Little Calumet River Planning Assistance to States

Aquatic Ecosystem Restoration at Heron Rookery, Martin Luther King South, Martin Luther King North and the Marshalltown Marsh

Planning Report

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US Army Corps of Engineers®
Chicago District

Executive Summary

Audubon Great Lakes requested that the Chicago District, US Army Corps of Engineers (USACE) initiate a study under the Planning Assistance to States (PAS) Program Section 22 of the Water Resources Development Act (WRDA) of 1974 (Public Law 93-251), as amended. The partners sought professional services from the USACE Chicago District to support the restoration of critical floodplain and wetland habitat functions at four specific natural area sites in Indiana on the west branch of the Little Calumet River (LCR). These sites are flood risk management (FRM) cells within the LCR levee system and provide habitat restoration opportunities. Two sites, the Highland Rookery and Martin Luther King South (MLKS), had conceptual designs furthered to support implementation by the partners, which would collectively provide hydrology for 224 acres of hemi-marsh native plant community.

Specifically, this study assessed and identified problems and opportunities, identified and evaluated measures and alternatives, and presented a technically acceptable solution to the ecological problems. In the process, three (3) wetland and two (2) native plant community alternatives were developed, with the addition of a fill removal alternative for MLKS.

Wetland Alternatives included:

1) Stabilized Hydroperiod via Water Control Structure
2) Unstable Hydroperiod & Sculpted Wetland Establishment
3) Stabilized Hydroperiod via Water Control Structure & Sculpted Wetland Establishment

Native Plant Community Alternatives included:

1) Invasive Species Removal
2) Native Plant Communities

Ultimately, the project partners selected Wetland Alternative 1 and Native Plant Community Alternative 1 for both sites since these alternatives would provide ecological benefits while being acceptable to capabilities and funding streams.

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1 Introduction

The USACE partnered with Audubon Great Lakes through the USACE Planning Assistance to States (PAS) program to undertake hydrologic analysis and wetland restoration planning for the West Branch of the Little Calumet River. The study is a joint effort between Audubon Great Lakes and USACE. A cost sharing agreement between Audubon Great Lakes and the Department of the Army was entered into on 1 July 2019. Additional support was provided by The Nature Conservancy, Wetlands Initiative, Lake County Parks and Recreation and the Little Calumet River Basin Commission.

The Little Calumet River Basin Development Commission (the Commission) was created in 1980 by the Indiana General Assembly as the local sponsor for the LCR, Indiana Flood Control and Recreation Project. This federal project was authorized in the 1986 under the Water Resources Development Act and was designed to provide protection from flooding up to the 200-year level on the west branch of the LCR from the Illinois State Line to Martin Luther King Drive in Gary, IN. Inclusion of the Marshalltown Levee just east of Martin Luther King Drive extended flood protection to Interstate 65. Most of the project levees were completed by 2009, resulting in over 2,000 acres of floodplain isolated within 22 miles of levee or floodwall.

The primary function of the Commission is to manage the LCR watershed to provide flood reduction and compensatory mitigation (DLZ and SEH 2013). However, three secondary goals have also been developed as outlined in the Comprehensive Watershed Plan for the Little Calumet River's Lake County Basin. These goals are to:

1. Improve water quality;
2. Improve opportunities for wildlife and habitat; and
3. Improve opportunities for recreation.

To this this end, a number of 'quality of life' improvement projects have already been identified, including projects to improve water and wildlife habitat quality along portions of Deep River, Hart's Ditch, Cady Marsh, and the Beaver Dam Ditch. The Commission works closely with the Audubon Great Lakes, Lake County Parks and Recreation Department, The Nature Conservancy, and The Wetlands Initiative to develop and implement some of these projects.

This PAS will support the first extension of these efforts directly into the LCR floodplain to expressly promote the Commission's quality of life goals. Ultimately, the study tasks will support the development of higher quality wetlands and habitat within lands administered by the Commission, providing critical benefits to both wildlife and the public at local and regional scales. The successful implementation of this work will further provide a rationale for additional investment in restoring wetland habitat within the basin. Careful management of these natural resources, including appropriate water level controls at specific points in the project would increase hemi marsh bird habitat.

1.1 Study Authority

Federal participation in this study is authorized by the Planning Assistance to States (PAS) Program: Section 22 of the Water Resources Development Act (WRDA) of 1974 (Public Law 93-251), as amended. This provides authority for USACE to assist the States, local governments, Native American Tribes and other non-Federal entities in the preparation of comprehensive plans for the development and conservation of water and related land resources.

The need for planning assistance is determined by the individual States and Tribes. Studies are only undertaken at the planning level of detail; they do not include detailed design for project construction. The studies generally involve the analysis of existing data for planning purposes using standard engineering techniques although some data collection is often necessary. Most studies become the basis for local planning decisions.

1.2 Purpose & Scope

The partners sought professional services from the USACE Chicago District to support the restoration of critical floodplain and wetland habitat functions at four specific natural area sites in Indiana on the west branch of the LCR. These sites are within the LCR levee system and collectively represent 224 acres of land within the floodplain:

- Highland Rookery - 126 acres
- Martin Luther King South (MLKS)- 98 acres
- Martin Luther King North (MLKN) –
- Marshalltown Marsh –

Plan Objectives

The objectives of the study are to:

- Evaluate the potential to improve hydrology and water level control at the Martin Luther King Drive and Highland Rookery wetlands;
- Develop a conceptual level design and parametric costs for ecosystem restoration alternatives at the 4 natural areas;
- Discuss the parameters and requirements of regulatory (Sections 408 and 401/404) oversight should restoration activities be implemented at the sites

2 Site Specific Opportunities

2.1 Plan Formulation

Plan formulation is an iterative process resulting in the development, evaluation and comparison of alternative plans to address identified study problems by achieving the outlined objectives. The Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies (P&G) (1983) established four accounts to facilitate the evaluation and display of the effects of alternative plans.

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

1. Identify a primary project purpose. For this portion of the study, ecosystem restoration (ER) is identified as the primary purpose, while operating within the limits of the construction Little Calumet River flood risk management project.
2. Formulate management measures to achieve planning objectives and avoid planning constraints, where measures are the building blocks of alternative plans.
3. Identify and select those sites/patches most beneficial for ecological restoration.

4. Formulate, evaluate, and compare an array of alternatives to achieve the primary purpose (ER) and identify cost effective plans.
5. Provide concepts, designs and supporting material for local implementation of recommended ecosystem restoration management measures.

Management Measures as Building Blocks

Management measures are features or activities that can be implemented at a specific geographic location to address all or a portion of the identified study problems. Measures can directly address the hazards, the way the hazards behave (performance), or indirectly address them through eliminating or reducing the consequences. Measures considered for this study are categorized as hydrogeomorphic, native plant community, adaptive management and best management practices.

The following measures have been frequently used in past restoration projects within the Calumet Region of northwest Indiana. These measures were developed in a fashion so that parametric costs are able to be applied for plan formulation purposes. The measures as building blocks would then have additive costs as they are mixed and matched to build the alternatives. Most measures do not inherently have benefits associated with them, so must be combined with other measures to achieve habitat outputs; therefore, measures were not screened, but developed to be technically effective and parametrically flexible. These are "rubber meets the road" measures in which ultimately, the contract set of plans and specification for any ER implementation would consist of. The following provides the potential breadth of specific measures that can be combined, or in some instances stand alone to solve problems and achieve the planning objectives. Some of the following measures may not be relevant for each of the five study areas. The measures will be further explored on a site by site basis in later sections of this chapter where alternatives are screened.

Hydrogeomorphic Measures

The following is a list of potential measures for restoring and creating the hydrogeomorphic setting(s) for native communities. The following outline provides a brief overview of potential actions, with measures italicized, and followed by specific parametric measure descriptions:

- *Demolition*
  - Concrete removal
  - Paved channel bottom and/or slopes
  - Loose fragments and foreign debris
  - Dam / obstruction removal
  - Remove / modify grade control structures
  - Remove / modify culverts/bridge crossings
  - Remove drain tiles/pipes
- Earthwork
  - *Excavation* and *grading* to achieve hydrology
    - Sidestream wetland shelves, riparian pocket wetlands
    - Transitional communities
  - Bank grading to achieve hydrology and slopes
    - Terracing for different plant communities
    - Reducing bank slopes on inside bends and straight runs
    - Floodplain connectivity
  - Channel reconfiguration
    - Meandering, braiding, etc.
    - Development for riffle/run/glide/pool

- Channel / Habitat Structures
    - *Water Control Structures*
        - Riverine Wetland In-channel (ie. Modified riffle with stop logs)
        - Palustrine Wetland (stop logs)
    - *Native Rock Structures*
        - Slab-rock, riffle, boulder cluster, cobble bar, etc.
        - J-hook, cross vane, etc.
    - *Large woody debris (LWD)*

Demolition – this measure entails those activities associated with the removal of structures within the channel, bank and floodplain zones. Specific structures that could be removed includes but is not limited to dams, weirs, bridge abutments, retaining walls, improved channels, pipes, outfalls and other defunct infrastructure. Specific materials to be removed under this measure includes but is not limited to large foreign debris, concrete, asphalt, metal, angular riprap, gabion baskets and geotextile fabrics. All materials removed would be appropriately reused, recycled or disposed of.

