# Shifting Grounds

## Bridging the Gap of Human and Wildlife

Bedford, Virginia

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Undergraduate Senior Project
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and State University
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## Acknowledgments

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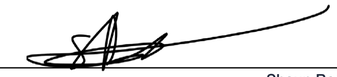
This senior project is submitted in partial fulfillment of the requirements for the Bachelor of Landscape Architecture Degree in the College of Architecture, Arts, and Design at Virginia Polytechnic Institute and State University.



**Shaun Rosier**
Senior Project Advisor

**Terry Clements**
Landscape Architecture Program Chair + Senior Project Coordinator

Within the field of landscape architecture there is often a disconnect between spaces designed for humans and spaces designed for wildlife. Most designs are focused on the anthropic experience without much regard for the non-human besides leaving patches that are intended for nature. Urbanization and growth has diminished habitat and integral ecosystems creating biodiversity issues around the world. This research explores how to break down the boundary of design for humans vs design for wildlife and instead codesign ecological programming with human programming. The noise, smell, and views of urban spaces have led to wildlife being pushed to the background and people often tune out the sounds of birds whistling in the background. This approach aims to bring the non-human from the background to the foreground and to our ground in a more than human approach to landscape architecture.

This project examines the Claytor Nature Center in Bedford, Virginia, exploring how the site can be reimagined with principles that promote reciprocal spaces of human and wildlife. Initial research involves a survey of scientific references of interactions between human and more than human life, and ecological design principles. An examination of the sites history and development will influence the research and future intentions of the site.

Case studies will be examined to explore how landscape architecture projects can solve the issues of the disconnect between human and nature, habitat loss, and design in ways that work with the land rather than against it.

Following research, site visits, and analysis, a design is developed applying research to test how this approach to landscape architecture can be achieved. A post design analysis will reflect on how successful this approach can be applied and  discover lessons learned.

“The fact is that no species has ever had such wholesale control over everything on earth, living or dead, as we now have. That lays upon us, whether we like it or not, an awesome responsibility. In our hands now lies not only our own future, but that of all other living creatures with whom we share the earth.”

**David Attenborough**

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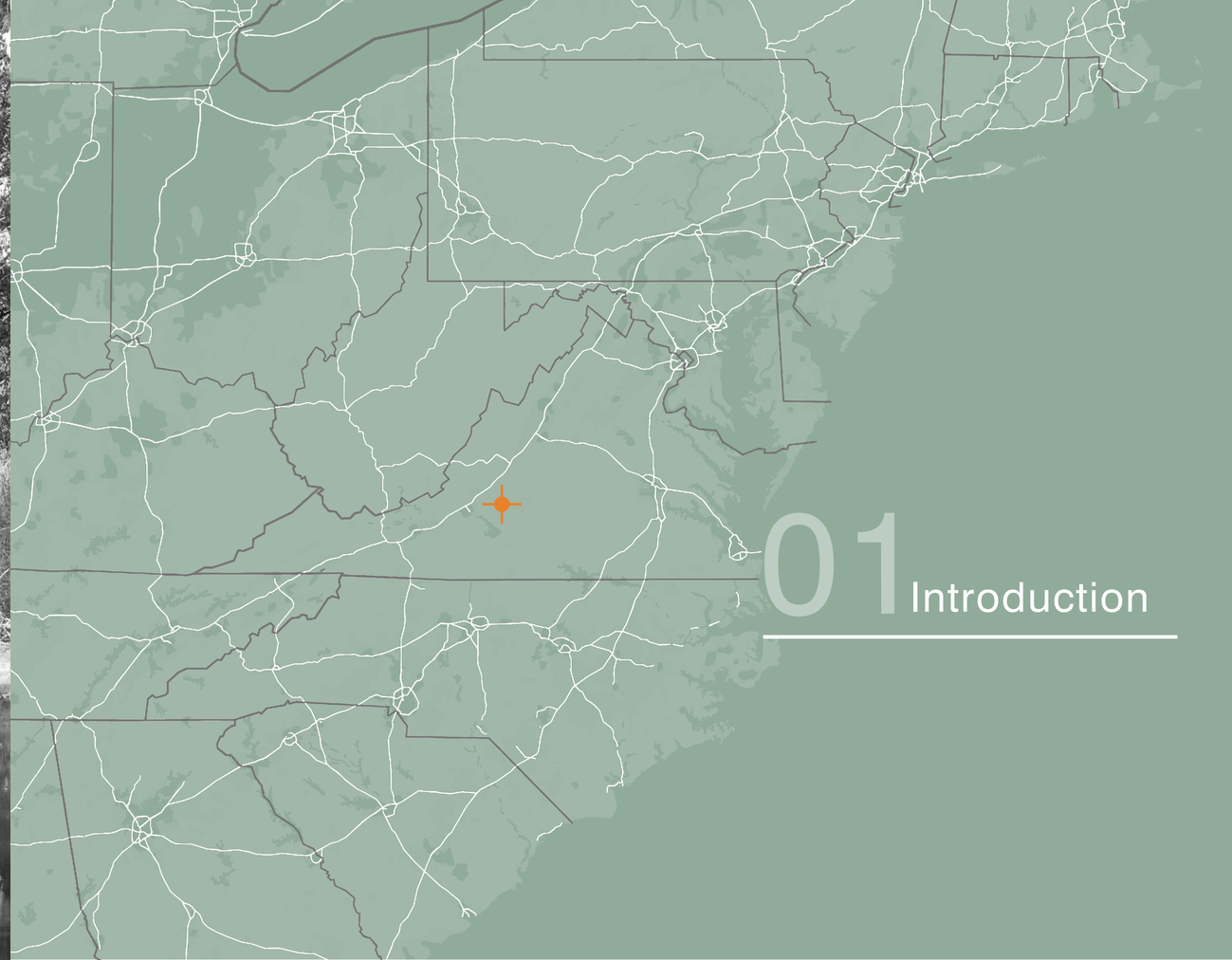
*All Images by author except as noted

