

Engineering With Nature®

+

Landscape Architecture W.P. Franklin & Moore Haven Lock and Dam

a report identifying design concepts for incorporating Engineering With Nature® and Landscape Architecture approaches into US Army Corps of Engineers project infrastructure



US Army Corps
of Engineers®



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Dredge
Research
Collaborative



Engineering With Nature®

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This report covers findings from research cooperative agreement W912HZ-18-2-0008 **Incorporating Engineering With Nature® (EWN®) and Landscape Architecture (LA) Designs into Existing Infrastructure Projects**, an agreement between the **U.S. Army Engineering Research Development Center (ERDC)** and **Auburn University (AU)** for FY18-19.

This report has been prepared by the PI at **Auburn University** and consultants from the **Dredge Research Collaborative**; it also incorporates research and insights from ERDC's **Engineering With Nature®** project team. The full report covers projects of all four participating districts; this excerpt includes only MVN.

Engineering with Nature® is the intentional alignment of natural and engineering processes to efficiently and sustainably deliver economic, environmental, and social benefits through collaborative processes.

Sustainable development of water resources infrastructure is supported by solutions that beneficially integrate engineering and natural systems. With recent advances in the fields of engineering and ecology, there is an opportunity to combine these fields of practice into a single collaborative and cost-effective approach for infrastructure development and environmental management.

The Dredge Research Collaborative is an independent 501c3 nonprofit organization that investigates human sediment handling practices through publications, an event series, and various other projects. Its mission is to advance public knowledge about sediment management; to provide platforms for transdisciplinary conversation about sediment management; and to participate in envisioning and realizing preferred sedimentary futures.

<http://engineeringwithnature.org>
<http://dredgeresearchcollaborative.org/>

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Moore Haven Project Site Project team members inspect existing conditions in November 2018

Introduction

This report concerns the development of innovative design concepts for a set of existing project infrastructures identified by the US Army Corps of Engineers' Engineer Research and Development Center (USACE ERDC). These design concepts combine Engineering With Nature® (EWN®) approaches to infrastructure design with landscape architectural (LA) approaches to infrastructure design in order to identify promising directions for the renovation, replacement, or augmentation of the identified case study infrastructures. Some of the case study infrastructures were completed decades ago, and now require replacement, providing the opportunity to rethink their engineering, form, and performance. Others are transitioning from one stage of their lifespan to another, and require modifications to meet new project goals. A third and final group of case studies are new project infrastructures currently in the design and planning stages, where these proposed designs might be modified to incorporate EWN® and LA principles.

Overall, the aims of this work have been to beneficially apply landscape architectural knowledge to selected public infrastructure resources, to advance transdisciplinary working methods that bring engineers, scientists, and landscape architects together to deal with infrastructural design problems, and to advance understanding of the role of Natural and Nature-Based Features (NNBF) in infrastructure design. As described by the EWN® initiative, "Natural and Nature Based Features are landscape features that are used to provide engineering functions relevant to flood risk management, while producing additional economic, environmental, and/or social benefits. These features may occur naturally in landscapes or be engineered, constructed and/or restored to mimic natural conditions. A strategy that combines NNBF with nonstructural and structural measures represents an integrated approach to flood risk management that can deliver a broad array of ecosystem goods and services to local communities."

The projects selected for the first year of this EWN®-LA research initiative represent a diverse cross-section of the USACE's portfolio of water infrastructure projects: a diversion canal in Louisiana, jetties in Baltimore, a pair of former dredged material placement sites in Florida, and a reservoir tide gate in Texas. Correspondingly, they have presented the project team with the opportunity to consider a diverse range of potential NNBF, which are documented in the following pages.

The full report covers all four case studies. This document is an excerpt that includes only the Moore Haven and W.P. Franklin sites, which are the case study projects for the Jacksonville District.

BACKGROUND

This collaborative research project emerged out of a workshop held at the US Army Corps of Engineers Engineering Research and Development Center in Vicksburg, Mississippi in Summer 2017. In that workshop, personnel from the USACE, members of the Dredge Research Collaborative, and a diverse group of landscape architects identified opportunities to integrate EWN® and LA approaches into new and existing water infrastructure projects and operations.

Engineering With Nature® is an initiative of the US Army Corps of Engineers. It is the intentional alignment of natural and engineering processes to efficiently and sustainably deliver economic, environmental, and social benefits through collaborative processes.

In the EWN® approach, sustainable development of water resources infrastructure is supported by solutions that beneficially integrate engineering and natural systems. With recent advances in the fields of engineering and ecology, there is an opportunity to combine these fields of practice into a single collaborative and cost-effective approach for infrastructure development and environmental management.”

EWN® outcomes are “triple-win”, which means that they systematically integrate social, environmental, and economic considerations into decision-making and actions at every phase of a project, in order to achieve innovative and resilient solutions that are more socially acceptable, viable, and equitable, and, ultimately, more sustainable.

As a field, **landscape architecture** is presently concerned with many of the same issues of infrastructural performance and potential that EWN® is currently pursuing, including in particular

the re-imagination of existing infrastructure to meet more diverse criteria encompassing engineering functions, ecological value, recreational opportunities, and aesthetic benefits. This overlap in concerns suggests that the design principles and precedent knowledge summarized as EWN® approaches may be beneficially combined with the design principles and precedent knowledge that has been accumulating in landscape architectural approaches to infrastructure, such as the work of landscape architects on recent international design competitions that deal with issues of coastal storm protection, public space, and ecological performance, like Rebuild by Design NYC and the Resilient by Design Bay Area Challenge. Moreover, landscape architects bring additional methods and expertise, including design, representation, and communication skills, that can aid in achieving the shared goals of EWN® and landscape architecture.

The members of the **Dredge Research Collaborative** work in precisely this area of contemporary landscape architecture, with a particular focus on coastal and riverine infrastructures that interact with sediment systems, and are correspondingly able to bring familiarity with both the challenges and the opportunities inherent in deploying EWN® approaches to water infrastructure.

PROJECT GOALS

1 Develop Innovative EWN[®]-LA Design Concepts

Develop innovative design concepts that integrate multiple benefits including engineering function, ecological value, recreational benefits, and aesthetic experiences into the selected existing infrastructures. These concepts should incorporate NNBF as a means of achieving these benefits. In some cases, this may mean developing completely new infrastructure design concepts and renderings (in lieu of integration into existing infrastructure) in order to advance the overall purpose of this research project and demonstrate use of alternatives to the existing (or originally proposed) structure(s).

2 Visually Demonstrate Alternatives

Illustrative design drawings and renderings are a primary tool within this project for demonstrating the nature of proposed design concepts. These images are intended to communicate both the form and performance of design concepts.

3 Document Concepts and Process

The project team will develop a report that showcases potential improvements to the infrastructure projects. This report will contain both recommendations of the EWN[®]-LA project team and a detailed description of the research process, including other alternatives that were not selected for the primary recommendations.

4 Disseminate Findings

The project team will incorporate project design concepts into conference presentations and journal articles in order to share the findings of this research. Part of the reason for showcasing alternatives that are not part of the final recommendation is in the hopes that these findings may be useful to other USACE districts considering similar projects in the future.

PROCESS

The first year of this research initiative has been an opportunity to establish a set of collaborative work procedures that involve all of the major project partners: the EWN® project team, including USACE, Auburn, and DRC personnel, and, most importantly, the individual districts that have offered up projects as case studies. These procedures can be divided into four major phases.

Identifying Sites

The first step of work was identifying specific project infrastructures that could benefit from the EWN®-LA research initiative. This work was done primarily through communication between the EWN® team, led by Dr. Jeff King, and the individual district partners.

Site Study and Visits

The second phase involved site visits by the EWN®-LA team to each project site, where the team was hosted by the project staff from the local district. This provided a crucial opportunity to understand the existing performance parameters of the project infrastructure, to understand project needs based on conversations with the local district, and to understand how proposed NNBF might be integrated with existing ecological and human systems.

Before and after these site visits, Auburn and DRC personnel developed study drawings to understand existing conditions at each site, focusing particularly on engineering needs (such as risk reduction), ecological systems, and human factors (such as the availability of recreational opportunities for nearby communities). Some of these drawings are included in this report.

Development of Design Concepts

With the information gleaned from the second phase in hand, the EWN®-LA team assembled in Auburn in January 2019 for a design strategy workshop. The aim of this workshop was to put all possible options for NNBF on the table for each case study, so that each district would be able to evaluate a broad array of options. Over two and a half days of discussion and drawing, the team produced initial versions of the design strategies, each of which contained a distinct idea for bringing EWN®-LA principles to bear on a case study.