Photo 1: Demolition of the Hofmann Dam, Aquatic Ecosystem Restoration (AER)

Excavation – this measure includes the removal of earthen materials to achieve required geomorphologies and hydrology for native communities. Large to small earth moving machines would be utilized to excavate earthen materials to specific elevations as required by the targeted native community. All materials would be reused on site to create diverse geomorphologies; stockpiled for reuses by others; and/or disposed of appropriately. This measure is typically coupled with grading.

Photo 2: Excavation of Lacustuary Lagoon at Northerly Island, AER

Grading – this measure includes the movement of earthen materials to achieve required geomorphologies and hydrology for native communities. Large to small earth moving machines would be utilized to spread, smooth and undulate surface soils to specific elevation as required by the targeted native plant community. This measure would typically be combined with excavation to provide final elevation, and/or soil amendments to ensure proper incorporation into surficial soils.

Photo 3: Grading River Bank to Mimic Natural Slopes and Morphology at Nippersink Creek, AER

Water Control Structures – this measure includes modification to or creation of water control structures to stabilize hydroperiodicity. This measure would help to support native plant communities and wildlife habitat. Structures would promote wildlife passage, and would not create hydrological surface disconnection. Structures would be used in-channel in riverine and palustrine wetland settings. This measure is combinable with a variety of measures and can help to provide critical marsh bird habitat.

Photo 4 Water Control Structure to Stabilize Hydroperiod at Indian Ridge Marsh, AER

Native Rock Structures – this measure includes the placement of rock/stone into the stream channel to provide required geomorphology and substrates for native stream community. This measure would be more applicable to those channel reaches that exhibit higher stream velocities. Large to small construction machinery would place rock slabs, boulders and/or cobbles that are of the same make up and general shapes as natural reaches with similar gradient. Rock/stone materials would take on various configurations as necessitated by the particular stream parameters present at the restoration site. Different configurations of rock structures would include but not be limited to slab-rock, riffle, boulder cluster, j-hook, cross-vane and cobble bar. All stone structure materials would be appropriately sized based on in-channel parameters. All materials would be sourced from local permitted sources to ensure clean and inert materials. This measure is combinable with a variety of measures as it can add critical habitat and stability components.

Photo 5: Boulder & Cobble Riffle Placement East Branch DuPage River Morton Arboretum, AER

Large Woody Debris Structures – this measure includes the placement of large woody debris (LWD) into the stream channel or into wetlands for habitat and stability components. This measure would be more applicable to those channel reaches that exhibit lower stream velocities and wetlands. Large woody debris consists of trees, their major branches, their rootwad and combinations of such. Typically, larger trees (20+ DBH) removed for excavation, grading or native plant community restoration are retained and utilized. These structures may consist of one to many trees placed into the stream channel and bank zones in various configurations to provide habitat and temporary stability. Depending on the forces exhibited in the area targeted, LWD may or may not need to be keyed into and/or tethered to the stream floor or earthen bank.

Photo 6: Large Woody Debris Structure and Soil Terracing, AER

Native Plant Community Measures

- Invasive Species Clearing & Grubbing
  - Clearing, grubbing, mowing
  - Herbicide
  - Flooding
  - Burning
  - Vegetation Monitoring
- Native Species Planting
  - Seeding
  - Dormant rootstock
  - Live plugs
  - Shrubs and trees
- Native Species Establishment
  - Herbivory control
  - Invasive species control

Invasive Species Removal – this measure includes the complete removal of non-native weeds and the selective removal of native weeds in areas that are not treated with other measures that would also provide clearing, such as excavation, grading and some demolition activities. Methods for removing invasive plant species include but are not limited to clearing and grubbing, mowing, burning, flooding, broad-cast herbicide application, spot-treatment herbicide application, etc. This measure is a one-time initial application or an initial series of applications to provide conditions for native plantings; this measure is not the same as those small spot treatment applications under the Native Plant Establishment measure. This measure includes a basic level of vegetation monitoring in order to assess the effectiveness of initial applications to remove invasive species and to guide follow-up applications.

Photo 7: Feller-Buncher Removing Cottonwoods and Ash from Globally Imperiled Ridge & Swale, AER

Native Plantings – this measure includes the procurement and planting of native plant species. Native planting lists would be specifically developed per plant community type specifying the rates of native

seed, live root stock, live plugs and live tree/shrub containers. Current potential for plant community general types include aquatic bed, marsh, meadow, prairie, savanna, woodland and forest.

Photo 8: Planting Native Wetland Plugs at Eugene Field Park, AER

Native Plant Establishment – this measure includes those elements required to establish and maintain newly created or restored plant communities. Specific elements include but are not limited to invasive species management, herbivory control, protective fencing, limited short-term watering, general plant survival, growth and coverage, etc.

Photo 9: Common Carp and Canada Geese Protection for Newly Planted Wetlands Plugs, AER

Adaptive Management Measures

Multi-year contracts should be utilized to ensure recruitment and establishment of native communities (abiotic and biotic) is successful. All hydrogeomorphic work would typically be accomplished within the

first several months of the contract to allow establishment and monitoring time. Options would be placed in the contract for future adaptive management measures that could be exercised at any point of the contract duration, but most frequently in years 3, 4 and 5. These may include but are not limited to changing or adjusting features to achieve the required hydrology, hydraulics and/or geomorphology; additional native plant treatments; or other improvements. All adaptive management decisions and exercising of contract options would be driven by monitoring. To be conservative, three adaptive management options would be included under this measure for high, medium and low adaptive adjustment needs. These would be Option A – for more intensive adjustments of geomorphology or hydrology $75,000; Option B – for more moderate adjustments of habitat and/or additional plantings $25,000; Option C – for minor habitat adjustments or additional plantings $10,000.

Photo 10: Adaptive Management of Seeps 1st and 2nd Year of Construction Red Mill Pond AER

2.2 Heron Rookery

Existing Conditions

Soils

The Heron Rookery site soils are predominantly Pewamo silty clay loam, calcareous variant. The Pewamo series consists of very deep, very poorly drained soils formed in till on moraines, near-shore zones (relict), and lake plains. The native vegetative cover for this series in Indiana consisted of forested wetland communities. Calcareous variant supported hydrophytic grass patches specific to LCR floodplain (USDA 2016). The other soil type present is Wauseon fine sandy loam. The Wauseon series consists of very deep, poorly drained or very poorly drained soils that are moderately deep or deep to dense till. They are often found on lake plains, wave-worked till plains, and deltas. Wauseon soils have an intermittent perched high water table between January and April in normal years. The native vegetative cover was deciduous swamp forest with *Quercus bicolor*, *Ulmus spp*., *Tilia americana*, and *Platanus occidentalis* (USDA 2017).

Figure 1: Heron Rookery Existing Aerial & Soils

Hydrogeomorphic Setting

Heron Rookery is a very flat site with less than 5 feet of topographic change across the entire site. The site is not directly adjacent to the LCR, but still experiences an unstable hydroperiod for the entire water year. Water levels often fluctuate on the order of feet during non-storm periods, but the source of

incoming water is unknown. Water leaving the site drains through a riprap armored channel (Photo 11) that discharges directly into the LCR through a sluice gate. As shown in Figure 2 the site is mostly flat and hydrologic and hydraulic models indicate that when flooding occurs it affects the site in a relatively homogenous manner. The site has a many dead mature trees throughout, particularly on the western half. These trees provided rookery habitat for the great blue heron (*Ardea herodias*) but are beginning to deteriorate and the herons have mostly stopped using the site as a rookery. The vegetation is dominated by invasive species including *Phragmites australis*, *Typha* spp., and *Phalaris arundinacea*.

