Engineering With Nature® + Landscape Architecture

Comite Canal

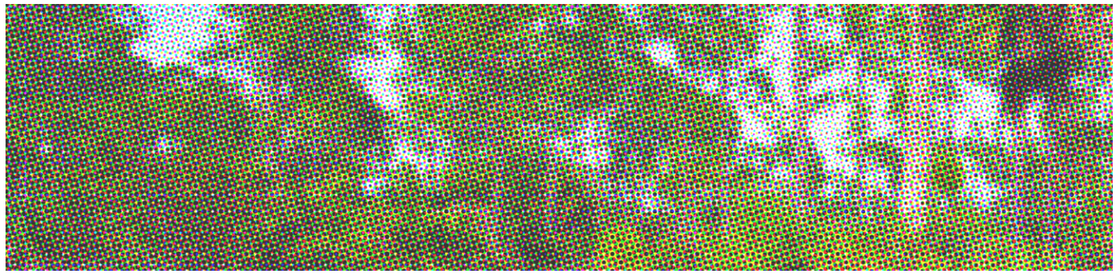
a report identifying design concepts for incorporating Engineering With Nature® and Landscape Architecture approaches into US Army Corps of Engineers project infrastructure

US Army Corps of Engineers®

EWN®

AUBURN UNIVERSITY

Dredge Research Collaborative



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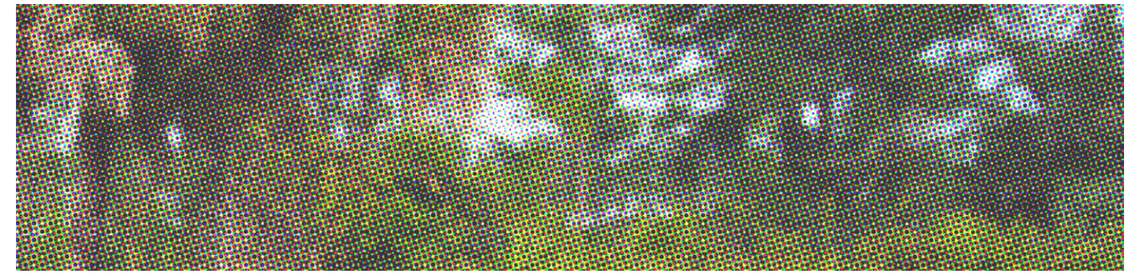

This report covers findings from research cooperative agreement W912HZ-18-2-0008 **Incorporating Engineering With Nature® (EWN®) and Landscape Architecture (LA) Designs into Existing Infrastructure Projects**, an agreement between the **U.S. Army Engineering Research Development Center** (ERDC) and **Auburn 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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Lily Bayou Control Structure 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 Comite River Diversion Canal, which is the New Orleans District case study.

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.

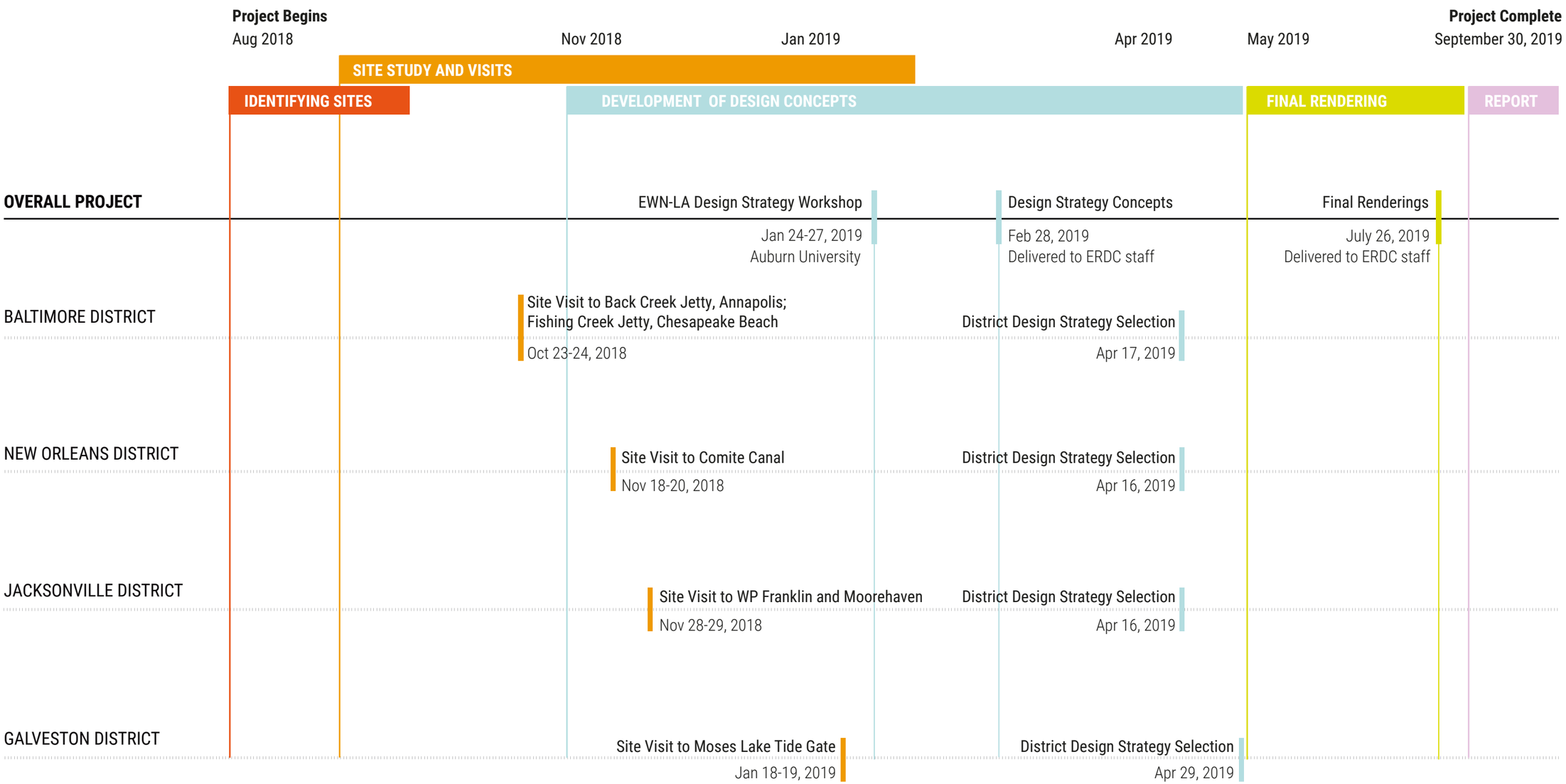
3 Document Concepts and Process

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.

TIMELINE


Project Begins
Aug 2018
Nov 2018
Jan 2019
Apr 2019
May 2019
Project Complete
September 30, 2019
SITE STUDY AND VISITS
IDENTIFYING SITES
DEVELOPMENT OF DESIGN CONCEPTS
FINAL RENDERING
REPORT
OVERALL PROJECT
EWN-LA Design Strategy Workshop
Jan 24-27, 2019
Auburn University
Design Strategy Concepts
Feb 28, 2019
Delivered to ERDC staff
Final Renderings
July 26, 2019
Delivered to ERDC staff
BALTIMORE DISTRICT
Site Visit to Back Creek Jetty, Annapolis;
Fishing Creek Jetty, Chesapeake Beach
Oct 23-24, 2018
District Design Strategy Selection
Apr 17, 2019
NEW ORLEANS DISTRICT
Site Visit to Comite Canal
Nov 18-20, 2018
District Design Strategy Selection
Apr 16, 2019
JACKSONVILLE DISTRICT
Site Visit to WP Franklin and Moorehaven
Nov 28-29, 2018
District Design Strategy Selection
Apr 16, 2019
GALVESTON DISTRICT
Site Visit to Moses Lake Tide Gate
Jan 18-19, 2019
District Design Strategy Selection
Apr 29, 2019

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

New Orleans District

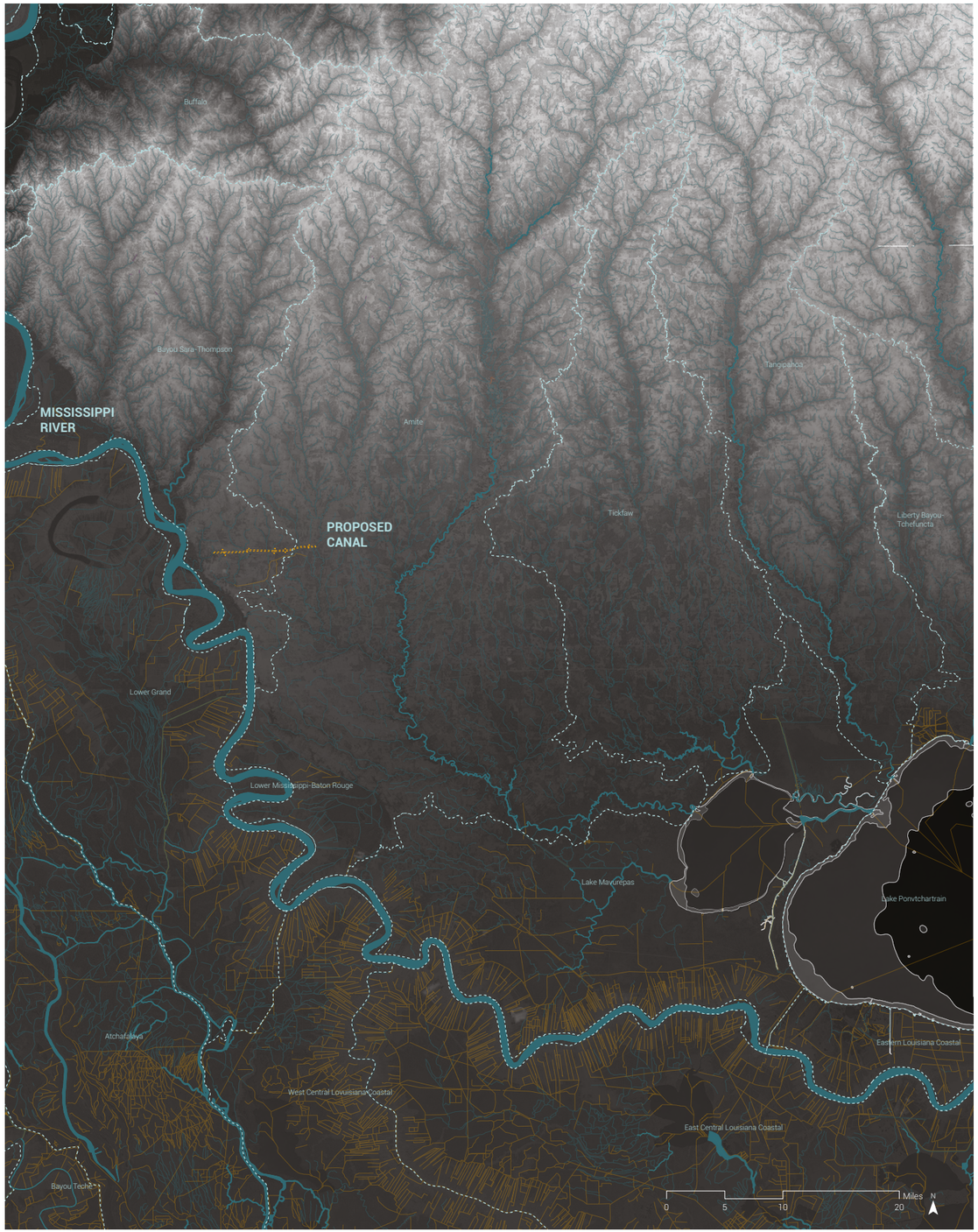
COMITE CANAL, BATON ROUGE

The Comite River Diversion Canal is a project of the New Orleans District (MVN) of the US Army Corps of Engineers, together with local non-federal sponsors. It is designed to divert water in flood events from the Comite River, which drains East Baton Rouge and adjacent parishes southeast into the larger Amite River, to the much larger Mississippi River. In so doing, it is expected to alleviate rainwater flooding which has been a significant problem recently for the adjacent communities of Zachary and Baker, as well as the broader Baton Rouge region.

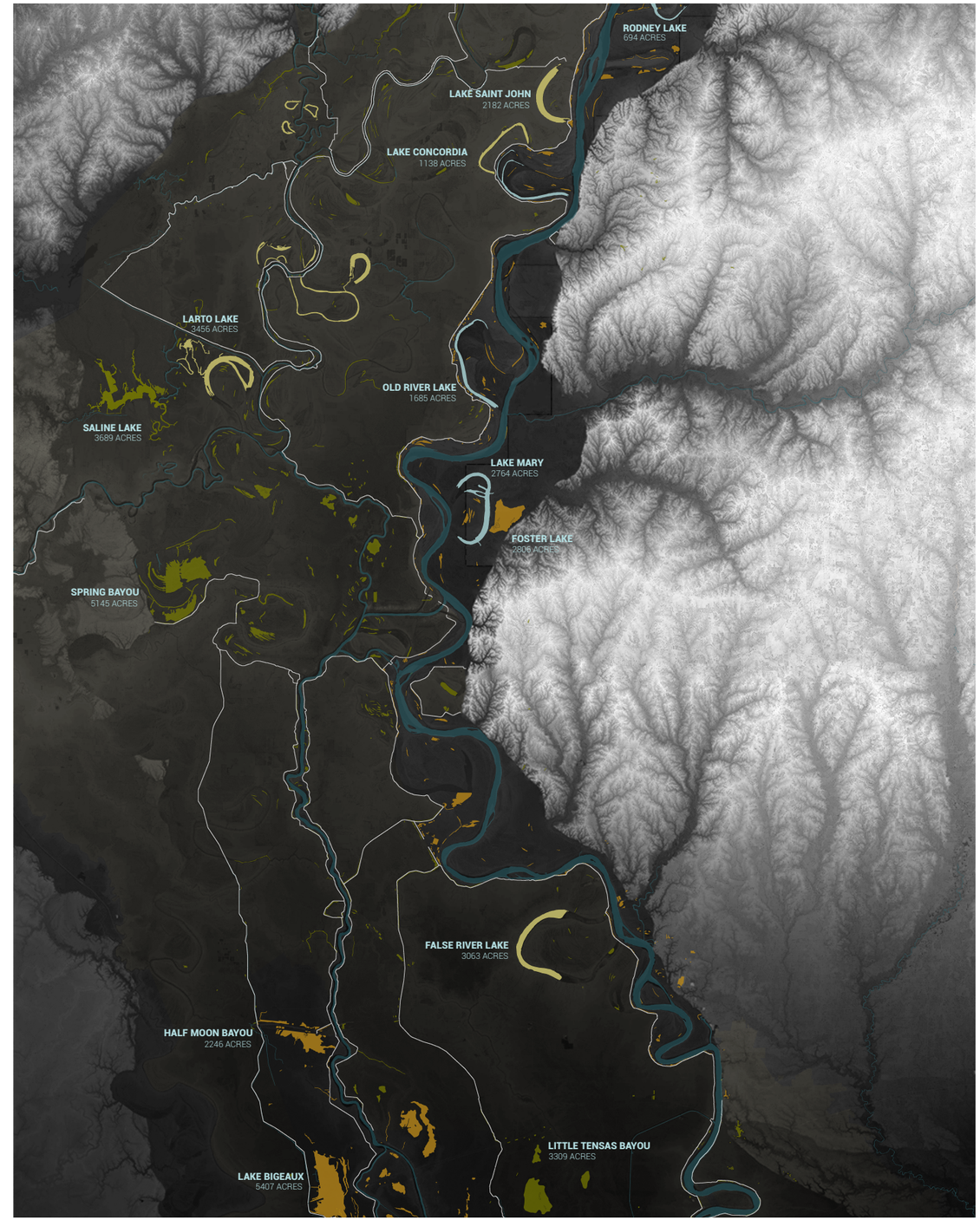
In August 2016, a major rainstorm formed over southern Louisiana; this storm dropped over 7 trillion gallons of water on the state, an unprecedented amount that is over three times what Hurricane Katrina dumped on Louisiana. Catastrophic flooding ensued in many parts of the state. Communities on the Comite and Amite rivers were particularly hard-hit.

