considered negligible for the most part during the 50-year period of analysis. Although there is a potential for average global temperatures to increase, weather to become flashier, and droughty periods with singular high rainfall events, the key to coping with these conditions is to have a highly diverse (heterogeneous genotypes) plant communities established so that they can ebb and wan with the changing climate patters, just as they would do under natural selection. Also, the presence of the T.J. O'Brien Lock and Controlling Works structure stabilizes vicinity hydrology, which tempers flashy water level bounces derived from storms.

The PDT inventoried EX conditions and forecasted FWOP and Future With-Project (FWP) habitat conditions within the Hegewisch Marsh study area. To determine if a project would be successful in providing increased ecosystem benefits, USACE must also consider the quantity in addition to quality. The FQA was therefore multiplied by the acres of habitat type (marsh, wet prairie, woodland). This Quality times Quantity is measured in non-monetary units called Habitat Units that are averaged across the project's life, called Average Annual Habitat Units (AAHUs). AAHUs are a comparative method to quantitatively measure EX conditions and forecast FWOP and FWP habitat conditions.

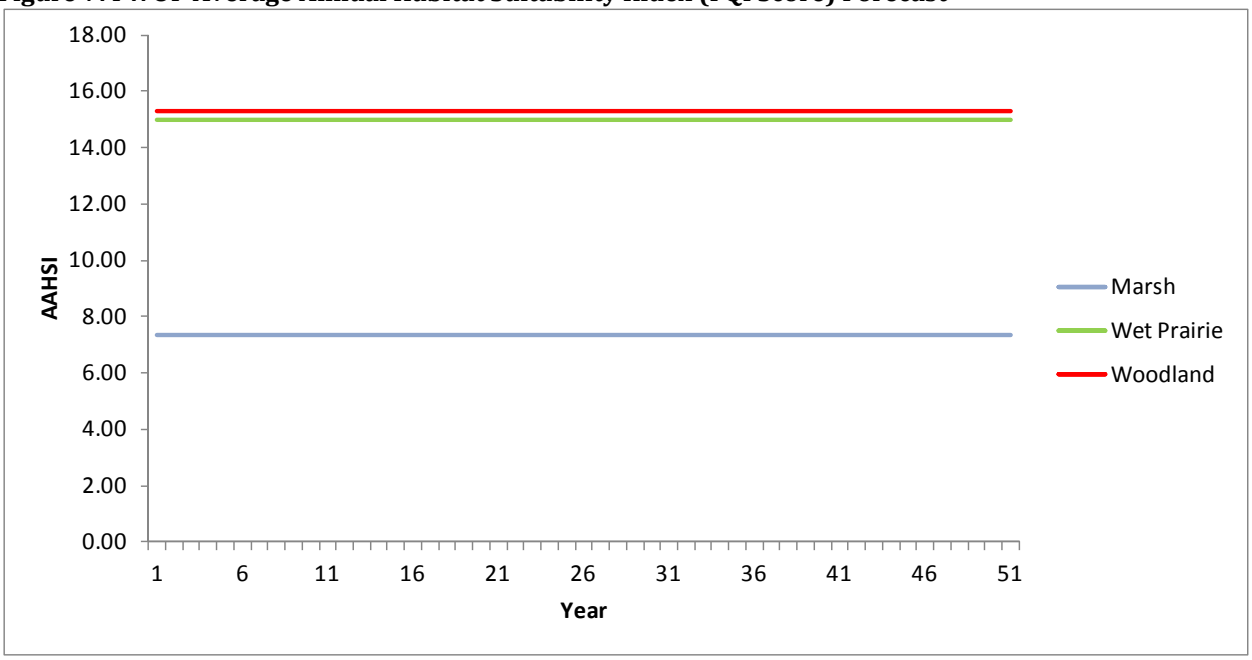
The FWOP condition forecasted for Hegewisch Marsh is that diverse native plant and animal communities would not restore naturally on its own, but would remain relatively static in terms of floristic quality for the foreseeable next 50years. **Table 3** and **Figure 7** presents the results of the project specific floristic inventory and forecast utilizing the FQA. FQA species inventory and calculation sheets are provided in **Appendix A**. This analysis shows that the current and FWOP conditions for native plant

communities, which are the basis for fish and wildlife habitat, are considered ruderal and weedy due to the lack of native conservative plant species which are indicative of healthy native habitats. This is the result of eradication of native plant species and seed bank; present, but degraded perched hydrology; degraded surficial microtopography; and the lack of natural processes to create and sustain habitat types (fire, stream meandering/channel migration).

Table 3: Existing Average Annual Habitat Suitability Index Score and FWOP Habitat Units

Description	Habitat Types	Acres	Ex HSI	FWOP AAHSI	Ex HUs	FWOP AAHUs
Ex Condition	Marsh	34.1	7.35		250.6	
	Wet Prairie	21.5	15.00		322.5	
	Woodland	63.3	15.30		968.5	
No Action /	Marsh	34.1		7.35		250.6
FWOP	Wet Prairie	21.5		15.00		322.5
	Woodland	63.3		15.30		968.5

Figure 7: FWOP Average Annual Habitat Suitability Index (FQI Score) Forecast



CHAPTER 3 – Problems and Opportunities

This chapter provides a description of identified problems within the study area along with opportunities for improvement. It also outlines the overall project goal along with a list of planning objectives and constraints.

3.1 Problems and Opportunities

The Great Lakes maintain 20 percent of the world's freshwater and are important for social, economic, and ecological values throughout the region. However, these values can be lost when the integrity of the system begins to decline. The current trend of the Great Lake's ecosystem is that it is declining. Anthropogenic modifications to the system have subsequently caused habitat degradation, fragmentation, pollution and invasive species issues, all of which are intertwined. As a result, ecosystem heterogeneity and clean water have become more of a concern. These trending problems can be lessened and ultimately reversed via physical and institutional efforts. The Hegewisch Marsh study provides a look at lines of opportunity to provide restored acres of wetland, fish, wildlife and important migratory bird habitat in an effort to reverse trends of biodiversity loss within the southern Great Lakes basin.

3.1.1 Study Area Problems

Historically, the Hegewisch Marsh natural area was most likely dominated by marsh and wet prairie/savanna riparian to the Calumet River. By the late 1800s, much of these communities in the Calumet Region were converted to urban or industrial use, and agriculture to a lesser degree. Subsequently, there was a significant loss of biodiversity within the region. Although historic native plant community types and seed banks were eliminated from the site, there are relatively healthy patches of native community types that have formed. These patches are currently persisting, but are under pressure from other highly altered opportunistic plant communities that impose pressure on hydrology and nonnative plant infestation. Human induced disturbances to the remaining natural processes at Hegewisch Marsh include fire suppression, altered hydrology and hydroperiod, and increased colonization of invasive species.

A brief period of agriculture followed by the persistence of industrialization has had a major influence on the physical structure of habitat and sustaining processes at Hegewisch Marsh. This has allowed invasive and nonnative species to colonize, and in turn has created a negative feedback loop in which invasive plant species play a role in dictating site hydrology. The lack of fire has also played into this by allowing certain fire intolerant species, such as Eastern Cottonwood, to be allowed to lower the water table. The following discussion illustrates the intrinsic ecosystem problems that are driven by man's alteration of the water cycle and introduction of invasive plant species.

Woody vegetation comprised of opportunistic and invasive shrubs and trees as well as dense stands of invasive herbaceous plants have significantly changed the structure and vegetative composition of the Hegewisch Marsh site. This has resulted in the disruption of water levels through increased evapotranspiration. Evapotranspiration is one of the most important output fluxes in wetlands and plant communities, in many cases accounting for up to 100 percent of annual water losses (Frank and Inouye 1994; Souch et al. 1998). A study by Paul K. Doss (1993) within northwest Indiana found that the hydrologic regime of wetlands is predominantly controlled by evapotranspiration of wetland flora as well as the evapotranspiration of upland phreatophytic vegetation. It was found that significant shifts in hydrological regimes as well as ground water depletion during daylight hours were controlled by the evapotranspirative demands of wetland and nearby upland vegetation (Doss 1993).

Dense monotypic stands of invasive hydrophytes, woody invasion of riparian hydric soils and important upland buffers are significant disruptors to the hydrologic regimes of the site's wetlands. A change in a plant community's species composition and structure drive changes in water balances (Sun et al. 2008). Woody vegetation alters water availability by intercepting precipitation, increasing infiltration via stemflow and root channels, and/or transpiring water that would otherwise reach the soil and recharge groundwater (Huxman et al. 2005; Farley et al. 2005). When compared to open water evaporation, cattail (*Typha latifolia*) evapotranspiration was shown to be 0.6 to 2.1 times greater than other native wetland vegetation (Brezny et al. 1973), which is the dominating species within the hemi-marsh currently.

A site at the Indiana Dunes National Lakeshore, with similar conditions of invasive cattail and common reed encroachment on remnant wetland vegetation, has been shown to exhibit higher evapotranspiration rates when compared to an undisturbed site (Souch et al. 1998). Also, standing water at both the undisturbed and disturbed wetland was shown to be a very important heat sink, where 90 percent of heat exchanges occurred in the water when water depths were more than 50 mm, in less than 30 mm of water the heat exchanges in the water and sediment were about equal, and heat exchanges occurred in the uppermost sediments when the water fell below the surface. With increasingly higher evapotranspirative demands as invasive herbaceous and woody species become more dominant, the altered temperature fluctuations within the water and sediment of the site's perched vernal pools and hemi-marsh may be driving the ecology, since the water/sediment temperatures drive dissolved oxygen solubility and nutrient cycles. These also regulate the metabolism and respiration of living organisms and dictate microbial biomass and activities (McCulley et al. 2004; Souch et al. 1998).

Based on site qualitative and quantitative investigations, and the study results above, the main problems at the Hegewisch Marsh in which the 506 Authority may address are as follows:

- Hydrogeomorphic conditions that limit native plant richness and abundance
- High abundance of invasive, water pumping trees, which reduce water levels and temporal longevity of vernal wetlands and hemi-marsh habitats
- Impaired connectivity for reptile and amphibians between Calumet River and Hegewisch Marsh due to bank configuration
- Impaired habitat patches due to invasive plant species dominance
- Lack of critical habitat for locally endangered and rare fauna
- Lack of high quality food source and resting habitat for migratory birds

3.1.2 Opportunities

The alteration, fragmentation, and finally loss of natural habitats are the major causes of the increasingly rapid decline in overall biotic diversity on earth (Burgess and Sharpe 1981; Harris 1984; Saunders et al. 1987). To solve such problems one must consider not only the dynamics of the target species or process, but also the changes in the biotic and abiotic surroundings (Per Angelstam 1992). Urban areas can harbor diverse ecosystems ranging from semi-natural habitats to wastelands, parks and other highly human-influenced biotopes with their associated species assemblages (Niemelä 1999). Although ecological processes in cities are the same as in rural areas, some of them, such as invasion by alien species are more prevalent in urban than in rural conditions (Niemelä 1999). Parks, remnants of natural habitats and other green patches are important for preserving biodiversity in urban areas (Okinger et al 2009). Okinger et al (2009) investigated the relative importance of habitat type and connectivity for butterfly species richness in the city of Malmö, Sweden and compared species richness and composition in the urban habitats with that in the surrounding agricultural landscape. This study highlights the importance of the urban landscape composition for species richness in urban habitats, but also demonstrates clearly that urban habitats, especially those characterized by an early-successional stage, can be of relatively high

conservation value in regions dominated by intensive human land use (Okinger et al 2009); that is the City of Chicago.

Humans fragment and alter landscapes to the detriment of fish and wildlife, especially birds. Marzluff and Ewing (2001) review the effects of urbanization on birds inhabiting nearby native habitats and suggest how restoration ecologists can minimize these effects. This study suggests that the severity of the effects of fragmentation is determined by (a) the natural disturbance regime, (b) the similarity of the anthropogenic matrix to the natural matrix, and (c) the persistence of the anthropogenic change. As a result, urbanization is likely to produce greater effects of fragmentation than either agriculture or timber harvest. Marzluff and Ewing emphasize the importance of maintaining, restoring and monitoring species reproduction, survivorship, and dispersal:

> Restoration ecologists, land managers, and urban planners can help maintain native birds in fragmented landscapes by a combination of short- and long-term actions designed to restore ecological function (not just shape and structure) to fragments, including: (1) maintaining native vegetation, deadwood, and other nesting structures in the fragment, (2) managing the landscape surrounding the fragment (matrix), not just the fragment, (3) making the matrix more like the native habitat fragments, (4) increasing the foliage height diversity within fragments, (5) designing buffers that reduce penetration of undesirable agents from the matrix, (6) recognizing that human activity is not compatible with interior conditions, (7) actively managing mammal populations in fragments, (8) discouraging open lawn on public and private property, (9) providing statutory recognition of the value of complexes of small wetlands, (10) integrating urban parks into the native habitat system, (11) anticipating urbanization and seeking creative ways to increase native habitat and manage it collectively, (12) reducing the growing effects of urbanization on once remote natural areas, (13) realizing that fragments may be best suited to conserve only a few species, (14) developing monitoring programs that measure fitness, and (15) developing a new educational paradigm. (Marzluff and& Ewing 2001)

Also, wetlands can be used in a cost-effective manner to treat nutrient-rich water for release to freshwater ecosystems (Hegewisch Marsh to the Lake Calumet Complex). Hu et al (2004) treated eutrophic water hydroponically with the freshwater macrophyte, *Ipomoea aquatica* Swamp Cabbage. After a 48-h exposure to the plant, chemical oxygen demand (COD), biochemical oxygen demand (BOD5), total suspended solids (TSS) and chlorophyll a (Chla) in the effluent were reduced by 84.5, 88.5, 91.1, and 68.8%, respectively, and the removal of nutrients (total nitrogen and total phosphorus) varied between 41.5 and 75.5%. The results of this study indicate that native marsh and plant community reestablishment within nutrient-rich, eutrophic water can be an effective, low-cost technique to restore shallow pond and lake communities (Hu et al 2004), and when coupled with rough fish removal (Crivelli 1983, Parkos et al 2003) would dramatically shift aquatic communities to a more natural, healthy state.

One crucial component that is important to ecosystem integrity and integrates both aquatic and riparian or buffer habitat is native plant community richness and structure. Historically, the Calumet Region was floristically lush with vast expanses of species rich and structurally diverse wetlands. While restoring wetlands in the Calumet Region of Chicago to their historical conditions is unlikely in many cases, converting small expanses of land into structurally diverse wetlands and buffering plant communities would provide critical habitat for a number of organisms. These patches of wetland and buffering plant communities would serve as an important refuge for migrant and resident bird species, as well as a variety of regional aquatic organisms (fish, amphibians, reptiles aquatic insects, small mammals, etc.).

Wetland Hydrogeomorphology

Currently, there are areas of degraded wetland and riparian zone due to hydrogeomorphic alteration. Based on the intent of the non-Federal sponsor and the potential for reestablishing localized hydrology, great opportunity exists to manipulate geomorphology to successfully reestablish hydrology for native plant communities. The Eugene Field Section 206 is an example of opportunity gained by geomorphic manipulation within an urban setting for hydrologic resurgence, which is now providing aquatic habitat for crayfish, frogs, turtles, great blue herons, green heron, egret, song sparrow and a multitude of dragonflies, damselflies, butterflies, leaf hoppers, grasshoppers, bees, flies and other aquatic and terrestrial insects. Eugene Field Park was once a marsh, then drained and filled in, then turned into a park, then sculpted to reestablish hydrogeomorphic characteristics, and finally returned to resemble its former wetland morphology (**Photo 12**). The opportunity seized was to express the hydrology by manipulating geomorphology to restore the proper water depths and periodicity for various marsh, wet savanna and meadow patches. These same opportunities exist within the Hegewisch Marsh study area in terms of vernal pools, wet woodland, wet savanna, side-stream marsh and hemi-marsh.

Photo 12: Eugene Field Park Section 206 Hydrogeomorphic Wetland Restoration August 2014

Invasive Species Domination and Wetland Hydrology

Currently, the Hegewisch Marsh's perched water table is being dried out faster than necessary to have structurally diverse vernal pool and hemi-marsh habitats. Based on the intent of the non-Federal sponsor and the Federal Objectives for the control and eradication of invasive species, opportunity exists to eliminate or reduce invasive plant species' influences in order to successfully reestablish native plant community species richness and structure. The Calumet Prairie Section 506 project is an example of an opportunity for hydrologic resurgence and native plant species richness and abundance increases gained by removal of invasive species. This project removed all of the non-native and invasive plant species responsible for dictating wetland hydrology from the wet sand prairie ecotype (**Photo 13**), which resulted in both hydrologic resurgence and noted increases in species richness and abundance. These same

opportunities exist within the Hegewisch Marsh study area in terms of vernal pools, portion of the woodland, wet savanna and hemi-marsh.