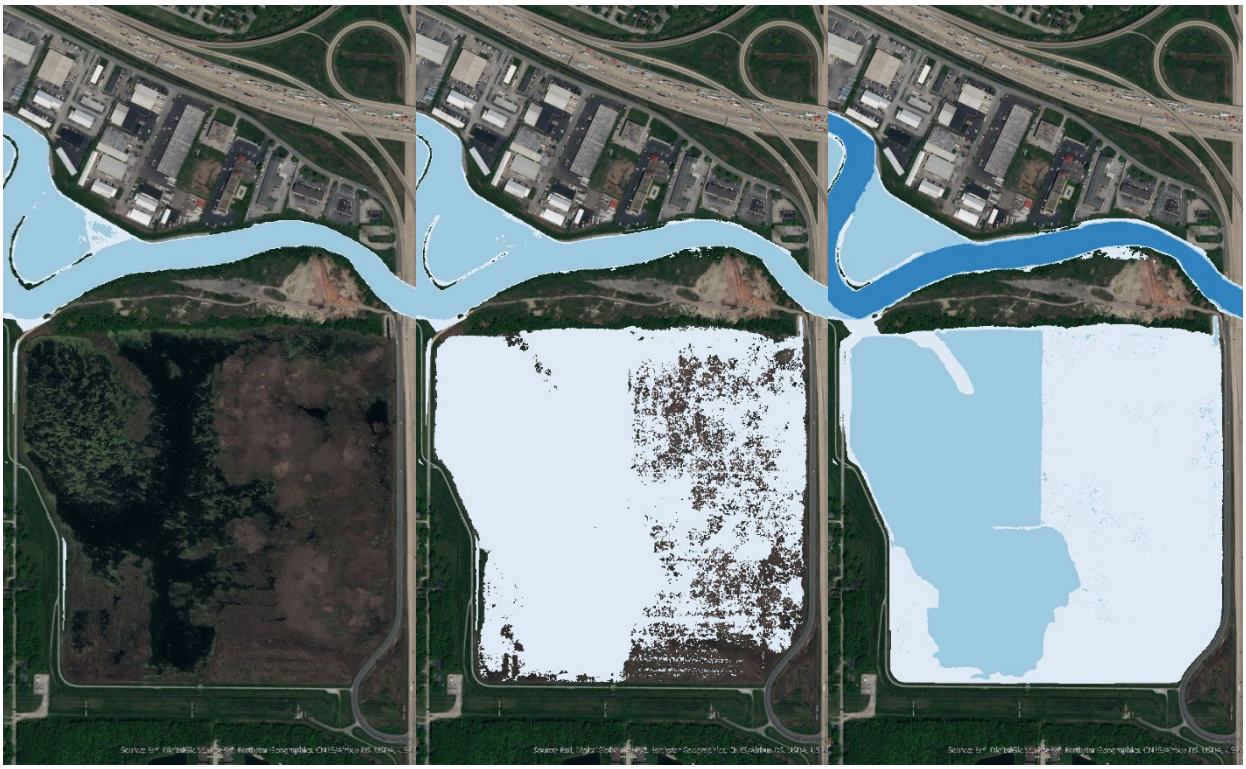

Figure 2: Modeled Inundation at Heron Rookery for 5, 25, and 100-year Flood Events (Left to Right)

Restoration Alternative Development

Alternatives were developed to address ecosystem problems by utilizing the measures as building blocks (Table 1). Three (3) wetland alternatives and two (2) native plant community alternative were developed from the list of measures that are listed in Section 3.1.3. Preliminary planning discussions ruled out the reestablishment of a rookery due to complications with sustainability and site conditions being no longer conducive to this type of habitat.

Table 1: Initial Array of Action Alternatives & Comprising Measures for Heron Rookery

Heron Rookery	Alternative				
Measure	**H1**	**H2**	**H3**	**N1**	**N2**
Demolition					
Excavation		X	X		
Grading		X	X		
Water Control Structures	X		X		
Native Rock Structures					
Large Woody Debris					
Invasive Species Removal				X	X
Native Plantings					X
Native Community Establishment					X
Adaptive Management	X	X	X	X	X
BMPs	X	X	X	X	X

H1 Stabilized Hydroperiod via Water Control Structure – This alternative would stabilize or moderate extreme hydrologic fluctuations. A stop log style water control structure constructed at the outlet to the river in the northeast corner of the site would hold additional water on site during low water times while allowing excess water to drain away during wet periods. This measure would maintain more consistent water levels and promote hemi-marsh and other wetland habitat. Water levels could also be raised or lowered for vegetation management purposed including drawdowns to allow for easier access or flooding for control of unwanted invasive and opportunistic plant species. Refer to Appendix D to see inundation maps modeling water levels throughout the site when the control structure stop logs are set to .5 ft, 1 ft, 1.5 ft, and 2 ft elevations.

Considerations: The use of control structures can be successful if properly maintained and operated. In addition to developing and following procedures for the desired hydroperiod, O&M tasks to ensure the structures are sustaining hemi-marsh and other desired wetland hydrology would include inspection after every significant flood event and monthly routine inspections during the growing season. Therefore, future risk of failure, and operations and maintenance costs would be higher for this alternative.

H2 Unstable Hydroperiod & Sculpted Wetland Establishment – This alternative would not stabilize or moderate extreme hydrologic fluctuations. This alternative would entail creating hemi-marsh and other wetland habitat structure by sculpting the landscape via excavation and grading. Wetland depressions would be sculpted to mimic natural wetland geomorphology based on existing hydrologic and soil conditions; the resulting fill would be used to create higher elevation areas with shorter hydroperiods that could sustain tree/shrub growth within hemi-marsh zones.

Considerations: The current uncontrolled hydrologic fluctuations do not mimic the natural flood regimes of unaltered floodplain wetlands and do not promote a robust native plant community. Although sculpting and grading would abate some of the hydrologic fluctuations, plant species richness would be decreased since many species cannot tolerate long-term extreme hydrologic fluctuations.

Photo 11: Proposed Location of Control Structure at Heron Rookery, Looking Upstream

H3 Stabilized Hydroperiod via Water Control Structure & Sculpted Wetland Establishment – This alternative would be a combination of alternatives H1 and H2. Water control structure(s) would moderate hydrologic fluctuations in addition to excavation and grading to create wetland depressions and upland areas where trees/shrubs could persist.

N1 Invasive Species Removal - This alternative would control invasive and opportunistic plant species with herbicide applications and prescribed burns including Hybrid Cattail (*Typha* X *glauca*), Common Reed (*Phragmites australis* ssp. *australis*), and Purple Loosestrife (*Lythrum salicaria*). This alternative would also provide monitoring to assess the effectiveness of initial invasive species removal efforts and would help to guide follow-up efforts.

Considerations: Invasive species removal can be successful and sustained if native plant communities are established following removal of invasive species. Native plants can establish from the existing seed bank or through planting and seeding. Removal of invasive species without planting and seeding of native plant species is not sustainable because invasive species will rapidly recolonize open areas without competition from robust native plants and establishment activities including herbicide application and mowing. Therefore, future risk of failure, and operations and maintenance costs would be higher for this alternative.

N2 Native Plant Communities –This alternative would include the invasive species control measures included in alternative N1, but would also seed and plant native species of local genotype. Herbicide applications, mowing, prescribed burns, and herbivory control would continue throughout the

establishment period to further suppress invasive species and promote the establishment of native vegetation.

Costs

Refer to Appendix E for table of parametric costs.

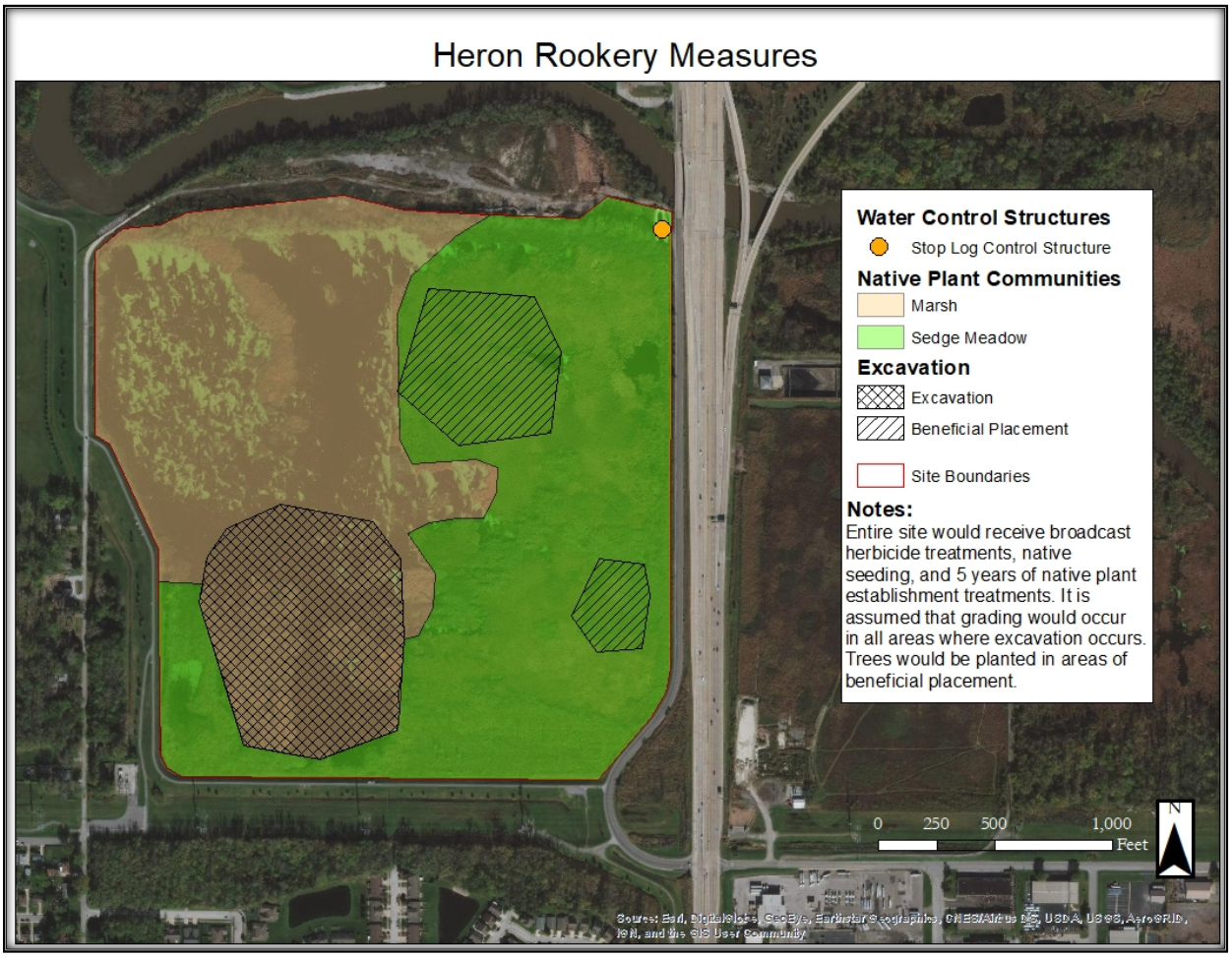

Figure 3: Heron Rookery Measures

2.3 Martin Luther King South

Existing Conditions

Soils

USDA soil maps classify the soils at MLKS as "urban land" and "borrow pits" (USDA 2019). These soil types appear to be confined mostly to this parcel. Warners silt loam immediately surrounds most of the site, and this was likely the dominant soil type at MLKS as well prior to human disturbance. The Warners series consists of very deep, very poorly drained soils on nearly level floodplains below springs flowing from limestone bedrock, at the margins of lakes, and on hillsides where there is seepage of calcium carbonate charged water and seepage areas of hillsides. The soils typically overlay marl or have marl within the soil. The native vegetative cover is a mixture of marsh, swamp, and woodland (USDA 2011).