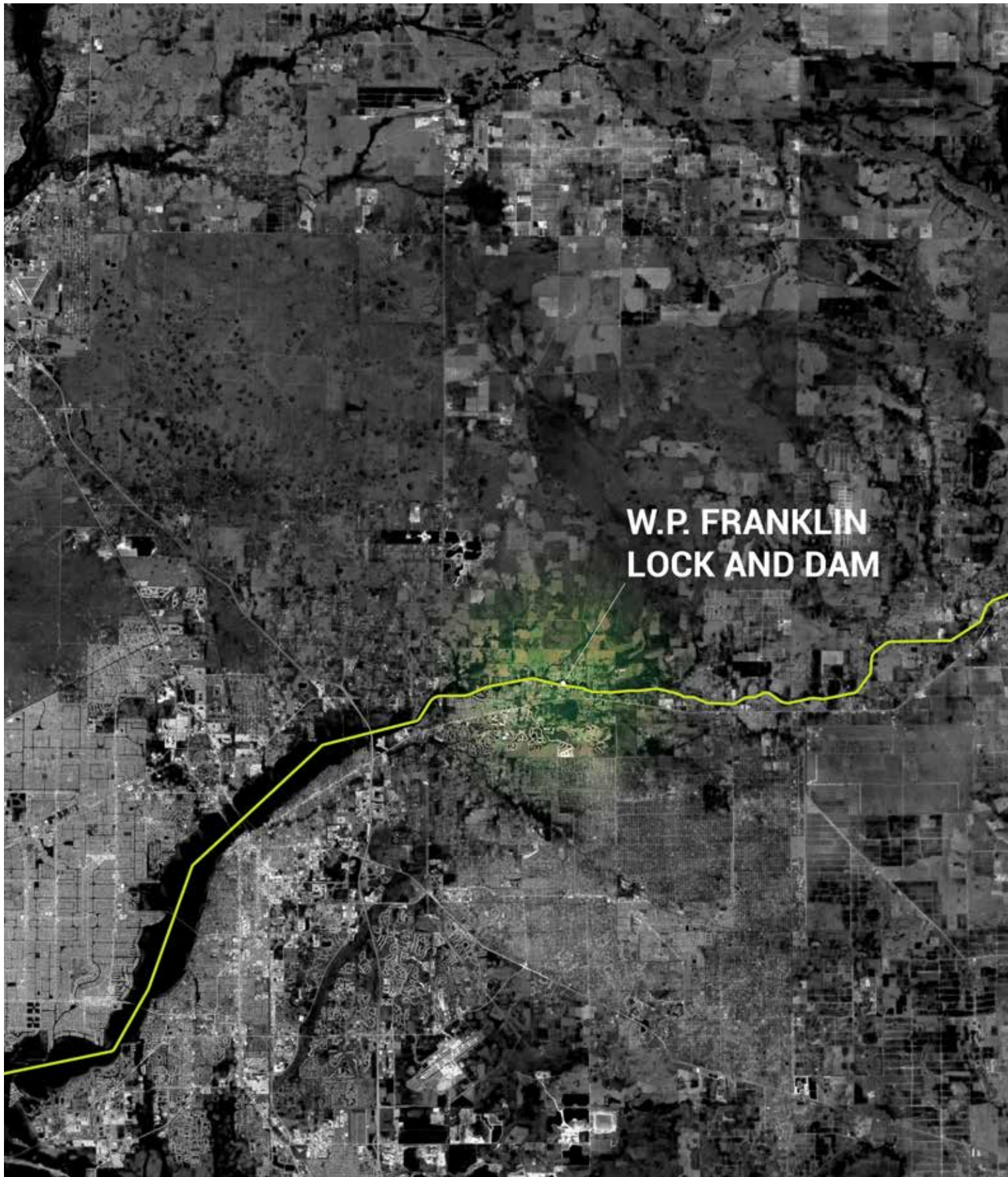
After the workshop, Auburn and DRC personnel developed refined ‘design strategy diagrams’ documenting these ideas. (These diagrams can be found later in this report.) After review by ERDC staff, the diagrams were presented via webinar to each district. Feedback from each district was collected, focusing on which preferred strategies should be further developed for inclusion in the final report.

Final Rendering and Report

Following the receipt of this feedback, the EWN®-LA team worked to synthesize the district’s preferred strategies into a single, more fully-developed design concept recommendation for each project infrastructure. Final renderings were developed and then documented in this report. While further collaboration will be necessary in order to bring these recommendations to fruition, the final renderings are intended to provide a compelling visual description of the great potential that each of these sites offers for incorporating successful, impactful NNBF into the project infrastructure.



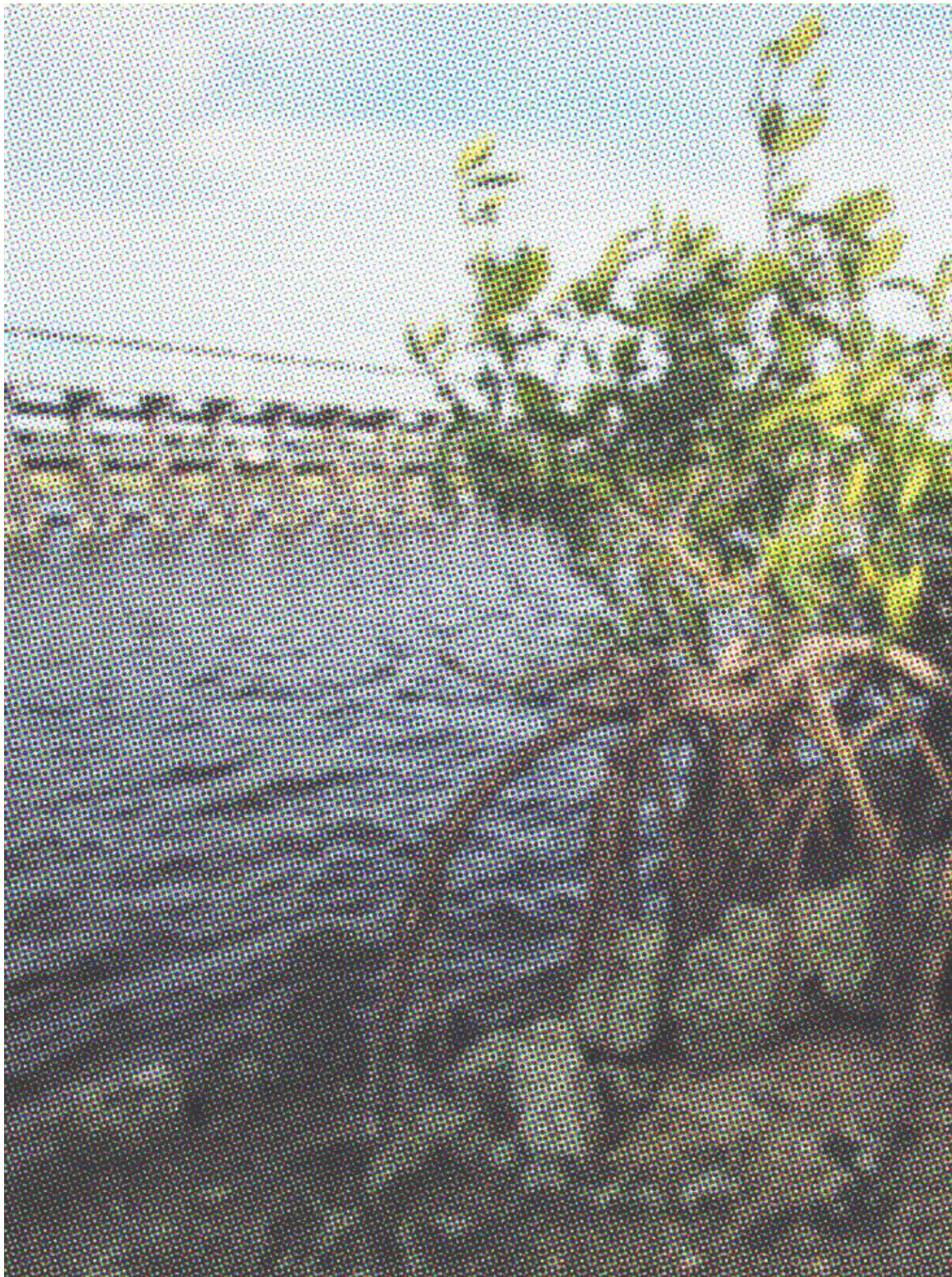
Winter Design Workshop Project team members discuss design concepts in January 2019



Jacksonville District Case Study Context and Project Locations



**MOORE HAVEN
LOCK AND DAM**



Jacksonville District

W.P. Franklin Lock and Dam

The W.P. Franklin Lock and Dam facility is located approximately 12 miles East of Fort Meyers, along the Caloosahatchee River in Southern Florida. The facility consists of both a navigational lock and dam structure that spans the river and an on-shore facility that contains camping sites, day-use amenities and a visitor center with educational components and programs. The site is located in the rapidly developing suburban fringes of Fort Meyers and is seen as a valuable educational and recreational amenity for a growing number of residents.

The Caloosahatchee River is part of the Lake Okeechobee Waterway that traverses Florida, in addition to being part of the larger Central and Southern Florida Flood Control Project--a system that is designed to both provide navigation and flood control. Constructed in 1965, the W.P. Franklin Lock and Dam also aids in the prevention of saltwater migration farther upstream due to its location at the Westernmost end of the waterway.

From meetings with representatives from both ERDC and the Jacksonville district of the United States Army Corps of Engineers, it is understood that future plans for the site may include the removal of the existing beach and the enhancement and re-purposing of the large open lawns located on the southern portion of the site. There is a strong desire to enhance the ecological education components of the facility as a way of increasing visitation and use. The general functioning of the lock and dam infrastructure are not expected to change.

In fall 2018, the Engineering with Nature and Landscape Architecture project delivery team (EWN-LA PDT) was asked to develop recommendations for how the W.P. Franklin Lock and Dam facility might incorporate EWN principles and NNBF. The following pages document the process of developing these recommendations and the recommendations themselves.

OPPORTUNITIES

During the EWN-LA workshop at Auburn University in January 2019, the project team identified a set of key opportunities that guided the development of design strategies and the final recommendation.