Photo 13: Calumet Prairie - Native sedges (*Carex* spp.) and marsh marigolds emerging following invasive species removal adjacent to areas where invasive shrubs and trees have not yet been removed

3.2 Goals, Objectives and Constraints

3.2.1 Goal

The goal of this study is to determine a cost effective and ecologically beneficial plan that would restore a sustainable native ecosystem of diverse native plant communities within Hegewisch Marsh.

3.2.2 Objectives

Federal Ecosystem Objectives

The Federal objective of water and related land resources planning is to contribute to national economic and/or ecosystem development in accordance with national environmental statutes, applicable executive orders, and other Federal planning requirements and policies. The use of the term “Federal objective” should be distinguished from planning/study objectives, which are more specific in terms of expected or desired outputs whereas the Federal objective is considered more of a National goal. Water and related land resources project plans shall be formulated to alleviate problems and take advantage of opportunities in ways that contribute to study objectives and to the Federal objective. Contributions to national improvements are increases in the net value of the national output of goods, services and ecosystem integrity. Contributions to the Federal objective include increases in the net value of those goods, services and ecosystems that are or are not marketable.

Restoration of the Nation’s environment is achieved when damage to the environment is reversed, lessened, eliminated or avoided and important cultural and natural aspects of our nation’s heritage are preserved. The objectives and requirements of applicable laws and executive orders are considered

throughout the planning process in order to meet the Federal objective. The following laws and executive orders that specifically provided guidance for this study include, but are not limited to:

- Endangered Species Act of 1973, as amended (16 USC 1531 et seq.)
- Fish and Wildlife Coordination Act, as amended (16 USC 661)
- Migratory Bird Treaty Act of 1918, as amended (16 USC 703 et seq.)
- Responsibilities of Federal Agencies to Protect Migratory Birds (E.O. 13186)
- Clean Water Act of 1977, as amended (33 USC. 1251 et seq.)
- National Environmental Policy Act of 1969 (42 U.S.C. 4321 et seq.)
- Invasive Species (E.O. 13112)
- Nonindigenous Aquatic Nuisance Prevention & Control Act of 1990, as amended (16 U.S.C. 4701 et seq.)
- National Invasive Species Act of 1996 (Public Law 104 – 332)
- Protection of Wetlands (E.O. 11990)
- Protection and Enhancement of Environmental Quality (E.O. 11514)
- Protection and Restoration of the Great Lakes (E.O. 13340)
- Floodplain Management (E.O. 11988)
- Preparing the United States for the Impacts of Climate Change (E.O. 13653)

Responsibilities of Federal Agencies to Protect Migratory Birds (E.O. 13186)

Migratory birds are of great ecological and economic value to this country and to other countries. They contribute to biological diversity and bring tremendous enjoyment to millions of Americans who study, watch, feed, or hunt these birds throughout the United States and other countries. The United States has recognized the critical importance of this shared resource by ratifying international, bilateral conventions for the conservation of migratory birds. Such conventions include the Convention for the Protection of Migratory Birds with Great Britain on behalf of Canada 1916, the Convention for the Protection of Migratory Birds and Game Mammals-Mexico 1936, the Convention for the Protection of Birds and Their Environment- Japan 1972, and the Convention for the Conservation of Migratory Birds and Their Environment-Union of Soviet Socialist Republics 1978.

These migratory bird conventions impose substantive obligations on the United States for the conservation of migratory birds and their habitats, and through the Migratory Bird Treaty Act (Act), the United States has implemented these migratory bird conventions with respect to the United States. This Executive Order directs executive departments and agencies to take certain actions to further implement the Act…

> (g) "Federal agency" means an executive department or agency, but does not include independent establishments as defined by 5 U.S.C. 104.
> (h) "Action" means a program, activity, project, official policy (such as a rule or regulation), or formal plan directly carried out by a Federal agency. Each Federal agency will further define what the term "action" means with respect to its own authorities and what programs should be included in the agency-specific Memoranda of Understanding required by this order. Actions delegated to or assumed by nonfederal entities, or carried out by nonfederal entities with Federal assistance, are not subject to this order. Such actions, however, continue to be subject to the Migratory Bird Treaty Act.

The Hegewisch Marsh restoration study/project has great potential to provide critical migratory bird habitat as identified by the Field Museum of Natural History, Audubon Society, the USFWS and other local naturalist and birding groups.

GLFER Authority Ecosystem Objectives

Based upon the authorizing legislation and the desires of the ecosystem and fishery management communities, the objective of the Great Lakes Fishery and Ecosystem Restoration Program is to provide ecosystem and fishery managers, and others interested in ecosystem restoration, with a planning, design, and construction tool. The following GLFER objectives apply to this project:

- Preserve and restore aquatic and associated riparian habitat as part of an ecosystem approach to fishery management (Restores and enhances Lake Michigan tributary riparian and wetland resources for native fishery species such as Yellow Perch and Smallmouth Bass).
- The restoration of ecosystems to promote naturally reproducing fish communities based on native fish populations (Provides estuary and marsh habitat important for spawning fish such as Yellow Perch, Largemouth Bass, Northern Pike, Panfish [Centrarchidae]).
- Control the introduction and/or spread of invasive aquatic species. (Removes non-native plant species from the site).
- Evaluate the success of projects in order to make future projects better. (Will monitor the restoration to apply lessons learned to future restoration projects).
- Assure coordination between locally implemented restoration actions and basin wide restoration plans. (Close coordination with the Illinois DNR and Chicago Park District to ensure plan goals are being met, but not repeated).

Since the proposed study is in accord with GLFER 506 objectives, and ecosystem restoration is a high priority mission, there is strong Federal interest providing habitat outputs to the Great Lakes. There is also Federal interest in other related outputs of the potential alternatives, which include increase in diversity and abundance of native species, restoring natural wetland hydrology, and increasing acres of ecotypes in the Lake Michigan basin. As well, there are opportunities within the study area to implement cost effective and environmentally justified activities that would increase the overall acreage of wetlands and natural habitats with the Great Lakes basin.

Planning Objectives

As part of the USACE Civil Works mission, the federal objective of ecosystem restoration projects is to restore the structure, function and dynamic processes of degraded ecosystems to a less degraded, more natural condition. The non-Federal sponsor has an ecosystem restoration objective that partners well with the federal objective stated above. Study objectives are statements that describe the desired results of the planning process by solving the problems associated with the study purpose, problems and opportunities. Objectives must be clearly defined and provide information on the effect desired, the subject of the objective (what will be changed by accomplishing the objective), the location where the expected result will occur, the timing of the effect (when would the effect occur) and the duration of the effect.

Two (2) planning objectives were identified by the study team, including the non-Federal sponsor and various stakeholders, to address the resource problems listed above:

Objective 1 – Reestablish Hydrogeomorphology to Support Natural Communities

Currently, Hegewisch Marsh is a result of filling and grading out riparian wetland habitats, therefore there is no natural recovery mechanism aside from a glacial event. This included altering the site's hydrology via soil and clay fill materials and grading-out micro-topography. Thus, changes to the current hydrologic regime desired are those that will rehydrate certain patches. These effects would be sustained over the life of the project and optimistically in perpetuity. This objective seeks to reestablish natural

hydrogeomorphic structure and parameters to support wetland and riparian habitats within the Hegewisch Marsh natural area. Improvement is predicted via the increase in quality (FWP HSI (FQI)) of native plant communities.

Objective 2 – Eradicate Invasive Species from All Plant Communities

Currently, Hegewisch Marsh wetland, riparian and important buffering habitats are dominated by non-native and invasive plant species. This condition resulted from alteration to the natural hydrogeomorphic landscape, disturbance to native soils, eradication of a native seed bank, prevention of natural processes, and the infestation of native and non-native weedy (ruderal) plants. The domination of plant communities by certain species such as Eastern Cottonwood, European Buckthorn, and Cattail have also caused wetland hydrology to be pumped away in excess of the natural condition via evapotranspiration. This causes native plant and animal species to further disappear. Thus, the changes to the native plant community desired are those that will reestablish a base native plant community matrix that will diversify overtime. These effects would be sustained and increased over the life of the project and optimistically in perpetuity via minor maintenance and, when necessary, additional native plantings by the non-Federal sponsor. This objective seeks to reestablish native plant community richness and structure to support critical wetland and riparian habitats within the Hegewisch Marsh natural area. Improvement is predicted via the increase in quantity (acres of native plant dominance) and increase in quality (FWP HIS (FQI)) of native plant communities.

3.3 Planning Constraints

The PDT has identified the following planning constraints primarily to ensure the protection of existing natural resources and to avoid disturbing subsurface contamination:

- Avoid adverse affects to existing migratory bird and butterfly habitats
- Avoid adverse impacts to the few vernal pools that are functioning on site
- Avoid adverse impacts to surrounding functional hydrogeomorphology
- Minimize the removal of trees that are not considered to be highly invasive or having adverse affects on hydrology or native species
- Avoid adverse affects to animals by avoiding various contaminated patches (see Figure 4)
- Avoid/minimize disturbing contaminated soils by limiting earth moving to less than 12 inches deep

CHAPTER 4 – Plan Formulation and Evaluation

The formulation, evaluation, and comparison of alternative plans comprise the third, fourth, and fifth steps of the USACE 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 alternative plans, and then evaluating and comparing those plans to select a final recommended plan, which is the best alternative for implementation.

Plan formulation for ecosystem restoration presents a challenge because alternatives have non-monetary benefits. To facilitate the plan formulation process, the Study Team used the methodology outlined in USACE Engineering Regulation, ER 1105-2-100, Planning Guidance Notebook. The steps in the methodology are:

1. Identify a primary project purpose. For this study, ecosystem restoration (ER) is identified as the primary purpose.
2. Formulate and screen management measures to achieve planning objectives and avoid planning constraints. Measures are the building blocks of alternative plans.
3. Formulate, evaluate, and compare an array of alternatives to achieve the primary purpose and identify cost effective plans.
4. Perform an incremental cost analysis on the cost effective plans to determine the National Ecosystem Restoration (NER) plan.

4.1 Habitat Measures

The codes provided for each measure are for purposes of plan formulation via the Institute for Water Resources IWR Planning Suite program, and are not intended to be direct acronyms. This coding is important to be unique for recognition within the programming. All Hydrogeomorphic Measures are depicted on **Plate 1.** All Plant Community Measures are depicted on **Plate 2**.

Hydrogeomorphic

Groundwater Dam (screened out) – This measure would seek to raise the elevation of the water table to allow the hemi-marsh to withhold water throughout the growing season that it receives from shallow subsurface drainage, precipitation runoff, and groundwater recharge (**Plate 1**). The groundwater dam would be constructed at the down-gradient side of the hemi-marsh and begin on high ground at the upstream end of the hemi-marsh, curving concentrically around the hemi-marsh to high ground at its downstream end. The finished elevation of the groundwater dam would be at the desired water elevation of the hemi-marsh. Although this measure may partially aid in restoring hydrology, it is very expensive and would require deep trenching in a site that is comprised of unclean manmade fill. Due to uncertainties of measure effectiveness, cost and contamination considerations, the study team, non-Federal sponsor and stakeholders have screened this measure from further consideration.

Water Control Structure (WCS) – This measure has investigated an existing water control structure that in the past has not provided effective water level control in recent years (**Plate 1**). On 13 June 2014, the PDT and non-Federal sponsor met on site to test the structure and determine its functionality. It was found that both the control structure and solar powered panels are fully functioning. This measure therefore is recommended to manage water levels and periodicity in the large wetland as a hemi-marsh. This would be accomplished via managing the pump system now in operation and the installation of the new water level gages by Illinois Department of Natural Resources (ILDNR). The marsh will be

adaptively managed in the future as yearly data is observed and collected to maximize hemi-marsh habitat structure and biodiversity.

Bank Naturalization (BN) – This measure seeks to reduce the bank slopes of the Calumet River and the two transitional areas along the basin marsh. The current river bank is a spoil pile from when the Calumet River was excavated, which was left in a haphazard and jagged geomorphic configuration. This measure would allow for native plant species to be established, allow turtles, frogs and snakes ease of passage between the river and marsh and vernal pool habitats, and provide Calumet River fishes with habitat along the toe of the bank. The same holds true for the two transitional zones on the east side of the basin marsh as identified on **Plate 1**.

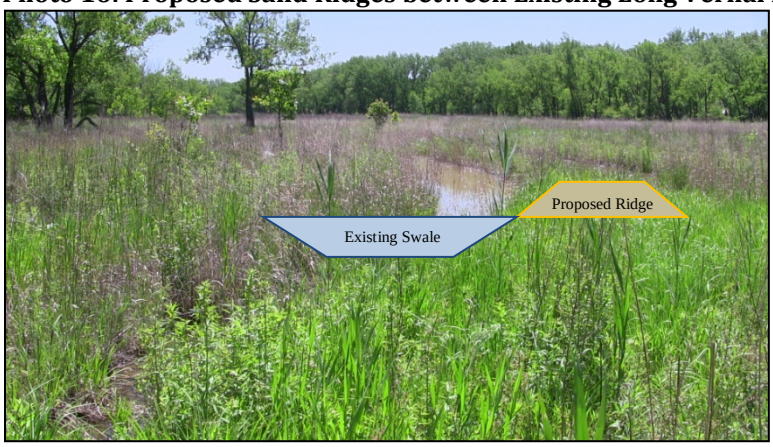
Photo 14: Reduce the slope of the Bank for Native Plant Growth and Animal Migration

Vernal Pools (VP)– This measure seeks to take advantage of the perched water table and naturalize the geomorphology of various wet areas into vernal pools as identified on **Plate 1**. Vernal pools are ephemeral wetlands that hold water long enough to support critical life cycles of amphibians and invertebrates. Most of the small existing wet surface water pockets within the site necessitate smoothing out the contours and moderately compacting the pool bottom in order to provide a base for native wetland plants to grow in. Also, incorporating organic compost soil amendment into the top 6-inches of the existing clay soil would decrease bulk density and increase organic matter. This would enhance microbial communities, providing shelter for amphibians and invertebrates, and stimulate plant growth.

Photo 15: Minor Grading of Edges, Compaction and Compost Addition

Ridge and Swale (RS) Creation – This measure seeks to utilize the long parallel wetland depressions/tire ruts to create ridge and swale geomorphic habitat. This measure would gently grade the existing depressions to smooth them out and add organic compost similar to the Vernal Pool (VP) measure. The ridges would be created by bringing in clean sand, and placing the sand between the swales to a height of 2feet at the crest. The ridges would be sloped down to the swale toe. The 4 acres of ridge would require about 6,600 cubic yards (cyd) of clean sand. The ridges would also require organic leaf litter compost to be worked into the top 6-inches of sand. This measure would provide critical habitats for locally endangered and rare fauna. Since this area has already been modified and filled from its historical state, the creation of a new sandy habitat patches for rare species such as the Lupine (*Lupinus perennis*) and its obligate host the Karner Blue Butterfly (*Lycaides melissa samuelis*). This type of habitat is being restored and created throughout the region by the Illinois DNR, the Nature Conservancy, and Indiana DNR. If this measure is not selected, the long parallel wetland depressions would be treated under the VP measure.

Photo 16: Proposed Sand Ridges between Existing Long Vernal Pools



Evapotranspiration Reduction (ER) – This measure seeks to reduce the rate of groundwater loss from evapotranspiration by removing non-native and weedy species. This measure addresses all invasive species over the entire 118.9 acres, with primary targets of Eastern Cottonwood, Green Ash, European Buckthorn, Cattail hybrids, Reed Canary Grass, and Common Reed. Trees and shrubs would be removed via cutting and leaving stumps and roots in place to avoid and minimize soil disturbance, which leaves subsurface organic material to decompose further benefiting the soil. In order to do this, stumps and remaining stems would need herbicide application to prevent resprout and regrowth. All herbaceous vegetation would be removed via large scale herbicide application, mowing, and/or controlled burning.