As part of its response, MVN returned to a plan that had been engineered but not funded in the 1990s: the Comite River Diversion Canal. One component of the canal, the Lilly Bayou Drop Structure, had been built in 2003, following another major flooding event from Tropical Storm Allison, but the remainder of the canal had gone unbuilt. The 2016 flooding has increased public understanding of the urgency of addressing flood risk management issues, and so today the Comite canal is moving rapidly toward construction.

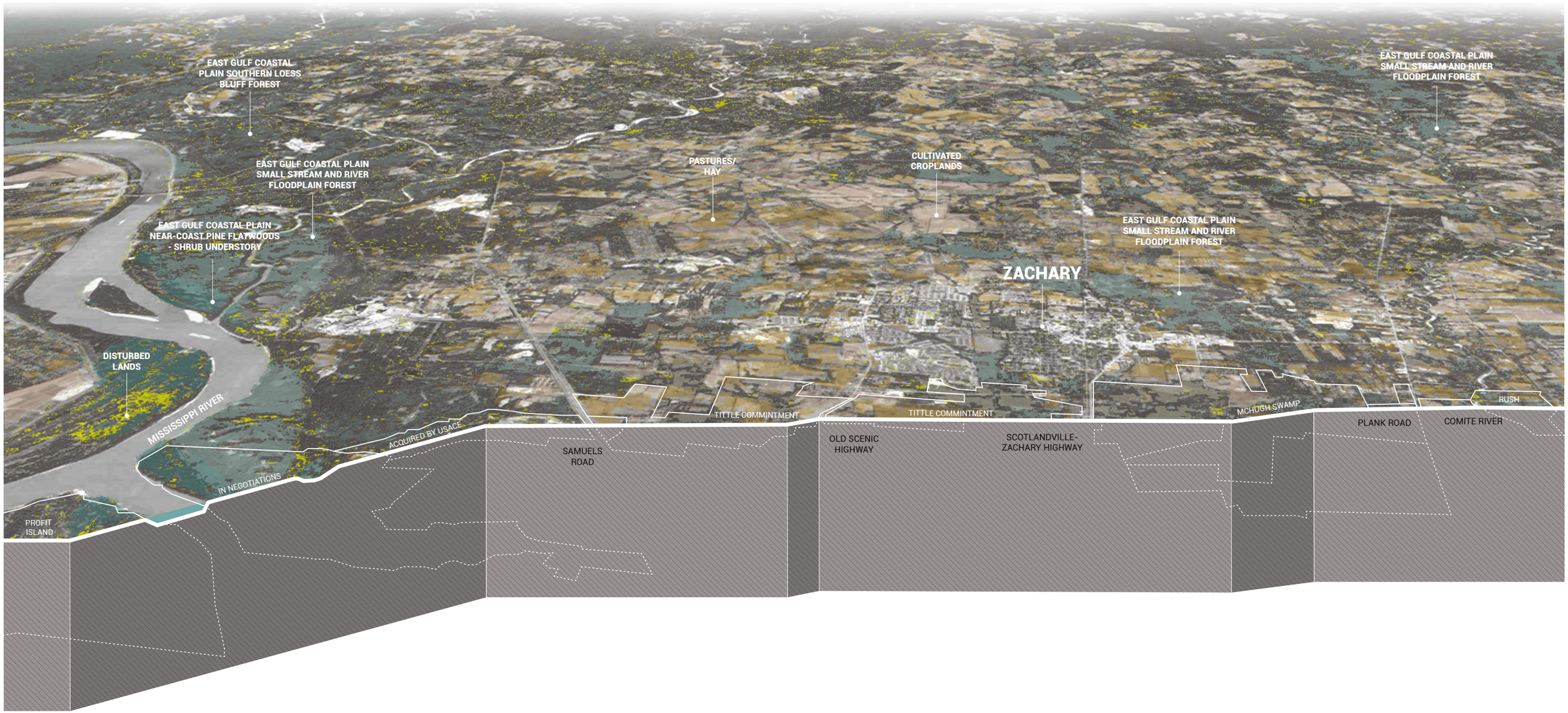
In fall 2018, the Engineering with Nature ® and Landscape Architecture project delivery team (EWN®-LA PDT) was asked to develop recommendations for how the on-going design and construction of the canal might incorporate EWN® principles and NNBF. The EWN®-LA PDT made a visit to the canal site with MVN in November 2018, developed draft design strategies (pages 22-33) in January 2019, and presented the draft design strategies to MVN in April 2019. This work culminated in this report, whose following pages document the process of developing recommendations and the recommendations themselves.



Site Context Natural and artficial drainage in the Baton Rouge region



Site Context Oxbows and backwaters in the Lower Mississippi River floodplain



Cross-section through the route of the canal, showing land use and major ecological communities

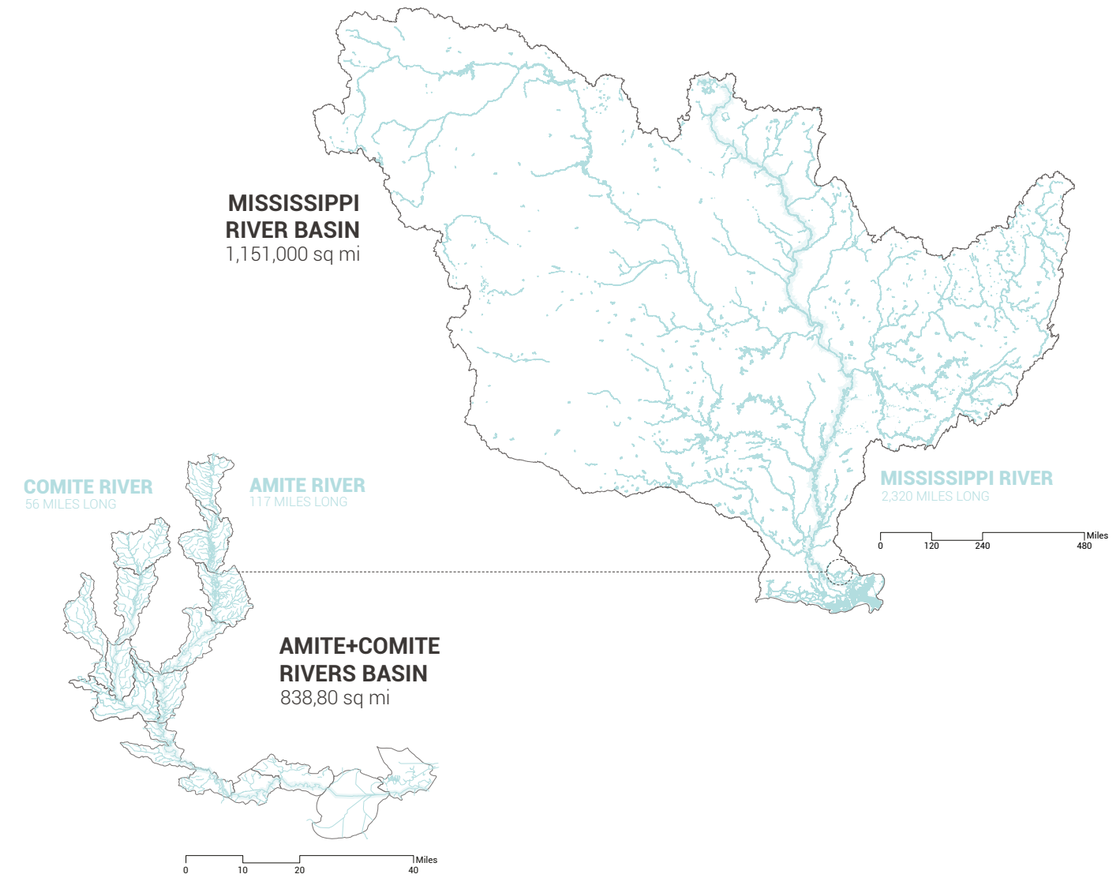
OPPORTUNITIES

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 Ecological Connection
The canal route passes through a number of existing ecological communities, including several types of forest (particularly pine flatwoods and bottomland hardwoods), a major swamp (much of which is incorporated into the project as mitigation land), and three bayous that run north-south across the canal. Connecting to these communities is a clear opportunity for enhanced ecological performance. The open areas that will undoubtedly exist along the canal route also present a similar opportunity to develop meadows and shrublands as pollinator habitat.

2 Recreational Opportunities
The communities near the canal have limited opportunities for outdoor recreation. Bike routes that are seperated from automobile traffic are rare, and opportunities for long hikes, runs, and walks are also uncommon. The canal offers a clear opportunity to provide a route that would be about twelve miles in one direction, and over a twenty-four mile loop. We anticipate that this recreational feature, together with other opportunities like views from constructed earthworks and fishing, would be of great value to the local communities.

3 Sidecast Material
The excavation of the Comite Canal will produce an enormous amount of material. Currently, this material is expected to be sidecast along the length of the canal as excavation proceeds. This sidecast process represents the most obvious opportunity to shape the landscape for ecological and recreational benefit, as the placed material could be graded into earthworks that would facilitate those benefits. One key constraint on the design of these earthworks is that a three-foot freeboard must be maintained along the length of the canal on both sides.



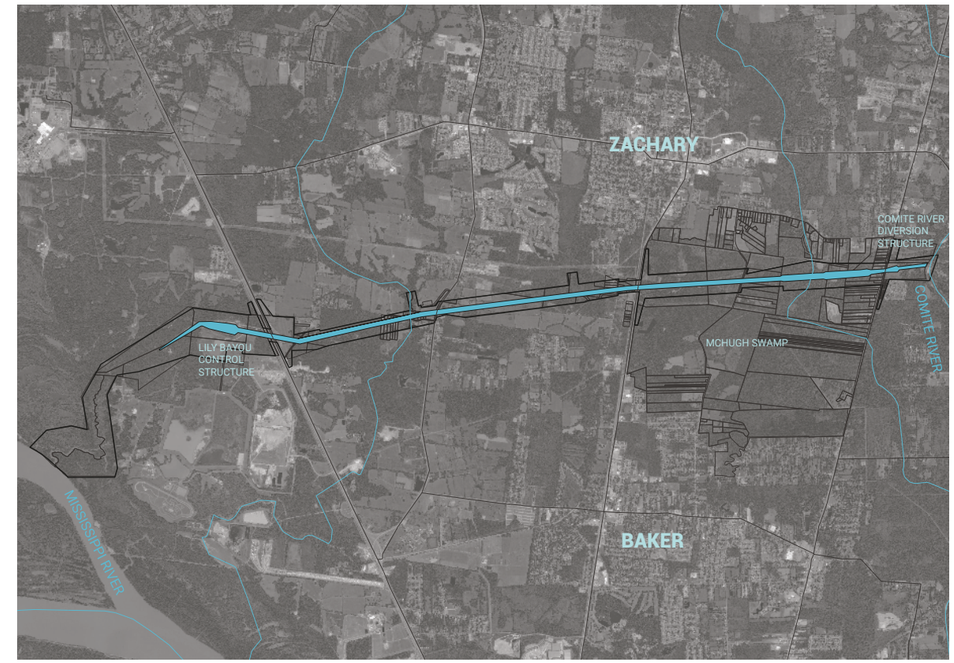
Watersheds The Comite River Diversion Canal will connect the Comite River to the much larger Mississippi River Basin, facilitating drainage in flood events.

STRATEGIES

The following spreads (pages 24-33) 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 New Orleans District in April 2019; MVN's feedback is compiled on page 34.

These strategies are intended to represent a broad range of options for implementing EWN® principles and NNBF in the context of the Comite Canal project. While all of them had some potential for implementation and have been reviewed by the EWN®-LA PDT 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 "alternating hills" of sidecast material, have been developed further and are reflected in the recommendation (pages 35-67). Others, like the idea of "floodroom setbacks", were determined to be infeasible or undesirable for a variety of reasons, and so have not been developed any further. 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.

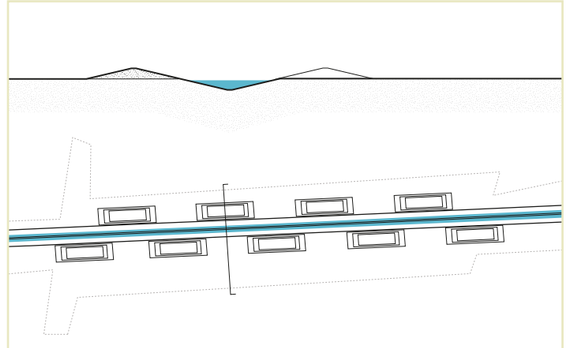


COMITE CANAL SITE

1 SIDECAST VARIATIONS

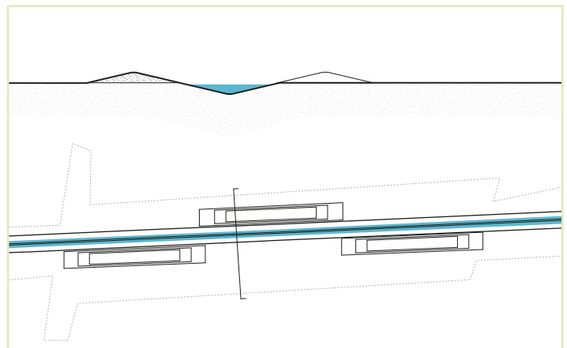
1A ALTERNATING HILLS

Sidecast material would be alternately placed on the north and south sides of the channel, creating a series of hills on each side of the channel.