1 Habitat Creation

The W.P. Franklin facility presently has an ongoing educational component focused particularly on boat safety, invasive species, and the infrastructural history of the Okeechobee Waterway. We anticipate that the creation of additional habitat areas along with the associated educational programming will enhance the overall educational offerings at W.P. Franklin, making it a more attractive educational destination for residents.

2 Educational Opportunities

Presently the site is managed to support various types of recreation including a beach, and landing strip for RC aircraft. Very little of this management takes habitat possibilities into consideration. The location of W.P. Franklin along the shores of the Caloosahatchee River provide tremendous opportunity for the creation of important habitat. One particularly unique opportunity comes from the sites location at the dam that controls the salinity of the river, thus providing a range of salinity along its shore. In addition, the large open fields can easily be converted to other habitat types without extensive site reconfiguration. Located in the suburban sprawl of Fort Meyers, W.P. Franklin has the opportunity to provide valuable and educational habitat in a region that is quickly losing habitat in the face of development.

3 Recreational Opportunities

The Caloosahatchee river is frequently used as a water-based recreational corridor, thus ensuring that portage and relaxation options exist will be helpful additions to the site. In addition, the provision of areas for fishing, hiking and other forms of passive recreation will be beneficial to larger cross-sections of the resident population.



W.P. Franklin Project Boundary

STRATEGIES

The following three pages show a series of potential design strategies developed in the EWN-LA workshop at Auburn University in January 2019. These strategies were presented to the Jacksonville District in April 2019; SAJ's feedback is described on page 22.

These strategies are intended to represent a broad range of options for implementing EWN principles and NNBF in the context of the W.P. Franklin lock and dam. While all of them had some potential for implementation and have been reviewed by the project team for some measure of feasibility, they were intended to explore a wide variety of both feasibilities and levels of expense.

Some of them, like the idea of "mangrove islands" have been developed further and are reflected in the recommendation. Others, like the idea of "cut and fill landscape", were determined to be infeasible or undesirable for a variety of reasons, and so have not been developed beyond their initial conception. All are documented here both as a reflection of the process involved in preparing this report and in the hopes that they may be useful to future efforts to incorporate EWN and NNBF in other contexts. The next three pages represent the categorization that was used when presenting the strategies and soliciting feedback from SAJ. These categories include:

Ecosystem Composition

This category explores how many and in what configuration the various possible habitats are organized on the site.

Shoreline Modifications

This category looks at a range of possible changes of the shoreline of the site along the river, with a particular focus at the area of the current beach

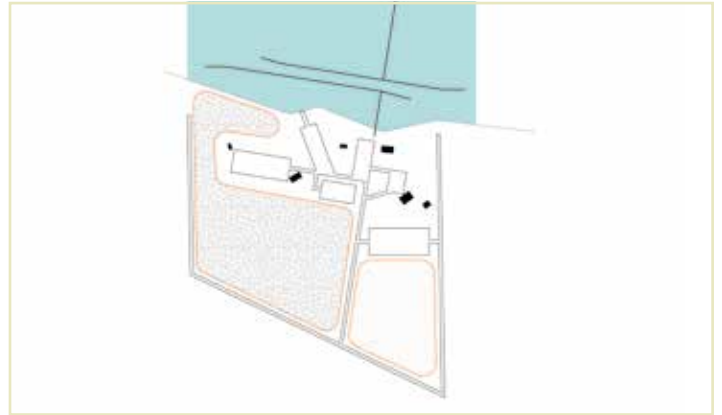
Human Experience

This category explores how visitors will interact with the different habitat zones of the site, with a strong focus on visitor circulation and observation.

1 ECOSYSTEM COMPOSITION

1A TWO PATCHES

Cultivate an ecological patch within each open area on either side of the road / oak allée. This would provide large areas for the establishment of two selected and important habitat types of the region.



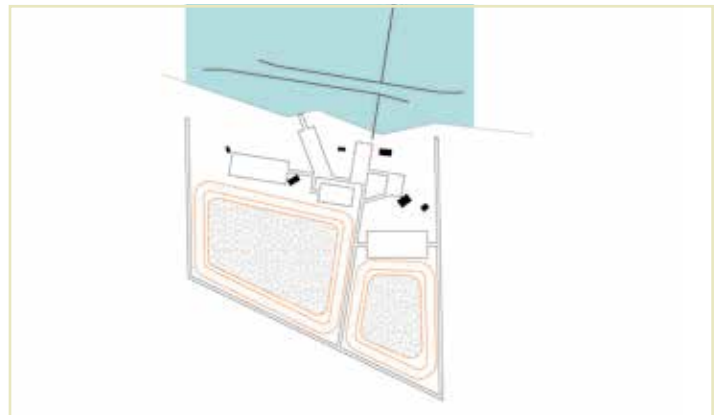
1B DEMONSTRATION

Dividing up the available land throughout the site into smaller patches to demonstrate restoration, ecological management practices, and test alternative groundcover and vegetation strategies for the region. This strategy would have the most obvious variation of types, yet could lack the experiential opportunities afforded by larger zones.



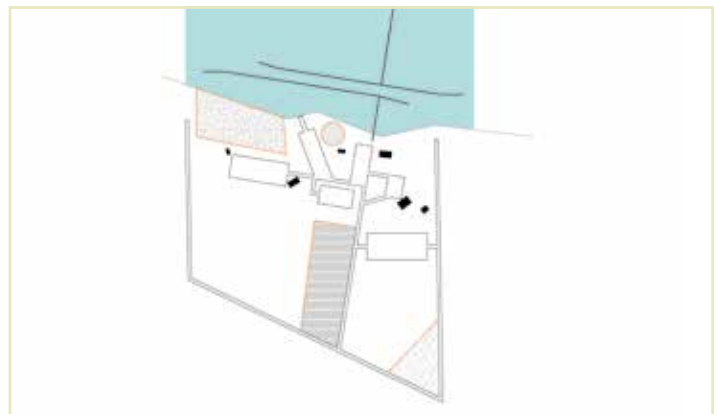
1C INTERIOR / EXTERIOR

Like 1A this strategy would cultivate two different patches on either side of the road. In this case, the patches would consist of an inner protected zone and an exterior zone that circumscribes the interior area. The interiors would function as protected habitat for species that are sensitive to human presence. The zones on either side of the road could be the same or different, offering opportunities for the display of either 2 or 4 different habitat types.



1D STRATEGIC IMPROVEMENTS

This strategy would limit the coverage of interventions to specific locations, and would focus on areas that are deemed the most impactful, while leaving other areas unmanaged for future consideration.

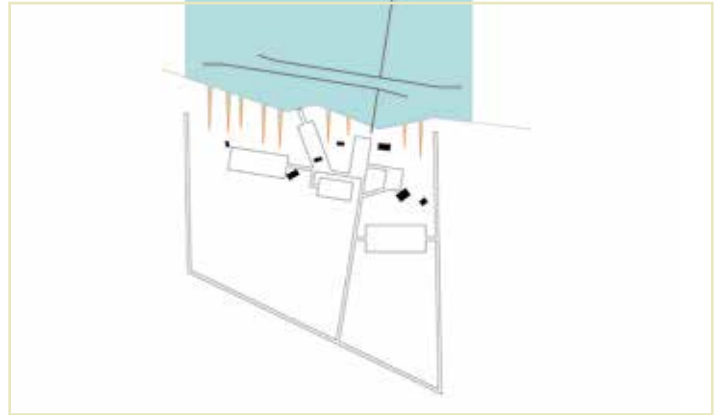


2

SHORELINE MODIFICATIONS

2A INLETS

Linear inlets along the water edge of the site would create more edge condition and sheltered zones for habitat.



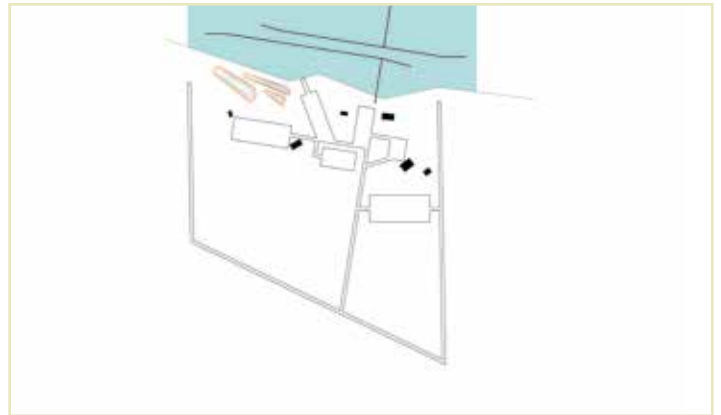
2B MANGROVE ISLANDS

A more elaborate version of 3A, this strategy would use processes of cutting and filling along the water edge of the site to create a series of islands would increase edge habitat and prepare the site for mangrove restoration. Islands could be both accessible via bridges and inaccessible, used primarily for sensitive birds and amphibians.



2C MICRO DUNES

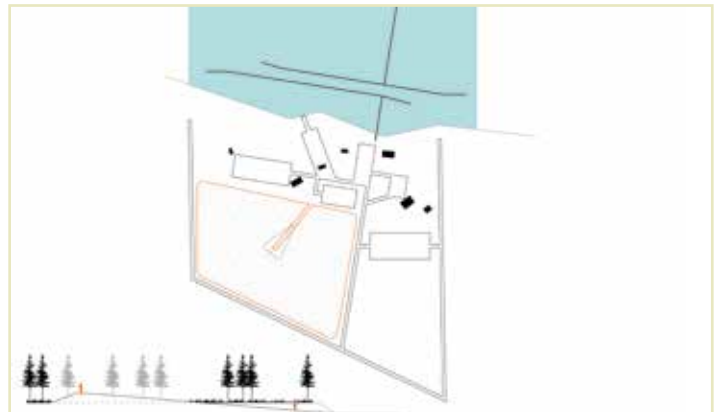
The micro-dune would use dredge material and the existing beach sand to create a dune landform, showcasing the potential for dune restoration in Florida. There could however be concern regarding the scale of this intervention being too small for any impact / habitat, in addition to its inaccurate location along an inland waterway.