Plant Communities

Marsh (M) – This measure seeks to establish aquatic emergent and submergent macrophytes to provide habitat structure and quality within the hemi-marsh basin and Calumet River side-stream marsh (**Plate 2**). Although the Calumet River side-stream marsh and hemi-marsh are lumped into this measure, benefits to fish species would be via the restoration of the Calumet River side-stream marsh only, since fishes would not be able to migrate into the hemi-marsh. It is not desired to have fish passage into the hemi-marsh due to the adverse impacts Common Carp would have in a basin type marsh, and to increase the viability of fishless amphibian habitat as well. This measure is dependent on measures WCS and ER for sustained hydrology. Approximately 34.1 acres of Marsh would be restored. Hydrophytic grass, forb and shrub species would be planted at different densities over the existing 34.1 acres. This measure also includes establishment activities such as watering, spot herbicide treatment, soil amendments, and predatory control features. The complete native planting list for the Marsh habitat is located in **Appendix A**. A few highly conservative species (C= 8 to 10) that would be established include Water Shield (*Brasenia schreberi*), Swamp-Loosestrife (*Decodon verticillatus*), Crimson-Eyed Rose-Mallow (*Hibiscus moscheutos*), Tufted Yellow-Loosestrife (*Lysimachia thyrsiflora*), Green Arrow-Arum (*Peltandra virginica*), Pickerel Weed (*Pontederia cordata*), Greater Water Dock (*Rumex britannica*), American Burr Reed (*Sparganium americanum*), and Steeplebush (*Spiraea tomentosa*). Measure activities are summarized as:

- Selectively seed Marsh areas to establish native base vegetation matrix
- Plant plugs of native Marsh species to provide habitat structure and diversity
- Install predatory control features (chicken wire, strings, snow fencing)
- Spot herbicide invasive species for length of contract
- Perform prescribed burns (as needed) over a five year period

Wet Prairie (WP) – This measure seeks to establish hydrophytic and transitional wetland species to provide habitat structure and quality within the Wet Prairie plant community type (**Plate 2**). This measure is dependent on measures WCS and ER for sustained hydrology and semi-dependent on BN to maximize future quality. Approximately 21.5 acres of Wet Prairie would be restored. Hydrophytic grass, forb and shrub species would be planted at different densities over the existing 21.5 acres. This measure also includes establishment activities such as watering, spot herbicide treatment, soil amendments, and predatory control features. The complete native planting list for the Wet Prairie habitat is located in **Appendix A**. This measure would be inclusive of planting VP, RS that overlap this habitat type should those measures be selected. A few highly conservative species (C= 8 to 10) that would be established include Groove-Stem Indian Plantain (*Arnoglossum plantagineum*), Parasol White-Top (*Doellingeria umbellate*), Four-Flower Yellow-Loosestrife (*Lysimachia quadriflora*), Wing-Angle Loosestrife (*Lythrum alatum*) and Sensitive Fern (*Onoclea sensibilis*). Measure activities are summarized as:

- Selectively seed Wet Prairie areas to establish native base vegetation matrix
- Plant plugs of native Wet Prairie species to provide habitat structure and diversity
- Install predatory control features (chicken wire, strings, snow fencing)
- Spot herbicide invasive species for length of contract
- Perform prescribed burns (as needed) over a five year period

Woodland (W) – This measure seeks to establish wet and mesic shade tolerant species to provide habitat structure and quality within the Woodland plant community type (**Plate 2**). This measure is dependent on measures WCS and ER for sustained hydrology. Approximately 63.3 acres of Woodland would be restored. Grass, forb and shrub species would be planted at different densities over the existing 63.3 acres. This measure also includes establishment activities such as watering, spot herbicide treatment, soil

amendments, and predatory control features. The complete native planting list for the Woodland habitat is located in **Appendix A**. This measure would be inclusive of planting VP that overlap this habitat type should those measures be selected. Trees to be reestablished to replace Eastern Cottonwood and Green Ash canopy include Downy Serviceberry (*Amelanchier arborea*), Shag-Bark Hickory (*Carya ovata*), Swamp White Oak (*Quercus bicolor*), Hill's Oak (*Quercus elipsoidalis*) and Pin Oak (*Quercus palustris*). A few highly conservative understory species (C= 9 to 10) that would be established include Kalm's Brome (*Bromus kalmii*), Square Sedge (*Carex squarrosa*), White Prairie Clover (*Dalea candida*), Canadian Lousewort (*Pedicularis canadensis*) and Round-Leaf Goldenrod (*Solidago paluta*). Measure activities are summarized as:

- Selectively seed Woodland areas to establish native base vegetation matrix
- Plant native Woodland trees to replace removed invasive and nonnative tree species
- Plant plugs of native Woodland species to provide habitat structure and diversity
- Install predatory control features (chicken wire, strings, snow fencing)
- Spot herbicide invasive species for length of contract
- Perform prescribed burns (as needed) over a five year period

4.2 Habitat Measures Cost and Assumptions

Conceptual planning-level cost estimates were prepared for measures that were developed by the study team in conjunction with the non-Federal Sponsors. These cost estimates do not represent Total Project Cost (TPC) estimates, but rather individual restoration measures that are the building blocks of alternatives. These plan formulation level cost estimates were developed by Cost Engineers using data from current similar construction contracts, cost data and publications, and informal discussions with vendors. Costs include construction, preliminary real estate estimates, monitoring and adaptive management, and operations and maintenance. A preliminary real estate estimate for plan formulation purposes was provided by Real Estate in which wetland was estimated at $2,000 per acre and non-wetland was $3,500 per acre. A 25 percent contingency was applied to all measures. Planning level unit costs were placed into a matrix to utilize the different costs for each measures of work (**Appendix A**). The measures were used to provide a monetary basis for the assessment of project alternatives. Additional design information was developed for the Tentatively Selected Plan (TSP) to refine a more detailed cost estimate.

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 2015). 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 this project is 50 years. The present value method was used to discount future costs to the base year. Costs are compounded or converted to present value for the base year then amortized over the 50year period of analysis to determine the average annual cost. The discount rate was determined by the appropriate Economic Guidance Memorandum to be 3.5 percent. The individual measures of the project have the construction period spread out over 1 to 5years depending on the longevity of the activity. Each year of every measure is either compounded or discounted to the base year. Calculation of the measures Average Annual Cost (AA Cost) was completed via the Certified IWR Planning Suite Annualization Calculator (**Table 4**).

Table 4: Total and Average Annual Costs per Measure

Code	Measure	Measure Cost*	LERRD Est.	AA O&M	AA Cost	Dependency	No Combo
WCS	Water Control Structure	[redacted]					
BN	Bank Naturalization					WPb	WPb
VPa	Vernal Pool w/o (RS)					WPa, WPb, W	RS, VPb
VPb	Vernal Pool w/ (RS)					WPa, WPb, W, RS	VPa
RS	Ridge & Swale Creation					WPa, WPb, VPb	VPa
ER	Evapotranspiration Reduction						
M	Marsh					WCS, ER	
WPa	Wet Prairie w/o (BN)					WCS, ER	BN, WPb
WPb	Wet Prairie w/ (BN)					WCS, ER, BN	WPa
W	Woodland					WCS, ER	

*includes monitoring & adaptive management %

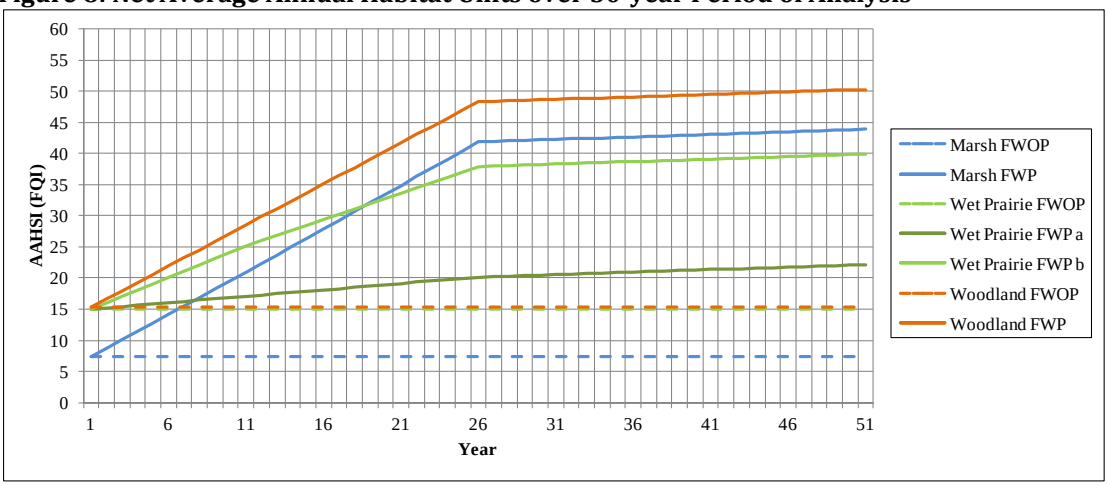
4.3 Habitat Measures Benefits

The evaluation of habitat benefits is a comparison of the Future Without-Project (FWOP) and Future With-Project (FWP) conditions for each measure (**Table 5 and Figure 8**). Environmental outputs are the desired or anticipated results of restoration measures and/or alternatives. The term "outputs" is often used interchangeably with "benefits" or "habitat units (HUs)". Ecosystem restoration plans may possess multiple output categories, as well as other effects that may need to be considered. At a minimum, the evaluation must address cost and outputs that have been determined to represent reasonable ecosystem restoration benefits. A comparison of the FWOP and FWP net gain in HUs was performed in order to determine if a measures, or group of measures (alternatives), would have beneficial effects to the Hegewisch Marsh ecosystem. The measures for this study were evaluated using the FQI w/adventives (non-native and weed species) of the Chicago Region (FQA) methodology (Section 2.5 Habitat Quality Forecasting). **Appendix A** provides the calculation sheets for the FWP Average Annual HSI and Average Annual Habitat Units (AAHUs), as well as the FQI calculation sheets and plant species lists.

Table 5: Total and Net Average Annual Habitat Units per Measure

Description	Habitat Types	Acres	AAHSI	AAHUs	NAAHUs
No Action / FWOP	Marsh	34.1	7.4	250.6	
	Wet Prairie a	21.5	15.0	322.5	
	Wet Prairie b	21.5	15.0	322.5	
	Woodland	63.3	15.3	968.5	
Action / FWP	Marsh	34.1	34.0	1160.9	910.3
	Wet Prairie a	21.5	19.4	418.0	95.5
	Wet Prairie b	21.5	33.2	713.3	390.8
	Woodland	63.3	40.9	2588.6	1620.2

Figure 8: Net Average Annual Habitat Units over 50-year Period of Analysis



4.4 Alternative Plan Generation

Ten (10) measures were input into the IWR Planning Suite in terms of costs and benefits shown in **Table 6**. Each measure is also coupled with the No Action (FWOP) condition for consideration as well. All plant community habitats are dependent on the (WSC) Water Control Structure and (ER) Evapotranspiration Reduction measures. (BN) Bank Naturalization affects future quality of the (WP) Wet Prairie habitat, therefore, there are two (WP) Wet Prairie measures, one with Bank Naturalization (WPa) and one without Bank Naturalization (WPb). (VP) Vernal Pools and (RS) Ridge and Swale hydrogeomorphic features are dependent upon (WP) Wet Prairie and (W) Woodland habitat restoration measures. (RS) Ridge and Swale is not combinable with (VPa) Vernal Pool and is dependent on Wet Prairie (WPa or WPb) and (VPb) Vernal Pool. The costs for (WPa) and (WPb) are identical because the planting list/scheme with or without bank naturalization are the same in terms of implementation costs. So, when combined with (BN), the coupled measures are $[redacted] more expensive than the without (BN) coupled. (VPa) would restore all of the vernal pools on site. (VPb) would restore only those vernal pools that are not considered for the swale portions of the Ridge & Swale habitat. Under (VPb), measure (RS) takes on the costs to restore the long vernal pools, which will serve as the swales. That is why (VPb) looks cheaper than (VPa), but this is not the case for (VPb), because it is dependent on (RS), thusly accounting for the costs between vernal pools only or vernal pools with a large section of ridge and swale.

Based on these inputs and criteria, the IWR Planning software generated seventeen (17) alternative combinations for ecosystem restoration. These alternative combinations were processed for Cost Effectiveness analyses via the Certified IWR Planning Suite Cost Effective and Incremental Cost Analysis, which are presented in the following sections.

Table 6: Measure AA Costs and Net AA Habitat Units (NAAHUs)

Code	Measure	AA Cost	NAAHUs	Dependent	No Combo
WCS	Water Control Structure	[redacted]	-		
BN	Bank Naturalization	[redacted]	-	WPb	WPb
VPa	Vernal Pool w/o (RS)	[redacted]	-	WPa, WPb, W	RS, VPb
VPb	Vernal Pool w/ (RS)	[redacted]	-	WPa, WPb, W, RS	VPa
RS	Ridge & Swale Creation	[redacted]	-	WPa, WPb, VPb	VPa
ER	Evapotranspiration Reduction	[redacted]	-		
M	Marsh	[redacted]	910.3	WCS, ER	

WPa	Wet Prairie w/o (BN)	[redacted]	95.5	WCS, ER	BN, WPb
WPb	Wet Prairie w/ (BN)	[redacted]	390.8	WCS, ER, BN	WPa
W	Woodland	[redacted]	1620.2	WCS, ER	

4.5 Cost Effectiveness/Incremental Cost Analysis

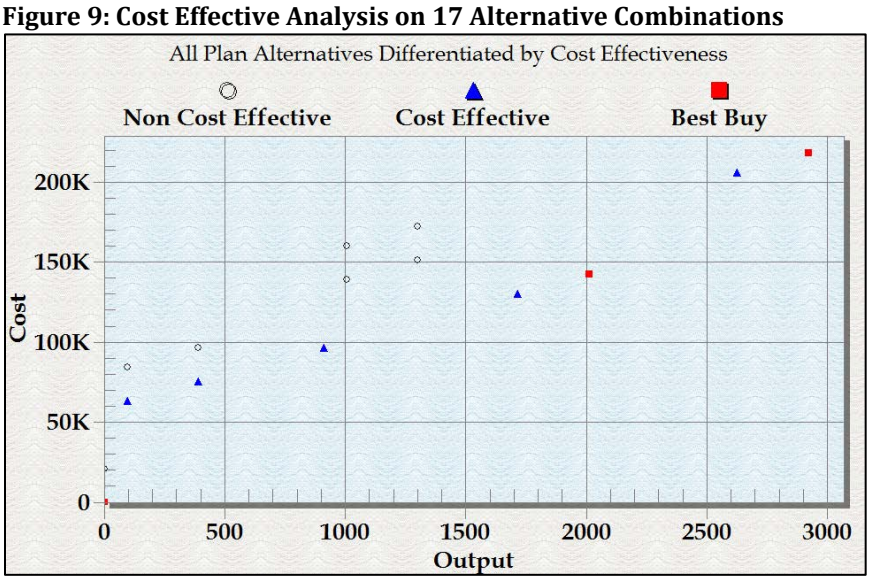
Cost effectiveness and incremental cost analysis (CE/ICA) are two distinct analyses that must be conducted to evaluate the effects of alternative plans according to USACE policy. First, it must be shown through cost effectiveness analysis that a restoration plan's output cannot be produced more cost 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.

Incremental cost analysis means that the subset of cost effective plans are examined sequentially to determine 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.

4.5.1 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. Seventeen (17) alternative combinations were analyzed for cost effectiveness. Of these, eight (8) cost effective combinations were identified (**Figure 9**), which is inclusive of the three (3) Best Buy Plans. The No Action plan is always deemed cost effective and a Best Buy Plan. Nine (9) alternative combinations were screened out as non-cost effective.

Figure 9: Cost Effective Analysis on 17 Alternative Combinations



4.5.2 Incremental Cost Analysis

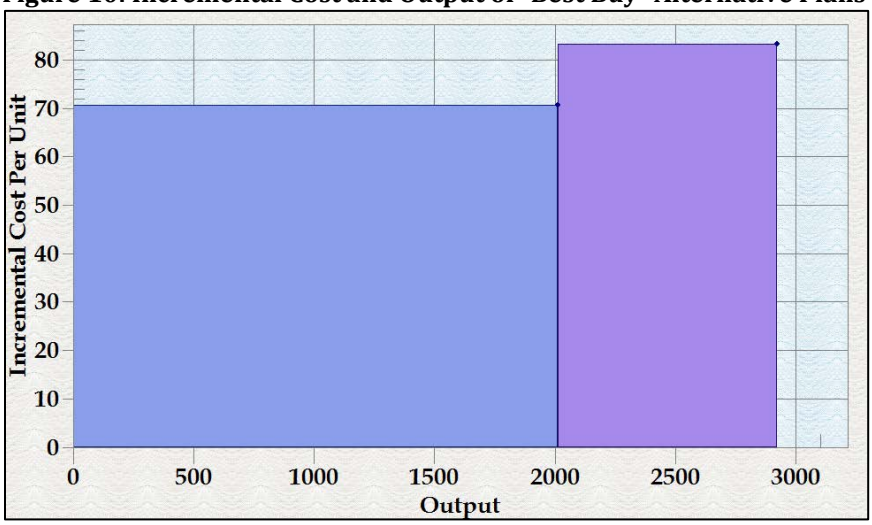
An incremental cost analysis was performed on the three (3) Best Buy Plans identified from the cost effectiveness analysis. The objective of the incremental cost analysis is to assist in determining whether the additional output provided by each successive plan is worth the additional cost. This incremental cost analysis (**Table 7** and **Figure 10**) compares seven alternative combinations for ecological restoration that were considered for selecting as the National Ecosystem Restoration (NER) Plan:

Table 7: Summary of CE/ICA "Best Buy" Alternative Plans

#	Alternative Plan	HU	AA Cost	AA Cost / HU	Inc. Cost	Inc. HU	Inc. Cost / HU
1	No Action Plan	-	-				
2	BN, ER , WCS, VPa, W, & WPb	2,011				2,011	
3	BN, ER, WCS, VPa, W, WPb & M	2,921				910	

- Alternative Plan 1 – No Action
- Alternative Plan 2 – (BN) Bank Naturalization, (ER) Evapotranspiration Reduction, (WCS) Water Control Structure, (VPa) Vernal Pools, (W) Woodland, and (WPb) Wet Prairie
- Alternative Plan 3 – (BN) Bank Naturalization, (ER) Evapotranspiration Reduction, (WCS) Water Control Structure, (VPa) Vernal Pools, (W) Woodland, (WPb) Wet Prairie and (M) Marsh

Figure 10: Incremental Cost and Output of "Best Buy" Alternative Plans



4.6 NER Plan Justification

The alternative plan(s) that qualified for further consideration were assessed in order to identify whether the benefits are worth the Federal investment. The effects include a measure of how well the plan(s) achieve the planning objectives, benefits and costs. Previously in the evaluation process, the positive effects of each plan on the Hegewisch Marsh ecosystem were considered individually and compared to the without-project condition. In this step, supportive facts are presented to determine if it is worthwhile to select a plan as the NER Plan for implementation. The supportive facts include the reality of the ecosystem outputs; significance of the ecosystem outputs; completeness, acceptability, effectiveness and efficiency of the potential plan, and any associated risks or uncertainties that may affect or result from the potential plan.