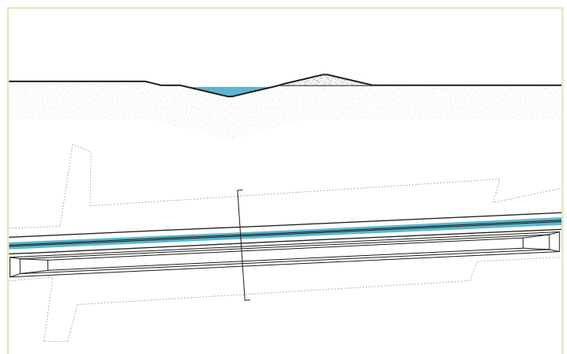
1B BIG HILLS

Concentrating the excavated material into fewer, larger hills adjacent to the channel would create larger expanses of meadow between hills and more dramatic recreational opportunities on the hills.



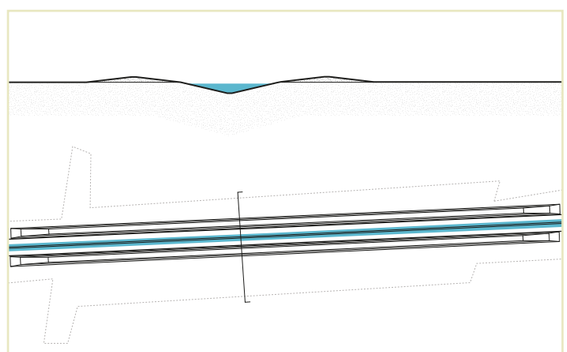
1C BERM ON ONE SIDE

If material is only sidecast to one side, that could open up the other side for land preservation and habitat creation. This strategy might also be necessitated in some areas where the channel is particularly close to the property boundary on one side.



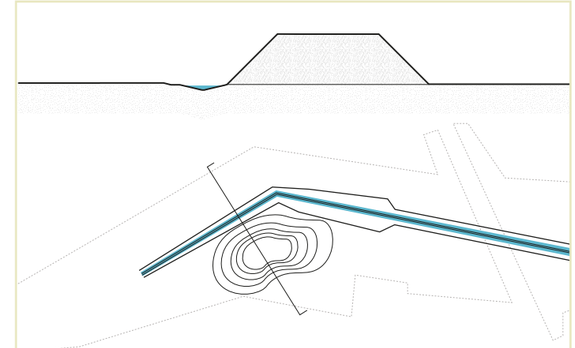
1D BERM ON BOTH SIDES (EXISTING)

This is the current proposal as we understand it. Excavated fill would be placed evenly on either side of the channel as it is dug. Small inlets would be cut occasionally into the north side berms to permit overland drainage into the canal.



1E ONE BIG MOUNTAIN PARK

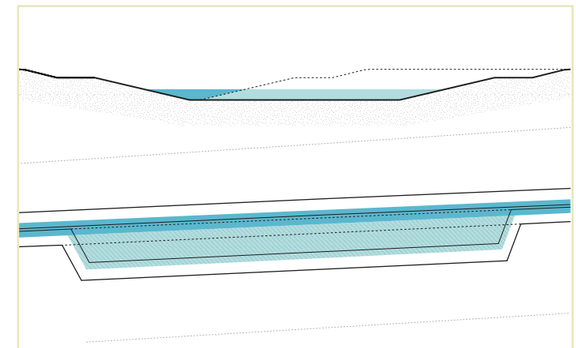
In a location where more space is available within the property boundary, such as the zone around the Lily Bayou Control Structure, a large, mountain-like landform could be constructed with a significant amount of the excavated fill. In the relatively flat landscape around Baton Rouge, a large topographic feature with opportunities for broad vistas and overlooks would be a significant recreational draw.



2 CHANNEL SETBACK

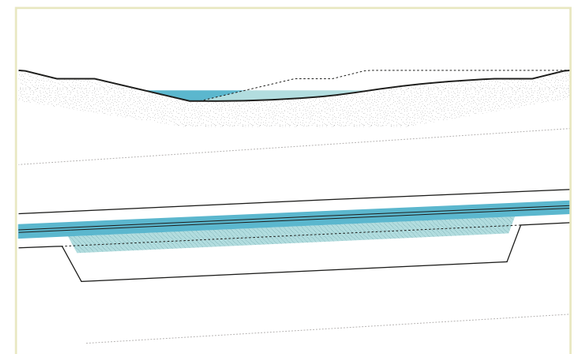
2A FLOODROOM SETBACK

A setback would make the channel wider, allowing for additional storage of water during storm and high flow events. This would be designed to create periodically-inundated wetland habitat that is consistent with local habitat. It is also possible that these spaces could be designed to store sediment, reducing shoaling in the main channel. A consideration with this and other setback strategies is that any time the channel is made wider, there will be additional excavation.



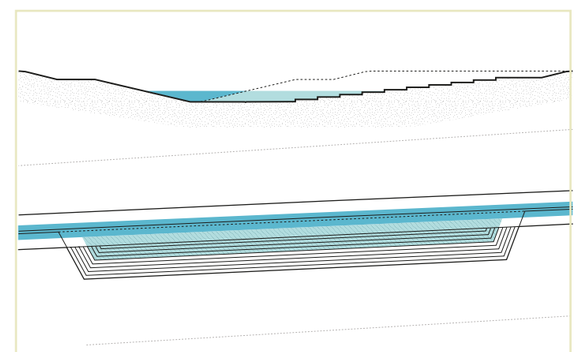
2B HORIZONTAL LEVEE

Drawing on engineering knowledge for 'horizontal levees', this strategy would decrease the slope of the channel bank, creating a gentle gradient.



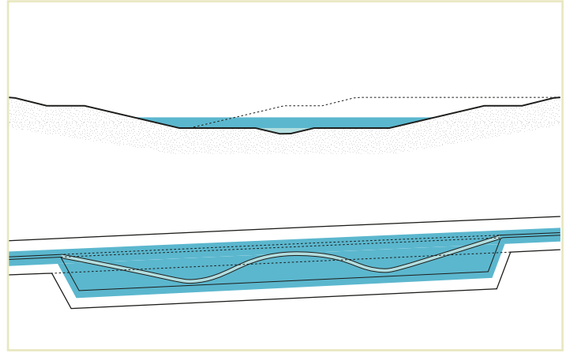
2C STEPPED HORIZONTAL LEVEE

The long slope of the horizontal levee strategy could also be subdivided into terraces that host a gradient of decreasingly mesic plant communities.



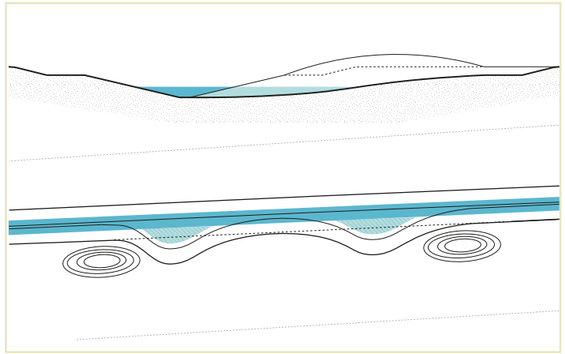
2D LOW FLOW DISTRIBUTARY

If the channel bottom is widened slightly, a low-flow distributary could be created at the bottom of the canal. This narrower and deeper channel would be cut into the channel bottom. It would have a sinuous morphology modeled after local bayous and intended to perform as a distributary of the Comite. The broad, flat full channel would then only fill during flood events.



2E FLOODROOM AND SIDECAST HILL

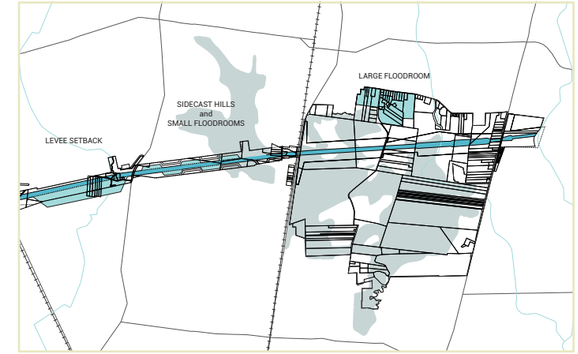
Floodrooms could be designed as sediment traps interspersed with adjacent sidecast hills. Material captured in the sediment traps could be placed on the sidecast hills over time. As a series of hills and depressions, with openings to the channel, this would reduce maintenance and create recreationally- and ecologically-desirable topographic diversity.



3 SITE CHARACTERIZATION AND ALIGNMENT

3A WETLAND EXTENSION

Adjacent wetlands and areas along the length of the canal that were historically wetlands would remain wetlands. Preliminary study of wetland classification shows wetlands are concentrated on the eastern end of the canal, in and around McHugh Swamp. There is a large area of current pasture north of McHugh that could be excavated as a shallow floodroom.

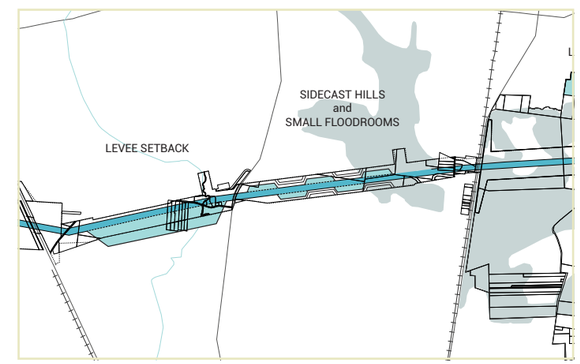


3B MATCH THE ECOSYSTEM TYPE

Ecosystems proposed along the length of the canal corridor should be designed in light of the existing ecosystems. New ecosystems would be matched to adjacent and historic conditions to create expanded ecosystem zones, connections, and transitions.

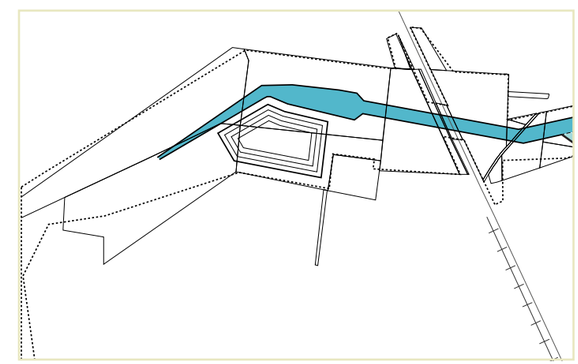
3C SPACE FOR SETBACKS

The central stretches of the canal offer the most opportunity for introducing levee setbacks (see strategy 2A), sidecast hills, and small floodrooms (see strategy 2E), because there is land available along the canal corridor in those stretches, but that land is not currently designated as wetlands. This could create additional space for water, habitat, and recreational opportunities.



3D ONE BIG PARK

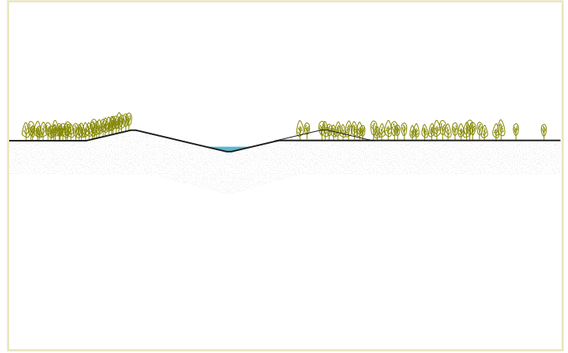
At the west end of the canal, there is an opportunity to create a large park and recreational space, likely including a large mountain-like landform (see 1E). This would build off the possibility and potential for the Lily Bayou outfall structure to become a destination point for infrastructure tourism.



4 SIDECAST GARDENS

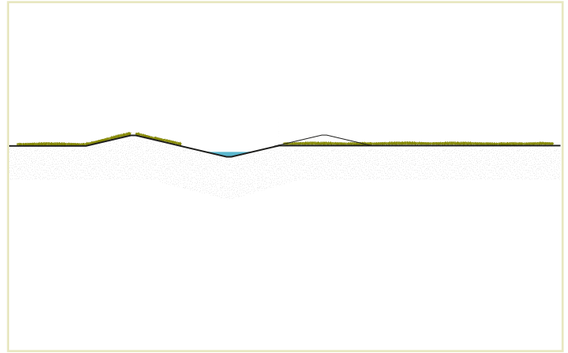
4A ALL FOREST

In some areas, a forest could be created along the channel corridor where sidecast material is placed.



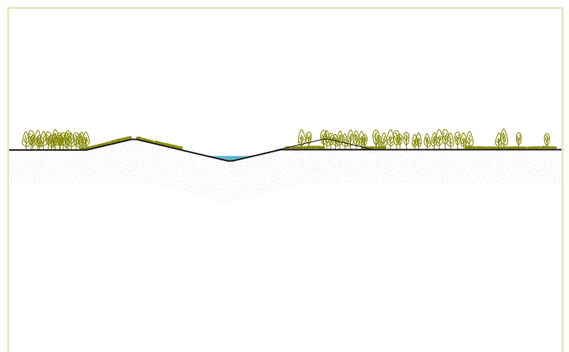
4B ALL MEADOW

In other areas, a meadow could be created along the channel corridor where sidecast material is placed.



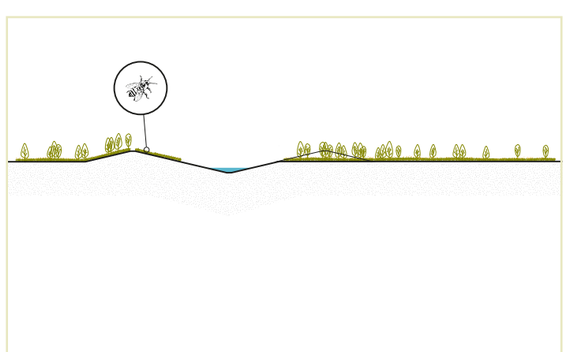
4C MIXED ECOSYSTEM

In still others, a mixture of plant communities could be created along the entire channel corridor where sidecast material is placed. These mixtures could be determined in relationship to topography as well as adjacent land.