Figure 01 *Big Otter River*



# 01 Introduction

## 1.1 Context Map

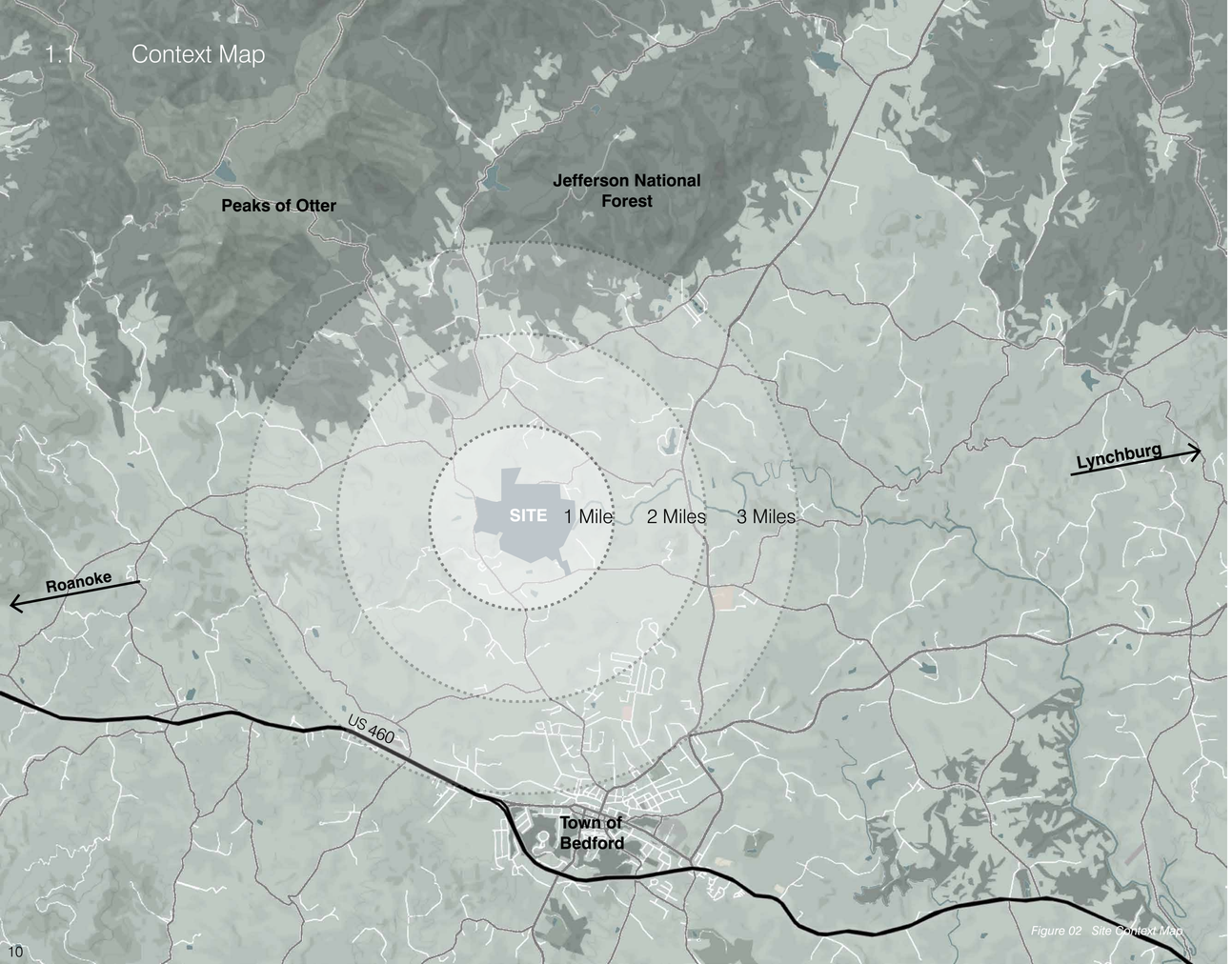



*Figure 02 Site Context Map*



## 1.2 Project Statement

The Claytor Nature Center is an existing 491 acre site located in Bedford, Virginia started in 1998 after a donation of land to the University of Lynchburg as a conservation easement. Since then the University has developed the site into a research center, wedding venue, formal and educational gardens, observatory, trail network, and more. In discussion with the Nature Center's Director, an opportunity has arisen to propose a master plan for the site that can provide a great senior project, and meet the desires of the Nature Center to consider further development. The outline of this masterplan fits the needs of the center