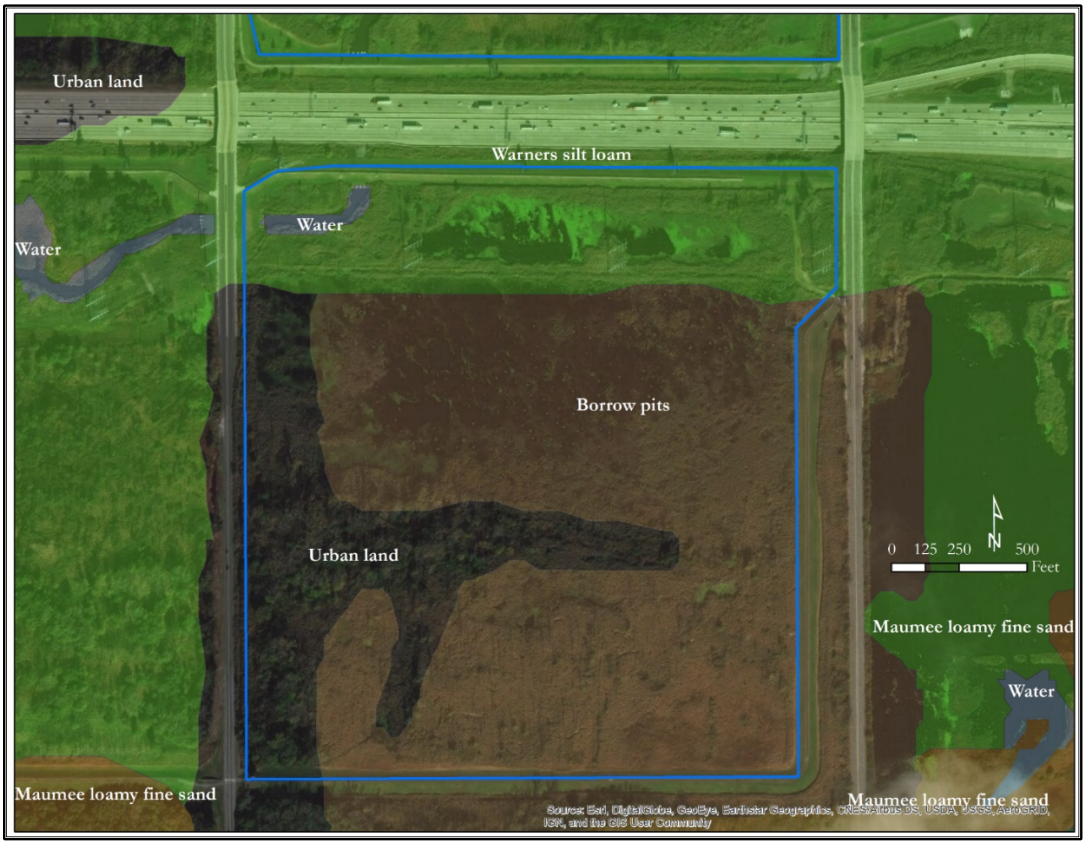

Figure 4: MLK South Existing Aerial & Soils

Hydrogeomorphic Setting

MLKS is a relatively flat site but has sporadic variations in topography likely due to anthropogenic alterations in the past as indicated on the USDA soil maps, which show the two dominant soil types as "urban land" and "borrow pits". The LCR flows through the northwestern most corner of the site where it makes a 90 degree turn to the north and flows under Interstate 94 as it exits the site. The hydroperiod is unstable throughout the year, but sitewide flooding is common. As shown in Figure 5 flood events at MLKS result in nearly homogenous inundation of the entire site, even at the 2 year flood event. This homogeneity is even more pronounced at MLKS than at the Heron Rookery site. The historic soils have

largely been altered, and this in combination with the unstable hydroperiod has promoted invasive species over native plant communities. There is a small remnant plant community in the southeastern corner of the site, which may be indicative of the historic vegetation and soil conditions. Aside from this small area the site is dominated by invasive species including *Phragmites australis*, *Typha spp*., and *Phalaris arundinacea*.

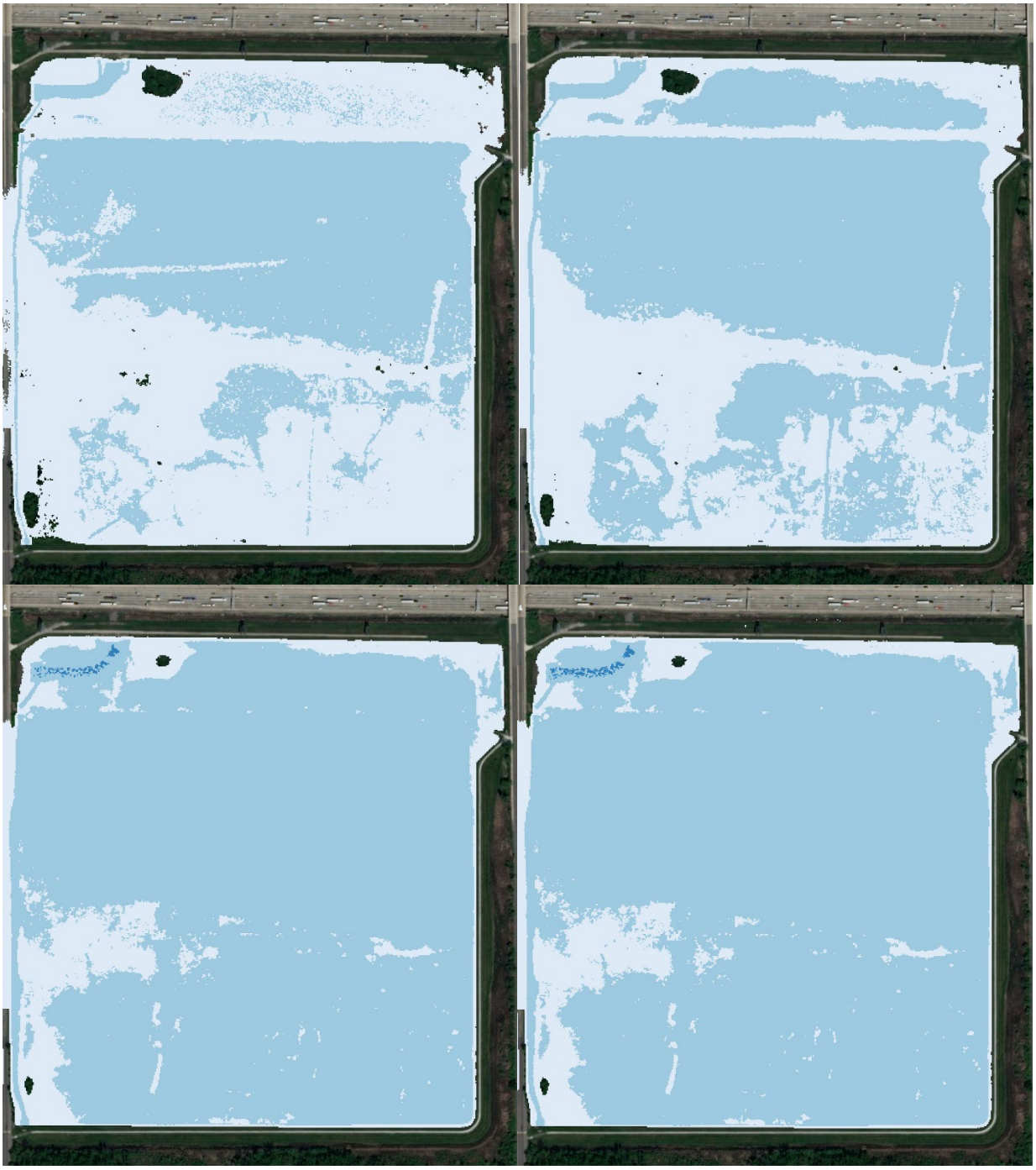

Figure 5: Modeled Inundation at MLKS for 2, 5, 25, and 100-year Flood Events (clockwise from upper left)

Restoration Alternative Development

Alternatives were developed by utilizing the preceding measures as building blocks (Table 2). Three (3) riparian / wetland alternatives, one (1) fill removal alternative, and two (2) native plant communities alternatives were developed from the list of measures that are listed in Section 3.1.3.

Table 2: Initial Array of Action Alternatives & Comprising Measures for MLK South.