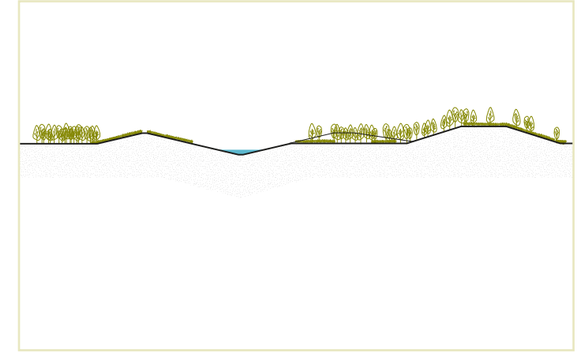
4D POLLINATOR HABITAT

Pollinator habitat would be created in drifts akin to natural meadows. These might be only a few hundred feet long each, and could be constructed in patches along the banks that receive abundant sunshine.



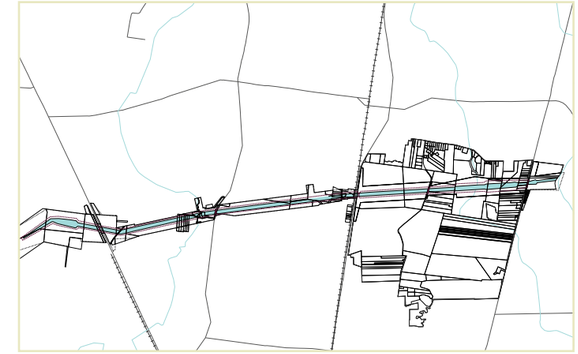
4E MIX OF HIGH POINTS AND LOW POINTS

Sidecast material would be placed to produce a mixture of high and low points, which would provide opportunities to curate ecological zones based on topographic conditions, offering recreational users a varied experience of topography as well as plant and animal communities.



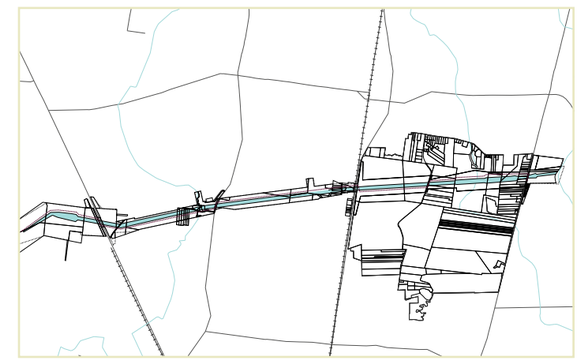
4F TRAIL ON BOTH SIDES

A trail on both sides of channel would create a series of loops, offering opportunities for a variety of experiences to bicyclists and pedestrians, depending on how the sidecast material is placed and planted.



4G TRAIL ALTERNATING SIDES

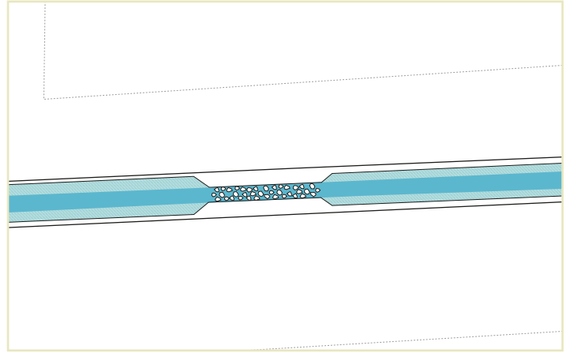
If the trail needed to be limited to one side, it could cross at major roads so that users could alternately experience both sides of the channel.



5 INSIDE THE CHANNEL

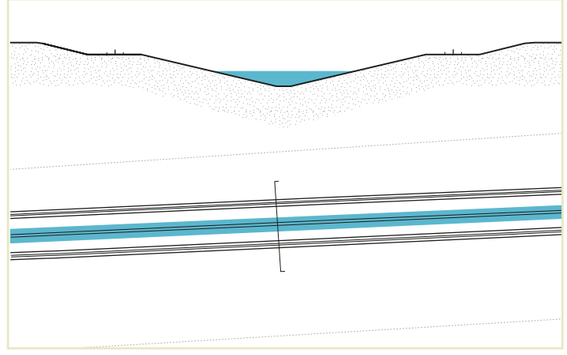
5A RUN, RIFFLE, POOL

This would mimic run, riffle, pool conditions of natural fluvial systems by slightly altering the grade and texture of the channel bottom. Convenient alignments for establishing this patterning would be to create a "riffle" condition at bridge crossings where there would already be more hard material and designed elements for supporting the bridge, and at the bayou a "pool" condition would potentially help with hydrological connectivity and habitat between the north and south bayou channel.



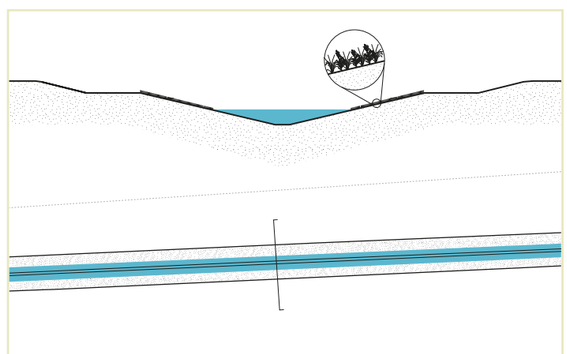
5B PATHS IN THE CHANNEL

Floodable recreational paths in the channel would allow for recreation within the channel and would bring people closer to the water during safe low flow conditions. These paths could be part of the linear path network and/or provide access for fishing. Questions concerning size (width) and material for meeting flood control requirements for the interior of the channel would need to be resolved.



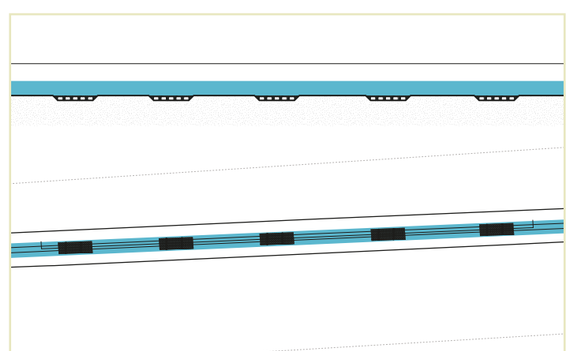
5C HYDROSEEDING AND GRASS PRAIRIE MIX

To reduce use of ecologically-limited rip-rap and/or mown lawn, the channel slopes could be hydroseeded with a grass prairie mix that would require less maintenance (mowing and/or fertilizers), create habitat, and be aesthetically interesting for public experience.



5D CHANNEL BOTTOM ROUGHNESS

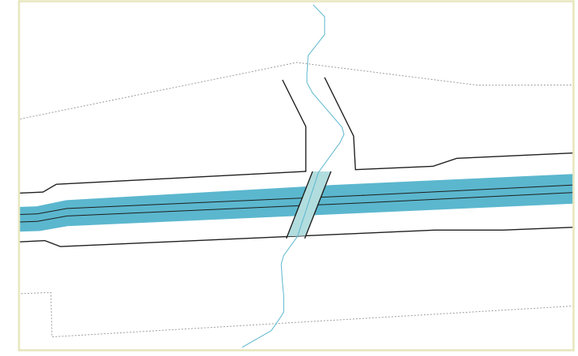
Channel bottom roughness would be introduced below the design elevation of the channel using eco-blocks or an equivalent to create a textured and varied surface for channel bottom habitat. Bayou fish utilize a gravelly substrate for spawning, so that substratum type would be targeted preferentially.



6 BAYOU CONNECTION FOR FISH

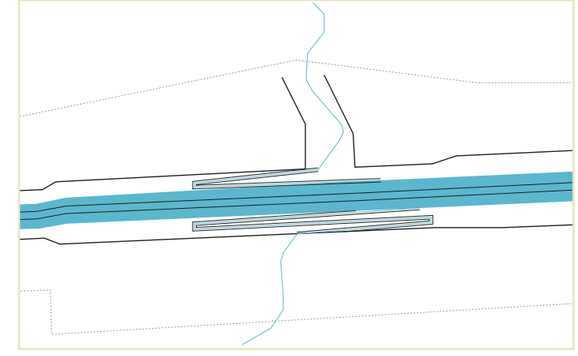
6A BAYOU BRIDGE

The bayou bridge is an engineered solution that would allow bayou water flow including fish to bypass the Comite Diversion Canal waters in an elevated channel or pipe into the southern bayou.



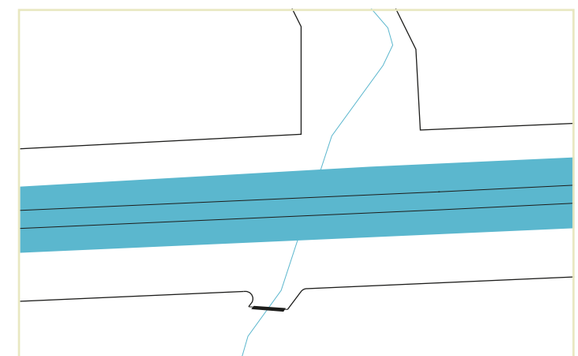
6B STREAM TRAIL

The stream trail would create a mini-stream that would switch back and forth across the banks of the channel designed for successful fish passage. This is typical of many fish passage designs.



6C FISH WEIR

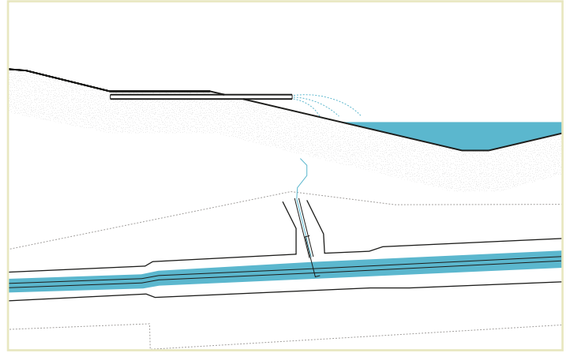
A weir could be provided on the outfall side of the bayou intersection (perpendicular to the channel) for water and fish to escape the channel in a high water event and flow south into the bayou.



7 BAYOU INLET CONNECTION

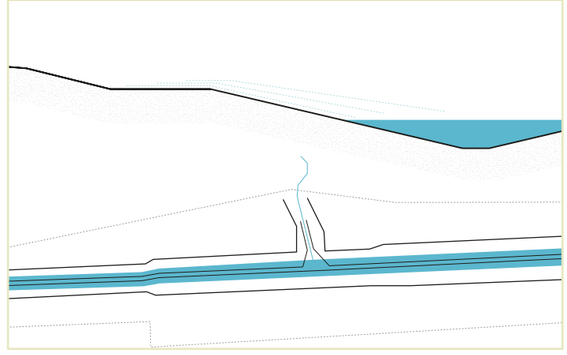
7A WATERFALL PIPE

Bayou water would enter the canal from an extended pipe, creating a waterfall to aerate the water before it enters the canal.



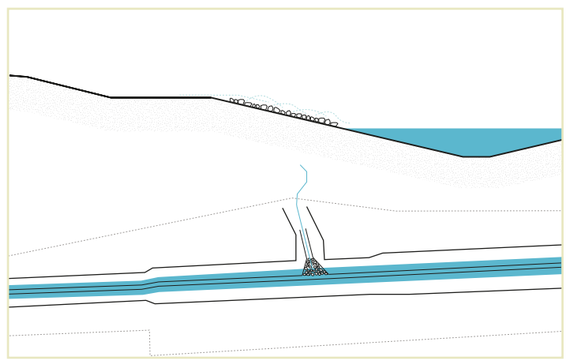
7B CASCADE

The inside of the channel on the inflow side of the bayou would be designed as a cascade to aerate the water.



7C AERATION WATERFALL

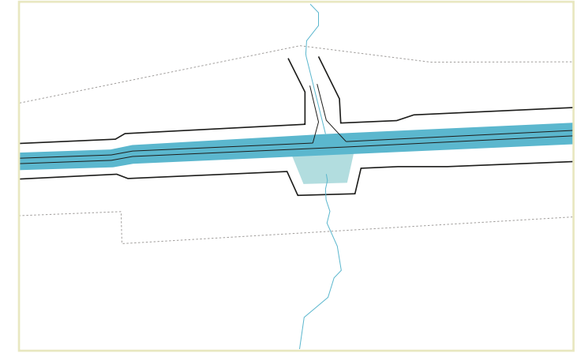
The inside of the channel on the inflow of the bayou would be designed as a waterfall to aerate the water.



8 UPLAND COOLING POCKET

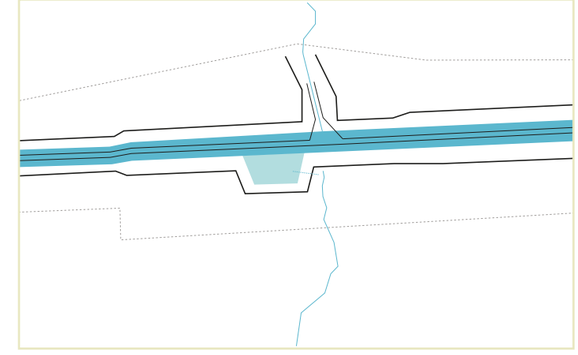
8A COOLING SITE IN BAYOU

A cooling site could be created by expanding the bayou channel with a mini-floodroom by pulling back the natural levee and shading this space with trees and other vegetation.



8B COOLING SITE OFFSET FROM BAYOU

A cooling site could be created in the sidecast area by setting back the channel and excavating to create transitional mini-pockets where the bayous come in that would be planted with vegetation to shade and cool the water.



PREFFERED STRATEGIES

The following summarizes feedback received from MVN regarding the strategies.

1 Sidecast Variations
The big mountain park was indicated as a highly preferred option. Alternating hills and the manipulation of mound heights were also indicated as acceptable, provided that a 3-foot freeboard is maintained above grade on both sides of the canal. The recommendation focuses in particular on exploring these options.

2 Channel Setback
Setback options were not preferred, so have not been explored further.

3 Site Characterization and Alignment
Aligning new ecological communities with the existing conditions, as described in 3A and 3B, was indicated as acceptable. Space for floodrooms was marked as not preferred.