including, but not limited to: housing for visiting students and professors, signage and kiosks, revenue generation, educational programming, and sustainable design.

## 1.3 Methodology

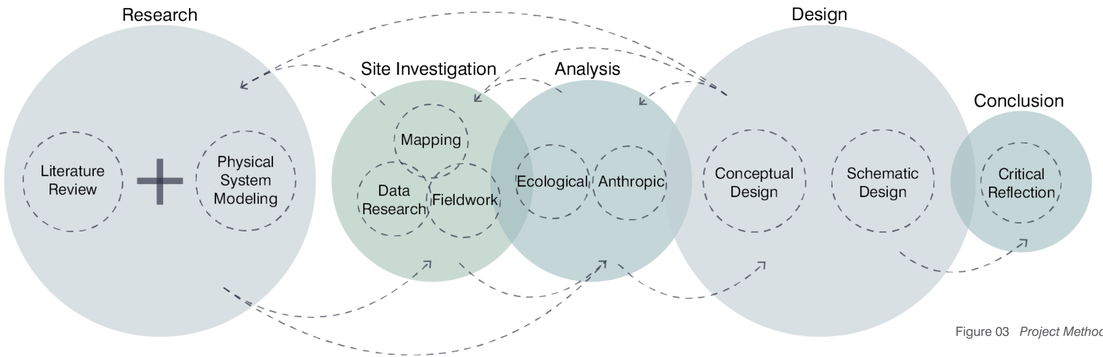



Figure 03 *Project Methodology*



## 1.4 Research Question

How can landscape architecture create an adaptive environment that promotes human and non-human interaction?

# 1.5 Goals and Objectives

1. Analyze the unbalanced relationship between humans and nature within landscape architecture. Exploring methods for how the barrier between the two can be broken down.

    a. By conducting research into the relationship between humans and nature and finding cases for how this can be improved.
    b. By developing a hierarchical strategy for relationships between human and nature.