3 HUMAN EXPERIENCE

3A MOUND SLICE

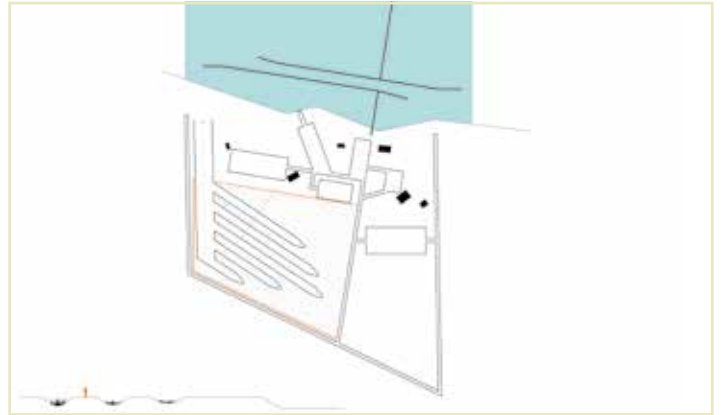
Adjacent wetlands and areas along the length of the This would focus ecological restoration on the largest contiguous area of land on the site. A cut and fill pathway would gradually ascend along a mound landform towards an overlook in the center of the large ecologically restored area for recreational viewing that would restrict access in other areas of the restored zone.



3 HUMAN EXPERIENCE CONT.

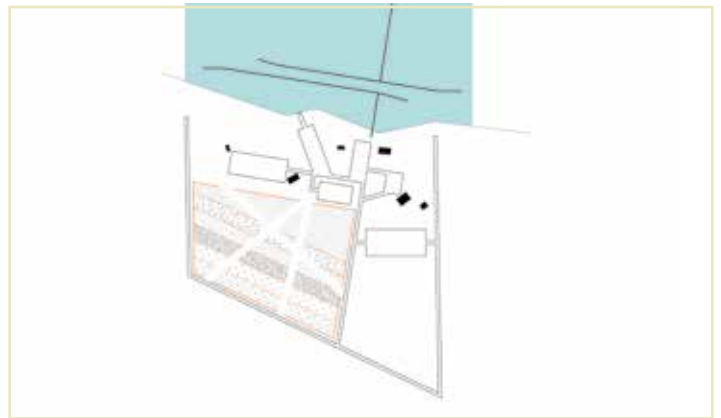
3B TERRACE AND SWALE

A series of terraces would be created with minor swales that drain into a larger vegetated swale that would connect to the waterway.



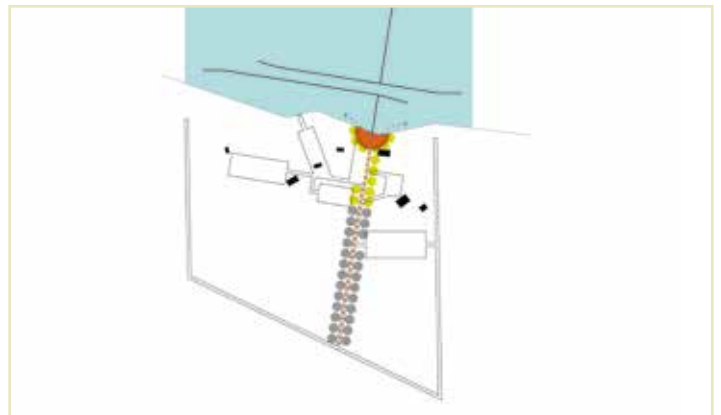
3C MEADOW SLICE

This would create various zones of meadow vegetation that would overtime become forested. Paths would be mown seasonally for recreation and maintenance access.



3D ALEE EXTENSION AND PORTAGE GROVE

Extending the allé of Southern Live Oaks and planting a grove by the lock would create linear continuity through the site and a destination at the lock. The oak grove would have a portage route that allows kayakers to safely travel around the lock and re-enter the waterway



3E CUT AND FILL LANDSCAPE

This strategy would create a number of mounds and ponds throughout the two larger areas of the site. The topographic diversity would allow a diversity of vegetation and habitat conditions.



PREFERRED STRATEGIES

The following summarizes feedback received from SAJ regarding the strategies.

1 Ecosystem Composition

The “two Patch” concept was indicated as the highly preferred option, with the “Demonstration” concept being indicated as the least preferred due to how patchy it appeared. The ideas of “Interior / Exterior” and “ Strategic Improvements” were selected as being acceptable, and possible alternatives depending on funding sources.

2 Shoreline Conditions

In this section, none of the options were highly preferred. However the idea of “Mangrove Islands” was seen favorably if combined with the “Inlets” strategy. This preference assumes the ability to control the spread of the mangroves in addition to not interfering with lock and dam operation. The “Micro Dune” idea was also seen as acceptable but it was agreed that this idea was mis-scaled and located here along the waterway and would be better served in more coastal location fitting of a sand dune.

3 Human Experience

The “Meadow Slice” option was selected as being the most preferred in this category, particularly because of its high level of public exposure and the ease of maintenance with existing resources. The “Mound Slice” was seen as acceptable, while the other options were not preferred. Issues with mosquitoes were raised with conditions that promoted open water, and proposals that could possibly interfere with the structural workings of the lock and dam were also discouraged.

4 Habitat Types

While actual habitat types were not ranked based on preference by SAJ, there was an indication that habitats should be successional and showcase the transitions from one habitat type to the other as visitors move through the site. For more specifics on recommended species, please refer to the recommendation section of this report on the following pages.



RECOMMENDATION

Our recommendation describes three primary habitat areas of the site:

- 1) Pine Flatwoods
- 2) Sandhills
- 3) Mangrove Islands.

These three areas are located on the southern open areas and the river shoreline respectively. This recommendation takes inspiration from many of the SAJ preferred options including “Two Patches” and “Interior/Exterior” habitat configurations, the “Mangrove Islands” shoreline concept and the “Meadow Slices” for pathways. The overall plan is meant to blend both highly engaging and experiential habitat types with maintenance strategies that can largely be conducted by existing operations personnel and volunteers. More detailed descriptions of each of these habitat areas can be found on the following pages.

Stitching these three areas together will be the effectively untouched vehicular circulation and parking areas throughout the site, in addition to a large percentage of the existing vegetation that is planned to remain. Augmenting the existing circulation, a new set of paths of various materials will link across the different habitat types, allowing visitors to transition seamlessly from one ecosystem to another.



Plan of W.P. Franklin Recommended Design

Pine Flatwood and Prairie

The Pine Flatwood portion of the site will be representative of one of Florida's great natural habitats. Here Slash Pines can be planted at varying densities to create both open and closed areas. Saw Palmetto and other plants will fill in the remaining openings. To function properly, flatwoods must be regularly burned every 3 to 5 years. If fires do not occur, the flatwood will transition into a hardwood dominated forest of full canopy trees, and the slash pine will not be capable or reproducing. While this will be a maintenance expense, the educational value of the event would be highly beneficial for visitors wishing to understand more about how this valuable ecosystem functions. Threatened species targeted with this habitat include the eastern indigo snake, the southeastern kestrel, and the caracara

Paths and Signage

Paths within the Pine Flatwood area will be simple mowed, cutting diagonally through the more varied and natural assembly of pine trees. Signage describing the ecosystem and the species found there will be located near the parking area in the Northeastern section of the flatwood.

Flora:

There are a range of plants that thrive within the Pine Flatwoods ecosystem, however the most essential species are a follows:

Slash pine (*Pinus elliottii*)

Saw Palmetto (*Serenoa repens*)

Blueberry (*Vaccinium darrowii*)

Wiregrass (*Aristida stricta*)



View from Pine Flatwood

Sandhills

The Sandhill ecosystem is more dominant to the North of the W.P. Franklin site, but is extensive enough to easily be re-created here. One of the reasons this is possible is due to the sandy soil found on the site. Like the Flatwoods, the Sandhill ecosystem must also be burned every 3-5 years. The burning of each area should not be done on the same cycle in order to encourage site diversity. The thick sand layer of soil and more dispersed trees help characterize the sandhill ecosystem. Threatened species targeted within this habitat include the red-cockaded woodpecker and the gopher tortoise

Paths and Signage

There will be several simple gravel paths through the sandhill area, but because of the open spacing of the trees, visitors should be permitted to wander among the trees as they see fit. However, on occasions where sensitive and threatened species are discovered -- such as a gopher tortoise -- measures must be taken to cordon off these areas to prevent disturbance. If this system proves unsatisfactory, simple removable rope rails can be installed to more precisely indicate path locations. The sandhills will be reached after passing through a portion of the flatwood, thus the signage location in the Northeastern area of the flatwoods near the parking will also have information applicable to the sandhills.