4 Sidecast Garden
The "all forest" option was marked as not preferred, so has not been explored further. Meadow, mixed ecosystem, and pollinator habitat options were marked as acceptable, and have formed the base of the vegetation strategy in the recommendation. For trails, a key concern was expressed about safety around the four drop structures on the north side of the canal. Consequently, the recommendation's approach to trails only crosses two of the four drop structures, and where it does cross those two structures, it recommends a bridge that would be covered with chain-link or a similar material, akin to how pedestrian bridges across highways and roads are often constructed.

5 Inside the Channel
With the exception of hydroseeding a prairie grass mix on the channel sides, the inside the channel strategies were not preferred.

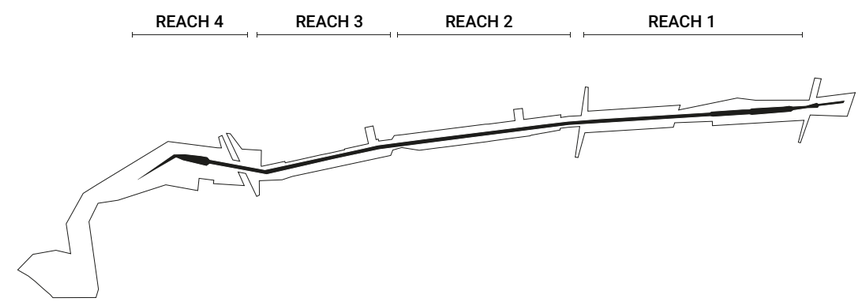
6 Bayou Connections for Fish
These options were not preferred.

7 Bayou Inlet Connection
The cascade and aeration waterfall options were indicated acceptable.

8 Upland Cooling Pocket
These options were not preferred.

RECOMMENDATION

Our recommendation centers on the goal of placing the sidecast material in order to maximize ecological and recreational benefits. We have organized the recommendation through four diagrams, each of which addresses one of the key components of achieving this goals. The diagrams, in turn, are organized by four reaches that we have divided the canal into, numbered from the Comite River Control Structure on the east (Reach 1) to the Lily Bayou Control Structure on the west (Reach 4).

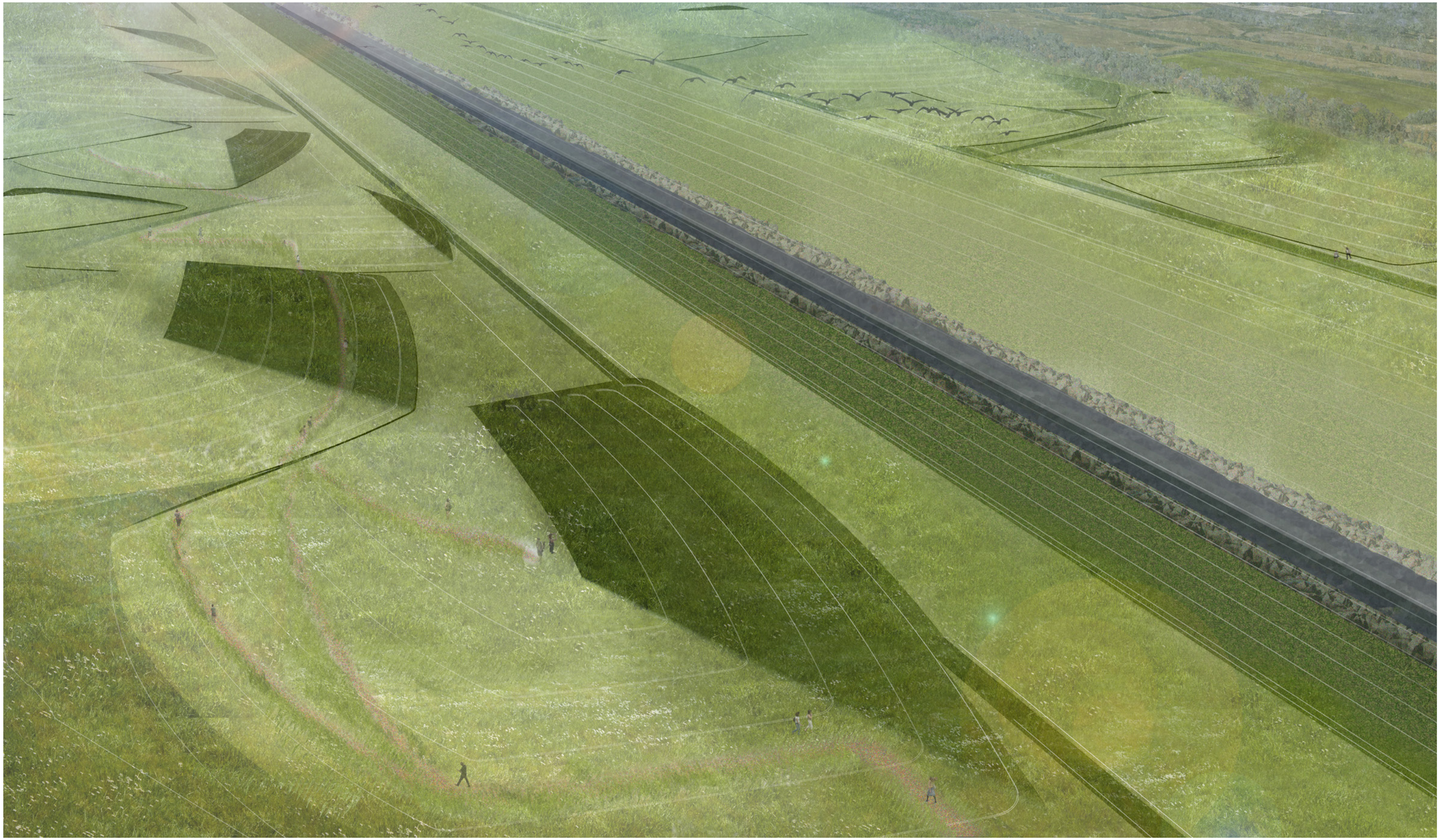


The first diagram, which follows on pages 38-39, shows our understanding of how much material is being excavated, our recommendation for how to distribute it in percentages for each reach, and how those placement strategies relate to the ecological and recreational goals of the recommendation. In general, we recommend casting most material along the side of the channel as it is excavated. The one major exception to this is that we recommend creating a large landform ("mountain") near the Lily Bayou Control Structure as a major recreational feature, using material from Reach 3.

These volumes are based off calculations provided by MVN in email communications, confirmed by measuring a sectional excavation off engineering drawings and projecting that excavation along the length of the diversion canal. In total, we project approximately 11 million cubic yards of excavation. The earthworks generated by this placement strategy can be scaled up or down to accommodate divergence between that estimate and final actual excavation amounts.

How, exactly, excavated material is shaped into new landforms is crucial for achieving ecological and recreational goals. The shapes of the landforms of each reach are inspired by landforms found in the region around the canal: rolling plains, bluff hills, and swamp terraces (see pages 52-67 for details). This 'native topography' joins together with native plantings to tie the recommendation to the existing landscapes of East Baton Rouge Parish and Louisiana (see page 43).

The other three diagrams — vegetation, paths, and program — are found and described on pages 40-41.



Bird's eye view of a portion of Reach 2 (Bluff Hills)

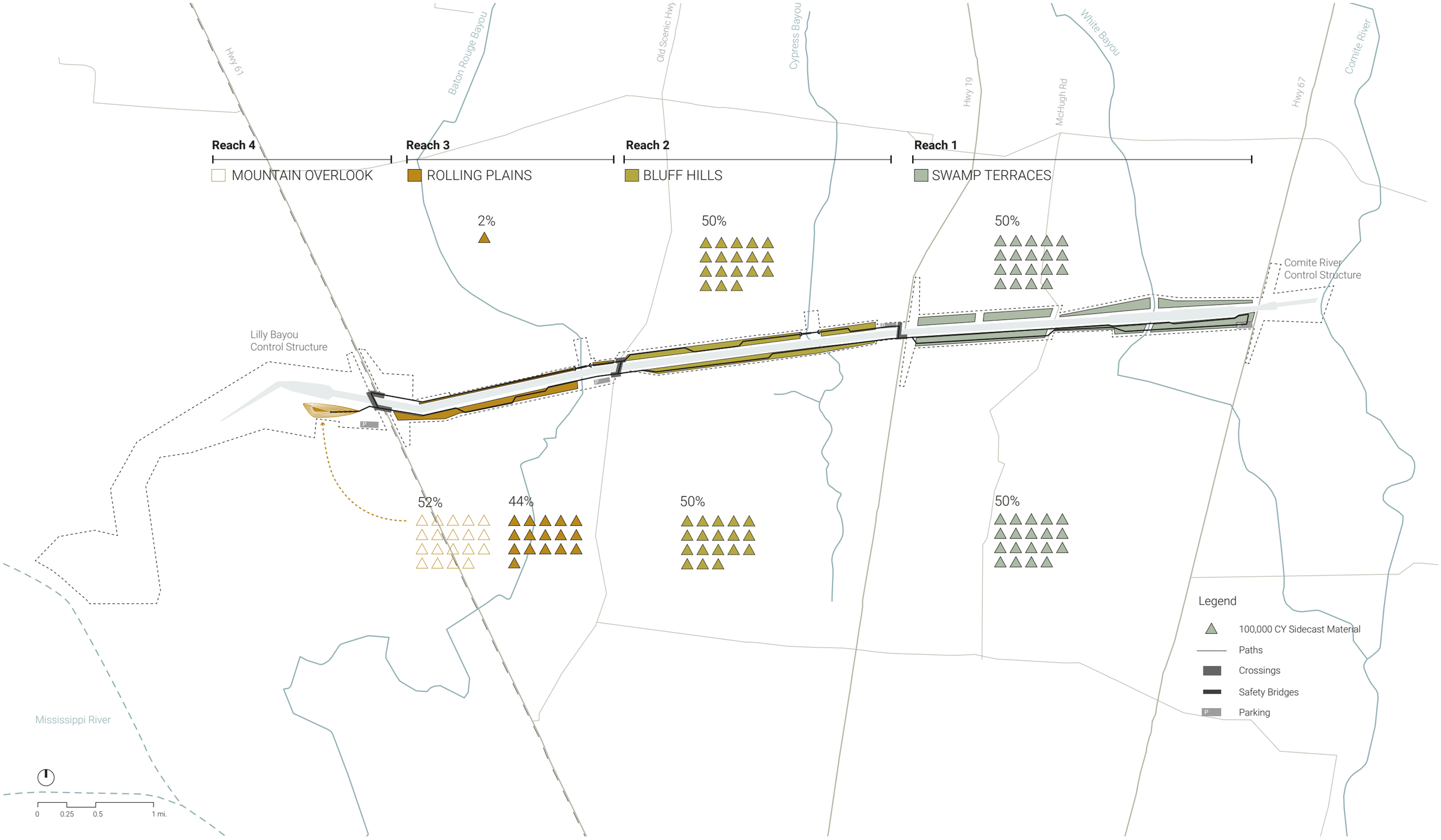
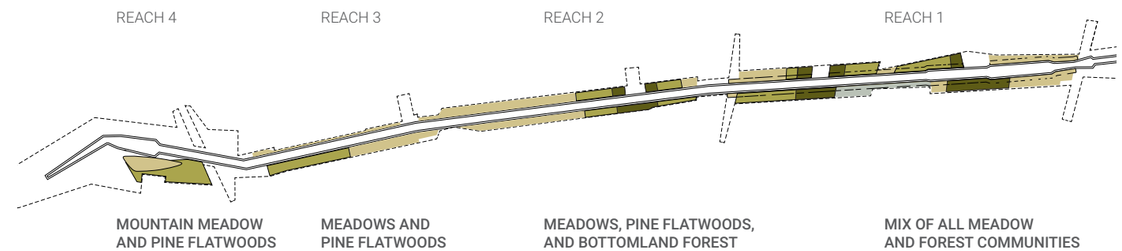


Diagram of reaches and sidecast material distribution

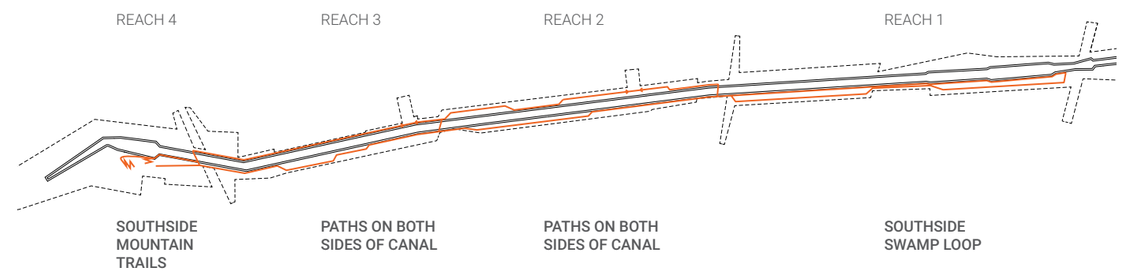
Vegetation
The recommendation includes three strategies for planting: mown native grasses in and near the channel; mown or managed pollinator meadow; and two types of canopy tree communities. A planting palette can be seen on page 45. In each reach, meadow and trees are interspersed. Trees are recommended where the adjacent land is currently forested, for ecological connectivity. We also recommend that species adapted to wet conditions, such as the mesic species of the "Bottomland Forest" community, be utilized where existing topography is lower and wetter.



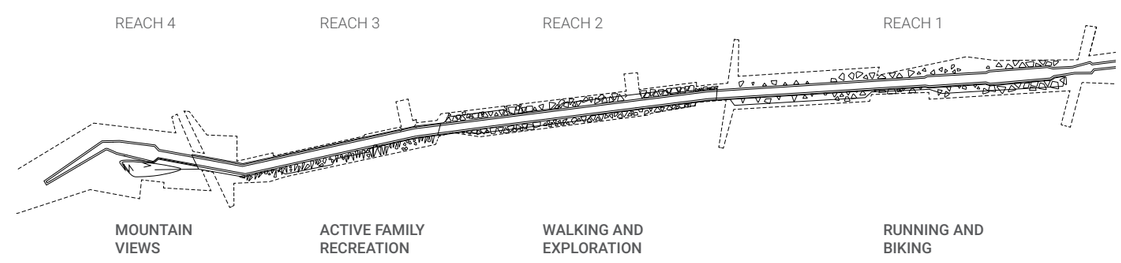
Paths
Our path strategy is focused on maximizing recreational opportunities and varied views, while minimizing safety concerns. Safety concerns are particularly notable at the intersections with roadways, which would need to be either signaled at-grade crossings or bridged, and at the two places where the path crosses bayou drop structures. At the drop structures, we recommend that small footpath bridges be securely wrapped in chain-link fencing or a similar material, as footpaths across highways are often secured. To minimize these conflicts, we recommend paths on both sides of the canal in only two of the four reaches, Reaches 2 and 3. In Reach 1, we recommend a path looping on the south side of the canal.