2. Explore how the Claytor Nature Center can be sustainably designed to increase utilization from the surrounding Bedford community and local universities.

    a. By selecting durable and sustainable materials and a native plant palette that is harmonious with the ecological nature of the site. Exploring how planting can assist in the transformation of an ecosystem.
    b. By proposing a successional plan to naturally convert hay fields to grassland and forest.
    c. By introducing programming that promotes ecological research opportunities that utilize existing on-site aquaculture laboratories.
    d. By creating places that can be used by all user groups of students, researchers, wedding visitors, or recreational visitors.

3. Explore how small-scale places and or structures encourage reciprocal interaction between human and non-human.

    a. By introducing stopping spaces that encourage people to slow down and become sensually aware of the surrounding spaces.
    b. By analyzing how different detailed designs can influence the way people use a space.
    c. By creating habitat for synanthropic species within spaces intended to be used by humans.

4. Create a design that establishes a symbiotic relationship between spaces for humans and spaces for wildlife.

    a. By creating a hierarchical trail system that connects small scale interventions of the landscape that create different micro ecosystems blending human and nature.
    b. By selecting synanthropic species and conducting research for how to co design spaces for these species and humans.

Figure 04 *Cloverlea Garden*

# 02 Theoretical Framework

## 2.1 Introduction

This research began with a literature review of ecological design theories relating to the site and research question. These theories were examined and diagrammed to determine how they can be applied to achieve a codesign of spaces for humans and non-humans. Along with literature review, case studies were analyzed to examine how this concept was applied to successful projects within landscape architecture.



## 2.2 Research Theories

Traditional Conservation Approach


Figure 05
Diagram adapted from "Envisioning Predator Free Miramar''
by Shanika Tuinder

Urban Conservation Approach

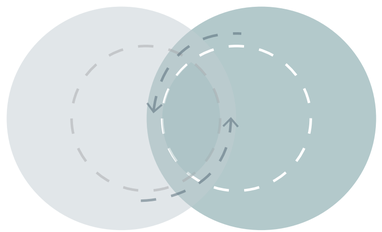


Figure 06
Diagram adapted from "Envisioning Predator Free Miramar''
by Shanika Tuinder

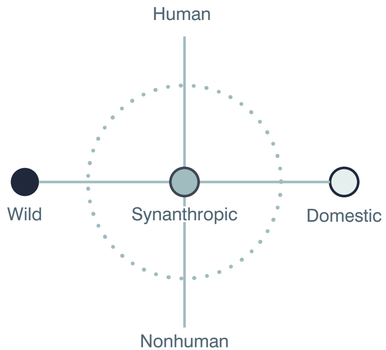



Figure 07
Diagram adapted from "Birds(i)View'' by Jessica McCormick

### Application to Design Research

- Design will apply a form of urban conservation approach to increase interaction between human and nature
- The goal will be creating synanthropic spaces where people and animals will coexist whether wild or domestic.

## Creative Conservation Landscapes

"Ecology provides the single indispensable basis for landscape architecture and regional planning" – Ian McHarg
Landscapes are often design according to three principles:
1. Ecology - Relative importance of nature conservation
2. Aesthetics - Public acceptance of 'wild vegetation'
3. Resources - Availability of resources for management or maintenance

It is very difficult prioritize all three, but balancing all three can create a creative conservation landscape: a middle ground that can provide the opportunity for conservation when resources are limited.

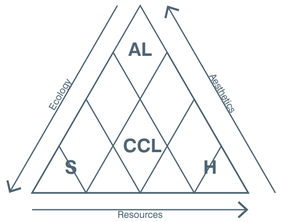



Figure 08
Diagram and research adapted from "The Dynamic Landscape" by Nigel Dunnett and James Hitchmough

### Application to Design Research

- This project should aim to creative a creative conservation landscape that balances use of spontaneous vegetation, horticultural vegetation, and anthropic landscapes.
- A mass space plan shall be created to match plant communities to soil-moisture-topography complex.