Flora:

Many of the same species of the sandhills are shared with the flatwoods. At W.P. Franklin the sandhills will lean heavily on the wildflower components of the ecosystem to establish a more clear separation between the two. Additionally, saw palmetto is a less essential component of the ecosystem and will be more discouraged here than in the flatwood. Essential species will be as follows:

Slash pine (*Pinus elliottii*)

Turkey Oak (*Quercus laevis*)

Prickly Pear Cactus (*Opuntia humifusa*)

Golden Aster (*Pityopsis graminifolia*)

Lopsided Indian Grass (*Sorghastrum secundum*)

Blazing Star (*Liatris garberi*)



View from within the Sandhills

Mangrove Islands

The location of W.P. Franklin along the Caloosahatchee River provides a unique opportunity to explore the possibilities of Florida's wide-ranging wetland habitats. Because of the dam structure, the site has a very unique gradient of salinity along its length, so finding species that can take advantage of that situation are important. Mangroves have slowly begun to occupy the site and it is recommended that this be permitted to continue and be enhanced as one of the primary features of the coastline. A new heavily vegetated shoreline will be much more resilient and habitat-rich than the presently mowed shore and beach. The endangered species targeted here would be the Wood Stork and Snail Kite.

Paths and Signage

A boardwalk will allow visitors to navigate the shore and the islands created there safely. Signage will be placed at both ends describing the habitat types and species that could be found there. Seating will also be placed in these areas.

Flora

The primary species of this zone will be the mix of Red, Black and White mangroves which can easily be located based on inundation requirements due to the somewhat stable water levels of the river as compared to the more fluctuating tidal coast. As the present northern range for mangroves, colder temperatures will aid in controlling spread and size. Recommended species are as follows:

- Red Mangrove (*Rhizophora mangle*)
- Black Mangrove (*Avicennia germinans*)
- White Mangrove (*Laguncularia racemosa*)
- Buttonwood (*Conocarpus erectus*)
- Salt Bush (*Baccharis halimifolia*)



View from Mangrove Islands Boardwalk



Jacksonville District

Moore Haven Lock and Dam

The Moore Haven Lock and Dam is located on the Western shore of Lake Okeechobee and is the initial structure to input water into the Caloosahatchee River along the Okeechobee Waterway that spans the state of Florida. At the Moore Haven site, the lock and dam structure are integrated within the Herbert Hoover Dike that encircles lake Okeechobee. This 143-mile long dike provides flooding protection and storage capacity for one of the largest lakes in the United States, and is fundamental part of the Central and Southern Florida Flood Control Project.

From meetings with representatives from both ERDC and the Jacksonville district of the United States Army Corps of Engineers, the priority at Moore Haven is how to address the site of a failed campground Northwest of the lock and dam structure. This area has unsuccessfully operated as a campground for an extended period of time and it has been decided to convert it to something more ecologically-focused. A desire was expressed to provide ecological engagement opportunities to the area in a day-use format that could provide ecosystem enhancement while also generating amenities for the local residents of Moore Haven and beyond. The general functioning of the lock and dam infrastructure are not expected to change.

In fall 2018, the Engineering with Nature and Landscape Architecture project delivery team (EWN-LA PDT) was asked to develop recommendations for how reconsider the former campground site so that it could incorporate EWN principles and NNBF. The following pages document the process of developing these recommendations and the recommendations themselves.

OPPORTUNITIES

During the EWN-LA workshop at Auburn University in January 2019, the project team identified a set of key opportunities that guided the development of design strategies and the final recommendation.

1 Recreational Opportunities

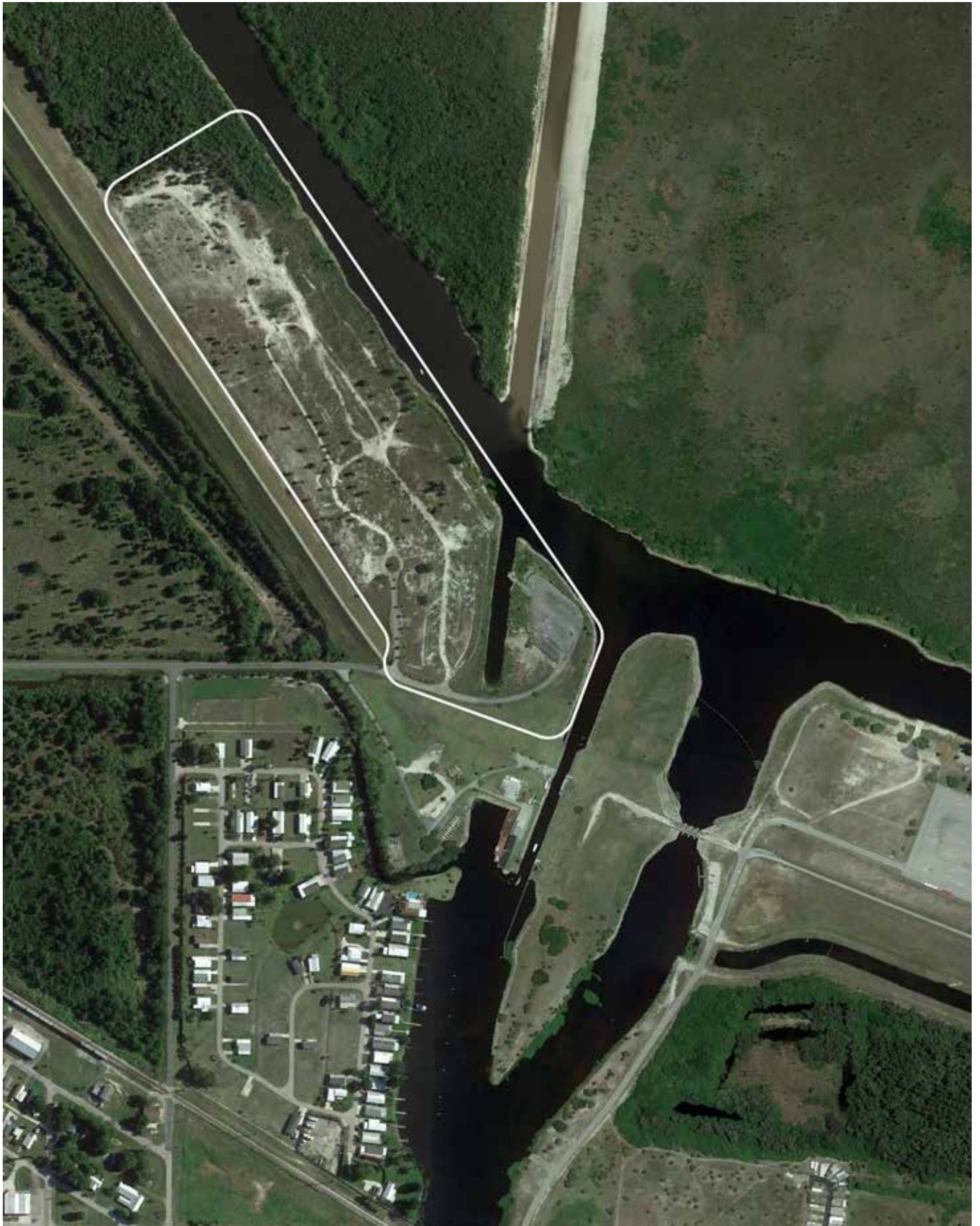
The More Haven Lock and Dam is located directly adjacent to the Herbert Hoover Dike trail and the small town of Moore Haven. The dike trail is used extensively for hiking by visitors, both local and from afar. The project site provides immediate access to this trail and could serve as a day-use stopping location for trail-goers. Kayaks are launched from the slip located near the parking lot and the site is used frequently for fishing. It is clear that camping is not a viable form of recreation at the site, but there is significant opportunity for short-term day uses that include more passive recreation.

2 Habitat Creation

The site's location on the shores of lake Okeechobee provide a unique opportunity to create a valuable habitat area that could be easily accessed by a range of visitors. The habitats created here could take advantage of the coastal condition and the high water-table to increase the existence of hydric soils and the species that benefit from them.

3 Site Regeneration

The site itself is composed of poor sandy soil, most likely dredged from the adjacent channel and river. This soil is incapable of growing many plants, and thus supports few terrestrial species of fauna. However, the wholesale ecological enhancement of the site is not financially feasible, as it would require a tremendous amount of both earthmoving and restorative planting. There is however an opportunity to restore the site through selective earthwork operations and planting that will catalyze a more long-term natural process of site regeneration. Parts of the site itself have a limestone-based bedrock at the surface. These areas could be leveraged to tell a geologic history of the site, as they are likely too large to remove.



Moore Haven Project Boundary

STRATEGIES

The following four pages show a series of potential design strategies developed in the EWN-LA workshop at Auburn University in January 2019. These strategies were presented to the Jacksonville District in April 2019. SAJ's feedback is described on page 39.

These strategies are intended to represent a broad range of options for implementing EWN principles and NNBF in the context of the Moore Haven lock and dam. While all of them had some potential for implementation and have been reviewed by the project team for some measure of feasibility, they were intended to explore a wide variety of both feasibilities and levels of expense.

Some of them, like the idea of "Dozer Ditches" have been developed further and are reflected in the recommendation. Others, like the idea of "Edge to Upland", were determined to be infeasible or undesirable for a variety of reasons, and so have not been developed beyond their initial conception. All are documented here both as a reflection of the process involved in preparing this report and in the hopes that they may be useful to future efforts to incorporate EWN and NNBF in other contexts. The next four pages represent the categorization that was used when presenting the strategies and soliciting feedback from SAJ. These categories include:

Cut and Fill

These strategies looked at various ways of earthmoving that could possibly benefit the habitats and visitor experience of the site.

Planting

A range of planting strategies were conceptualized as a way of exploring the possibilities of re-vegetation and maintenance.