It is important to note that this is only a general diagram of path routes. Exact path routes will need to be developed in relationship to exact landforms, as shown in the detail plans on pages 53, 57, 61, and 65.

The path should generally have multiple lanes, accommodating both slower walkers and faster runners and bikers. In some places, these lanes may diverge. As with exact path routes, this will need to be detailed through further design development.



Program
We recommend that each of the four reaches be developed to focus on a different recreational experience: monumental views from the Mountain Overlook, family-oriented activities in the Rolling Plains, walking on winding paths among the Bluff Hills, and running on the Swamp Terrace Loop. Each reach could be a destination on its own or experienced sequentially from either end of the channel.



Bluff Hills precedent landform and ecosystem

Rolling Plains precedent landform and ecosystem

Swamp Terraces precedent landform and ecosystem

REGIONAL LANDFORM AND ECOLOGICAL COMMUNITY

We recommend that the recreational and ecological opportunities along the length of the canal derive design direction from the landforms and ecological communities of the Mississippi Valley Loess Plains, the Omernik Level III ecoregion that the canal is situated in.

Regional Landforms
The earthworks shown on the following pages are abstracted versions of natural topographic patterns typical in the Mississippi Valley Loess Plains. An overall axonometric diagram shows these contrasting conditions on pages 46-47, while detail plans, sections, perspectives, and axonometrics on pages 52-67 show typical proposed conditions in each reach.

Bluff Hills: Approximately 30 miles northwest of Baker and Zachary, there is a unique Wildlife Management Area, the Tunica Hills, which is a major regional recreational attraction. The Tunica Hills are the most prominent example in the region of a landform called "loess bluff hills". This landform is characterized by a diversity of microenvironments, including sharp dissecting ravines, flat hilltops, and dry slopes. In Reach 2, this is translated into a mosaic of irregular mounds which typically have one sharper ("bluff") face.

Rolling Plains: This landform is locally found between Tunica Hills and the vicinity of the Comite Canal, around St. Francisville. While less sharp in relief and less diverse than the bluff hills, the rolling plains still offer irregular and frequently sloping topography. This topography often extends in long, finger-like ridges. In Reach 3, this is translated into a repeating pattern of long, low mounds which will offer a 'rolling' experience to the walker or jogger.

Swamp Terraces: The Comite Canal and Baton Rouge are both located in the Omernik Level IV ecoregion of the "Baton Rouge Terrace". It is characterized by low, flat topography with winding bayous and frequent bottomlands. In Reach 1, this is translated into a more infrequent placement of larger mounds, set within a 'terrace' that slopes gently away from the canal toward adjacent wetlands.

Recommended plant species for pollinator habitat, shown on sidecast berms

Planting Palette

The planting palette is broken into three major ecological communities, each with a different mixture of species. Distribution of these communities can be seen on pages 48-51.

Pollinator Meadow

The following meadow planting pallette was provided by Tosin Sekoni (ERDC USACE) for planting the sidecast material. These native species were selected for their potential to attract and create habitat for pollinator species.

Herbaceous

- *Asclepias tuberosa*, Butterfly Milkweed
- *Sarcostemma cynanchoides*, Climbing Milkweed
- *Asclepias syriaca*, Common Milkweed
- *Asclepias gigantean*, Giant Milkweed
- *Asclepias incarnata*, Swamp Milkweed
- *Asclepias perennis*, White Milkweed
- *Asclepias verticillata*, Whorled Milkweed
- *Helianthus mollis*, Ashy Sunflower
- *Monarda fistulosa*, Wild Bergamont
- *Phlox divaricata*, Bluemoon Phlox
- *Phlox pilosa*, Sananna Phlox
- *Eryngium yuccifolium*, Rattlesnake Master
- *Eupatorium coelestinum*, Blue Mistflower
- *Lobelia siphilitica*, Blue cardinal flower
- *Passiflora aragorn*, Passionvine
- *Agasstache anisatum*, Anise Hyssop
- *Coreopsis tinctoria*, Golden Tickseed

Shrubs

- *Sambucus nigra* ssp. *canadensis*, Elderberry
- *Euonymus americanus*, Strawberry Bush
- *Ilex vomitoria*, Yaupon Holly
- *Viburnum dentatum* var. *dentatum*, Arrowwood
- *Cephalanthus occidentalis*, Buttonbush
- *Asimina parviflora*, Dwarf Pawpaw
- *Morella cerifera*, Wax Myrtle
- *Acaciella angustissima*, Prairie Acacia
- *Vaccinium elliotii*, Huckleberry

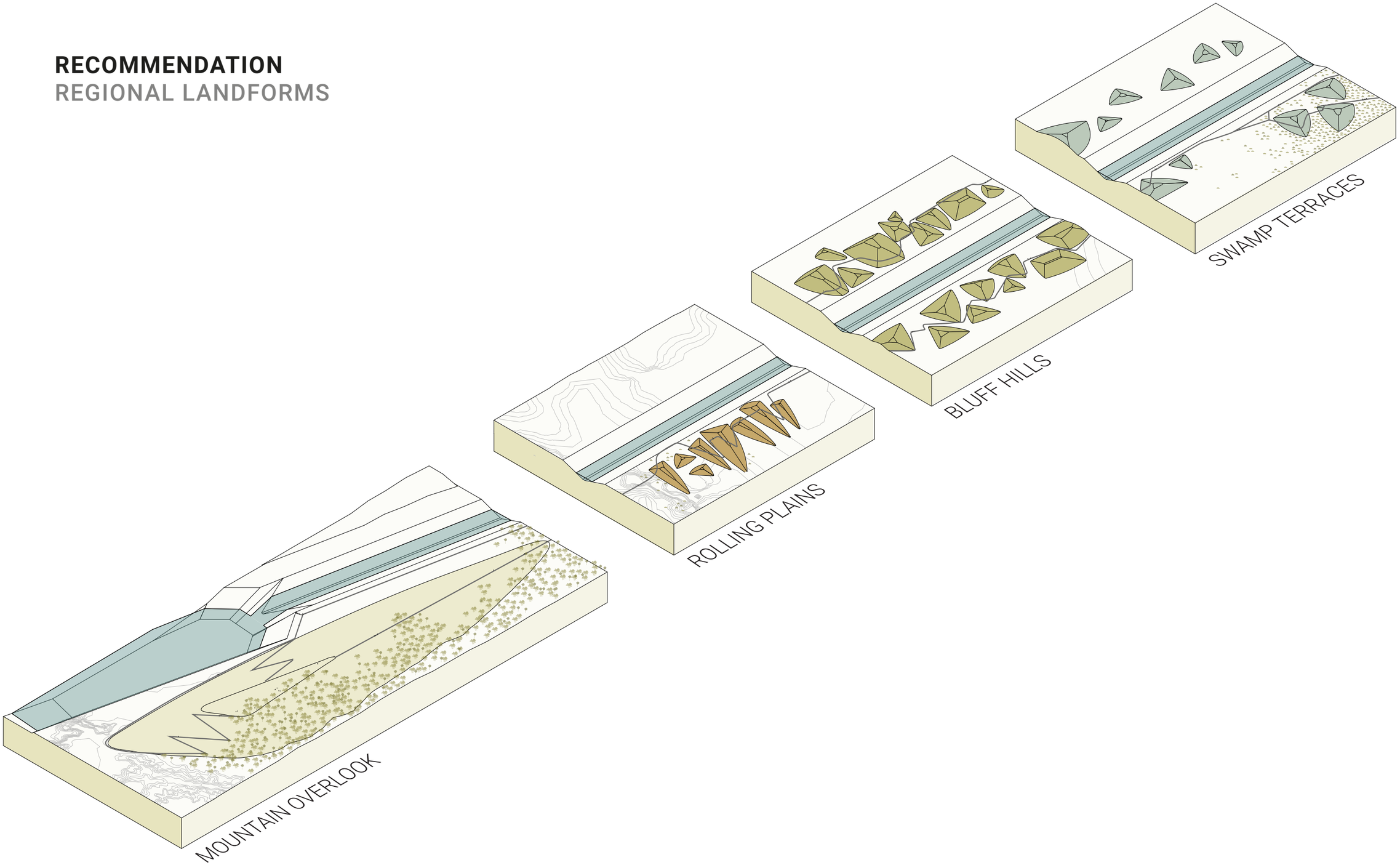
Bottomland Hardwood

- *Pinus taeda*, Loblolly Pine
- *Nyssa aquatica*, Water Tupelo
- *Acer rubrum*, Red Maple
- *Liquidambar styraciflua*, Sweetgum
- *Platanus occidentalis*, Sycamore
- *Taxodium distichum*, Bald Cypress
- *Serenoa repens*, Saw Palmetto

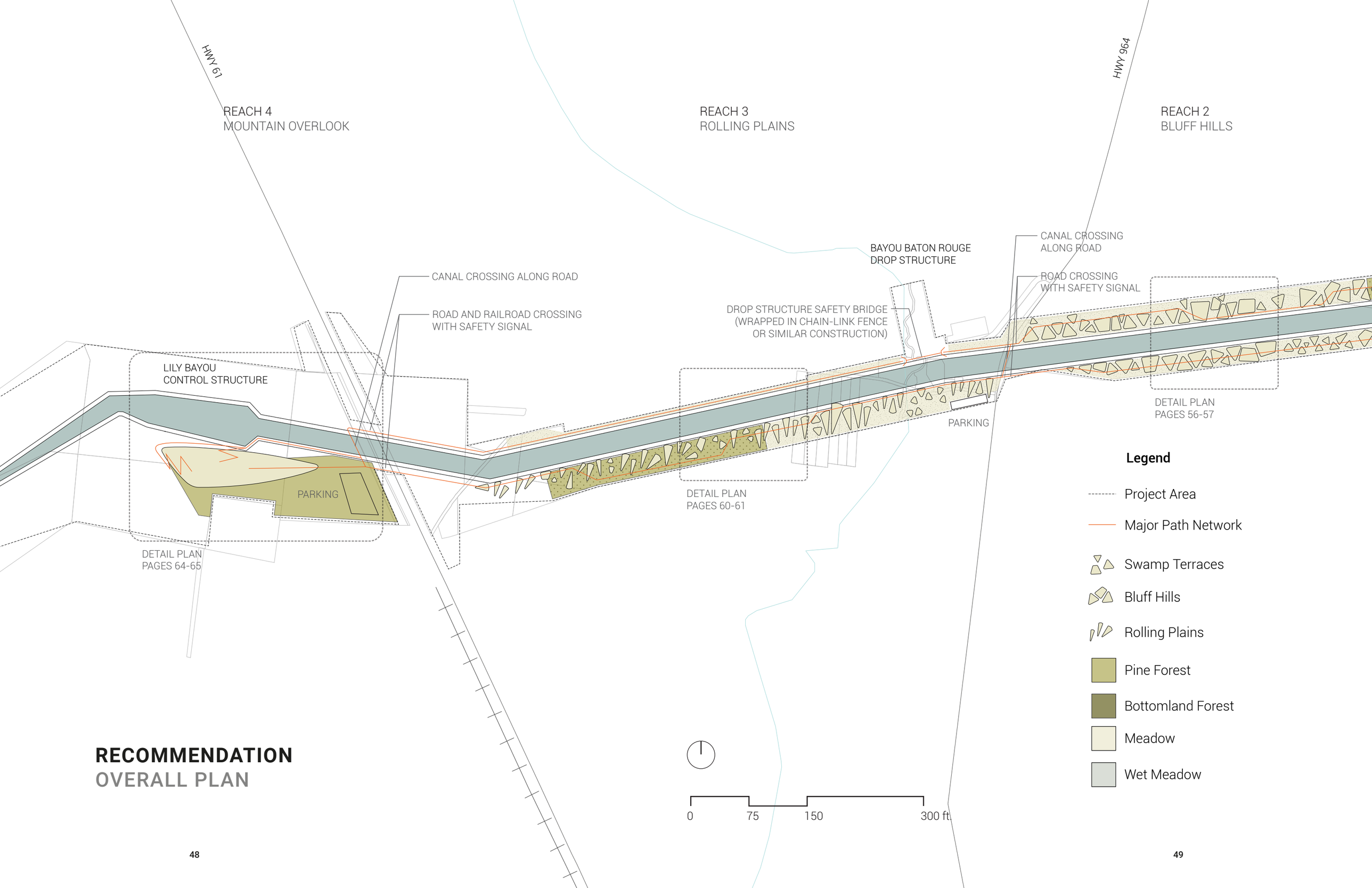
Near-coast Pine Flatwoods

- *Pinus palustris*, Longleaf Pine
- *Pinus elliotti*, Slash Pine
- *Quercus germinata*, Sand Live Oak
- *Serenoa repens*, Saw Palmetto
- *Ilex glabra*, Inkberry