MLK South	Alternative					
Measure	**H1**	**H2**	**H3**	**E1**	**N1**	**N2**
Demolition				X		
Excavation		X	X	X		
Grading		X	X	X		
Water Control Structures	X		X			
Native Rock Structures						
Large Woody Debris						
Invasive Species Removal					X	X
Native Plantings						X
Native Community Establishment						X
Adaptive Management	X	X	X	X	X	X
BMPs	X	X	X	X	X	X

H1 Stabilized Hydroperiod via Water Control Structure – This alternative would stabilize or moderate extreme hydrologic fluctuations. A stop log style water control structure constructed at the northwest outlet near the river would hold additional water on site during low water times while allowing excess water to drain away during wet periods. This measure would maintain more consistent water levels and promote hemi-marsh and other wetland habitat. Water levels could also be raised or lowered for vegetation management purposed including drawdowns to allow for easier access or flooding for control of unwanted invasive and opportunistic fish and plant species.

Considerations: The use of control structures can be successful if properly maintained and operated. In addition to developing and following procedures for the desired hydroperiod, O&M tasks to ensure the structures are sustaining hemi-marsh and other desired wetland hydrology would include inspection after every significant flood event and monthly routine inspections during the growing season. Therefore, future risk of failure, and operations and maintenance costs would be higher for this alternative.

Photo 12: Proposed Location of Control Structure at MLK South

H2 Unstable Hydroperiod & Sculpted Wetland Establishment – This alternative would not stabilize or moderate extreme hydrologic fluctuations. This alternative would entail creating hemi-marsh and other wetland habitat structure by sculpting the landscape via excavation and grading. Wetland depressions would be sculpted to mimic natural wetland geomorphology based on existing hydrologic and soil conditions; the resulting fill would be used to create higher elevation areas with shorter hydroperiods that could sustain tree/shrub growth within hemi-marsh zones.

Considerations: The current uncontrolled hydrologic fluctuations do not mimic the natural flood regimes of unaltered floodplain wetlands and do not promote a robust native plant community. Although sculpting and grading would abate some of the hydrologic fluctuations, plant species richness would be decreased since many species cannot tolerate long-term extreme hydrologic fluctuations.

H3 Stabilized Hydroperiod via Water Control Structure & Sculpted Wetland Establishment – This alternative would be a combination of alternatives H2 and H3. Water control structure(s) would moderate hydrologic fluctuations in addition to excavation and grading to create wetland depressions.

E1 Remove Urban Fill – This alternative would consist of removal and disposal of the lobe of urban fill located along the western site boundary and through the central portion of the site. Fill would be hauled off-site and disposed of properly. This alternative is combinable with all of the H and N alternatives.

N1 Invasive Species Removal - This alternative would control invasive and opportunistic plant species with herbicide applications and prescribed burns including Hybrid Cattail (*Typha* X *glauca*), Common Reed (*Phragmites australis* ssp. *australis*), and Purple Loosestrife (*Lythrum salicaria*). This alternative would also provide monitoring to assess the effectiveness of initial invasive species removal efforts and would help to guide follow-up efforts.

Considerations: Invasive species removal can be successful and sustained if native plant communities are established following removal of invasive species. Native plants can establish from the existing seed bank

or through planting and seeding. Removal of invasive species without planting and seeding of native plant species is not sustainable because invasive species will rapidly recolonize open areas without competition from robust native plants and establishment activities including herbicide application and mowing. Therefore, future risk of failure, and operations and maintenance costs would be higher for this alternative.

N2 Native Plant Communities –This alternative would include the invasive species control measures included in alternative N1 but would also seed and plant native species of local genotype. Herbicide applications, mowing, prescribed burns, and herbivory control would continue throughout the establishment period to further suppress invasive species and promote the establishment of native vegetation.

Costs

Refer to Appendix E for table of parametric costs.

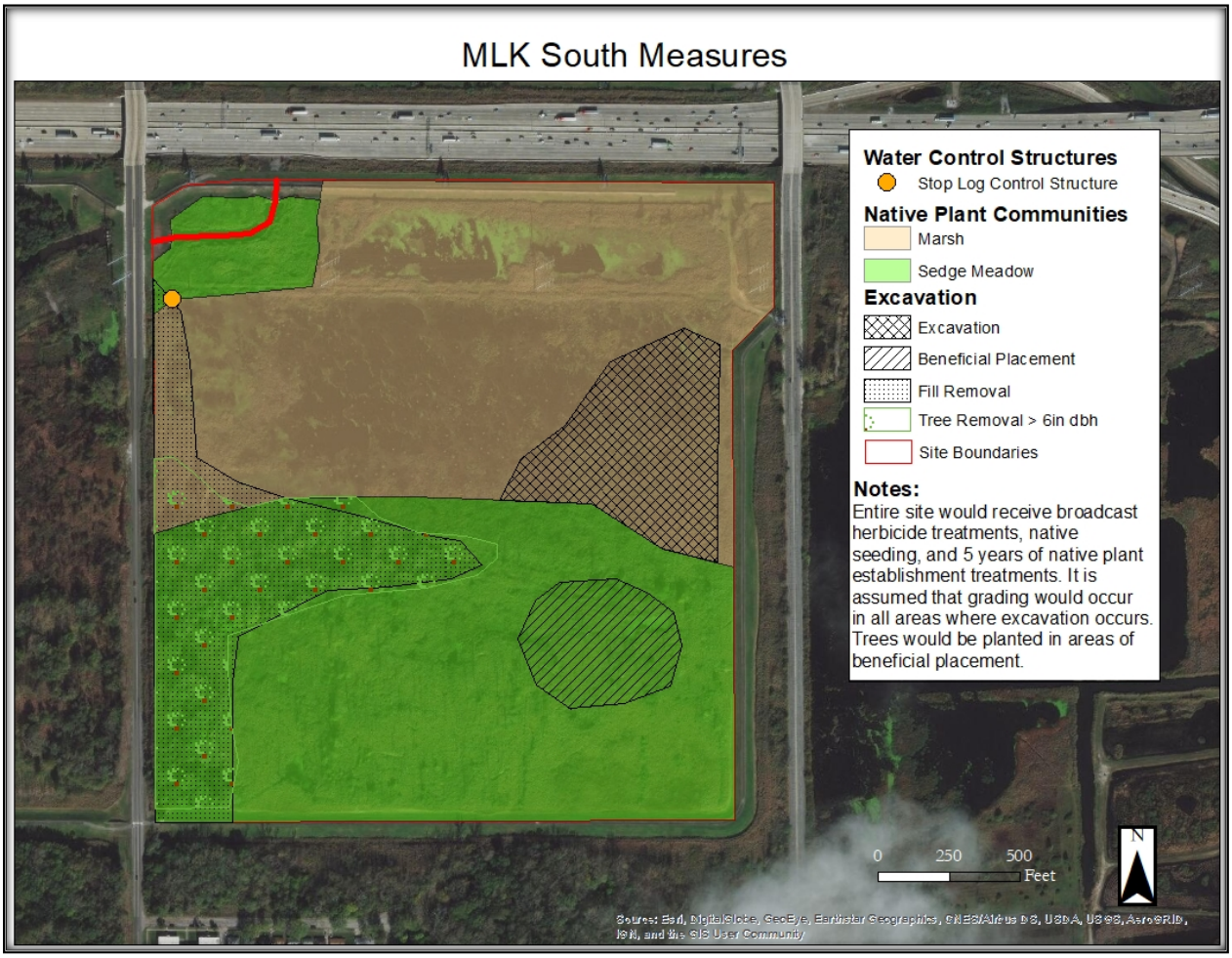

Figure 6: MLK South Measures

2.4 Marshalltown Marsh

Existing Conditions

- Maumee Loamy Fine Sand – Sandy Outwash/Lake Plains - +2 ft. to -1 ft.
- Marl Beds – Calcareous – Formed by alluvial deposition at slack water points – Probable Wide Slough Morphology (The Lakes of Northern Indiana and Their Associated Marl Deposits, Blatchley 1900)
- Warners Silt Loam – Formed by floodplain action – Highly Calcareous with marl impregnation - wet-mesic woodland with Swamp/Marsh inclusions

Existing Conditions

- Unstable hydroperiod for entire water year
- River channelized (probably several times) and moved
- Remnant channel scars from Little Calumet River and Deep River
- Calcareous soils confirmed
- Potential for drain tiles
- Excessive coverage of *Phragmites* spp. / invasive plant species
- Limited native hemi-marsh and other native community types