Paths and Recreation

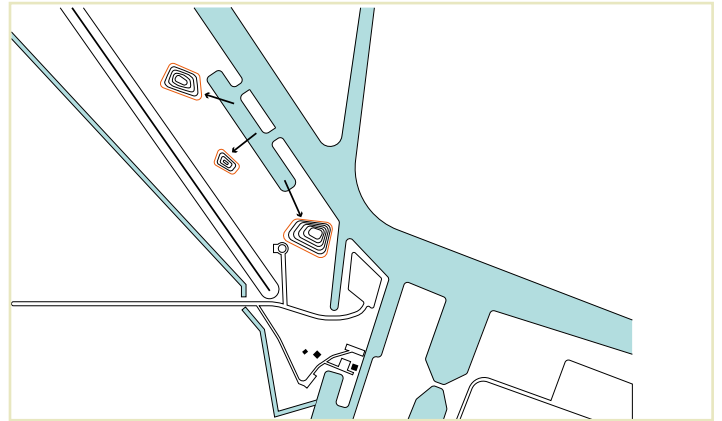
These strategies described different methods of providing visitor access and use of the site.

1

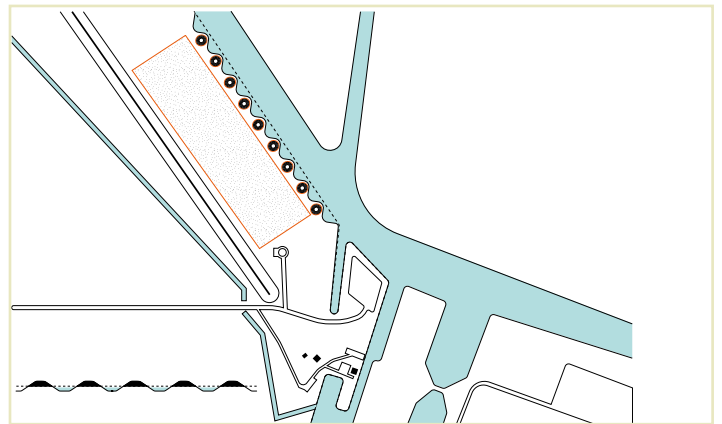
CUT AND FILL

1A **EDGE TO UPLAND**

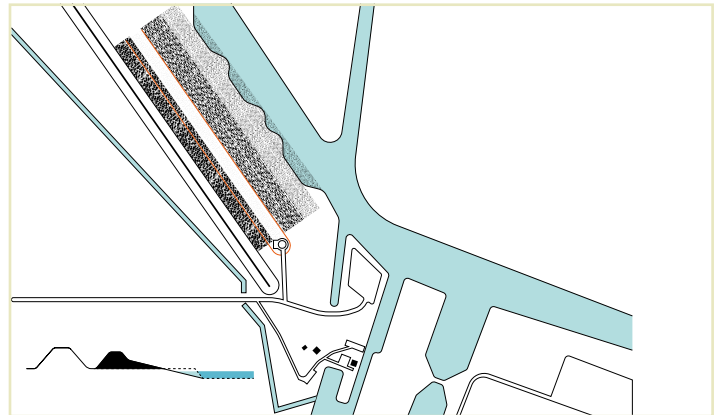
By excavating material at the edge of the site it is possible to create some protected water habitat in conjunction with mounds and upland topography.

1B **MICRO EDGE TOPOGRAPHY**

By small-scale cutting and filling along the edge of the channel, it is possible to create a more varied edge condition habitat.

1C **GRADIENT TOPOGRAPHY**

This strategy would use material excavated from the shoreline area to build topography in a gradient along the channel, with the highest areas near the existing dike.

1D **EXCAVATOR CUT AND FILL**

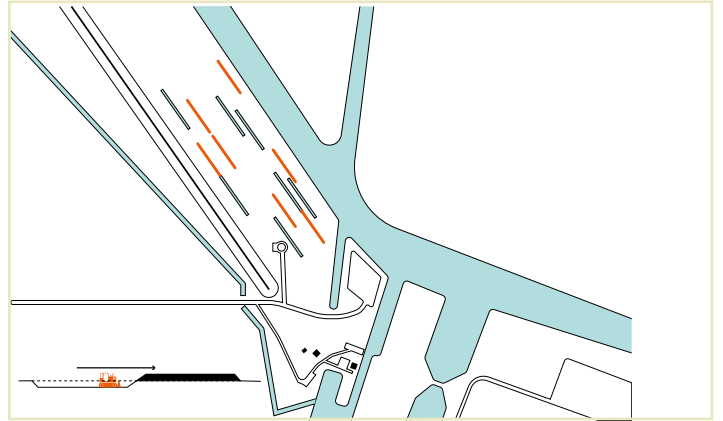
Using the geometry of the excavator, this strategy creates topographic diversity across the site that would host particular habitat and vegetation regimes that are adapted to the depressed and elevated conditions created by the excavation/placement process.



1 CUT AND FILL CONT.

1E DOZER DITCHES

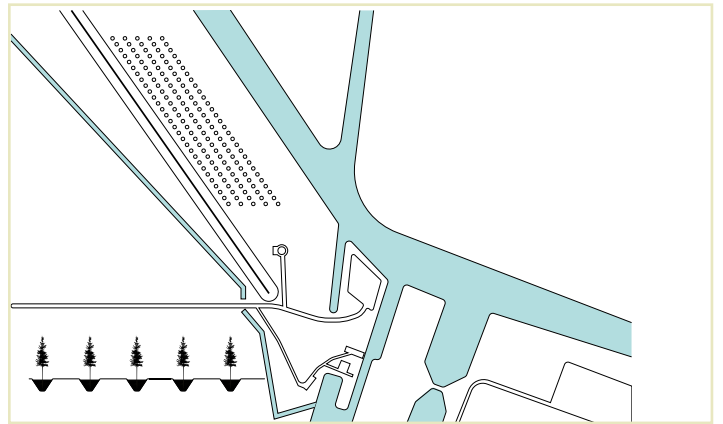
Following the linearity of the site, this strategy would create ditches and berms using a straightforward method of excavating and placing along straight lines. Like option 1D, this strategy would create a type of topographic diversity that would allow for the selective colonization of species based on elevation.



2 PLANTING

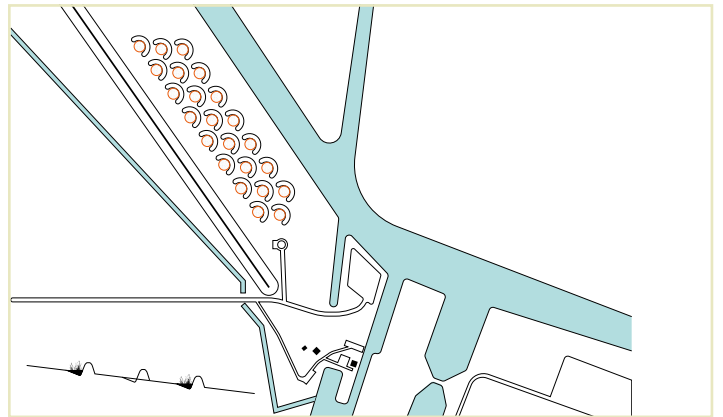
2A ZIA HOLES

A strategy used in Africa, Zai holes are depressions or holes created for establishing plantings in difficult soil/climate conditions. This strategy would selectively excavate and amend areas to promote the growth of singular plants, thus reducing the amount of remediation need to establish vegetation.



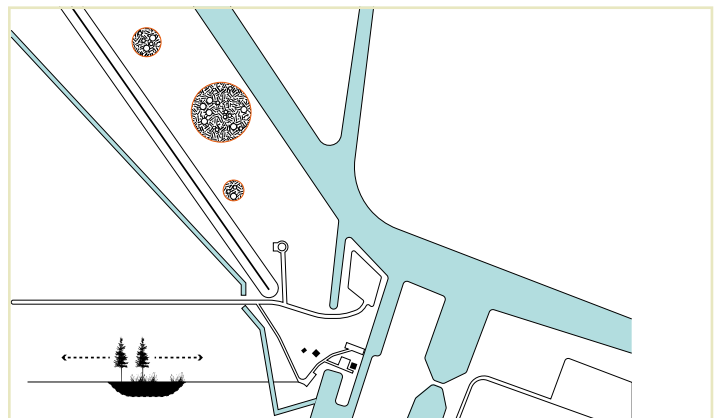
2B BOOMERANG BERMS

Small berms in the form of a boomerang or other shape would create micro topographies to support revegetation of the sloped landscapes by holding water and creating areas of saturation.



2C NURSE TREES

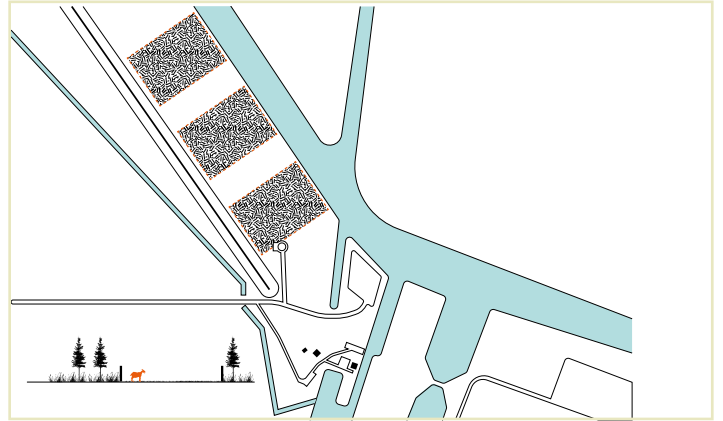
By focusing on particle areas, select improvement and nurse trees would be used to cultivate particular ecological zones of higher intensity.