4.6.1 Significance of Ecosystem Outputs

Due to the challenges associated with comparing 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 Hegewisch Marsh restoration outputs are herein recognized in terms of institutional, public, and/or technical importance.

Institutional Recognition

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.

Migratory Bird Treaty Act (1918)

The Migratory Bird Treaty Act is the domestic law that implements the United States' commitment to four international conventions for the protection of migratory birds and their habitats. The Act protects species or families of birds that live, reproduce, or migrate within or across international borders at some point during their annual life cycle. The four Migratory Bird Conventions are:

- Convention for the Protection of Migratory Birds with Great Britain on behalf of Canada (1916)
- Convention for the Protection of Migratory Birds and Game Mammals - Mexico (1936)
- Convention for the Protection of Migratory Birds and Their Environment - Japan (1972)
- Convention for the Protection of Migratory Birds and Their Environment - Union of Soviet Socialist Republics (1978)

The Mississippi Flyway

There are four principal North American flyways – the Atlantic, Mississippi, Central and Pacific. The Mississippi Flyway’s eastern boundary runs along western Lake Erie, whereas the western boundary is somewhat ambiguous as it merges unnoticeably into the Central Flyway. The longest migration route in the Western Hemisphere lies in the Mississippi Flyway from the Arctic coast of Alaska to Patagonia, in which some shorebird species fly this nearly 3,000 mile route twice. Parts of all four flyways merge together over Panama. About 300 species of bird pass along Lake Michigan's shoreline annually, and is one of America's most important migration routes for songbirds and is considered globally significant with approximately five(5) million individuals passing through during the migration season.

The Lake Michigan route of the Mississippi Flyway includes the Hegewisch Marsh natural area, which is ideal for migratory waterfowl due to it being uninterrupted by mountains, dotted with tens of thousands of lakes, wetlands, ponds, streams and rivers, and is well timbered in certain reaches. Illinois and Indiana farmland consists of corn and soybean fields, which do not provide the type and variety of food and shelter required by nearly all migrating birds. In comparison, Lake Michigan's shoreline provides a variety of plant life and habitat for resting and refueling. Chicago's parks and even residential backyards

are particularly important because they are the only patches of habitat left within a concrete watershed. The preservation of open space along water bodies is critical to the survival of millions of birds that migrate through Chicago every spring and fall. The Hegewisch Marsh natural area has great potential to provide critical migratory bird habitat with the restoration measures implemented. Currently, 62 percent of migratory and residential birds known from the Chicago Region have been observed at the Hegewisch Marsh.

Alternative Plan 3 is in full support of the Migratory Bird Treaty Act, whereas Alternative Plan 2 excludes restoring important side-stream and hemi-marsh habitats, which many of the bird species are dependent upon.

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 would restore river bank, side-stream marsh, basin hemi-marsh, wet prairie, woodland, and fish habitat, thus providing forage and shelter for numerous migratory bird species. This project lies within a significant portion of the Mississippi Flyway along the coast of Lake Michigan that particularly favors both ecological and economically valuable waterfowl species. Alternative Plan 3 fulfills the USACE's role and responsibility by utilizing its Ecosystem Restoration Mission, authority and supporting polices to restore diverse habitats for Migratory Waterfowl and fishes that support these bird species, whereas Alternative Plan 2 excludes restoring important side-stream and hemi-marsh habitats, which many of bird species are dependent upon.

EO 13547 Stewardship of the Ocean, Our Coasts, and the Great Lakes – This order establishes a national policy to ensure the protection, maintenance, and restoration of the health of ocean, coastal, and Great Lakes ecosystems and resources, enhance the sustainability of ocean and coastal economies, preserve our maritime heritage, support sustainable uses and access, provide for adaptive management to enhance our understanding of and capacity to respond to climate change and ocean acidification, and coordinate with our national security and foreign policy interests. Alternative Plan 3 would maximize restored physical characteristics of Lake Michigan coastal habitats, whereas Alternative Plan 2 excludes restoring important side-stream and hemi-marsh habitats.

EO 13340 Great Lakes A National Treasure - 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. Alternative Plan 3 would restore physical characteristics of Lake Michigan coastal habitats, which is in full support of this Act. 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
2. Non-point source pollution
3. Coastal health
4. Habitat/species
5. Contaminated sediments/AOCs
6. Indicators/information
7. Sustainable development
8. Invasive species

Fish and Wildlife Conservation Act of 1980 – all Federal departments and agencies to the extent practicable and consistent with the agency's authorities should promote the conservation of non-game

fish, wildlife, and their habitats. Alternative Plan 3 would restore physical characteristics of Lake Michigan coastal habitats, whereas Alternative Plan 2 excludes restoring important side-stream and hemi-marsh habitats.

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 both the habitat and aesthetic values of Hegewisch Marsh would be achieved via Alternative 2 or 3. This project would provide leadership by providing an example to other large metropolitan areas that industrialized and urbanized areas can be reclaimed for the public and nature to enhance environmental quality.

EO 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. Alternative 3 would restore wetlands inclusive of the side-stream marsh, basin hemi-marsh, wet prairie and woodland habitats, which takes action to further support the enhancement of Lake Michigan. Alternative Plan 2 excludes restoring important side-stream and hemi-marsh habitats.

EO 13112 Invasive Species – This executive order calls for actions "to 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..." This EO utilizes the laws of the United States of America, including the National Environmental Policy Act of 1969, as amended (42 U.S.C.§ 4321 et seq.), Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990, as amended (16 U.S.C.§ 4701 et seq.), Lacey Act, as amended (18 U.S.C.§ 42), Federal Plant Pest Act (7 U.S.C.§ 150aa et seq.), Federal Noxious Weed Act of 1974, as amended (7 U.S.C.§ 2801 et seq.), Endangered Species Act of 1973, as amended (16 U.S.C.§ 1531 et seq.), and other pertinent statutes. Completed in 2001, the National Invasive Species Management Plan, served as a comprehensive "blueprint" for federal action on invasive species, as well as NISC's primary coordination tool. This coordination tool provided the first comprehensive national plan for invasive species action. It called for about 170 specific actions within nine categories of activity, about 100 of which have been established or completed. Actions identified in the 2001 Plan continue to be implemented. The 2008 through2012 National Invasive Species Management Plan (2008 Plan) was the first revision of the 2001 Plan. The 2008 Plan focused upon five "Strategic Goals": Prevention; Early Detection and Rapid Response; Control and Management; Restoration; and Organizational Collaboration. To accomplish these strategic goals, critical support for efforts such as research, data and information management, education and outreach, and international cooperation elements were included in the plan. The 2008 Plan identified prevention as the first line of defense, and calls for preventing the introduction and establishment of invasive species to reduce their impact on the environment, the economy, and health of the United States.

Executive Order (EO) 13112 also includes specific duties for federal agencies in regard to invasive or nuisance aquatic species. Excerpts from the order relating to federal agencies are contained in the following paragraphs:

> (a) Each Federal agency whose actions may affect the status of invasive species shall, to the extent practicable and permitted by law,
>
> (1) identify such actions;
>
> (2) subject to the availability of appropriations, and within Administration budgetary limits, use relevant programs and authorities to: (i) prevent the introduction of invasive species; (ii) detect and respond rapidly to and control populations of such species in a cost-effective and environmentally sound manner; (iii) monitor invasive species populations accurately and reliably;

> (iv) provide for restoration of native species and habitat conditions in ecosystems that have been invaded; (v) conduct research on invasive species and develop technologies to prevent introduction and provide for environmentally sound control of invasive species; and (vi) promote public education on invasive species and the means to address them; and

Alternative Plan 3 fully addresses the intent of EO 13112.

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 conserve ecosystems upon which endangered and threatened species depend. Implementation of Alternative Plan 3 would improve hunting habitat for the state threatened black-crown night-heron and peregrine falcon (*Falco peregrinus*). Also, this alternative would provide sufficient side-stream habitat to provide for state listed Banded Killifish and potentially Iowa Darter by provide spawning and foraging habitat.

Clean Water Act – restore the chemical and biological integrity of the Nation's waters. Although water quality improvement is not within the USACE Mission, policy acknowledges that habitat restoration provides incidental water quality improvements most of the time. The Clean Water Act also has provisions for wetland and biological integrity protection. The No Action Alternative does not support this Act by denying opportunity to improve water quality and increase viable wetland acres. Alternatives 2 and 3 support the Clean Water Act since water quality improvements would be realized.

EO 13653 Preparing the United States for the Impacts of Climate Change – The impacts of climate change — including an increase in prolonged periods of excessively high temperatures, more heavy downpours, an increase in wildfires, more severe droughts, permafrost thawing, ocean acidification, and sea-level rise — are already affecting communities, natural resources, ecosystems, economies, and public health across the Nation. These impacts are often most significant for communities that already face economic or health-related challenges, and for species and habitats that are already facing other pressures. Managing these risks requires deliberate preparation, close cooperation, and coordinated planning by the Federal Government, as well as by stakeholders, to facilitate Federal, State, local, tribal, private-sector, and nonprofit-sector efforts to improve climate preparedness and resilience; help safeguard our economy, infrastructure, environment, and natural resources; and provide for the continuity of executive department and agency (agency) operations, services, and programs. The Federal Government must build on recent progress and pursue new strategies to improve the Nation's preparedness and resilience. In doing so, agencies should promote: (1) engaged and strong partnerships and information sharing at all levels of government, (2) risk-informed decision-making and the tools to facilitate it, (3) adaptive learning, in which experiences serve as opportunities to inform and adjust future actions, and (4) preparedness planning.

Alternatives 2 and 3 support this EO via the sequestration of carbon and carbon dioxide by increasing the acreage and biomass of native plant material above and below ground. Even dead plant material in the form of peat, detritus and mucks prevents carbon from entering the atmosphere. Converting homogenous spaces to diverse structures and native plants would ultimately absorb more sunlight than reflect it into the atmosphere and in turning heating up the planet.

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.

Millennium Reserve

The Millennium Reserve is a transforming region in the Calumet and southeast Chicago lakefront areas, 210 square miles in all, with thriving commerce, communities, and wildlife. The goal is to catalyze innovative partnerships and action in the region that:

I. Honor its cultural and industrial past
II. Restore and enhance the natural ecosystems
III. Support healthy and prosperous communities and residents
IV. Stimulate vigorous and sustainable economic growth

The Reserve recognizes that conservation and sustainable land use in urban areas are inextricably linked to healthy communities and a robust economy. Millennium Reserve stretches from downtown Chicago southeast to the Indiana border and southwest to suburban Park Forest. It encompasses numerous neighborhoods on Chicago's south side, the southeast lakefront, and 37 south suburban municipalities. In aggregate, the Reserve includes a collection of over 15,000 acres of open space such as parks, trails, wetlands, and forest preserves. Nearly 6,000 of these acres are considered high-quality natural areas. One million residents live within the Reserve. Millennium Reserve is a shared vision that unifies public, nonprofit, and commercial leaders seeking to make the most of the region's assets. Moreover, it is an ongoing initiative guided by partners who understand community priorities, and it is designed to make on-the-ground projects happen. The initiative includes projects that range from neighborhood-based in scale to those of regional significance. Millennium Reserve recognizes the work of partners, particularly those whose decades-long commitment to the region have created the foundation for this initiative.

Partners provide their own human and financial resources. They catalyze action by focusing, leveraging, and augmenting existing resources and by working within a collaborative framework to achieve exponential results. These results will provide tangible benefits for the region that can be measured by job growth, new acres restored, increased public access to natural areas, and much more. Millennium Reserve is part of President Obama's America's Great Outdoors initiative, which works to align federal programs with locally-developed conservation and recreation goals. Since its inception, Millennium Reserve has welcomed over 100 partners and key stakeholders.

The Hegewisch Marsh is an identified restoration project by the Millennium Reserve.
http://www2.illinois.gov/gov/millennium-reserve/Pages/HegewischMarsh.aspx

Green Corps

The mission of Green Corps is to train organizers, provide field support for today's critical environmental campaigns, and graduate activists who possess the skills, temperament, and commitment to fight and win tomorrow's environmental battles. Following Earth Day 1990, a wave of environmentally minded college graduates left academia looking for a way to put their values to work. In 1992, U.S. PIRG launched Green Corps as a graduate school for environmental organizers. This program not only gave participants a solid academic grounding in their field of choice; it provided concrete campaign experience with leading environmental and social change organizations, and even paid participants to enable them to engage full-time in their chosen work. Fast forward more than two decades: Green Corps has trained and graduated more than 350 organizers who are putting their skills to work with Sierra Club, Greenpeace, Environment America, Food and Water Watch, Rainforest Action Network and other groups on issues ranging from global warming to reforming our food system, from saving our national parks to protecting the Arctic. The Hegewisch Marsh is a specific project site that the Green Corps is helping to restore. The Green Corps is in full support of Alternative 3.

Hegewisch Marsh Site Plan

This 2006 Master Plan, titled Hegewisch Marsh Site Plan, was developed by over 20 stakeholders over various years. This plan determined what the best restoration measures would be for the site, both in terms of habitat and recreation.

Stakeholder Support

Support of the Hegewisch Marsh Ecosystem Restoration Project and Alternative Plan 3 presented in this Detailed Project Report includes, but are not limited to: the US Environmental Protection Agency (USEPA), US Fish and Wildlife Service (USFWS), Illinois Environmental Protection Agency (IEPA), Illinois Department of Natural Resources (IDNR), the Audubon Society Chicago, the Field Museum of Natural History, the John G. Shedd Aquarium are all critical and involved stakeholders. The Audubon Society, Field Museum of Natural History, and the Shedd Aquarium have National and Global interests in persevering and restoring biodiversity.

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.

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.

Status and Trend measures the relationship between previous, current and future conditions.

Connectivity is the measure of a resource's connection to other significant natural habitats.

Limiting Habitat is the measure of resources present supporting significant species.

Technical Summary – Wildlife conservation in urban habitats is increasingly important due to current *urbanization trends* (Fernández-Juricic and Jokimäki 2001). Alternative Plan 3 focuses on restoring diverse habitats within the Hegewisch Marsh, which is *representative* of a *scarce* coastal ecosystem resource. Habitats include an open marshy system with snags, rootwads and limbs to mimic deadfall (all trees or tree parts used for habitat); patches of wet woodland with vernal pools; riparian buffer of emergent reeds and grasses along the Calumet River; wet prairie of sensitive grasses, forbs, and shrubs. This type of system is *scarce* within the Chicago Region, with no identifiable high quality marshes in the

surrounding area. These habitats were known to occur more frequently at one point in history; however, there are currently no known areas of this type of riverine backwater system. In terms of *connectivity*, this project adds to the increasing patches of habitat within the City of Chicago, lessening the distance species have to travel over inhospitable areas of urbanized lands. The coastal zone of Lake Michigan in Illinois is trending towards wide spread improvement and connectivity, indicative of projects such as the Ravine projects along the north shore, 63rd Street Dune and Beach 506, Northerly Island 506, and various smaller parks being restored by the Chicago Park District. Connectivity within the site is important as well, especially between different plant communities for amphibians, reptiles, small mammals and insects. Hydrologic gradients provide the basis for plant community species richness and structure, and because of the gradients, these plant communities seamlessly connect to each other. This makes it critical to restore in-between habitats such as fringing marsh, which connects the submersed pond habitat with the riparian wet prairie and woodland habitats. Species such as the Tiger Salamander require all three habitats in order to survive. Their eggs and larvae would be incubated within isolated vernal pools, and then as they morph into adults they move into the fringe marsh and pools, finally emerging and seeking wet woodland habitats. Certain keystone fishes, such as Northern Pike and Grass Pickerel require spawning habitat for reproduction and recruitment, and just as well need the fringe marsh along the Calumet River for spawning and nursery habitat (Stephenson 1990, Jude and Papas 1992). The State Threatened Banded Killifish's critical spawning and foraging habitat is fringe marsh. The fringe area of many lakes and ponds is also critical in that they provide structure and food to maintain diverse macroinvertebrate populations that support both aquatic and terrestrial species (Krieger 1992). Many species of water fowl also require fringe marsh for both nesting and rearing of young. Restoring viable habitat within and along the Lake Michigan coastal zone would provide a critical habitat for migratory waterfowl and wetland fishes such as Grass Pickerel and Warmouth. The proposed habitat restoration would have great potential to support various state threatened species, including the Banded Killifish, Yellow-Headed Black-bird, and Black-Crown Night-Heron.