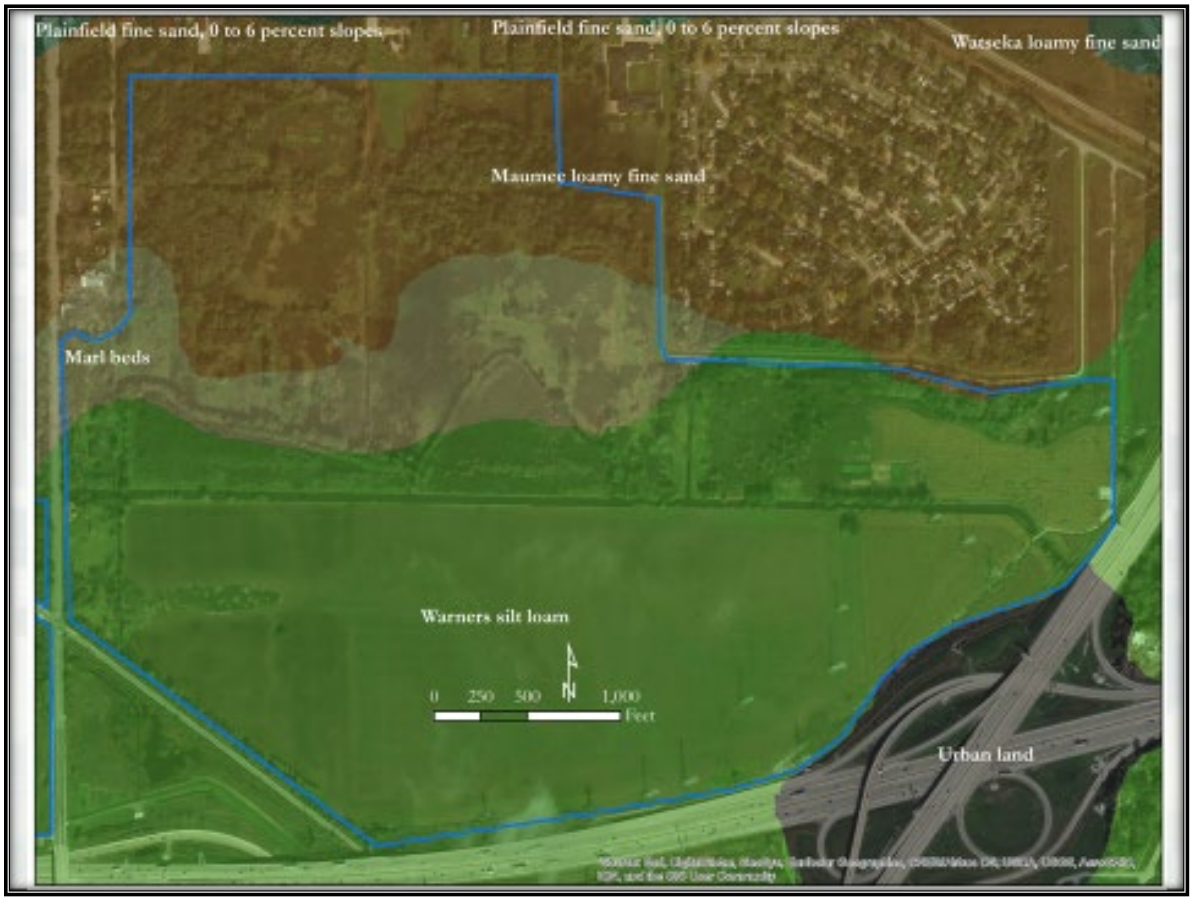

Figure 7: Marshalltown Marsh Existing Aerial & Soils

Photo 13: Moderately Health Wetland at Marshalltown Marsh

Photo 14: Typical Amorphous Reach of Channelized River at Marshalltown Marsh

Restoration Alternative Development

Alternatives were developed by utilizing the preceding measures as building blocks (Table 5). Five (5) riverine alternatives, three (3) riparian / wetland alternatives, and one (1) water control structure alternative were developed from the list of measures that are listed in Section 3.1.3.

Table 3: Initial Array of Action Alternatives & Comprising Measures for Colorado Tract.

Colorado/Marshalltown Marsh	Alternative								
Measure	**R1**	**R2**	**R3**	**R4**	**R5**	**H1**	**H2**	**H3**	**N1**
Demolition						X	X	X	
Excavation		X		X	X		X	X	
Grading		X		X	X	X	X	X	
Water Control Structures									
Native Rock Structures	X	X	X	X	X				
Large Woody Debris	X	X	X	X	X				
Invasive Species Removal									X
Native Plantings									X
Native Community Establishment									X
Adaptive Management	X	X	X	X	X	X	X	X	X
BMPs	X	X	X	X	X	X	X	X	X

The following riverine alternatives (R), are not combinable with each other, but combinable with hydrology (H) and native plant communities (N).

R1 In Stream Habitat Only – This alternative would maintain the current channel alignment, hydraulic and geomorphic conditions while placing low-profile riffle, boulder, cobble and large woody debris structural habitats. These would be placed directly on the ditch's bed and banks in areas of aggradation (sediment accumulation) and areas of erosion.

R2 In Stream Habitat & Floodplain Connectivity – This alternative would maintain the current channel alignment while grading banks to reconnect the river to the floodplain and installing medium-profile riffle, boulder, cobble and large woody debris structural habitat on bed and on bank (Photo 12). The furthest extent of the floodplain grading would be the location for excess material beneficial reuse. This includes creating micro-drainage divides and gaps for surface water connectivity and natural drainage patterns. It is not practical or necessary to fund holistic erosion control blankets for this activity; spot treatments of coir logs would be utilized on the new banks until vegetation establishes.

R3 Natural Riverine Establishment – This alternative would entail inducing the river to erode its own banks to jump start meandering and migration. The river's alignment would generally be the same as the existing alignment but will be subject to natural channel migration over longer periods of time. This process would specifically be induced by placing sacrificial large woody debris structures in the river channel; the structure would eventually become bank or stream habitat. These structures would intentionally direct flow into the bank to cause a moderate to high rate of erosion and deposition. This natural process is termed cut and fill alluviation. This process naturally creates and sustains riverine habitats including but not limited to oxbows, backwaters, islands, riffles, pools, undercut banks, substrates, sandy point bars and large woody debris inputs. This alternative also includes the use of rock structures to ensure the stream safely enters and exits from the site. To make this alternative more feasible

from an acceptability aspect, it would be combined with bank and floodplain grading activities to greatly reduce the amount of material eroded and moved within the wetted stream channel. There would be no use of BMPs and stream dynamic equilibrium would be dependent on a sequential planting plan.

R4 Sculpted Riverine Establishment – This alternative would entail returning riverine habitat structure without natural processes by sculpting the landscape. The river's alignment would be as depicted in in Alternative R4 Map. This would be accomplished via excavation, grading, placing native rock structures and large woody debris. Stream channel and banks would be sculpted to mimic a natural geomorphology, where channel development - glide, riffle, run and pool - features would be strategically placed and graded to maintain geomorphology (Photo 11). Bank rations of a typically healthy stream would be used: outside bend (20:1); inside bend (5:1); straight run (10:1). Low flow channels would be made more sinuous. Stream dynamic equilibrium would be controlled with large woody debris, rock structures and a timely native planting plan. This alternative also includes the use of rock structures to ensure the stream safely enters and exits from the site.

R5 Prairie Slough through Marl Bed – This alternative would return the stream to a potential former flowage path where a marl bed is present. In this alternative the river would be wide and shallow with no defined channel. This would be accomplished via low-intensity grading, redirecting existing channel flows and placing large woody debris in a manner that promotes a wide, slow moving, and marsh-like slough. Where the river channel leaves the marl bed zone, the stream channel would be returned to a narrow channel with and banks as in alternative R4. This alternative also includes the use of rock structures to ensure the stream safely enters and exits from the site.

H1 Hydrologic Resurgence via In-line Valves – This alternative would resurge natural surface and subsurface hydrology and hydroperiodicity. Strategically installing backwater valves would both temporarily and/or permanently disable the existing drain tile system. These backwater valves (Figure 9) could be installed during the planning phase in order to gain information on potential off-site flooding effects, plant community distributions, planting schemes, and drainage pattern development. Drain tiles would be permanently disabled at some point during construction by grouting the valves shut. This grouting also ruptures the clay drain tiles overtime without excavation via hydrostatic pressure. This alternative also includes low-intensity grading to adjust topography to further refine hydrologic expression.

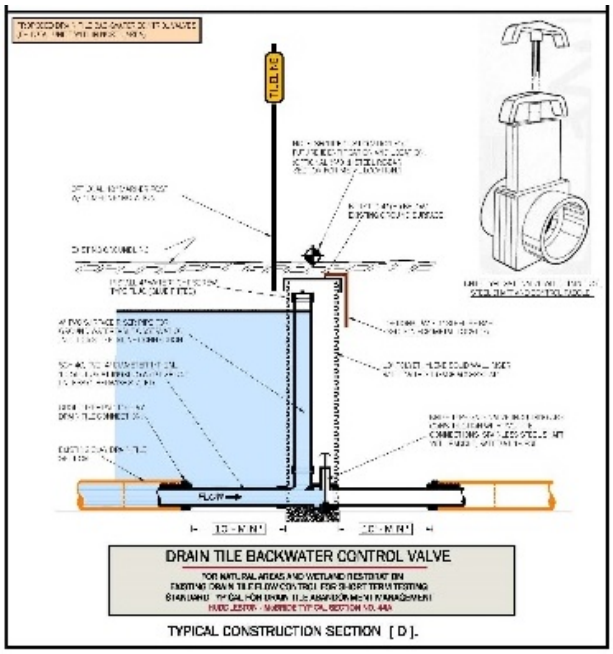

Figure 8: Typical Drawing of Backwater Valve with On/Off Lever.

H2 Hydrologic Resurgence via Drain Tile Disablement – This alternative would resurge natural surface and subsurface hydrology and hydroperiodicity. Holistically or strategically breaking clay drain tiles would permanently disable the existing drain tile system. This alternative also includes low-intensity grading to adjust topography to further refine hydrologic expression.

H3 Hydrologic Resurgence Via Grading Basins – This alternative would resurge natural surface and subsurface hydrology and hydroperiodicity by grading swaths of landscape down to the normal water table, primarily to erase tributary ditches on site. This alternative also includes a low amount of acres for low-intensity grading to adjust topography to further refine hydrologic expression.