2 PLANTING CONT.

2D GRAZING MANAGEMENT

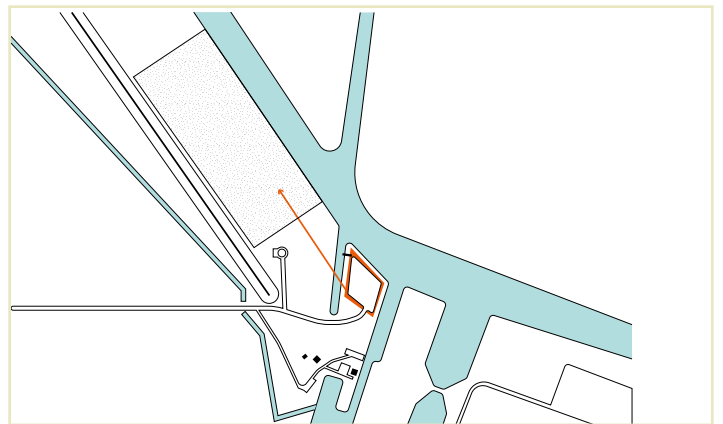
This strategy would use temporary fencing to enclose and rotate grazing animals across the site to manage the vegetation and remediation of the soils.



3 PATHS AND RECREATION

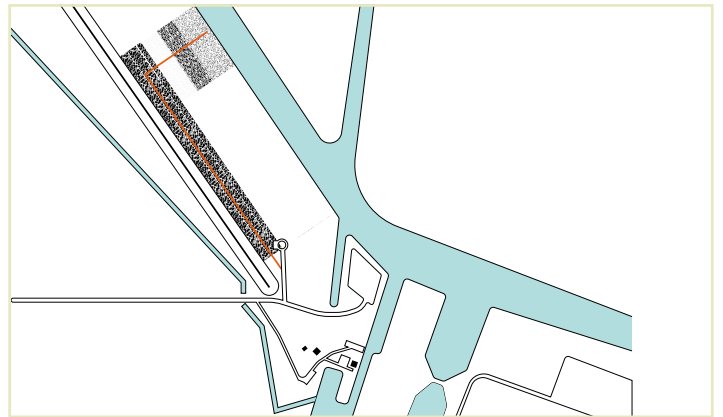
3A KAYAK AND PARKING

A kayak landing could be strategically located within the existing slip, next to parking, providing safe and convenient access into the water without disturbing other parts of the site.



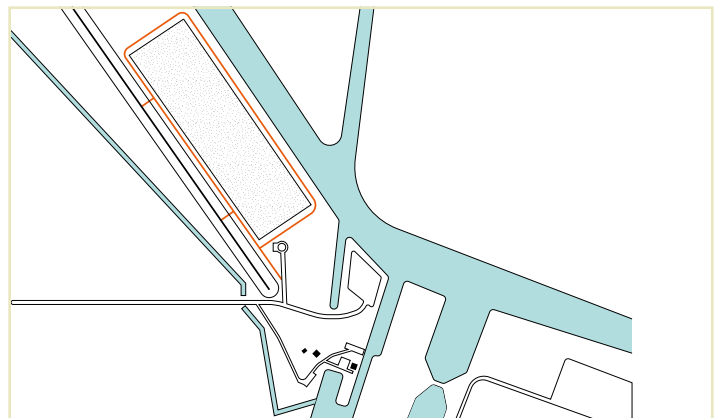
3B TRANSECT TRAIL

The transect trail would take a short linear transect through the site, providing a slice of the ecological conditions and experiences.



3C CIRCUIT PATH

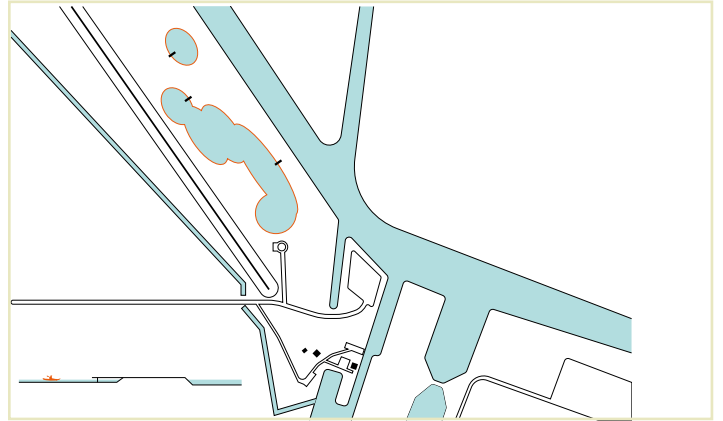
This path would circumnavigate the site, leaving the core open and more attractive to sensitive habitats while still providing observation opportunities from the perimeter. This path would connect to the existing dike trail.



3 PATHS AND RECREATION CONT.

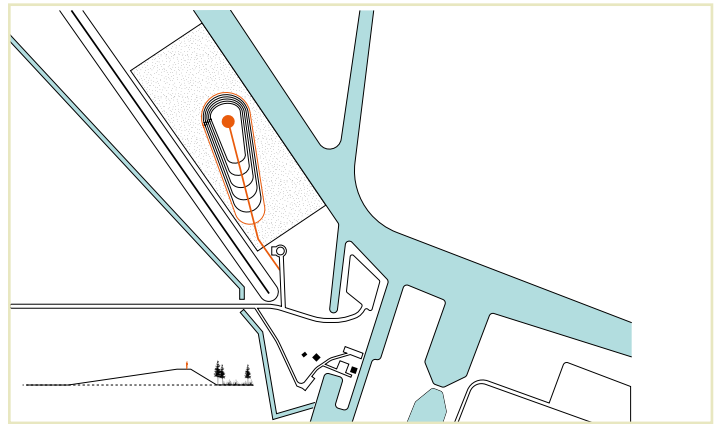
3D KAYAK POOLS

Kayak pools would create safe and ecologically interesting pools that are sheltered from the main channel.



3E HIGH POINT

Using excavated or available imported material, a highpoint could be created for a more dramatic view of the site and the surrounding Okeechobee landscape.



PREFERRED STRATEGIES

The following summarizes feedback received from SAJ regarding the strategies.

1 Cut and Fill

Of all the strategies presented, “Excavator Cut and Fill” and “Dozer Ditches” were the most preferred, due to their ease of implementation. “Micro Edge Topography” was also seen as acceptable, however it, like some other options, raised concerns about the impacts of the project on the existing shoreline infrastructure.

2 Planting

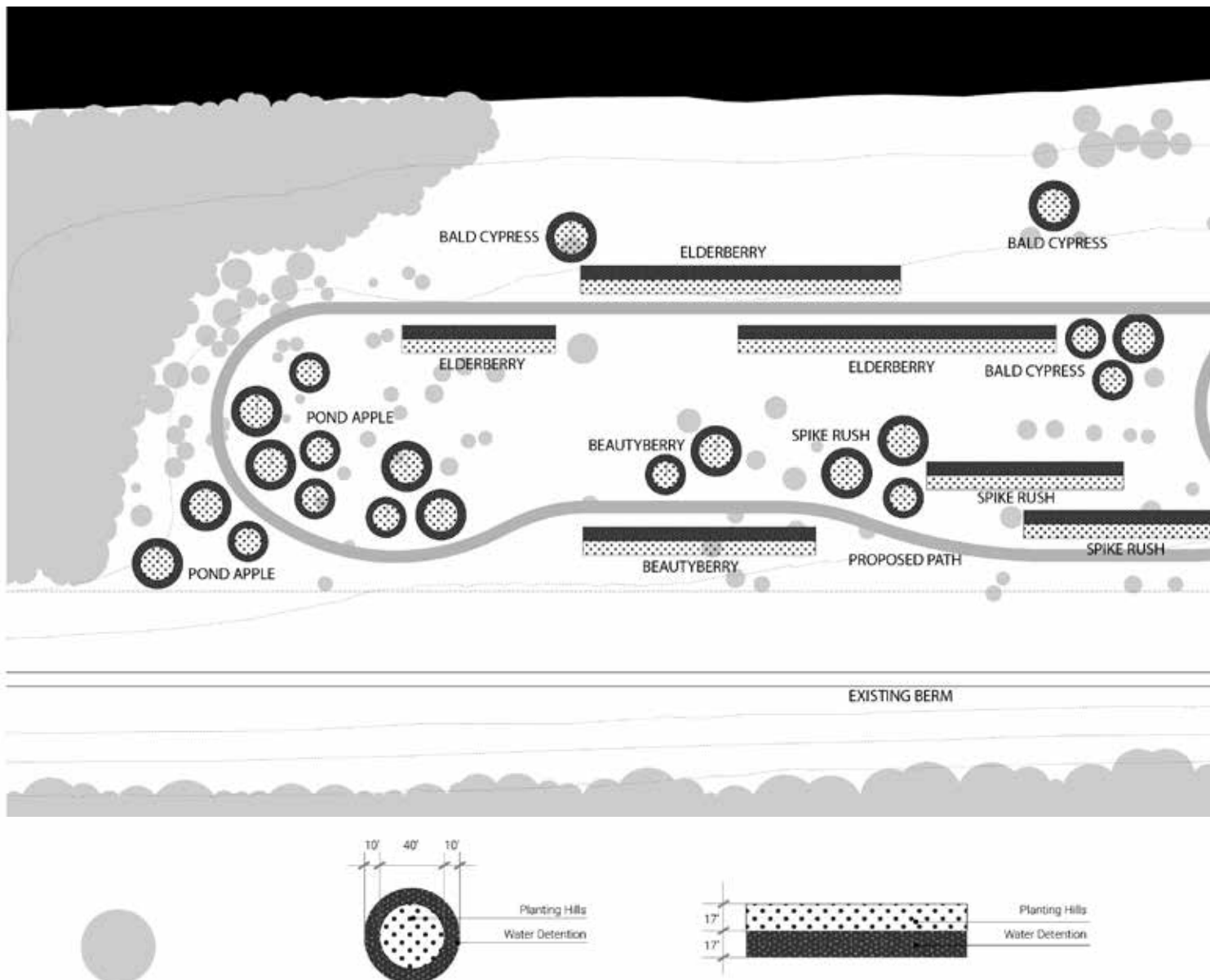
With respect to planting options, none of the options were seen as completely unacceptable. However the concept of “Nurse Trees” was the most preferred, again because it requires a small initial investment as assumes that the site can regenerate through time. “Zia Holes” would also provide a similar opportunity by only planting and restoring very specific locations on the site. The idea of incorporating animals as grazers to help transform the site was not seen as feasible or acceptable.