4.6.2 Acceptability, Completeness, Effectiveness and Efficiency

Acceptability, completeness, effectiveness, and efficiency are the four evaluation criteria USACE uses in evaluating 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. The tentatively recommended plan must be acceptable to the non-Federal cost-sharing partner.

The Hegewisch Marsh 506 study was developed in a collaborative fashion, in which planning and design meetings screened and refined habitat restoration measures. The Federal, State and local groups that participated in these activities (Hegewisch Marsh Site Plan) are discussed in the previous section. Alternative 1, No Action, provides no ecosystem improvements and is not acceptable to the Federal Objective, the non-Federal sponsor's goals and stakeholder desires. Alternatives 2 and 3 are the most acceptable in terms of the Federal Objective and non-Federal sponsor/stakeholder vision for reestablishing a sustainable and viable ecosystem within the Hegewisch Marsh study area. Alternative 2 provides limited benefits but generally leave critical aquatic habitat types (Marsh) in a degraded state. Taking the Federal Objective, study objectives, and non-Federal sponsor/stakeholder needs into consideration, Alternative 3 provides the most diverse habitat possible and therefore would be the most acceptable.

In terms of onsite contamination, this project is acceptable according to the 28 October 2016 Memorandum for the Supplemental analysis of HTRW issues with Hegewisch Marsh ecosystem restoration project. This memorandum provided final guidance and affirmation to the plan formulation processes conducted under this Feasibility Study in terms of contamination. This decision is primarily supported by the completed remedial actions completed by the CPD and accepted by regulatory agencies, the plan formulation processes in which remaining suspect areas were removed from the Federal project, the limitation of earth moving, and due diligence in response to past Federal actions.

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 an adaptive management plan should be proposed and must be accounted for in the implementation plan.

All of the factors were considered in the development or post formulation assessment of alternative plan costs/outputs, consistency with other Federal and non-Federal Plans, real estate, operation and maintenance (O&M), monitoring and non-Federal sponsorship. Alternative 1 does not provide any action to restore degraded habitats and therefore is incomplete in realization of ecosystem improvements. Alternative 2 is incomplete in terms of restoring all potential aquatic habitats and is inconsistent with State and local plans for reestablishing a healthy coastal zone. Alternative 3 is the most complete in that it would change Hegewisch Marsh from a degraded green space into a diverse and native habitat system for fish, wildlife and migratory birds. Alternative 3 would have the least O&M and adaptive management features since the alternatives are complete from ecological systems context.

In terms of onsite contamination, this project is complete based on the fact that the CPD remediated the site to the fullest extent required to reestablish a healthy ecosystem. Shortly after remediation, the site exhibited increases in native plant and animal species richness, including the State Endangered Yellow-Headed Black Bird. Vegetation, macroinvertebrate sampling, and the earthworm bioassay, completed to address bioaccumulation, suggested that no significant toxicity from metals or pesticides is expected in the project area.

Effectiveness

A plan must provide and account for meeting goals and objectives of the study to ensure the realization of the planned restoration outputs.

Objective 1 – Reestablish Hydrogeomorphology to Support Natural Communities

This objective seeks to reestablish natural hydrologic and geomorphic parameters to support critical wetland and riparian habitats within the Hegewisch Marsh natural area.

Objective 2 – Eradicate Invasive Species from All Plant Communities

This objective seeks to reestablish native plant community richness and structure to support critical wetland and riparian habitats within the Hegewisch Marsh natural area.

- Alternative 1 takes no action, and therefore does not meet the two planning objectives since the future without-project conditions do not foresee natural recovery of this system.

- Alternative 2 would basically restore Wet Prairie and Woodland habitats without critical Marsh habitats. This alternative would provide about 84.8acres of Wet Prairie and Woodland habitat. This alternative does not address Objective 1 and only begins to address Objective 2.

- Alternative 3 builds upon Alternative 2 by adding Marsh restoration along with contouring to restore hydrogeomorphic features and plant assemblages for Sedge Meadow, Vernal Pools, and Marsh habitats. This alternative would provide about 118.9acres of habitat. This alternative addresses Objective 1 and Objective 2.

Efficiency

An ecosystem restoration plan must represent a cost-effective means of solving habitat problems and seizing opportunities to improve the environment. It must be determined that the plan's restoration outputs cannot be produced more cost effectively than any other plan via the USACE's Six-Step Planning Process.

Ten (10) measures, including No Action, were refined to seize site specific opportunities, address Hegewisch Marsh's problems and were further honed by targeting two ecosystem objectives. Using the USACE Institute for Water Resources Planning Suite Software, 17 alternative combinations were generated from the measures. Through the CE/ICA analyses, eight (8) cost effective combinations were identified, which is inclusive of the three (3) Best Buy Plans. The No Action plan is always deemed cost effective and a Best Buy Plan. Nine (9) alternative combinations were screened out as non-cost effective. Only Best Buy Plans were considered for selection, therefore Alternatives 2 and 3 are deemed highly efficient.

4.6.3 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 for example, which exist in areas subject to 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.

Overall, there is very low risk associated with Alternatives 2 and 3 not performing as predicted. Sufficient investigations to the level of project complexity were performed to ensure that the restored plant communities would not revert to invasive, weedy species again by (a) lessons learned from constructed park like plant restoration projects i.e. Eugene Field Park 206, 63rd Street Dune & Beach 506 and Northerly Island 506, (b) designing plant communities to the hydrology and geomorphology instead of fighting it i.e. the overall design replicating plant communities indicative of system, and (c) a dedicated non-Federal sponsor that has a Natural Areas Program, will maintain the project as constructed with intended ecological benefits.

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. A prominent issue is that invasive plant species are adapted for colonizing areas that are disturbed and have ruined soils. Measures that alleviate ruined soil properties consist of minor grading and adding leaf litter compost to the top 6 inches of soil during late summer or early fall. Incorporating soil amendments such as this will decrease bulk density, hold moisture longer and increase organic matter and microbial activity. This would further the soil's ability to provide for native plants and reduce the vulnerability of the plant community to noxious weed invasion. This measure has been found to work on several Chicago District habitat restoration projects where the soils were physically ruined. The other end of the spectrum would be the addition of inorganic substrates to reverse the overly organic substrates currently in place. The only situation worse than a plant community completely comprised of weedy, nonnative species, is no plant community at all. Hegewisch Marsh currently has an ideal condition for planting native coastal species since there is about a layer of topsoil greater than 12 inches over all unnatural fill materials.

Native plantings also have an associated risk of not establishing due to a variety of unforeseen events. Predation from herbivorous animals is likely since Common Carp and Canada geese are quite abundant in the area. Weather also plays a large role in the establishment success of new plantings. Periods of drought, flood or early frost can alter the survival percentage of plantings. 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 may or may not affect project outcomes. 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 for the near future. This climate concern is alleviated by having a broader pallet of adaptive plant species to compensate for climatic shifts.

Concerns of erosive forces are not apparent for this project since it is in a stable and sheltered area, protected from wind, waves and flowing streams.

The historic, present and future environmental conditions of the Hegewisch Marsh study site were considered during plan formulation for this study to assess the risks related to human health. Although the site was principally degraded by activities associated with the creation and maintenance of the Calumet River navigation project by USACE as well as the fly dumping of debris, a recent project to remediate and restore the site in anticipation of further habitat restoration was voluntarily completed by the City of Chicago. The City of Chicago conducted remediation of the most contaminated areas of the site with the goal of reducing risk of human health and ecological exposures. Given that the site will be used for recreation purposes only, with very limited human exposure, any remaining contamination in the project area is not a risk to humans." To further reduce the risk of human health impairment during construction, the NER plan limits soil disturbance at the site and avoids certain areas completely that have unknowns associated with them. Also, the environmental conditions at the site will be provide to the site workers to develop any necessary health and safety controls required during earthwork activities

Consideration of ecological risk associated with the project was based upon site specific analyses performed. After the project is completed, soil contamination levels will remain the same, but these contaminant levels were determined to not be significant enough to impose ecological risk. Although several of the soil samples in the remaining project site (Zone D) exceed the Calumet Open Space Reserve (COSR) Ecotox Protocol Threshold and Benchmark levels, the project is not designed to change the soil concentrations of these contaminants. In order to determine whether the existing contaminants would pose an ecological risk, an ecological risk assessment was conducted (bioavailability and toxicity studies), and it concluded that restoring the habitat can be conducted without imposing ecological risk.

The COSR Ecotox Protocol allows for site-specific assessments if screening levels are exceeded. Vegetation sampling, macroinvertebrate sampling, earthworm bioassays, and a simultaneously extracted metals/acid volatile sulfide (AVS/SEM) analysis were completed by TTEMI. The additional sampling suggested metals in sediments are bound to AVS and organic carbon, which makes these metals unavailable. Vegetation, macroinvertebrate sampling, and the earthworm bioassay, completed to address bioaccumulation, suggested that no significant toxicity from metals or pesticides is expected in the project area.

4.7 National Ecosystem Restoration (NER) Plan Recommendation

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.

This restoration project was planned in cooperation with the Chicago Park District and various Federal, State and local stakeholders. Also, 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 allow all stakeholder parties to contribute.

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 that are in construction and design phases. 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 Migratory Birds in terms of human uses and aesthetics has been documented through numerous sources, most importantly the Migratory Bird Treaty Act (1918) and EO 13186 Responsibilities of Federal Agencies to Protect Migratory Birds.

Non-monetary values associated with the Hegewisch Marsh restoration project include a variety of ecological, social and educational benefits. The project will provide important stop-over habitat for birds traveling along the Great Lakes portion of the Mississippi 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 Hegewisch Marsh as a natural area will markedly increase the ecological integrity of the surrounding area and is well worth the investment.

Wetlands are important due to the massive losses in recent history and the need to recover them. The “No Net Loss" is the US government's overall policy goal regarding wetland preservation. The goal of the policy is to balance wetland loss due to economic development with wetlands reclamation, mitigation, and restoration efforts, so that the total acreage of wetlands in the country does not decrease, but remains constant or increases. To achieve the objective of no net loss, the federal government utilizes several different environmental policy tools which legally protect wetlands, provide rules and regulations for citizens and corporations interacting with wetlands, and incentives for the preservation and conservation of wetlands. Given the public benefits provided by wetland ecosystem services, such as flood control, nutrient farming, habitat, water filtration, and recreational area, the estimation that over half the acreage of wetlands in the US has been lost within the last three centuries is of great concern to local, state, and federal agencies as well as the public interest they serve.

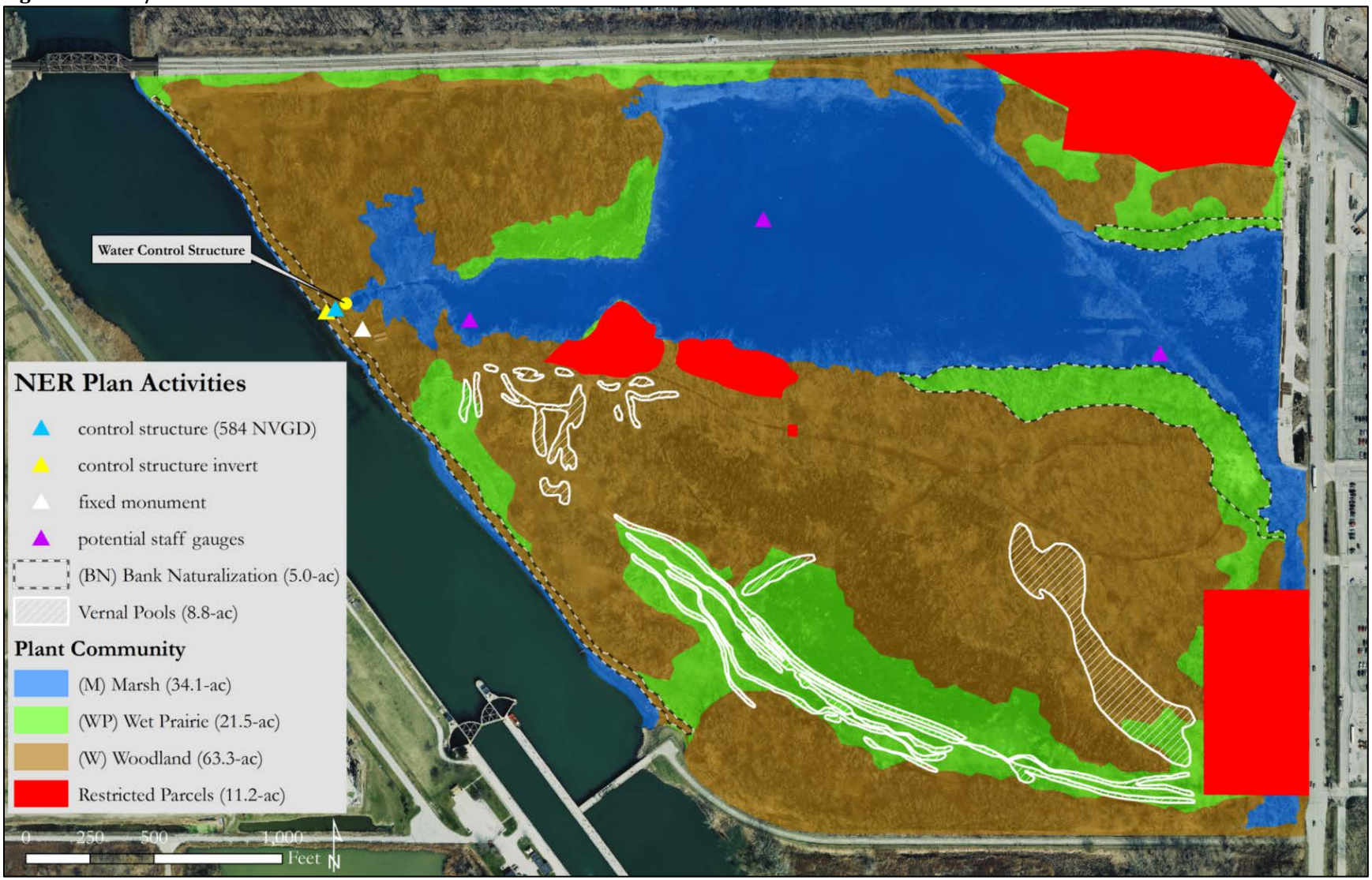
The first legal protection of wetlands came from President Jimmy Carter in 1977. He signed EO 11990 into law requiring Federal government agencies to take steps to avoid impacts to wetland when possible. Then, in 1989 President George H. W. Bush established the National policy of "no-net loss of wetlands". This set the groundwork to replace each newly impacted wetland with a replacement wetland of the same size and with similar wetland functions and values. Non-tidal wetland acres within the U.S. have actually increased in recent years; about 250,000 acres of forested wetlands were created or restored between 1998 and 2004 (USFWS). It was on Earth Day, 2004, that President George W. Bush announced that "no-net loss" had been accomplished nationally and that we had a net-gain of wetlands: more wetlands had been restored or created than were being destroyed in the US. He also announced a new policy beyond "no-net loss". That goal was to establish three million more acres of wetlands beyond those being lost. Following the lead of the previous three Presidents, Barack Obama has increased funding the North American Wetlands Conservation Act and has provided funding specifically to the Great Lakes for restoration via the Great Lakes Restoration Initiative funding.

Acceptability – Restoring marsh habitat is consistent with the Federal Objective, Laws, EOs, and concerns of state and local groups seeking to restore habitat for Migratory Birds within the Great Lakes route of the Mississippi Flyway.

Completeness Criteria – Eliminating the marsh component of this site would allow a void between the pond habitat and the riparian zones, eliminate the most important wetland feature for Migratory Waterfowl, and eliminate critical fish spawning habitat. Leaving the opportunity to restore marsh habitat off the table because it is slightly more expensive due to the extensive damage caused by past Federal Activities that led to degradation of the Hegewisch Marsh study area. Also, removing the Marsh would not be complete in terms of ceasing opportunities provided by GLRI, which the funds can only be used to restore habitat, address invasive species issues or remediate AOCs.

The plan that reasonably maximizes net National Ecosystem Restoration benefits and is consistent with the Federal objective, authorities and policies, is identified as the NER plan. This NER Plan is considered as the Preferred Plan for direct, indirect and cumulative effects assessment under NEPA in the following Chapter. The NER/Preferred Plan was determined to be Alternative 3 (**Figure 11 and Plate 3**).