RECOMMENDATION
REGIONAL LANDFORMS



Axonometric showing typical landforms for each of the four reaches



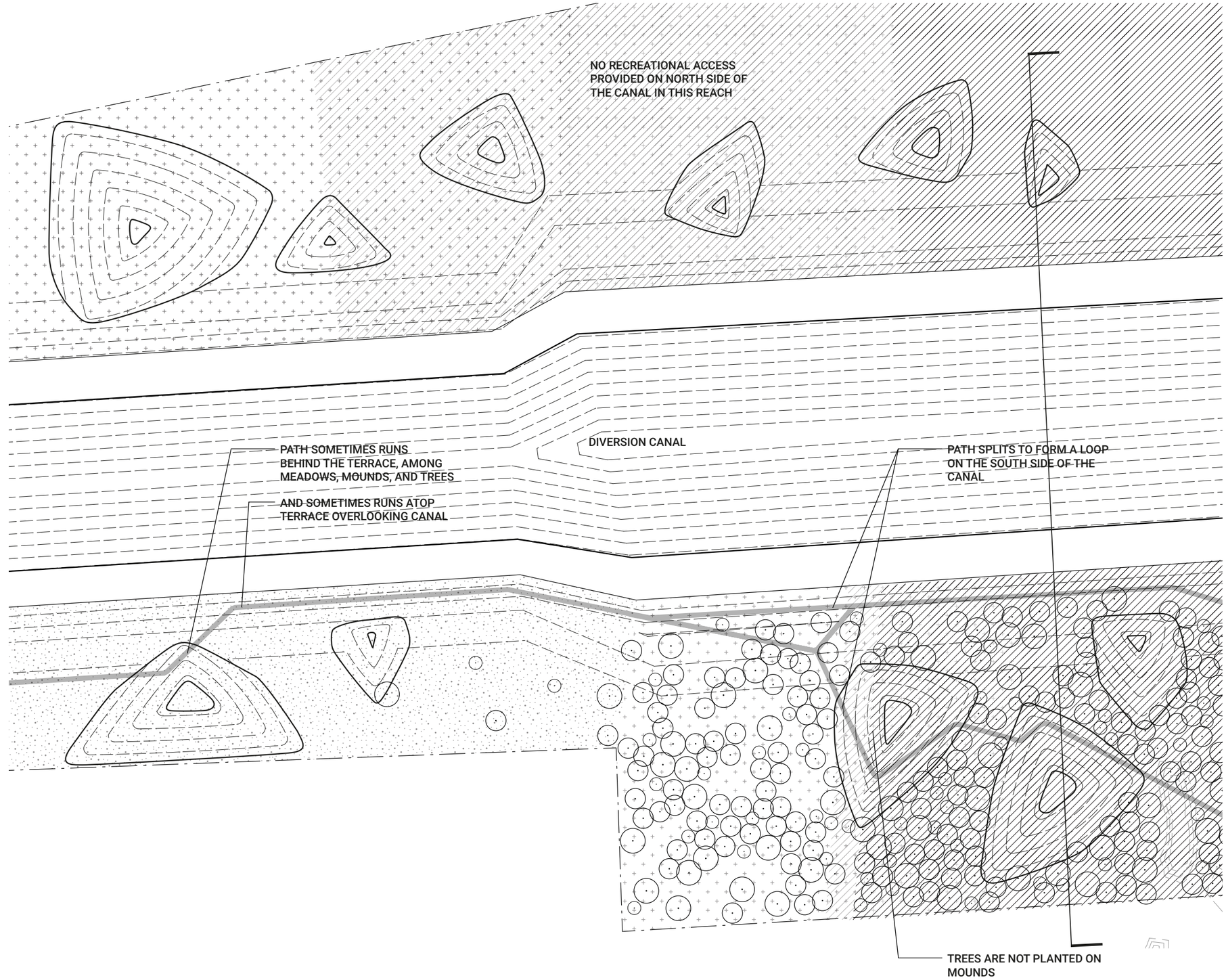
RECOMMENDATION
OVERALL PLAN

REACH 2
BLUFF HILLS
CYPRESS BAYOU
DROP STRUCTURE
DROP STRUCTURE SAFETY BRIDGE
(WRAPPED IN CHAIN-LINK FENCE
OR SIMILAR CONSTRUCTION)
PARKING
HWY 19
ROAD AND RAILROAD
CROSSING WITH SAFETY
SIGNAL
CANAL CROSSING ALONG ROAD
MCHUGH CONTROL
STRUCTURE
REACH 1
SWAMP TERRACES
WHITE BAYOU
CONTROL STRUCTURE
COMITE RIVER
DIVERSION
STRUCTURE
HWY 67
PARKING
DETAIL PLAN
PAGES 52-53
MCHUGH SWAMP

SWAMP TERRACES

This reach, immediately downstream of the Comite River Control Structure, provides an opportunity to build strong visual, experiential, and ecological connections to the adjacent bottomlands of the McHugh Swamp. These adjacent areas are mostly undeveloped, forested, and mesic. In light of this, we recommend that the path system here be designed to focus on the needs of runners and bikers, who would be most likely to utilize the full length of the canal path system. We also recommend that vegetation in this area include high percentages of the Bottomland Forest and Wet Meadow plant communities, both of which are adapted to mesic conditions.

The plan at right shows typical proposed conditions in a portion of Reach 1, and additional detail for this vicinity is shown in perspective, section, and axonometric on the two following pages.

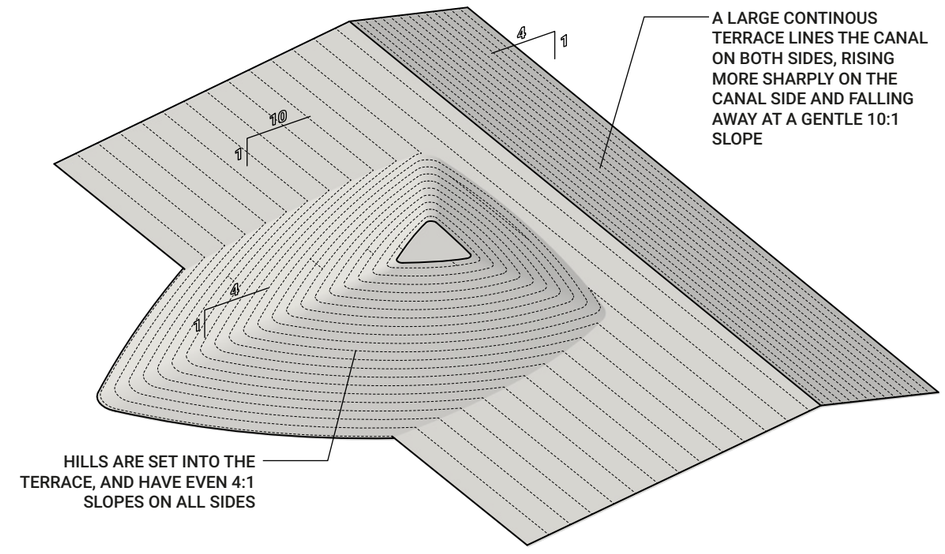


Legend

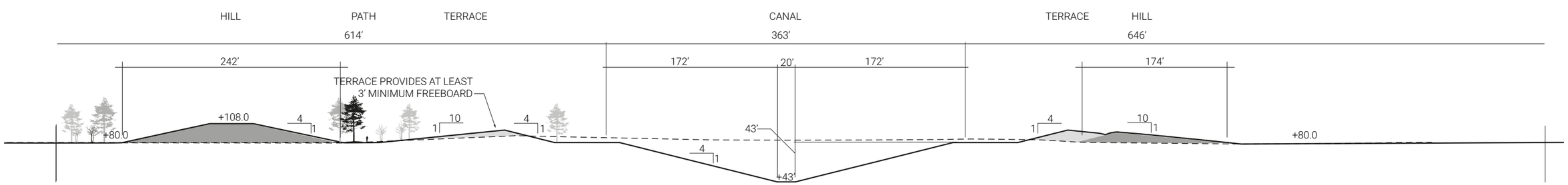
- Pine Forest
- Bottomland Forest
- Wet Meadow

0 75 150 300 ft.

View across several Swamp Terrace landforms showing a path and plants typical of the Bottomland Hardwood community



Typical Swamp Terrace Landform with 1-foot contours

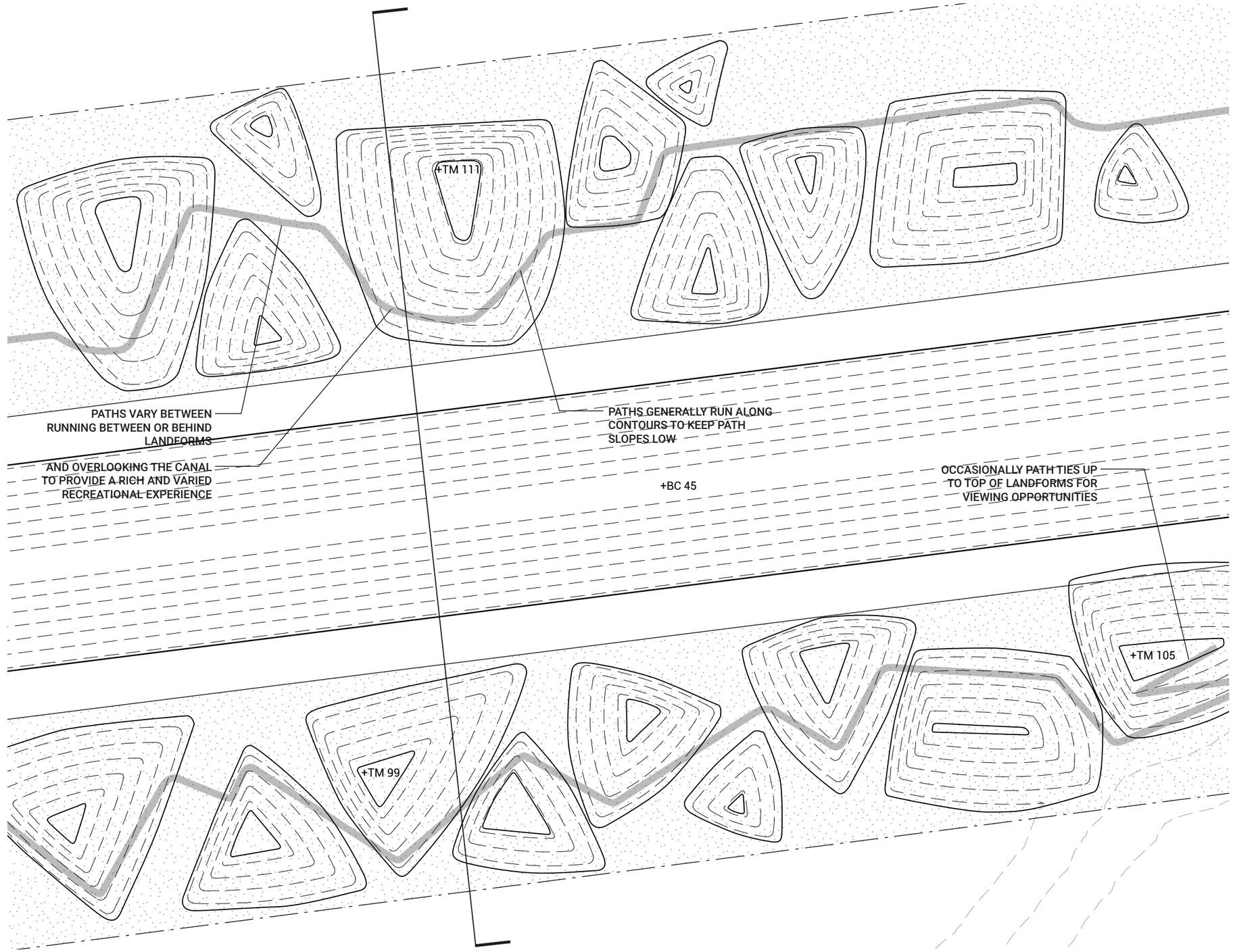


Swamp Terrace Section

BLUFF HILLS

In this reach, the adjacent areas are primarily farmland and small, fragmented parcels of forest. This provides a good opportunity to develop this reach for passive recreation. Paths would weave between and along the sides of frequent mounds, providing varied experiences and views for walkers, in addition to bikers and runners on longer routes. Large expanses of pollinator meadow would be emphasized, though a treed zone of pines blending into bottomland hardwoods is recommended near the low ground of the existing bayou.

The plan at right shows typical proposed conditions in a portion of Reach 2, and additional detail for this vicinity is shown in perspective, section, and axonometric on the two following pages.

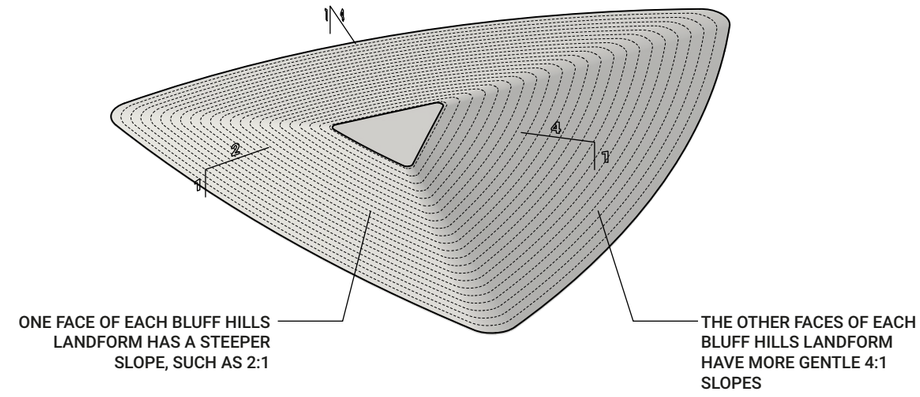


Legend

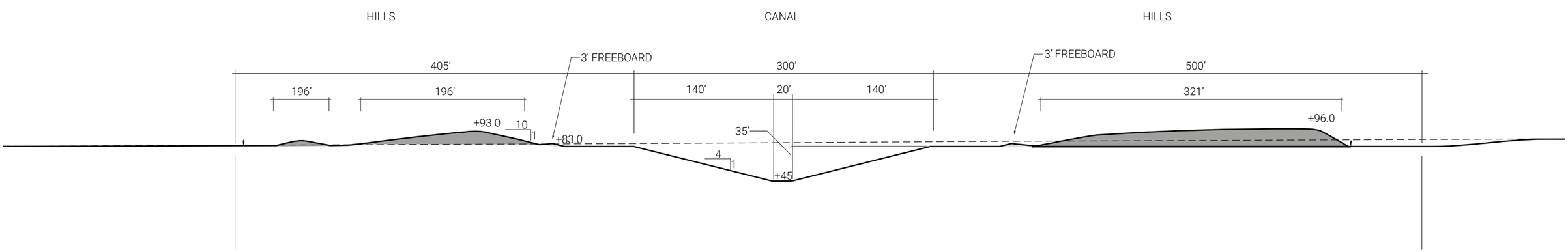
Meadow

0 75 150 300 ft.