## Urban Conservation Approach

The traditional approach to design involves separating places into spaces for humans and spaces for nature. For example: the Town of Blacksburg is designed for humans, but miles away, the Jefferson National Forest is a protected area for wildlife conservation. These landscapes lose the opportunity for the connection of human and ecological systems. This connection is positive for the well being of people and correlates to a positive effect on populations of wildlife. The Urban Conservation Approach (Tuinder 2021) designs for this integration between human and nature and creates a "dynamic socio-ecological system"

### Application to Design Research

- The design should incorporate an urban conservation approach that incorporates a cohesive socio-ecological system.

## Animal Aided Design

Landscape architecture tends to lack design with an ecological conservation approach (McCormick 2021). Animal aided design aims to integrate wildlife conservation with urban planning. Application of AAD can increase biodiversity and allow for positive human and non human interactions.

### Designing for the Synanothrope

A synanothrope is an undomesticated organism that lives within close association with people (mouse, squirrel, or raccoon).

- As people continue to expand and create built environments there is an opportunity to create relationships between human and nature. There is a clear separation between spaces for people and places for animals. Creating the spaces between is the most difficult, yet the most important for the future of design.
- Domesticated animals have become a part of our lives and don't fall under this category. On the other hand, wild animals such as bears cannot safely be part of this interaction. The between species (birds, mussels, insects, etc) are great for creating integration within place

### Application to Design Research

- Animal aided design begins by understanding the wildlife and needs of the species (nesting, habitat, food sources, etc). Understanding the species is necessary to establish a connection.
- While you can design for a species, it is impossible to know whether or not that species with use the space. Therefore, the space must be adaptable and respond well to change.
- Synanothropes are key species for creating human and wildlife interactions.



# 2.3 Hierarchy of Encounter

After an analysis of ecological research, this hierarchy of encounter began to develop. This hierarchy became the cornerstone of cohabitat design for this project and influenced placemaking.

### 1st Degree

Direct contact through touch or feeding. Strongest connection between human and animal.

### 2nd Degree

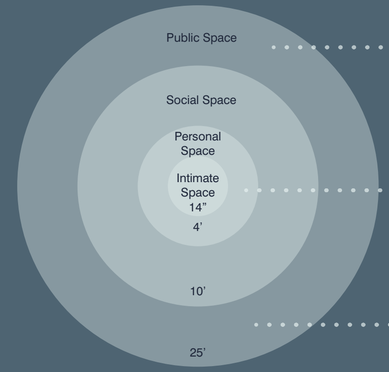
Connection made between human and nature through a direct sighting of an animal or human.

### 3rd Degree

Indirect connection made between human and nature. Sighting of evidence left behind from human or animal.

## Proxemics Theory

Developed by Edward Hall, the theory of proxemics studies how humans perceive space and how social interactions are affected by non verbal cues such as touch and body movement. Proxemics can be applied to interaction between human and non human because humans and wildlife interactions vary at different distances. Within the intimate space there is a drastically different sense of details and comfort than at the public space distance.