Figure 11: NER/Preferred Plan



CHAPTER 5 – ENVIRONMENTAL ASSESSMENT

This chapter involves prediction of direct, indirect and cumulative environmental effects to current conditions stemming from implementation of the Preferred Plan/NER Plan.

5.1 Need and Purpose

Before the late 1800's, the Hegewisch Marsh area was a marshy ecosystem riparian to the Calumet River. Over a period of several decades, this ecosystem was severely altered by human activities. Currently, Hegewisch Marsh no longer provides a diversity of high quality habitats sufficient to maintain structure and support healthy plant and animal communities. Based on site inventory and characterization by the USACE, a set of Problems and Opportunities were developed by the study team, non-Federal Sponsors and supporting stakeholders. These drive the need for action, which is summarized as the historic loss of significant migratory bird, fish and wildlife habitats. The purpose of this feasibility study and integrated environmental assessment is to identify the most environmentally beneficial, cost effective and publicly supported habitat restoration project to restore wetland habitat.

5.2 Alternatives Considered

Section 4.1 provides discussion on the suite of measures that were developed to address study problems and meeting objectives. These measures that were processed through the IWR Planning Suite program to generate cost effective plans. The cost effective and incremental cost analysis takes implementation and real estate costs and ecosystem outputs into consideration. Ecosystem outputs were measured via the Floristic Quality Index (FQI). Three (3) alternative plans, including the No Action Plan, were deemed best case scenarios for project implementation. Alternative 3 was selected as the National Ecosystem Restoration (NER) Plan, which for the purposes of this Environmental Assessment is termed the Preferred Plan. Rationale for selecting the NER/Preferred Plan is presented in Section 4.6.

- Alternative Plan 1 – No Action
- Alternative Plan 2 – (BN) Bank Naturalization, (ER) Evapotranspiration Reduction, (WCS) Water Control Structure, (VPa) Vernal Pools, (W) Woodland, and (WPb) Wet Prairie
- Alternative Plan 3 – (BN) Bank Naturalization, (ER) Evapotranspiration Reduction, (WCS) Water Control Structure, (VPa) Vernal Pools, (W) Woodland, (WPb) Wet Prairie and (M) Marsh

5.3 The Affected Environment

A detailed description of the affected environment can be found in Chapter 2 – Study Area inventory and Forecasting. Based on data collection, analysis, and modeling conducted under this feasibility study and coordination with Federal, State and local governmental agencies and published studies by academia, it was determined that the physical, chemical and biological conditions of Hegewisch Marsh are in a state of habitat degradation. As a result, dominant species present at the site are tolerant to habitat loss, anthropogenic disturbance and poor water quality are present (synanthropic species). Slight improvements in water quality and some vegetation patches that have occurred are not enough for native plant and animal communities to reestablish, resulting in missing critical structural habitat components. The No Action Alternative conditions are synonymous with the Future Without-Project Conditions, which are presented in Section 2.6.

5.4 Direct and Indirect Effects of the Preferred Plan

In addition to the effects discussed in the following sections, a 404(b)(1) analysis is provided in **Appendix A**. This analysis further documents whether or not there are effects to the aquatic environment resulting from the construction activities of the preferred plan.

5.4.1 Physical Resources

Geology, Glacial Stratigraphy and Soils

Hegewisch Marsh lies over the Equality Formation and is situated within the Carmi Member and sandwiched between two fingers of the Dolton Member. Pebbly sand is the dominant material within the Hegewisch Marsh study area. Since the minor surficial grading would not disturb this geomorphic feature or displace glacial materials present, there would be no adverse effects resulting from implementation of the Preferred Plan/NER Plan. Geomorphic features and composition effects resulting from the implementation of the Preferred Plan/NER Plan are considered to be beneficial. If native soils are present onsite, they would be preserved through the planting of native vegetation throughout the park.

Water Quality

The Preferred Plan/NER Plan would have incidental water quality benefits through the removal of invasive plant species, especially those that greatly alter hydrology via evapotranspiration. The subsequent establishment of native marsh, wet prairie and woodland species would also provide moderate water quality improvements. Adverse effects to water quality stemming from construction activities are not anticipated.

Hazardous, Toxic and Radioactive Wastes

The Preferred Plan/NER Plan would not result in the release of or influence HTRW materials. Identified areas have been avoided via the plan formulation process and are detailed in Section 2.1. Minor earthwork will be limited to depths authorized by past remediation plans, which prevent contamination from being disturbed. If further negative determinations are made based on USACE policies and/or public review of this document, all earth disturbing actions would be eliminated from the plan.

Hydrology

Implementation of the Preferred Plan/NER Plan would result in minimized effects to local hydrology by manipulating geomorphology to expose subsurface hydrology for existing vernal pools and wet prairie patches. Since the Preferred Plan/NER Plan would be implemented in a fashion as to not manipulate widespread water levels and focus on manipulating geomorphology to the existing hydrology, no significant adverse affects resultant from implementing the Preferred Plan/NER Plan are expected.

5.4.2 Ecological Resources

Plant Communities

All plant communities that naturally once existed at the Hegewisch Marsh were destroyed during the construction of the Chicago Waterway System. Subsequent efforts have resulted in a low richness and abundance of native plant species within the habitats at Hegewisch Marsh. The Preferred Plan/NER Plan recommends the removal of hydrogeomorphic restorative measures, invasive/nonnative plants and

Eurasian species and the reestablishment of several different native plant communities. Based on this, there would be no adverse effects to plant communities within Hegewisch Marsh or the surrounding areas resulting from implementation of the Preferred Plan/NER Plan. Plant community effects resulting from the implementation of the Preferred Plan/NER Plan are considered to be beneficial.

Macroinvertebrates

There have been no studies of the existing macroinvertebrate population within Hegewisch Marsh; however the Preferred Plan/NER Plan promotes the success of macroinvertebrates by reestablishing native plant communities, preserving large woody debris in place along the banks of the lagoon and through the introduction of small stone outcroppings within the Lagoons (mudpuppy habitats). There are currently areas within Hegewisch Marsh which are planted with native plant species for butterfly habitat. Those areas will be supplemented with additional native seeds and plugs to further increase species richness and habitat structure. Based on this, there would be no adverse effects to aquatic or terrestrial macroinvertebrate communities within Hegewisch Marsh or the surrounding area resulting from implementation of the Preferred Plan/NER Plan. Macroinvertebrate effects resulting from the implementation of the Preferred Plan/NER Plan are considered to be beneficial.

Fishes

Currently, many native and non-native fishes occur within the Calumet River. The only measure that would directly affect fishes would be the side-stream marsh habitat restoration, which would convert a monotypic stand of common reed into a more species rich marsh shelf that would provide enhance spawning opportunity for certain fishes, such as Northern Pike, Sunfishes: Centrarchidae. Based on the changes to the side-stream marsh, no adverse long or short term effects to fish native fishes are expected to result from implementation of the Preferred Plan/NER Plan.

Reptiles & Amphibians

The Preferred Plan/NER Plan recommends minor grading to facilitate amphibian and reptile migration, and would restore hydrogeomorphic aspects of the existing vernal pools for amphibian reproduction. Based on this, there would be no adverse effects to reptile and amphibian communities within Hegewisch Marsh or the surrounding area resulting from implementation of the Preferred Plan/NER Plan. Reptile and amphibian community effects resulting from the implementation of the Preferred Plan/NER Plan are considered to be beneficial.

Birds

The Hegewisch Marsh study area is located within the Great Lakes portion of the Mississippi Flyway, which is nationally recognized as an important route for many migratory and resident birds. The Preferred Plan/NER Plan recommends the removal of invasive plant species and the establishment of native plants which provide habitat for organisms and plants that support migratory birds and in particular, water birds (herons, ducks, mergansers, grebes, etc). Coordination on bird habitat restoration features and activities are being coordinated with the Audubon Society Chicago. Coordination with the USFWS has established a window of no invasive species clearing between 01 March and 01 October. Removal of woody debris/deadfall would be extremely limited if deemed necessary. Based on this, there would be no adverse effects to migratory and residential birds within Hegewisch Marsh or the surrounding area resulting from implementation of the Preferred Plan/NER Plan. Bird species effects resulting from the implementation of the Preferred Plan/NER Plan are considered to be beneficial.

Mammals

Currently, only those mammal species indicative of urban life are present within the Hegewisch Marsh study area. Based on this, there would be no adverse effects to small or large mammals within Hegewisch Marsh resulting from implementation of the Preferred Plan/NER Plan. Mammal species effects resulting from the implementation of the Preferred Plan/NER Plan are considered to be beneficial, but minor.

Threatened and Endangered Species

Federal – Currently, there are no Federally Endangered or Threatened Species, or their critical habitats within the Hegewisch Marsh study area. Based on this, there would be no adverse effects to Federally Listed Species resulting from implementation of the Preferred Plan/NER Plan.

State – The Illinois Natural Heritage Database was queried on 11 June 2014 for important resource areas and State Listed Species. The EcoCAT Report IDNR project number 1412156 report shows the following protected sites are within the vicinity of the Hegewisch Marsh: 130th Street Marsh INAI Site and Lake Calumet INAI Site. The EcoCAT Report also provide occurrence of the following State Listed Species that are known to occur within the potential project site's vicinity: Banded Killifish (*Fundulus diaphanus*), Blanding's Turtle (*Emydoidea blandingii*), Black-Crowned Night Heron (*Nycticorax nycticorax*), Common Moorhen (*Gallinula chloropus*), Little Blue Heron (*Egretta caerulea*), Peregrine Falcon (*Falco peregrinus*), Yellow-Crowned Night Heron (*Nyctanassa violacea*), Yellow-Headed Blackbird and (*Xanthocephalus xanthocephalus*). EcoCAT Report 1412156 may be found in Appendix A. State Listed species not identified on the EcoCAT Report but are known to occur in the vicinity of Hegewisch Marsh include Iowa Darter (*Etheostoma exile*), Mudpuppy (*Necturus maculosus*), American Bittern (*Botaurus lentiginosus*), Black Tern (*Chlidonias niger*), Black-Billed Cuckoo (*Coccyzus erythropthalmus*), King Rail (*Rallus elegans*), Least Bittern (*Ixobrychus exilis*), Northern Harrier (*Circus cyaneus*), Osprey (*Pandion haliaetus*), and Snowy Egret (*Egretta thula*).

The USACE's intentions are to restore sustainable, native plant community. This is undertaken by ensuring hydrogeomorphic features are sufficient and that invasive plant species no longer have a dominating affect. The USACE provides specific language within the contracting documents to ensure observance and subsequent protection of both State and Federally listed species are adhered to. Based on this, there would be no adverse effects to state Threatened and Endangered Species within Hegewisch Marsh resulting from implementation of the Preferred Plan/NER Plan. Effects to State listed species resulting from the implementation of the Preferred Plan/NER Plan are considered to be beneficial.

5.4.3 Cultural Resources

Archaeological and Historical Properties

There are no properties in the vicinity of Hegewisch Marsh that are currently listed on the National Register of Historic Properties. Clearance has been provided by the Illinois Historic and Preservation Agency in a letter dated 17 April 2013. Native American groups having an historic cultural interest in northeast Illinois have been consulted (letter dated 09 April 2013).

Social Properties

The Hegewisch Marsh is located in a non-residential area primarily surrounded by the Chicago Ford Manufacturing Facility. The Preferred Plan/NER Plan will not have any adverse impacts on the area's

social properties. Aesthetic and open space improvements resulting from implementation of the Preferred Plan/NER Plan may positive effects on adjacent parks and neighborhoods.

Recreational Activities

The Preferred Plan/NER Plan would have no adverse, long term effects on recreational activities at Hegewisch Marsh. Short term impediments to passive recreational activities will occur during first and second years of construction. After all physical restoration features are implement after the second year, portions of the park would be open to the public for recreation once again.

5.4.4 17 Points of Environmental Quality

The 17 points are defined by Section 122 of the Rivers, Harbors and 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 to remove invasive species or employ minor topographic grading.

Displacement of People – None of the alternative plans will displace any people.

Aesthetic Values – Currently, portions of Hegewisch Marsh are aesthetically unpleasing due to the overgrowth of invasive plants causing woodlands to be choked out and erosion on the banks of Hegewisch Marsh lagoon, therefore; only benefits in aesthetic values are expected by all alternative plans.

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 potentially 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 have the potential to increase surrounding land values since the aesthetics would improve due to project restoration measures.

Public Facilities – Any of the alternative plans would not adversely affect public facilities within the study area.

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 Plan allows for the Hegewisch Marsh ecosystem to remain degraded. The Preferred Plan/NER Plan would have improve natural resources such as fish, wildlife, migratory birds, water quality, natural food production, fishing, bird watching, paddling, etc.

Air Quality – The local air quality in Chicago and Cook County are considered 'non-attainment' under the Clean Air Act for ozone, particulates (PM-10 and PM-2.5), and lead. The project is within the non-attainment zone. Once implemented, the project itself will be neutral in terms of air quality, with no features that either emit or sequester air pollutants to a large degree. During the project construction, heavy equipment would cause minor, temporary air quality impacts, however all equipment will be in compliance with current air quality control requirements for diesel exhaust, fuels, and similar requirements. A general conformity analysis was not conducted due to the short and temporary nature of any air quality impacts.

Water Quality – As discussed previously, any of the alternative plans would not adversely affect water quality. The Preferred Plan/NER Plan would incidentally improve water quality by providing native aquatic macrophytes which would increase and stabilize dissolved oxygen levels and reduce nutrients within the water column of the marsh.

5.5 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 the 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.

5.5.1 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 was 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. The analysis will include Hegewisch Marsh and a 1.5 mile radius around the project site.

Three temporal boundaries were considered:

- Past – mid to late1800s because this is the approximate time that the landscape developed for agricultural and industrial use
- Present – 2014 when the decision is being made on the most beneficial ecological restoration.
- Future – 2064, 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 project area. In this case, reasonably foreseeable future actions include:

- Further improvements in water quality due to large-scale projects, small BMPs and education
- Further improvements in aquatic and riparian habitat in and along the Lake Michigan system
- Further improvements in connectivity between Lake Michigan system habitats

5.5.2 Cumulative Effects on Resources

The plan formulation process took into account existing and planned projects, studies and known ecological restoration projects in the study area. Existing Projects were identified in Section 1.5.2 that have the potential for affecting or being affected by a potential Hegewisch Marsh restoration project. Prior studies and reports, listed in Section 1.5 were reviewed to ensure that the modeled conditions are the best possible representation of actual conditions. The Technical Recognition Section also takes existing and future habitat restoration projects into consideration for assessing project effects. Finally, the study team also worked with Federal, State and local agencies to coordinate ongoing planning to address local environmental and infrastructure issues.

<u>Physical Resources</u>

The past has brought alteration to the physical resources of the Hegewisch Marsh study area. Geology, soils, topography, hydrology, and fluvial geomorphology have all been modified or obliterated to suit man's needs. As a result, geomorphology and hydrology are impacted due to site specific and watershed-scale alterations, as well as daily activities such as road salting, municipal discharge, and the human impacts on areas of the park not purposed for recreation. It is reasonably foreseeable that small projects within the Calumet River system for ecological restoration purposes would occur. Best management practices and water reclamation systems are not numerous and big enough to cause significant detrimental effects from sewer waters into the Calumet River system at this point, but could possibly be in the future as technology advances. Given the past, current and future condition of the coastal Lake Michigan system, the implementation of ecosystem restoration and infrastructure projects would be minor terms of the vast array and quantity of adverse effects caused by development; however, they are important in terms of beginning to address all the human induced problems the watershed suffers. There are no irrecoverable loss of resources identified in terms of geology, soils, substrates, topography, hydrology, water quality and fluvial geomorphology due to implementation of the Preferred Plan/NER Plan.

Cumulative beneficial effects to the Calumet River system are anticipated in terms of soils, substrates, hydrology, hydraulics, and water quality.

Ecological Resources

The ecology along the Calumet River has had significant impacts as a result of previous physical resource alterations. The watershed was once a diverse mosaic of marsh, prairie, savanna, woodland, and glacial ponds that had a steady and dependable hydrology. Extreme landscape modification has caused most of the natural land use to be converted into concrete. It is estimated that only about 2 percent of the remaining 14 percent of open space in Illinois is considered high quality ecosystem, and that this 2 percent also suffers from fragmentation. No longer is there a natural landscape to provide enough natural lands for fish and wildlife habitat or to attenuate large rainfall events. Considering these past, current and future conditions of the watershed, the implementation of the Preferred Plan/NER Plan within Hegewisch Marsh is minor in terms of the vast array and quantity of significant effects caused by industry and urbanization; however, it is instrumental in beginning to address the human induced problems the watershed suffers. Therefore, there are no irrecoverable losses of resources identified in terms of plant, insect, fish, amphibian, reptile, bird, and mammal taxa or to their habitats they occupy due to implementation of the Preferred Plan/NER Plan. Cumulative beneficial effects to the coastal Lake Michigan system are anticipated in terms of fish and wildlife and their preferred habitats.