2.5 Martin Luther King North

Historic Conditions

- Marl Beds – Calcareous – Formed by Deposition at slack water points – Probable Wide Slough Morphology (The Lakes of Northern Indiana and Their Associated Marl Deposits, Blatchley 1900)
- Warners Silt Loam – Formed by floodplain action – Highly Calcareous with marl impregnation - wet-mesic woodland with Swamp/Marsh inclusions

Existing Conditions

- Unstable hydroperiod for entire water year
- River channelized (probably several times) and moved
- Excessive coverage of *Phragmites* spp. / invasive plant species
- Limited native hemi-marsh and other native community types

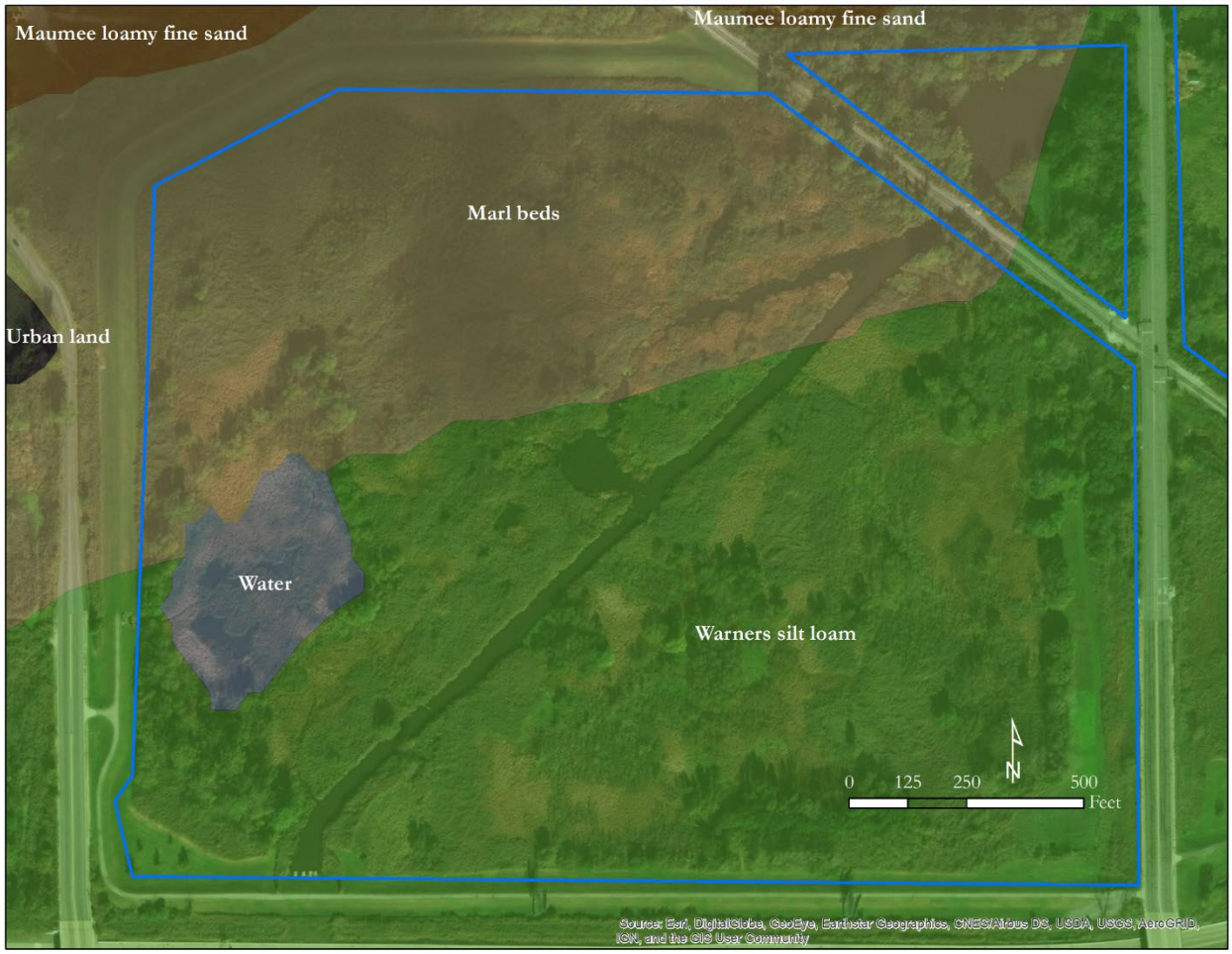

Figure 9: MLK North Existing Aerial & Soils

Restoration Alternative Development

The following riverine alternatives (R), are not combinable with each other, but combinable with hydrology (H) and native plant communities (N).

Table 4: Initial Array of Action Alternatives & Comprising Measures for MLK North.

MLK North	Alternative									
Measure	**R1**	**R2**	**R3**	**R4**	**R5**	**H1**	**H2**	**H3**	**W1**	**N1**
Demolition						X	X	X		
Excavation		X		X	X		X	X		
Grading		X		X	X	X	X	X		
Water Control Structures									X	
Native Rock Structures	X	X	X	X	X					
Large Woody Debris	X	X	X	X	X					
Invasive Species Removal										X
Native Plantings										X
Native Community Establishment										X

Adaptive Management	X	X	X	X	X	X	X	X	X	X
BMPs	X	X	X	X	X	X	X	X	X	X

R1 In Stream Habitat Only – This alternative would maintain the current channel alignment, hydraulic and geomorphic conditions while placing low-profile riffle, boulder, cobble and large woody debris structural habitats. These would be placed directly on the ditch's bed and banks in areas of aggradation (sediment accumulation) and areas of erosion.

R2 In Stream Habitat & Floodplain Connectivity – This alternative would maintain the current channel alignment while grading banks to reconnect the river to the floodplain and installing medium-profile riffle, boulder, cobble and large woody debris structural habitat on bed and on bank (Photo 12). The furthest extent of the floodplain grading would be the location for excess material beneficial reuse. This includes creating micro-drainage divides and gaps for surface water connectivity and natural drainage patterns. It is not practical or necessary to fund holistic erosion control blankets for this activity; spot treatments of coir logs would be utilized on the new banks until vegetation establishes.

R3 Natural Riverine Establishment – This alternative would entail inducing the river to erode its own banks to jump start meandering and migration. The river's alignment would generally be the same as the existing alignment but will be subject to natural channel migration over longer periods of time. This process would specifically be induced by placing sacrificial large woody debris structures in the river channel; the structure would eventually become bank or stream habitat. These structures would intentionally direct flow into the bank to cause a moderate to high rate of erosion and deposition. This natural process is termed cut and fill alluviation. This process naturally creates and sustains riverine habitats including but not limited to oxbows, backwaters, islands, riffles, pools, undercut banks, substrates, sandy point bars and large woody debris inputs. This alternative also includes the use of rock structures to ensure the stream safely enters and exits from the site. To make this alternative more feasible from an acceptability aspect, it would be combined with bank and floodplain grading activities to greatly reduce the amount of material eroded and moved within the wetted stream channel. There would be no use of BMPs and stream dynamic equilibrium would be dependent on a sequential planting plan.

R4 Sculpted Riverine Establishment – This alternative would entail returning riverine habitat structure without natural processes by sculpting the landscape. The river's alignment would be as depicted in in Alternative R4 Map. This would be accomplished via excavation, grading, placing native rock structures and large woody debris. Stream channel and banks would be sculpted to mimic a natural geomorphology, where channel development - glide, riffle, run and pool - features would be strategically placed and graded to maintain geomorphology (Photo 11). Bank rations of a typically healthy stream would be used: outside bend (20:1); inside bend (5:1); straight run (10:1). Low flow channels would be made more sinuous. Stream dynamic equilibrium would be controlled with large woody debris, rock structures and a timely native planting plan. This alternative also includes the use of rock structures to ensure the stream safely enters and exits from the site.

R5 Prairie Slough through Marl Bed – This alternative would return the stream to a potential former flowage path where a marl bed is present. In this alternative the river would be wide and shallow with no defined channel. This would be accomplished via low-intensity grading, redirecting existing channel flows and placing large woody debris in a manner that promotes a wide, slow moving, and marsh-like slough. Where the river channel leaves the marl bed zone, the stream channel would be returned to a narrow channel with and banks as in alternative R4. This alternative also includes the use of rock structures to ensure the stream safely enters and exits from the site.

H1 Stabilized Hydroperiod via Water Control Structure – This alternative would stabilize or moderate extreme hydrologic fluctuations. A hybrid riffle-stop log style water control structure constructed at the northeast corner of the site where the river flows under the railroad crossing would hold additional water on site during low water times while allowing excess water to drain away during wet periods. This measure would maintain more consistent water levels and promote hemi-marsh and other wetland habitat. Water levels could also be raised or lowered for vegetation management purposed including drawdowns to allow for easier access or flooding for control of unwanted invasive and opportunistic plant species. Water control structures would be designed to allow for wildlife passage.

Considerations: The use of control structures can be successful if properly maintained and operated. O&M tasks to ensure the structures are operating to maximize hemi-marsh and other wetland hydrology would include inspection after every flood event, monthly routine inspections during the growing season, and an operation plan that is adhered to. Therefore, future risk of failure, and operations and maintenance costs would be higher for this alternative.