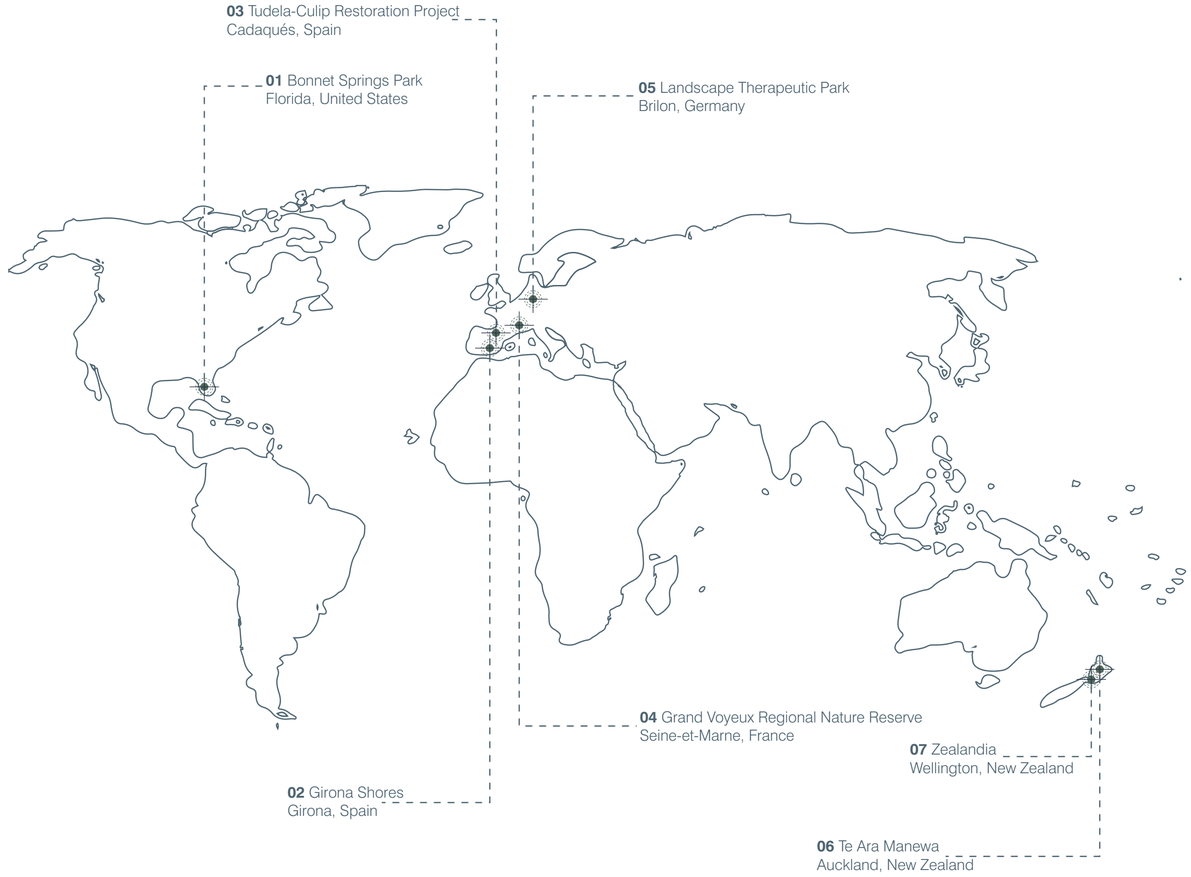



Most 2nd degree interactions will occur within the public space bubble. Although they can occur at further distances, the most meaningful interactions occur within 25'.

1st Degree interactions occur within personal space. The level of detail visible to the eye within 4' creates a feeling of interaction that cannot be achieved from further distances.

3rd Degree interactions occur within the public space bubble to view remnants or a human or animal.

## 2.4 Case Study Research



# 01. Case Study
## Bonnet Springs Park

Figure 09 *Bonnet Springs Park*



## Bonnet Springs Park
Lakeland, Florida
Sasaki

The park transformed an abandoned rail yard into ecological habitat and a community park. The design offers a unique form of universal design with long meandering boardwalk ramps that create an experience of walking amongst the trees. The designers also offer the choice of the ramp or stairs giving the user the choice of experience.

### Application to Design Research

- Providing ramps in such a way that it creates an experience of connecting with nature should be applied to offer universal design to site designed areas.
- Offering the choice of stairs that quickly bring you up or down to a space while also offering a long meandering path can encourage users to slow down

Figure 10 *Bonnet Springs Boardwalk*

Figure 11 *Nature Center*

# 02. Case Study
## Girona Shores

Figure 12 *Girona Shores*



# Girona Shores
## Girona, Spain
EMF Landscape Architecture

A self initiated project by landscape architect Estudi Martí Franch with the goal of being a model that could be replicated in other sites. The project worked to develop and maintain green infrastructure that creates potential for human occupation and ecological biodiversity. The site forms a dynamic edge for the city of Girona with a hierarchical nature of public space.

### Application to Design Research

- Utilize "Pilot projects" a small scale, low cost way of experimenting ideas for forming a connection between human and ecology.
- Create a hierarchy of space through varying levels of vegetative growth and programming.
- The low cost methods for management and implementation create feasible designs for the Claytor Nature Center.
- Design is very site specific and requires on site observations and sketches.