3 Paths and Recreation

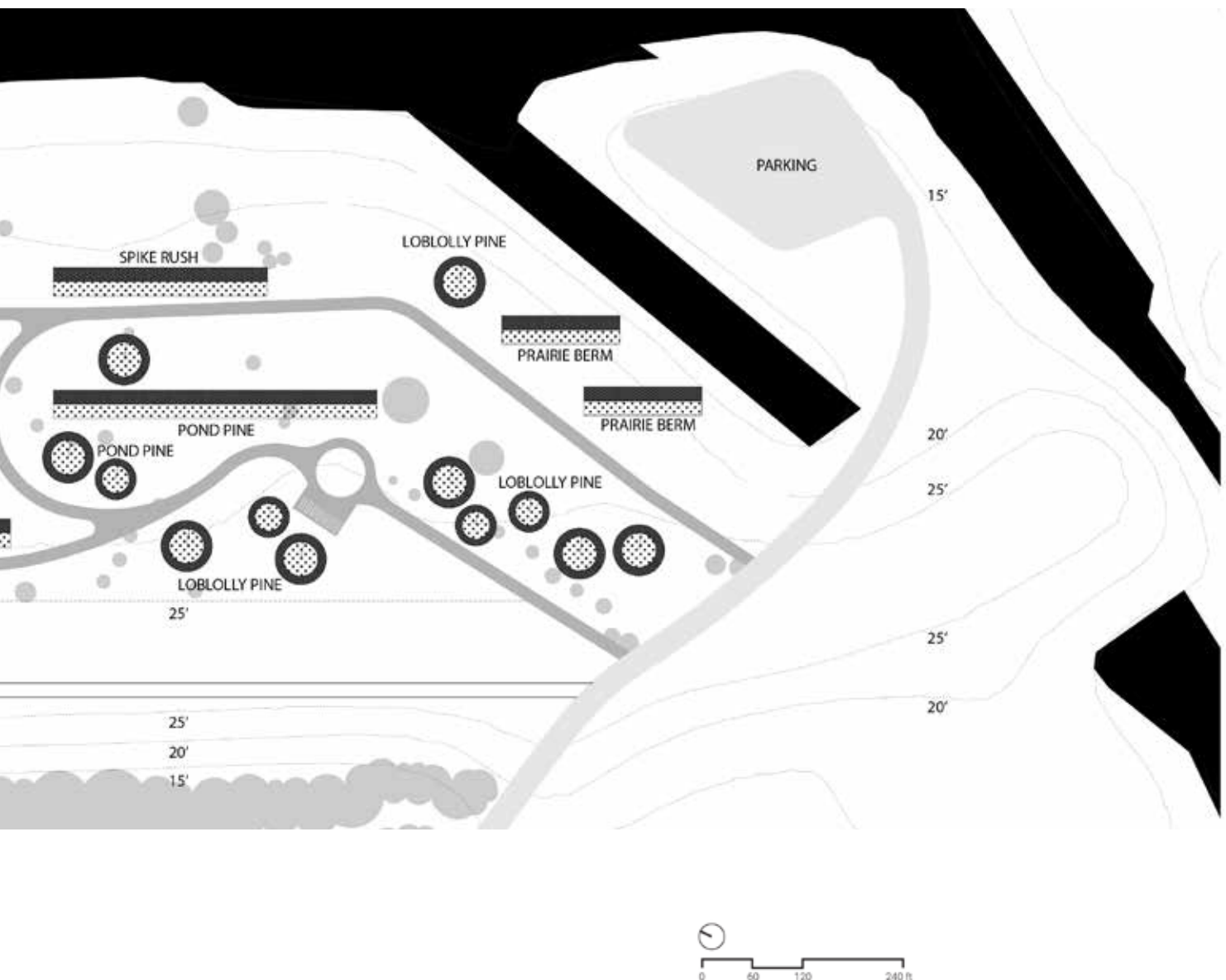
The feedback for the location of paths was quite varied, with ideas of the “Transect Trail” and “Kayak and Parking” being seen as the most acceptable options. “High Point” considered redundant due to the views available from the neighboring Herbert Hoover Dike, and any proposals that connected to the dike itself were also considered infeasible. “Kayak Pools” were also not preferred, but no justification was given. It is assumed that this type of active recreation is not favored at the interior of the site, or worth all of the excavation necessary. A recommendation was provided to use crushed shells for the path surface.

RECOMMENDATION

Our recommendation assumes that the vast majority of the site will remain untouched simply due to funding limitations. Modification of the site near the Herbert Hoover Dike and the canal have been minimized. Improvements will happen as insertions into the existing site as opposed to a complete re-construction. These improvements include a mix of excavator and bulldozer operations in order to create low areas for water to collect and new habitats to develop. These areas could then be augmented with better-quality soil from elsewhere and then planted. The species planted in these small areas would function as nurseries, slowly spreading from them to other portions of the site, promoting a long-term larger site restoration.



A circuit path will run through the site, exposing visitors to the wide range of ecosystems and habitats that are created through the excavation and planting operations. These operations include the creation of a collection of “islands” with the excavator that will provide protected habitat areas for specific nurse plantings, and the creation of a series of ridge/swale forms that run the length of the site that provide water catchment and storage in addition to more linear ecological experiences for visitors. Parking is focused in the existing parking location to the Southeast of the site. Passive recreation, with an emphasis on wildlife observation, will be prioritized; while highly active forms of use, including overnight activities will be discouraged.







Bird's eye view of Moore Haven

Experience

Entering from the parking area to the South East, visitors can follow the circuit trail through the entire length of the site. This trail is made of readily-available crushed shells and should be adequately compacted to ensure accessibility for limited-mobility visitors. The gently curving path slides between enhancement areas of the ditches and islands and allows for an ever-changing experience. Benches should be located strategically to provide opportunities for visitors to rest or quietly observe wildlife throughout the site. Initially the geometrically rigid forms of the ditches and islands will be clearly evident to visitors, but over time, as water and plants begin to overtake these areas and spread, they will become more blurred and natural in appearance. The limited areas of enhancement will always provide the opportunity to see remnants of the former site conditions, in particular, the underlying bedrock and the shrubs and grasses that had acclimated themselves to the harsh soil conditions.

Habitats

The Moore Haven site is located at the intersection of USDA Hardiness Zones 9b and 10a. This particular location has historically contained a mix of prairies and freshwater marshes. These areas contain very few canopy trees, but Pond Apple, Coastal Willow and Swamp Tupelo can be found here. On the former campground site, due to the substrate of dredged material and frequent disturbance, the ecosystem value is quite limited, thus work will be necessary to re-introduce a more productive series of habitats. This process will take place primarily within the small earthwork zones of the site. Here the elevated areas can be supplemented with better soil and can be used to introduce more historically characteristic prairie and pine flatwood species. In the depressions, local marsh plants should be planted. In both the upland and wet conditions, some areas should remain un-planted to allow local species to self-populate. The minimum recommended species for each of these areas are as follows:

Upland

Trees

Pond Apple (*Annona glabra*)

Loblolly Pine (*Pinus taeda*)

Pond Pine (*Pinus serotina*)

Bald Cypress (*Taxodium distichum*)

Shrubs

Elderberry (*Sambucus nigra*)

Beautyberry (*Callicarpa americana*)

Spiny Black Olive (*Terminalia molinetii*)

Other

Pink Sundew (*Drosera capillaris*)

Yellow Colicroot (*Aletris lutea*)

Blazing Star (*Liatris garberi*)

Wetlands

Trees

Coastal Plain Willow (*Salix caroliniana*)

Swamp Tupelo (*Nyssa sylvatica*)

Shrubs

Buttonbush (*Cephalanthus occidentalis*)

Salt Bush (*Baccharis halimifolia*)

Sand Cordgrass (*Spartina bakeri*)

Other

Pickrel Weed (*Pontederia cordata*)

Gulf Coast Spikerush (*Eleocharis cellulosa*)

Fauna

While it is impossible to predict exactly what animal and invertebrate species will call Moore Haven home it is hoped that it will attract locally threatened species such as the Snail Kite, Scrub Jay, Wood Stork, and Eastern Indigo Snake.



View from Pond Apple Grove



View from Herbert Hoover Dike