Cultural and Historic Resources

There are no properties in the vicinity of Hegewisch Marsh that are currently listed on the National Register of Historic Properties., therefore, negative effects expected to archaeological or cultural resources resulting from implementation of the Preferred Plan/NER Plan are not expected. Coordination with the Illinois Historic Preservation Agency (IHPA) will continue through the design and implementation phase.

Cumulative Effects Summary

The cumulative effects of the Preferred Plan/NER Plan are considered to be beneficial and environmentally important, but not significant from the cumulative/watershed effects perspective. The environment and its human community are expected to benefit from replacing unsightly and overgrown non-native plant communities with rich and abundant native plant communities.

5.6 Compliance with Environmental Statutes

The Preferred Plan 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; EO 12898 (environmental justice); EO 11990 (protection of wetlands); EO 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. There were no adverse environmental effects identified which cannot be avoided should the proposal be implemented [1502.16 (102(2)(C)(ii))]. This proposal reverses some of the adverse affects of how man's local and short-term uses of the environment, while maintenance and restoring the long term productivity of a portion of Lake Michigan's coastal zone [1502.16 (102(2)(C)(iv))]. There have been no irreversible and irretrievable commitments of resources identified resulting from the proposed action should it be implemented [1502.16 (102(2)(C)(v))]. The proposed project supports land-use plans identified in the South Lakefront Framework Plan, Phase 2 Hegewisch Marsh and South Shore Cultural Center in terms of natural area restoration [NEPA 1502.16].

Energy Requirements & Natural or Depleteable Resources

The only energy requirements to sustain this project would be the power of the sun, wind and animals. The sun will keep the hemi-marsh at the specified elevations to maximize hemi-marsh productivity by running the small pump as described in Section 4.1 (WCS) Water Control Structure. Also, the sun is imperative for plant growth. Wind and animal power is needed to distribute native plant seeds in the late fall and through the winter months. Temporary use of fossil fuel burning vehicles would be used in the first two years of construction on an intermittent basis to grade surficial soils, remove weeds, place habitat features and plant native seeds and plugs. Since long term energy requirements to sustain this project are highly sustainable in the sun, wind and creature, it is expected there would be no irrecoverable loss to energy resources resulting from implementation of the Preferred/NER Plan.

Environmental Justice

EO 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 Hegewisch Marsh is located in a non-residential area primarily surrounded by the Chicago Ford Manufacturing Facility and other industrial land uses; however, the area is identified by the USEPA's EJMapper as being a low income, minority area. Primary residential areas that would utilize Hegewisch Marsh include the Chicago neighborhoods of South Chicago, Eastside, Hegewisch, and South Deering and the municipalities of Calumet City and Burnham, IL.

Clean Air Act

The local air quality in Chicago and Cook County are considered 'non-attainment' under the Clean Air Act for ozone, particulates (PM-10 and PM-2.5), and lead. The project is within the non-attainment zone. Once implemented, the project itself will be neutral in terms of air quality, with no features that either emit or sequester air pollutants to a large degree. During the project construction, heavy equipment would cause minor, temporary air quality impacts, however all equipment will be in compliance with current air quality control requirements for diesel exhaust, fuels, and similar requirements. A general conformity analysis was not conducted due to the short and temporary nature of any air quality impacts.

Section 401 of the Clean Water Act

A Section 404(b)(1) analysis was completed for the preferred plan and is located in Appendix A. Features addressed by the 404 include stone and woody debris placement for fish habitat and minor grading for wetland restoration purposes. No adverse effects were determined. Since project activities under the jurisdiction of Section 401 are very limited and are all restorative in terms of aquatic ecosystem and water quality, Section 401 Water Certification is already granted via Regional Permit 5 as this project fits all of the requirements. A courtesy copy of the NEPA Document, 401 Certification Application and 404(b)(1) Analysis will be provided to the ILEPA for their records and comment opportunity.

USFWS Coordination

Coordination with the USFWS commenced with a project scoping letter dated 09 April 2013. This environmental assessment identified the NER/Preferred Plan to have "no effects" on federally endangered species or their habitats as determined by following the protocol and guidelines provided by Region 3 Fish & Wildlife Service (http://www.fws.gov/midwest/endangered/section7/index.html); which precludes the need for further consultation under Section 7. Coordination under the FWCA of the NER/Preferred Plan was completed during the Agency and public review period. Once the USFWS reviews the document during the 30-day Agency Review period, it is anticipated that a stamp of "No Objection" would be provided, concurring that the habitat restored would be valuable to migratory and residential birds. A "No Invasive Species Clearing" window between 01 March and 01 October would be established via coordination with the USFWS and the local birding community to protect migratory birds. The USACE recommends a fish spawning window between 01 March and 01 July.

State of Illinois Natural Resources Coordination

Coordination with the ILDNR commenced with a project scoping letter dated 09 April 2013. Resulting from the 30-day Agency Review period, the Illinois DNR has provided a letter of concurrence dated ____ that "no effects" to State Listed species would result from restoring native plant communities at the Hegewisch Marsh.

Coastal Zone Management, Illinois

Consistency was determined by the Illinois Coastal Zone Management Program in a letter dated 25 April 2013.

State of Illinois Historic Preservation Act

Coordination with the Illinois Historic Preservation Agency (IHPA) commenced with a project scoping letter dated 09 April 2013. In a letter 17 April 2013, the IHPA informed USACE that no historic properties are affected by the NER/Preferred Plan.

5.7 Draft Finding of No Significant Impact (FONSI)

The draft Finding of No Significant Impact (FONSI) maybe found in Appendix A. An Environmental Assessment was completed for the proposed habitat restoration Hegewisch Marsh, Chicago, Illinois. The Environmental Assessment has found that there would be no adverse effects resulting from implementation of the Preferred Plan/NER Plan. A 30-day Agency and Public Review period was held from 02 May 2017 to 02 June 2017. All pertinent comments received were incorporated document. The Final NEPA document and supporting appendices were placed on the Chicago District's Civil Works webpage for maximum distribution. The FONSI will be updated with accurate dates and Agency responses after the 30-day Agency and Public Review.

CHAPTER 6 – PLAN IMPLEMENTATION

This chapter outlines details for implementing the Preferred Plan/NER Plan. Plan implementation details include sequencing, environmental assessment findings, mitigation requirements, permit requirements, agency and stakeholder views, project schedule, total project costs and cost sharing requirements.

6.1 Project Authorization

Study and implementation authorization by Congress is provided by the Great Lakes Fishery and Ecosystem Restoration (Section 506 WRDA 2000, as amended). Following completion and approval of this feasibility study, USACE implementing guidance allows the Chicago District to enter into a Project Partnership Agreement for completing design, plans and specifications, construction and subsequent monitoring.

6.2 NER Plan Implementation and Sequencing

Alternative 3 was selected as the National Ecosystem Restoration (NER) Plan, which for the purposes of this Environmental Assessment is termed the Preferred Plan. Rationale for selecting the NER/Preferred Plan is presented in Section 4.6. Alternative Plan 3 consists of the following measures presented in Section 4.1: (BN) Bank Naturalization, (ER) Evapotranspiration Reduction, (WCS) Water Control Structure, (VPa) Vernal Pools, (W) Woodland, (WPb) Wet Prairie and (M) Marsh

The implementation of all of these measures would restore riverine fish habitat, side-stream marsh, hemi-marsh, wet prairie, wet woodland and vernal pool, all of which are riparian to the Calumet River. The implementation of these features is generally described as follows and according to the measures descriptions in Section 4.1. More detail would be added to the plan should this project commence to the design and implementation phase, for example, specifying spatial distribution of native plugs within a given zone and species clumping, planting centers, soil amendment percentages, temporary predator controls, and establishment activities. General construction activities and sequencing would include:

(1) Site Preparation – The first task would be to install safety fencing, signage 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. Instructive signage for workers would be set up as well to signify off limit work areas and site restrictions. The following are recommendations and guidelines to be implemented resulting from the HTRW and Phased ESA analyses and fully discussed in Appendix E:

a) The first is that additional sampling is required in Zone B to determine the western and eastern boundary of lead contamination above the Tier 3 human health risk remedial objective. This is the only area requiring additional sampling.

b) Restoration efforts to restore habitat and increase species diversity and abundance through minor soil grading and plantings can be conducted without imposing unnecessary ecological risk. The maximum soil disturbance must be limited to within one-foot of existing grade to reduce the potential human health or ecological risks associated with significant earthwork and/or grade changes at the site.

c) All excavated materials must be reused on-site.

d) In addition, measures to prevent erosion and prevent migration of materials off-site should be implemented during construction, including dust control practices, soil erosion and sediment

controls and site-specific storm water pollution prevention plan (SWPPP) to include silt fence, gravel ingress/egress, tire washing, and other BMPs as necessary. Contract shall require construction of geotextile lined gravel lay down areas for contractor staging and storage.

e) The Phase I ESA also recommends that the Chicago Park District design and install natural barriers in Zones A and B to discourage site users from entering those portion of the site in accordance with IEPA recommendations. The Phase I ESA also recommended that the Park District implement enforcement measures to prevent future fly dumping on-site.

(2) Invasive Species Eradication – All invasive plant species would be physically and if need be, chemically eradicated from the planting zones. A "No Invasive Species Clearing" window between 01 March and 01 October was established via verbal coordination with the USFWS and the local birding community. All woody invasive species removed too small for snag habitat would be chipped into small pieces and spread over areas within Hegewisch Marsh. Based on lessons learned from Chicago District restoration projects, the addition of these wood chips greatly aids in starting a plant community from scratch and saves money by avoiding hauling and disposal costs and is environmentally preferred over burning the material, especially in mixed soil conditions.

(3) Geomorphic Contouring – Once targeted woody and invasive species are removed, bank and vernal pool would be graded to provide a suitable hydrology and micro topography for establishing native plant species. These areas will be contoured and all excess soils will be incorporated into the landscape within Hegewisch Marsh project site. Grading activities would be limited to less than 12 inches below surface grades to avoid past remediation, most of which can be accomplished by hand raking or small push tillers. Graded areas will be planted with seeds, plugs or shrubs and immediately stabilized to prevent erosion according to the plant community the work falls within. Large stones and woody debris gathered from the site would be placed on the side-stream marsh's toe within the Calumet River during this step as well. Organic leaf litter compost and wood chips would be spread as needed within the plant community zones.

(4) Water Level Management – The purpose of the water level management plan is to support one of the primary goals of the Hegewisch Marsh restoration project, i.e. to establish and maintain a hemi-marsh appropriate for wetland-dependent birds within a wetland historically supporting these species. Hemi-marsh is a type of wetland characterized by an interspersed mixture of emergent vegetation and open water, ideally approaching a ratio of 1:1 or approximately 50% emergent vegetation and 50% open water. This mix is found across the intersecting range of depths where emergent vegetation and open water occur together, typically over a foot in depth out to three or more feet in depth. Emergent vegetation tends to dominate in shallower water, and eventually gives way to more open water as depth increases. Therefore, our water management goal is to determine the range of depths that will maximize the extent of hemi-marsh development and implement a water level management strategy that will facilitate the establishment and long-term maintenance of hemi-marsh emergent vegetation in a 1:1 ratio with open water.

The water level management strategy will consist of three components: vegetation establishment, marsh maintenance, and adaptive management. The establishment phase will be implemented in coordination with or by the contractor/party responsible for the initial planting and establishment of vegetation. Water levels will be initially low to facilitate initial planting and/or the germination of seed, then brought up at a rate to promote establishment across the full range of depths. Normal maintenance will require that a growing season depth or depth range be determined that can be maintained with the equipment on hand (drop box and solar-powered pump), and will result in sufficient hemi-marsh habitat to meet project goals. A mean summer or growing season water level of 583 feet NAVD88 will result in 31 surface acres of water, and maximize the extent of hemi-marsh to 20 acres across a depth range of one to three feet. Emergent marsh will dominate the 7 acres from the wetland edge out to one foot in depth, and open water

will dominate the 4 acres of marsh exceeding three feet in depth. A shallower summer mean will result in significantly less hemi-marsh area, while a deeper summer mean will not allow sufficient seasonal or annual variation as the maximum depth will top out at approximately 584 feet NAVD88.

(5) Native Plant Community Establishment – Next would be to establish native plant communities of side-stream marsh, hemi-marsh, wet prairie, wet woodland with interspersed vernal pools over the remainder of the construction period. Planting lists are presented as Future With-Project Planting Lists located in Appendix A. Zones would be seeded and planted with seed and live plugs. Live plug areas will require predatory control, primarily stringing and caging to prevent Canada Goose and Common Carp predation. Again, the duration of the construction contract would primarily be for spot herbicide application and additional planting; most activities similar to home gardening activities.

(5) BMPs – Soil erosion and sediment control measures will be designed during design phase and will comply with local and federal environmental requirements. The minimum measures required at the project site may include:

- Hydroseeding, seeding, and mulching to stabilize disturbed areas
- Installation of silt fences around graded slopes and stockpile areas
- Protection of the ponds where grading occurs with silt fencing prevent sediments from traveling into the ponds
- Stabilizing construction entrances to limit soil disturbance at the ingress/egress from the site
- Installing erosion blanket over unprotected finished grades that are to be unplanted for at least two weeks

Recreational Features – Components of recreation are not proposed under this project.

6.3 Real Estate Considerations

This Real Estate Plan Appendix E was prepared in support of the AFB-level feasibility study of the Hegewisch Marsh ecosystem restoration study. The Real Estate Plan identifies and describes the area proposed for construction, operation and maintenance of the Project, in addition to the real estate requirements and procedures for implementation of a recommended Plan.

Non-Federal Sponsor Lands – CPD is the fee simple owner of the majority of the land required, 88.7 acres. MWRD owns 14.56 acres of the project area and is not anticipated to be a non-federal sponsor. CPD currently maintains the land through a long term recreation lease. In order to be included in the project and protect the federal investment CPD will be required to acquire fee simple interest in the property. If CPD is unwilling or unable to acquire fee simple interest a lesser estate may be considered or the area will be removed from the project. 0.57 acres is owned by USACE for the T.J. O'Brien Lock and Controlling Works. It is anticipated CPD would enter in to a long term recreation lease or license agreement in order to maintain the improved area.

Non-Standard Estates – There are none for this study.

LERRDs Crediting – Currently crediting amount is estimated to be [redacted].

6.4 Permit Requirements

The following required permits are anticipated and will be obtained prior to implementation of plan components:

- 401 Water Quality Certification (Certified with Region 5 Permit)
- National Pollutant Discharge Elimination System (NPDES) General Permit (327 IAC 15) – Illinois Environmental Protection Agency
- Illinois Coastal Management Plan Consistency Determination (25 April 2013)

6.5 Monitoring Plan

Ecosystem restoration monitoring plans, activities, results and cost sharing are governed by 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.

Component 1 – Structural Sustainability

This component covers the structural sustainability of the implemented features. It is a qualitative assessment of whether each feature is retaining its physical character and project purpose. The most important information derived from this component would be to determine if adaptive management measures are needed or not. This monitoring would take place once every other year for 10-years. Structural components are currently broken down into the following:

1) Contoured banks and fish habitat of the Calumet River
2) Newly created vernal pools
3) Plant community reestablishment
   a) Hemi-marsh
   b) Wet Prairie
   c) Woodland

Visual observations during site visits will be used to determine if structural integrity and sustainability exist within the project. Based on said site visits, adaptive management protocols may be initiated.

Component 2 – Biological Response

These monitoring events would occur every other year during a 10-year monitoring period.

Plant Communities

Evaluation of plant community zones would be accomplished using the Floristic Quality Assessment Index (FQA) and native plant richness, as described in the 2.5 Plant Communities Assessment. In short, the FQA is a measure of overall environmental quality based 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 should 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 restorations and ongoing monitoring. Success criteria for this parameter would be achieving FQI scores or greater, as predicted under this study:

Description	**Habitat Types**	**Acres**	**FQI**
NER Plan	Marsh	34.1	34.0
NER Plan	Wet Prairie	21.5	33.2
NER Plan	Woodland	63.3	40.9

Fish Community

The monitoring for this community will be implemented by the Chicago District, USACE. The success criteria for fish communities will be a species richness and abundance counts and observations if fish are spawning or not. This habitat would be sampled prior to construction to establish a baseline.
In general, surveys will be conducted in summer/early fall during the course of the monitoring period. Transects will be laid out to include all habitats and restoration measures. Fishes would be collected via 15 minute runs of boat electrofishing along each transect, identified to species, enumerated, weighed and measured. Fish community monitoring would be in the Calumet River along the site's bank, which is included in the project boundary. The sidestream marsh, woody debris, and stone habitat area is depicted on Figure 11: NER/Preferred Plan as the long blue strip in the Calumet River extending from the 130th street bridge to the O'Brien Lock & Dam Controlling works.

Amphibian Community

Monitoring amphibian populations would be coupled with other monitoring activities and would note the presence or absence of amphibian species. Vernal pools are important reproduction habitat for certain amphibians and reptiles. Vernal pools would be frequently investigated to document the success of amphibian and reptile species utilizing them for reproduction. Success criteria would be that the vernal pools are providing reproduction and foraging habitat for various species of amphibians, most importantly Tiger and Bluespotted Salamander which have been observed from the site.