H2 Hydrologic Resurgence Via Grading Basins – This alternative would resurge natural surface and subsurface hydrology and hydroperiodicity by grading swaths of landscape down to the normal water table, primarily to erase tributary ditches on site. This alternative also includes a low amount of acres for low-intensity grading to adjust topography to further refine hydrologic expression.

Photo 15: Proposed Location of Instream Control Structure at MLK North

3 Recommended Plans for Designs

3.1 Final Site Alternatives

Project partners selected a set of final site alternatives for each individual site after careful consideration of the alternatives that meet planning objectives and constraints and reasonably maximizes environmental benefits while passing tests acceptability and effectiveness. Selected plans will be further analyzed and detailed so that plans and specifications can be created by the partners to implement the alternatives.

Heron Rookery Final Alternatives

The final alternatives for the Heron Rookery site are H1 and N1. The implementation of these alternatives is generally described as follows and according to the alternative descriptions in Section 3.2.3.

Plan Components and Benefits

The selected alternatives for Heron Rookery include invasive species removal and stabilizing the hydroperiod throughout the site by utilizing a stop log style water control structure. The Heron Rookery site has been degraded over time through altered flood regimes and invasive species establishment, but implementation of the selected alternatives would help to address these ecosystem stressors. Heron Rookery experiences rapid and dramatic changes in hydroperiod due to incoming water from offsite, especially during precipitation events, but the water can drain down quickly leaving the site relatively dry. Wetland plants native to the Midwest are adapted to more stable hydroperiods, so erratic hydroperiodicity often promotes of invasive species monoculture establishment rather than diverse native species assemblage. Extensive populations of *Phragmites australis* throughout Heron Rookery have formed monocultures and have pushed out native species. Removing invasive species and stabilizing the hydroperiod to hold shallow water for longer periods of time would promote heterogenous native floodplain habitats that support native wetland specialist species of fish, insects, birds, and mammals.

USACE conducted hydrologic modeling and analysis to assess the effects of the proposed water control structure and determined that implementation of the selected alternatives would not adversely affect the USACE Little Calumet Flood Control Project due to the low elevation of the proposed water control structure. The stop log water control structure accomplishes the goal of stabilizing the hydroperiod by maintaining shallow water across the site during dry periods, but allows flood waters to overtop and exit the site without significant backups as shown by the inundation maps provided in Appendix D.

Plans, Specifications, and Permitting

During the design phase, additional detailed information would be gathered for certain aspects of the project such as water control structure design details including footing depths and water control structure materials. Vegetation surveys would be conducted to identify and map areas where native plant communities are established so that they could be protected during the invasive species removal phase of work.

The selected alternatives would require various permits. A Section 408 request to alter a USACE project would be submitted to USACE for review since the Heron Rookery site is within the USACE LCR Flood Control Project. The selected alternatives would affect waters of the United States, so the Indiana Department of Environmental Management (IDEM) may decide a Section 401 Water Quality Certification (401 WQC) would be analysis. Finally, Section 404 of the Clean Water Act (CWA) regulates the discharge of fill material into waters of the United States, and since the selected alternatives

include placing material into a wetland a Section 404 permit need to be reviewed by USACE Chicago District. These activities for Section 401 and 404 would fall under regional permits for wetland restoration.

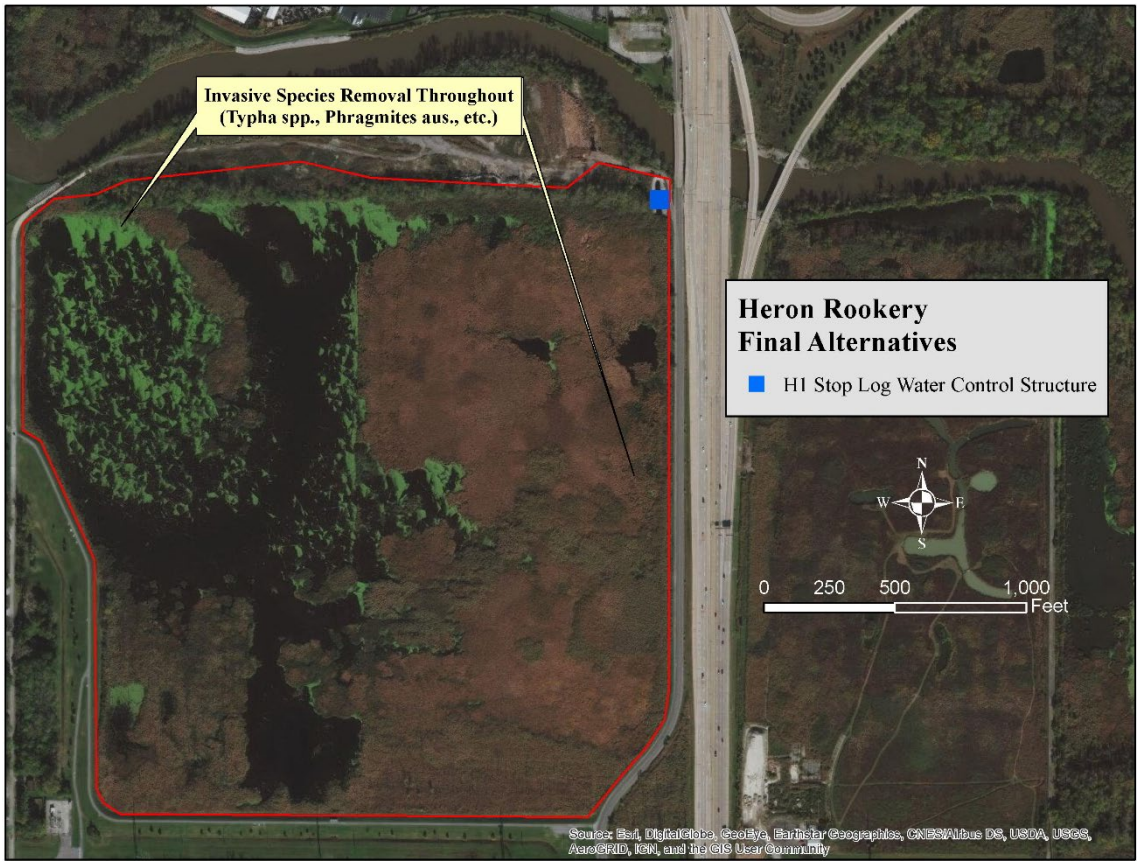

Figure 10: Heron Rookery final alternative selection.

Martin Luther King South Final Alternatives

The final alternatives for the Martin Luther King South site are H1 and N1. The implementation of these alternatives is generally described as follows and according to the alternative descriptions in Section 3.3.3.

Plan Components and Benefits

Similarly to the selected alternatives for Heron Rookery, the selected alternatives for MLKS include invasive species removal and stabilizing the hydroperiod throughout the site by utilizing a stop log style water control structure. MLKS experiences rapid and dramatic changes in hydroperiod due to incoming water from offsite, but the water can drain down quickly leaving the site relatively dry. The MKS site has been degraded over time through soil disturbance, altered flood regimes, and invasive species establishment. Wetland plants native to the Midwest are adapted to more stable hydroperiods, so erratic hydroperiodicity often promotes of invasive species monoculture establishment rather than diverse native species assemblage. Implementation of the selected alternatives would help to stabilize hydroperiodicity and would create more stable hemi-marsh habitat and would remove invasive species, but would not address problems associated with the altered soils. Extensive populations of *Phragmites australis* throughout MLKS have formed monocultures and have pushed out native species. Removing invasive

species and stabilizing the hydroperiod to hold shallow water for longer periods of time would promote heterogenous native floodplain habitats that support native wetland specialist species of fish, insects, birds, and mammals.

USACE conducted hydrologic modeling and analysis to assess the effects of the proposed water control structure, and determined that implementation of the selected alternatives would not adversely affect the USACE Little Calumet Flood Control Project due to the low elevation of the proposed water control structure. The stop log water control structure accomplishes the goal of stabilizing the hydroperiod by maintaining shallow water across the site during dry periods, but allows flood waters to overtop and exit the site without significant backups as shown by the inundation maps provided in Appendix D.

Plans, Specifications, and Permitting

During the design phase, additional detailed information would be gathered for certain aspects of the project such as water control structure design details including exact placement, footing depths and water control structure materials. Vegetation surveys would be conducted to identify and map areas where native plant communities are established so that they could be protected during the invasive species removal phase of work. A pocket of native species are present in the southeast corner of the site, so that population would likely be mapped and designated as a protected area during project implementation.

The selected alternatives would require various permits. A Section 408 request to alter a USACE project would be submitted to USACE for review since the Heron Rookery site is within the USACE LCR Flood Control Project. The selected alternatives would affect waters of the United States, so the Indiana Department of Environmental Management (IDEM) may decide a Section 401 Water Quality Certification (401 WQC) would be analysis. Finally, Section 404 of the Clean Water Act (CWA) regulates the discharge of fill material into waters of the United States, and since the selected alternatives include placing material into a wetland a Section 404 permit need to be reviewed by USACE Chicago District. These activities for Section 401 and 404 would fall under regional permits for wetland restoration.

Figure 11: MLK South final alternative selection.

4 References

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5 Appendices

A. Alternative Maps & Water Control Concepts

B. Technical Guidelines

C. Plan Sheets

D. Inundation Scenario Maps

E. Parametric Costs