Figure 13 *Girona Shores Paths*

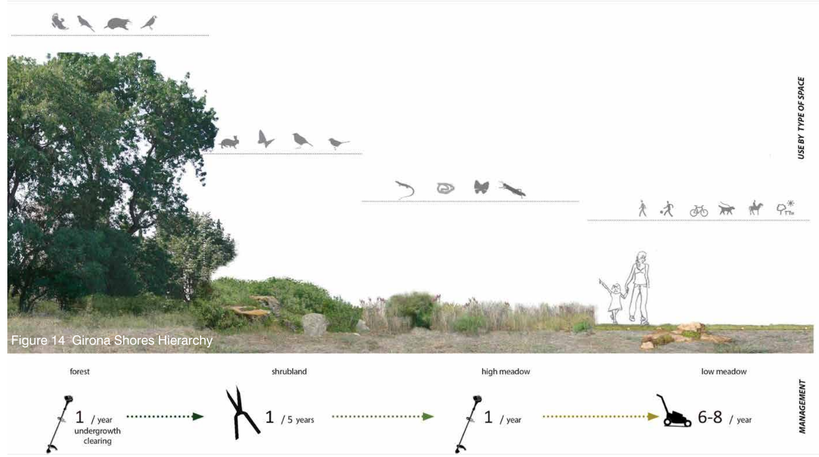



Figure 14 Girona Shores Hierarchy

# 03. Case Study
## Tudela-Culip Restoration Project

Figure 15 *Tudela-Culip Restoration Project*



# Tudela-Culip Restoration Project
## Cadaqués, Spain
EMF + Ardevol

An ecological approach to landscape architecture EMF calls “reclaiming by undoing”. Their approach aims to transform the site to fit the natural landscape and celebrate nature instead of building on top of it. This process involved years of research and site exploration to learn how to replicate the land and deconstruct existing building. The site is connected through a hierarchy of trails with strategically placed overlooks and stopping points.


Figure 16 *Trail Hierarchy Plan*

### Application to Design Research

- A hierarchy of trails should be used with small scale interventions that blend to the natural formation of the land and reclaim scarred places.
- Blending the natural materials on the site with proposed spaces binds human and nature.

Figure 17 *Tudela-Culip Restoration Project*

Figure 18 *Tudela-Culip Restoration Project*

# 04. Case Study
## Grand Voyeux Regional Nature Preserve

Figure 19 *Grand Voyeux Nature Preserve*



# Grand Voyeux Regional Nature Reserve

Seine-et-Marne, France

Territories Landscape Architecture

A man made nature preserve on land used as a gravel pit for nearly 30 years. The goal was to create discreet observation through camouflage to protect this sensitive healing landscape. The design intervention introduced observatories with shapes that make the viewer invisible to birds and allows for comfortable viewing.

### Application to Design Research

- Camouflage can serve as an opportunity for creating human and nature interactions where normally difficult
- Consider using these shapes and vegetation to hide the human in the natural environment
- Creating comfort in places for interactions increases the chance of the viewer staying

Figure 20 *Bird Observation Structure*

Figure 21 *Bird Observation Structure*

# 05. Case Study
## Landscape Therapeutic Park

Figure 22 *Landscape Therapeutic Park*



# Landscape Therapeutic Park

## Brilon, Germany

Planergruppe Oberhausen and B.A.S. Kopperschmidt & Moczalla

A therapeutic park that explores the relationships between human and nature. The park features a trail with 13 stations that are small interventions to engage senses and connect a person to the landscape. These interventions create inviting spaces for people to slow down and relax in a forest environment.

### Application to Design Research

- Utilizing small scale interventions that engage the mind with the natural environment
- Creating a narrative design that provides space for people of varying personalities (social spaces, private spaces, relaxation spaces)

Figure 22 *Landscape Therapeutic Park*

Figure 23 *Private Spaces*

Figure 24 *Outdoor Room*

# 06. Case Study
## Te Ara Manawa

Figure 25 *Te Ara Manawa*



# Te Ara Manewa
## Auckland, New Zealand
Isthmus

Habitat markers seen on the right create opportunities for play between children and birds. The well crafted totems stand out within a landscape in an aesthetically pleasing way and entice passing by visitors to slow and be curious about what creatures occupy the space.