Supporting Data

During community assessments, air, water and soils parameters would be measured if appropriate to the given community. These include but are not limited to: temperature, pH, conductivity, DO, turbidity, carbon, nitrogen, and phosphorus.

Component 3 – Planning Goal & Objectives

The goal of this proposed project is to restore native wetlands and create a more complex ecosystem to benefit fish, amphibians, reptiles, mammals, and migratory birds. Planning objectives for this study are as follows:

- Objective 1 – Reestablish Hydrogeomorphology to Support Natural Communities
- Objective 2 – Eradicate Invasive Species from All Plant Communities

These objectives would be assessed the same way as the FWOP and FWP project benefits were modeled as described in the Main Report, Section 2.5 – Habitat Quality Forecasting. The modeling would be completed as described in Section 2.5 – Plant Community Assessment and Monitoring Component 2, Biological Response, Plant Communities. If the following specific success criteria are not achieved, the non-Federal sponsor would need to implement necessary measures to bring the quality of these plant communities up to the functional levels expected from restoration activities:

Description	**Habitat Types**	**Acres**	**AAHSI***	**AAHUs**	**NAAHUs**
Action / FWP	Marsh	34.1	34.0	1160.9	910.3
	Wet Prairie	21.5	33.2	713.3	390.8
	Woodland	63.3	40.9	2588.6	1620.2

*FQI of the Floristic Quality Assessment

Monitoring Responsibilities

The US Army Corps of Engineers will currently be responsible for implementing all three Monitoring Components as described above.

Schedule of Costs

Table 8: Monitoring Schedule and Costs

[redacted]

Adaptive Management

Adaptive management will be a critical component to the long-term management and health of the hemi-marsh. Summer water levels should be lowered in dry years and allowed to remain higher in wet years, a pattern that will also promote all wetland communities associated with the marsh, e.g. the shoreline marsh and adjacent wet meadows. Since the water levels are not entirely dependent upon seasonal weather trends, they may be manipulated to achieve management goals. For example, if muskrats are decreasing cattail cover to the point that hemi-marsh characteristics are being lost (i.e., the balance of cover is shifting strongly towards open water), water levels can be lowered to promote cattail germination and re-establishment. If submersed or emergent vegetation is being lost to common carp, the carp can be eliminated following a drawdown, which will also re-start the marsh vegetative communities. It is important to understand that these systems are dynamic by their very nature and are naturally characterized by changing conditions. If they are held in a static condition, they will eventually stagnate and degenerate. From the perspective of adaptive management, the water level management strategy should allow or even impose variation in water levels as a tool to nudge the hemi-marsh in one direction or another to maintain an interspersed, 1:1 mixture of emergent vegetation and open water, coupled periodically with stronger management actions (such as complete drawdowns) to maintain the hemi-

marsh. The key element to success will be an ability to monitor conditions within the marsh in order to respond appropriately.

6.6 Operation & Maintenance

A detailed O&M Manual containing all the duties will be provided to the non-Federal sponsor after construction is closed out. The O&M for Chicago District ecosystem projects are practical and minimal due to initial project design efforts and design targets for sustainability. Mostly if not all of the O&M activities are no different than the specific activities that would take place during construction. The O&M described here is not the same as the Adaptive Management measures described in the previous section. The O&M costs of the project are estimated to an average annual cost of [redacted] with a 3.75% interest rate over 50 years. The following are currently known operation and maintenance activities that the non-Federal Sponsor would undertake.

Invasive Plant Species Control – The maintenance activity is probably the most important to conduct. Staying ahead of the weeds goes a long way in avoiding large scale herbicide or physical eradication and replanting efforts. Three work days a year by a qualified entity would be able to keep weeds from invading the Hegewisch Marsh ecosystem since the acres are so small. Most problematic areas will be the bank transition and emergent marsh zones. Species such as white and yellow sweet clover, cut-leaved teasel, reed canary grass, common reed, buckthorn, honeysuckle, tree of heaven.

Native Plant Community Maintenance – It will be required to maintain the species richness, abundance and structure of the restored plant communities within Hegewisch Marsh. Invasive plant species are not the only threat to plant community degradation. Aside from minor re-plantings, it will be important to continue to protect plant communities from external changes by man's daily activities, whether single incidents or chronic stressors. These can cause plant communities to experience significant species richness declines even to the point of becoming monotypic stands. The best operational measure to quickly identify and rectify external stressors is vigilance. Routine inspections by the non-Federal sponsor's qualified stewards are imperative to notice adverse change quickly. The long term monitoring plan provided above will not catch quick change as would routine inspection by site stewards.

Water Control Structure Operation – The function of the water control structure will be critical to maintain hydrology and hydro-periodicity of the hemi-marsh. The Chicago Park District already manages and maintains this structure; therefore this activity would be easily accomplished.

6.7 Implementation of Environmental Operating Principles

In assessing the environmental effects, USACE implemented the following Environmental Operating Principles (EOPs)[1] as part of this Feasibility Study. The October 2013 Memorandum from the Chief of Engineers, LTG Thomas P. Bostick,on the Reissuance of the US Army Corps of Engineers EOPs states that "The Corps level of environmental commitment must expand and intensify". LTG Bostick also states that "I fully support greater transparency and enhanced consideration of minority populations and low-income populations in Corps decision making." Finally, LTG Bostick states that "I am holding my senior leaders accountable to support the intent of these principles."

[1] USACE. Environmental Operating Principles.
https://eko.usace.army.mil/usacecop/environmental/eop/

Foster sustainability as a way of life throughout the organization.

Plans to restore native plant and fauna communities to Hegewisch Marsh will be easily sustainable due to the careful selection of appropriate native plant communities according to site hydrology. Also, the T.J. O'Brien Controlling Works property that is owned and maintained by the USACE is adjacent to and has a small portion of the lands as part of the Hegewisch Marsh 506 study. The condition of these USACE owned and maintained lands are currently out of compliance with this EOP based on the existing abundance of invasive plant species, primarily Common Reed (*Phragmites communis*). Partnering on this cost shared project would fulfill this EOP in terms of both sustainability and USACE policies on invasive species. Additionally, the proposed work would be maintained in perpetuity by the CPD.

Proactively consider environmental consequences of all Corps activities and act accordingly.

The study team considered environmental consequences of proposed restoration features and construction activities. Cumulative effects assessment was completed to ensure all things were considered. Participation from Federal, state and local agencies and stakeholders were also held to ensure the most environmentally beneficial project. It is apparent from historical documents that the Hegewisch Marsh was utilized by the USACE for disposal of dredged materials during the construction of the T.J. O'Brien Controlling Works and the operation and maintenance of the Calumet River navigation channel (Kowlenko & Bilotti 1997, page 68). Based on the USACE's past contributions to the degradation of this natural area, it is prudent to provide assistance in restoring the site to its fullest ecological potential. Partnering on this cost shared project would fulfill this EOP in terms of helping abate past degradation caused by the USACE.

Create mutually supporting economic and environmentally sustainable solutions.

The study team formulated potential restoration plans to determine what the most cost-effective solution for ecosystem restoration is; however, appropriate engineering studies and biological assessments were performed to ensure that an implemented plan would be sustainable. Chicago District ecosystem designs left off where the CPD had concluded their remediation of the site, and base establishment of native plant communities appropriately to avoid conflicts between abiotic factors and biological requirements.

Continue to meet our corporate responsibility and accountability under the law for activities undertaken by the Corps which may impact human and natural environments.

This project is exemplary for meeting USACE corporate responsibility and accountability. HTRW analyses were completed and reviewed to ensure construction activities would not result in an unlawful release of contamination (Appendix D). The Laws, Compliance Statues and Executive Orders support the NER plan, which are discussed in the Federal Objective, Institutional Significance of the NER Plan and Compliance. It is apparent from historical documents that the Hegewisch Marsh was utilized by the USACE for disposal of dredged materials during the construction of the T.J. O'Brien Controlling Works and the operation and maintenance of the Calumet River navigation channel (Kowlenko & Bilotti 1997, page 68). Based on the USACE's past contributions to the degradation of this natural area via the placement of contaminated sediments, it is prudent to provide assistance in restoring the site to its fullest ecological potential. Partnering on this cost shared project would fulfill this EOP in terms of helping abate past impact to both the human and natural environment caused in part by the USACE.

Consider the environment in employing a risk management and systems approach throughout life cycles of projects and programs.

Planning Guidance (ER1110-2-100) and Civil Works Guidance for HTRW (ER1165-2-132) include guidance related to the presence of HTRW within the footprint of a proposed Civil Works Project. The PGN notes that : "the Corps will not participate in clean up of materials regulated by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) or by the Resource Conservation and Recovery Act (RCRA)." (ER1110-2-100, Para 2-4(p). The Civil Works HTRW Guidance (ER1165-2-132, paragraph 8a) directs that "Alternative project plans may consider avoidance of HTRW as well as possible responses. At least one alternative plan should be formulated to avoid HTRW sites to the maximum extent possible, consistent with project objectives (emphasis added)." ER1165-2-132 also notes that if a site has been remediated, this information should be considered (paragraph 11c).

In accordance with the planning guidance (ER1110-2-100) and HTRW guidance (ER1165-2-132), and the tenets of SMART Planning, the PDT conducted an analysis of baseline conditions, which included identifying risks associated with elements of the project area, and evaluating the significance of those risks. Significant risk can be associated with the presence of regulated materials within the project lands as noted in HTRW Guidance (ER1165-2-132). LRC OC developed a Supplemental HTRW Issue Paper which summarized the work that had been completed for the Hegewisch Marsh. The Issue Paper concluded that due to the prior voluntary remediation activities, clean-up activities and deed restrictions, the risk of CERCLA liability is low.

Based on site history, contamination, filling and HTRW Analysis and recommendations, the following guidelines were followed in order to employing a risk management and systems approach

- Zone A – No USACE restoration activities were pursued for this zone. Removed from study area.
- Zone B –No USACE restoration activities were pursued for this zone. Removed from study area.

- Zone C – No USACE restoration activities were pursued for this zone. Removed from study area.
- Zone D – Project study areas includes all acres outside of Zones A, B, C and Truss Staging Area. Zone D contains reduced levels of contamination that suggest habitat restoration would increase species diversity and abundance at the site; where minor grading through surficial soil disturbance and plantings can be conducted without imposing unnecessary ecological risk in accordance with the Calumet Ecotox Protocol. The Ecotox Protocol is a framework established by Federal, State, and Local agencies for investigation ecotoxicological risks and defining standard for rehabilitation that address ecological health within the Calumet area. USACE formulation of ecosystem restoration measures would be restricted to less than 1-foot deep of earth disturbance if grading techniques are required to achieve appropriate hydrogeomorphology.
- Truss Storage Area: No USACE restoration activities were pursued for this zone. Removed from study area.

This plan formulation process shows that this EOP was employed to the greatest extent possible.

Leverage scientific, economic, and social knowledge to understand the environmental context and effects of Corps actions in a collaborative manner.

This Feasibility Study was conducted in a manner that leveraged scientific knowledge provided by the US Environmental Protection Agency, Illinois Department of Natural Resources, Illinois Environmental Protection Agency, V3 Consulting, and the Wetlands Initiative and previously constructed Chicago District ecosystem restoration projects. The study team also meet with governmental agencies, local industry, and environmental interest groups to gather scientific, economic and social information that pertains to the Hegewisch Marsh study area.

Employ an open, transparent process that respects views of individuals and groups interested in Corps activities.

This study process and subsequent Feasibility Report was drafted in a manner that has reduced redundancies, excessive and inconsequential information, and confusing engineering and policy discussions. Presentation of this study was done in a clear sequential order to show what the natural condition of Hegewisch Marsh was historically, what the existing conditions are now, what they would be if left alone, what could be done, and what should be done based on considerations of ecosystem improvement and associated costs. Due to the Hegewisch Marsh study site being located within an USEPA designated Environmental Justice zone, consideration of low-income and minority population's opportunity to have high quality recreational areas needs to be taken into consideration. Partnering on this cost shared project would fulfill this EOP in terms of providing high quality natural open space for passive recreational activities.

6.8 NEPA Compliance

The President's Council on Environmental Quality guides public participation opportunities with respect to Feasibility Reports and Environmental Assessments, Engineering Regulations, and procedures for implementing NEPA. The Hegewisch Marsh ecosystem restoration plan was determined to be in compliance with NEPA and all other appropriate statutes, executive orders and memoranda (Section 5.6 Compliance with Environmental Statutes). Coordination and compliance for this feasibility study and integrated environmental assessment included comprehensive public involvement, agency coordination, and review of and has included compliance with applicable Federal statues per the USACE Engineering Regulation 1105-2-100, Planning Guidance Notebook.

6.8.1 Mitigation Requirements

Since this is an ecosystem restoration project in which once lost resources would be recovered by the Federal Action, mitigation is not warranted.

6.8.2 Public/Agency Comments & Views

Agency Coordination and Review of the Draft EA

Scoping letters were issued to the Illinois Historic Preservation Agency, Illinois Department of Natural Resources, Native Tribes, US Environmental Protection Agency, and the US Fish and Wildlife Service on 09 April 2013. The Illinois Historic Preservation Agency concurs with the project in a letter dated 17 April 2013. ILDNR Coastal Zone Management consistency was received on 25 April 2013. The USFWS has provided response and defers comment until review of the draft Environmental Assessment during Agency and Public review. The USEPA has provided response to the scoping letter and supports the project with a letter dated 16 May 2013. Considerations provided by the USEPA were incorporated into this document. This section will be updated post Agency and Public Review.

Public Review of the Draft EA

This section will be completed post Agency and Public Review period.

Public Meeting on the Draft EA

This section will be completed post Agency and Public Review period.

Publication of the Finding of No Significant Impact (FONSI)

This section will be completed post Agency and Public Review period. The draft Finding of No Significant Impact may be found in Appendix A.

6.9 Project Schedule & Costs

Table 9: Study & Tentative Project Schedule

Schedule Item	Completion Date
Alternative Formulation Briefing Approval	Apr-17
Agency and Public Review	May-Jun-17
Feasibility Report Approved	Jun-17
Project Partnership Agreement (PPA) Signed	Jun-17
Real Estate Complete	Jun-17
Contract Award	Sep-17
Implementation Complete	Fall 2022

6.9.1 Total Project Costs

Total project costs include costs for study, design, implementation, contingencies, construction management, engineering during construction (EDC) and project management. Costs for design and management are estimated based on a percentage of estimated implementation costs and contingencies. These costs will be revised prior to the execution of a Project Partnership Agreement (PPA) and actual costs for these activities will be used to remedy final cost sharing responsibilities during project close-out. Total project costs were escalated to the mid-point of estimated construction using factors contained in EM 1110-2-1304, Civil Works Construction Cost Index System (CWCCIS). **Table 10** provides a summary of the Fully Funded Project costs for the NER Plan as presented in the Cost Certification TPC. Using the fully funded escalated costs and the implementation schedule, a summary of funding requirements by fiscal year was developed as presented in **Table 11** for the NER Plan.

Table 10: NER Plan Total Project Cost (First Cost FY15)

INTENTIONALLY REMOVED

Table 11: NER Plan Cost Apportionment (First Cost FY15)

INTENTIONALLY REMOVED

6.9.2 Financial Capability of Non-Federal Sponsor

In accordance with regulation ER1105-2-100, Appendix D, the non-Federal sponsor has sufficient funds currently available. 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 7 – RECOMMENDATION

I have considered all significant aspects of the problems and opportunities as they relate to the project resource problems of the Hegewisch Marsh restoration project. Those aspects include environmental, social, and economic effects, as well as engineering feasibility. I recommend that the NER Plan be implemented as a Federal project, with such modifications thereof as in the discretion of the Commander, USACE may be advisable. The estimated First Cost FY15 of the NER Plan is [redacted] and the estimated annual operations, maintenance, repair, replacement and rehabilitation (OMRR&R) cost is [redacted]. The Federal portion of the estimated total project cost is [redacted] for Design & Implementation. The non-Federal share of the estimated first cost of the project is about [redacted] and will be covered by lands, easements, rights-of-way, utility or public facility relocations, and dredged or excavated material disposal areas (LERRDs) of [redacted], WIK of [redacted] and a cash contribution of [redacted].

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 Hegewisch Marsh, City of Chicago, Illinois 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. Federal implementation of the recommended project would be subject to the non-Federal sponsor agreeing to comply with applicable Federal laws and policies, including but not limited to:

a. Provide 35 percent of total project costs as further specified below:

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 authorized to be used to carry out the *Project*.

The recommendations contained herein reflect the information available at this time and current departmental policies governing formulation of individual projects. They do not reflect program and budgeting priorities inherent in the formulation of a national Civil Works construction program nor the perspective of higher review levels within the Executive Branch.

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Christopher T. Drew
Colonel, U.S. Army
District Commander