Perspective view of an open pollinator meadow and wide paths in the Bluff Hills



Typical Bluff Hills Landform with 1-foot contours

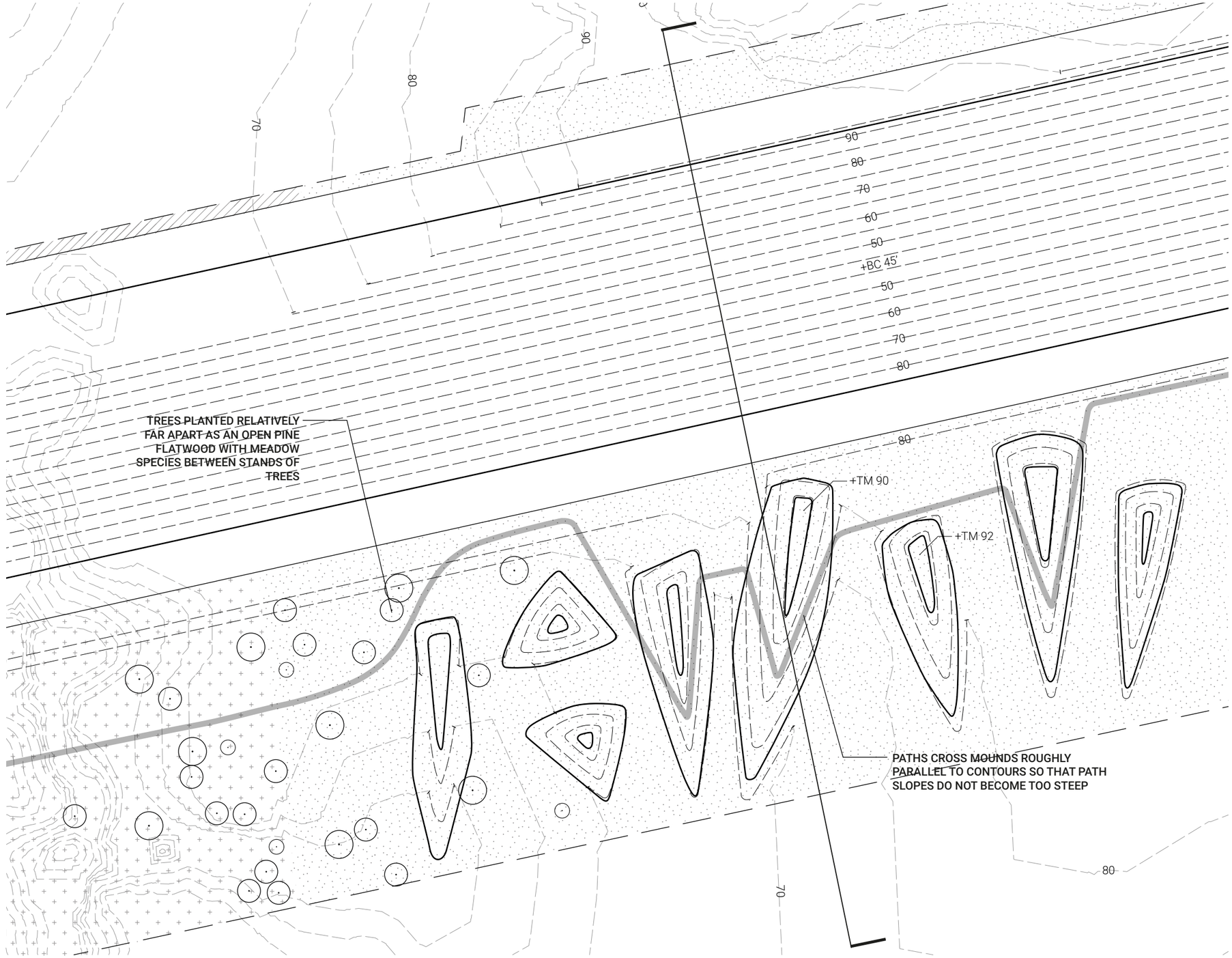


Bluff Hills Section

ROLLING PLAINS

Like Reach 2, this reach is situated in the midst of existing farmland and small parcels of forest. Some small-scale residential development is also present. As the "mountain" is immediately to the west in Reach 4 and likely to be a strong recreational draw, we recommend developing this reach with a focus on active family recreation. The long, low hills of this reach provide a gently varying experience as paths climb over and along them. Plant communities would be about half meadow species (at the eastern end) and half tree species (at the western end), emphasizing connectivity with existing woodlands a the western end of Reach 3.

The plan at right shows typical proposed conditions in a portion of Reach 3, and additional detail for this vicinity is shown in perspective, section, and axonometric on the two following pages.

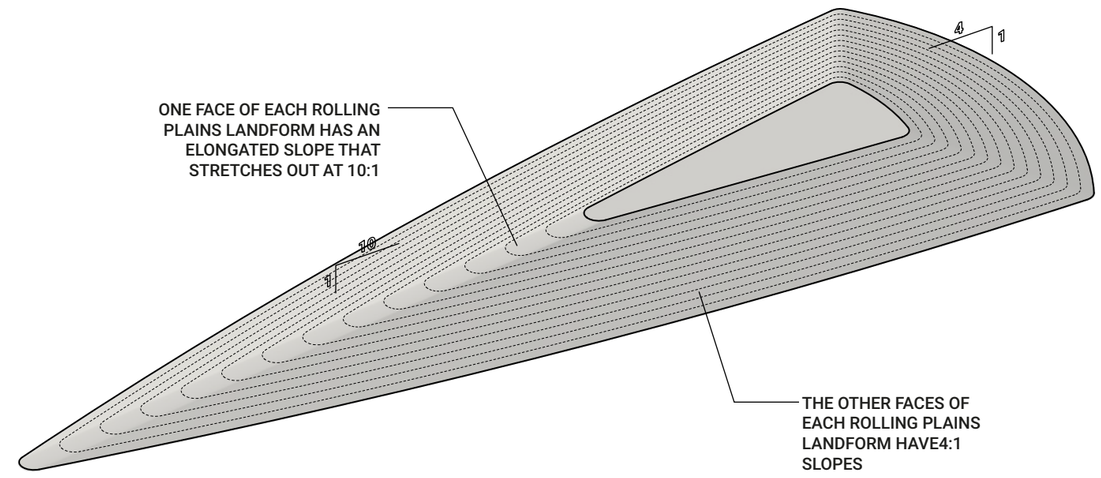


Legend

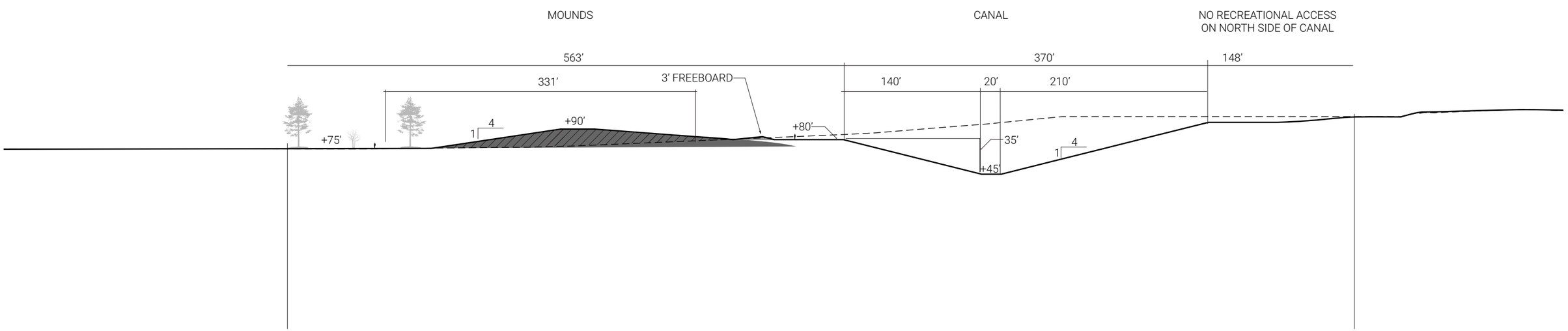
- Pine Forest
- Bottomland Forest
- Meadow

0 75 150 300 ft.

View of a path winding between landforms in the Rolling Plains



Typical Rolling Plains Landform with 1-foot contours



Rolling Plains Section

REACH 4

MOUNTAIN OVERLOOK

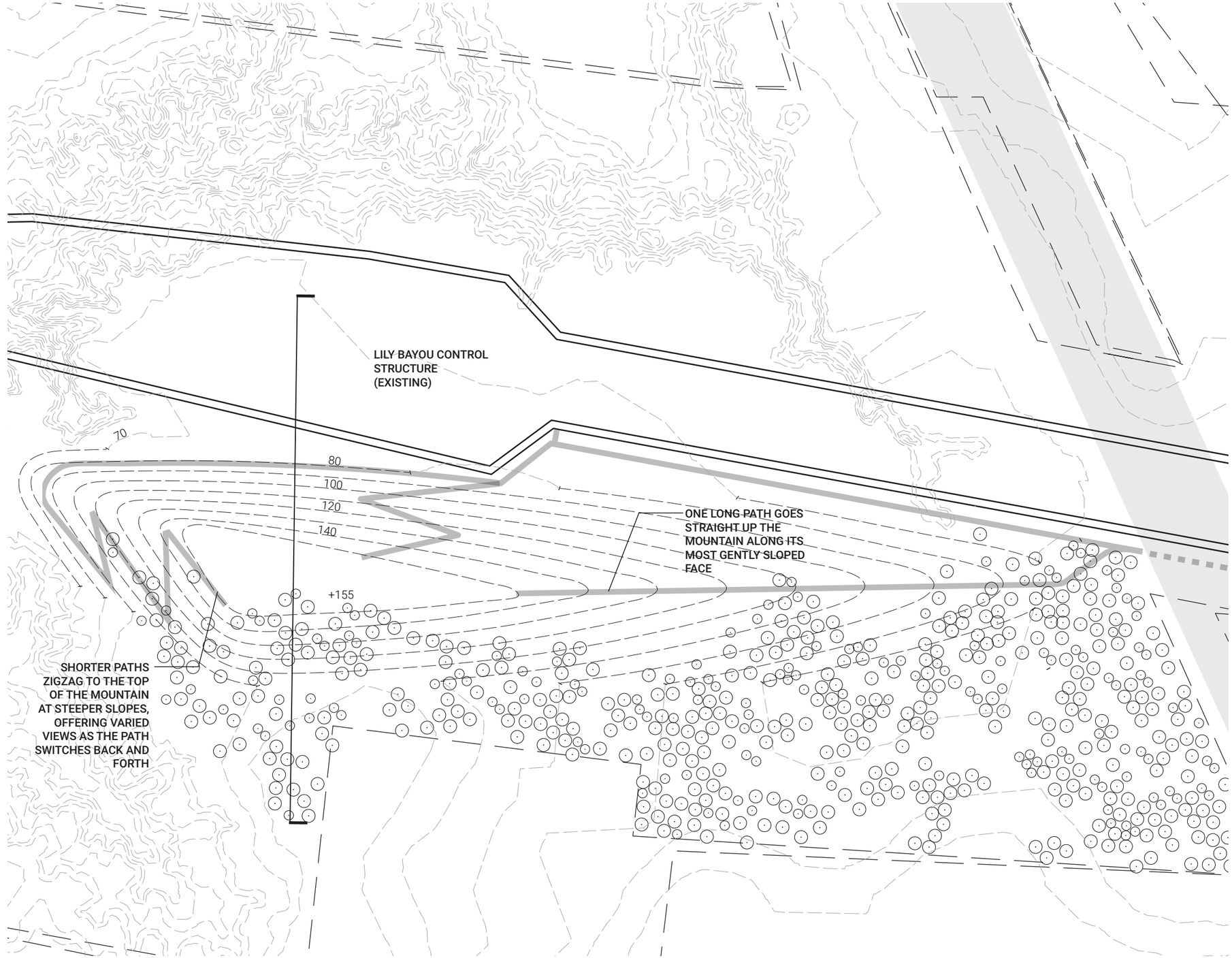
We recommend transporting a significant volume of excavated material to this location from adjacent Reach 3 (see pages 38-39). This material would be shaped into a single large landform, which would function as a beacon in the relatively flat landscape of the Baton Rouge region. From its top, recreational users would experience expansive views of the Mississippi River, its bottomlands, the Comite Canal, forests, and surrounding agricultural areas. Accessible paths up to and down from the top should be aligned to offer distinct experiences, orienting the pedestrian variably toward canal, river, mountain, and surrounds.

The plan at right shows proposed conditions for Reach 4, and additional detail for this reach is shown in perspective, section, and axonometric on the two following pages. (Note that, because of the size of the mountain, the scale of these drawings is different from the scale of the drawings for Reaches 1-3.)

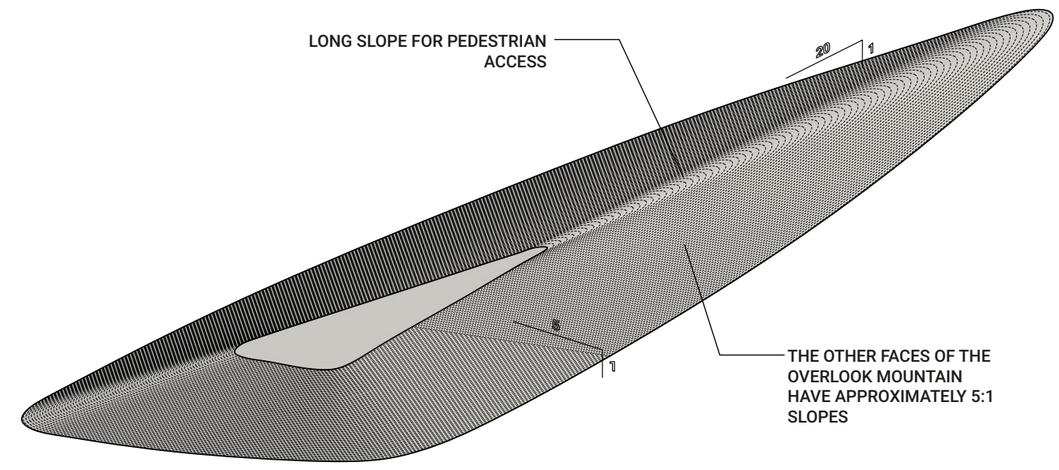
Legend

Meadow

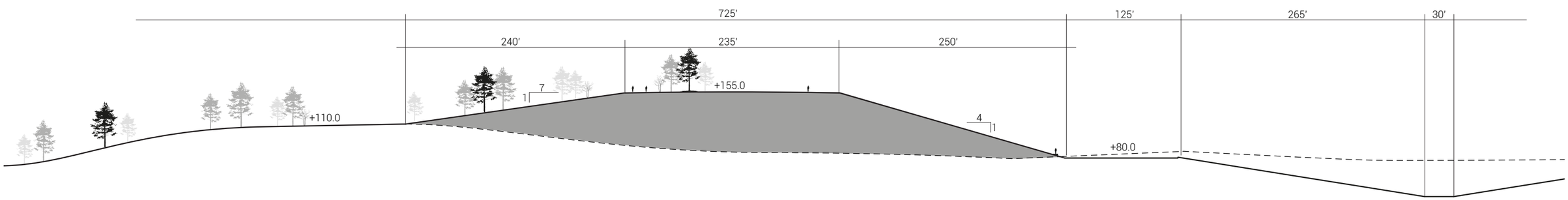
0 125 250 500 ft.



View of the long path leading up the Mountain Overlook



Mountain Overlook axonometric with 1-foot contours



Mountain Overlook Section

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.

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