### Application to Design Research

- Utilizing the habitat markers can help to create unique nesting/burrowing for woodpeckers amongst design spaces
- Creating boardwalks with dead end lookouts create opportunities for users to slow down and become sensually aware.

Figure 26 *Habitat Marker*

Figure 27 *Lookout Spaces*

# 07. Case Study
## Zealandia

Figure 28 *Zealandia*



# Zealandia
## Wellington, New Zealand

Zealandia is “the worlds first fenced in eco sanctuary”. The 3 meter fence provides protection from predators and humans and allows for biodiversity to thrive within the sanctuary. The project aims to reintroduce native wildlife that was lost from the inhabitation of New Zealand by invasive predators that has not existing on the island before humans arrived.

### Application to Design Research

- Fencing could be used as a way to encourage human - non human interaction that is protected from the rising deer populations.
- Programming to include night and twilight hikes as interaction learning experience could be used for nocturnal animal connection and education.
- Fencing in areas can be used as a way of trial testing different restoration techniques.
- Project can use community engagement to bring restoration and interaction.

Figure 29 *Predator Protection Fence*

Figure 30 *Habitat Viewing*

Figure 31 *Habitat Viewing*

Figure 32 *Nighttime Hiking*

Figure 33 *Blossoming Flower*

# 03 Site Analysis

## 3.1 Introduction

The site consists of 491 acres within Bedford, Virginia. Although the site is owned and operated by the University of Lynchburg, it is 24 miles away from the university. This distance creates a barrier that separates the two from being easily accessible by students. Being located nearby to the town of Bedford though creates ample opportunity for the nearby community. The site can be utilized by the town and local schools for hiking, fishing, weddings, field trips, camping, stargazing, nature art, and many other outdoor activities. The site also features an “eco-lodge” which provides housing for visiting students that would otherwise not be able to make multi day trips.



## 3.2 Site Inventory

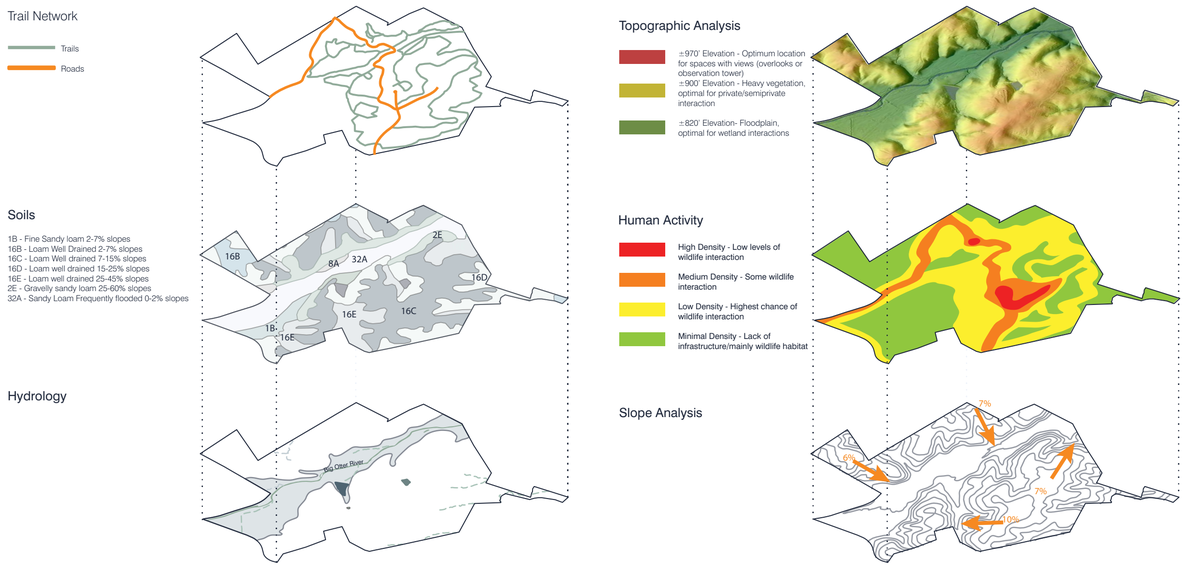



Figure 34 *Site Inventory*

## 3.3 Site Analysis

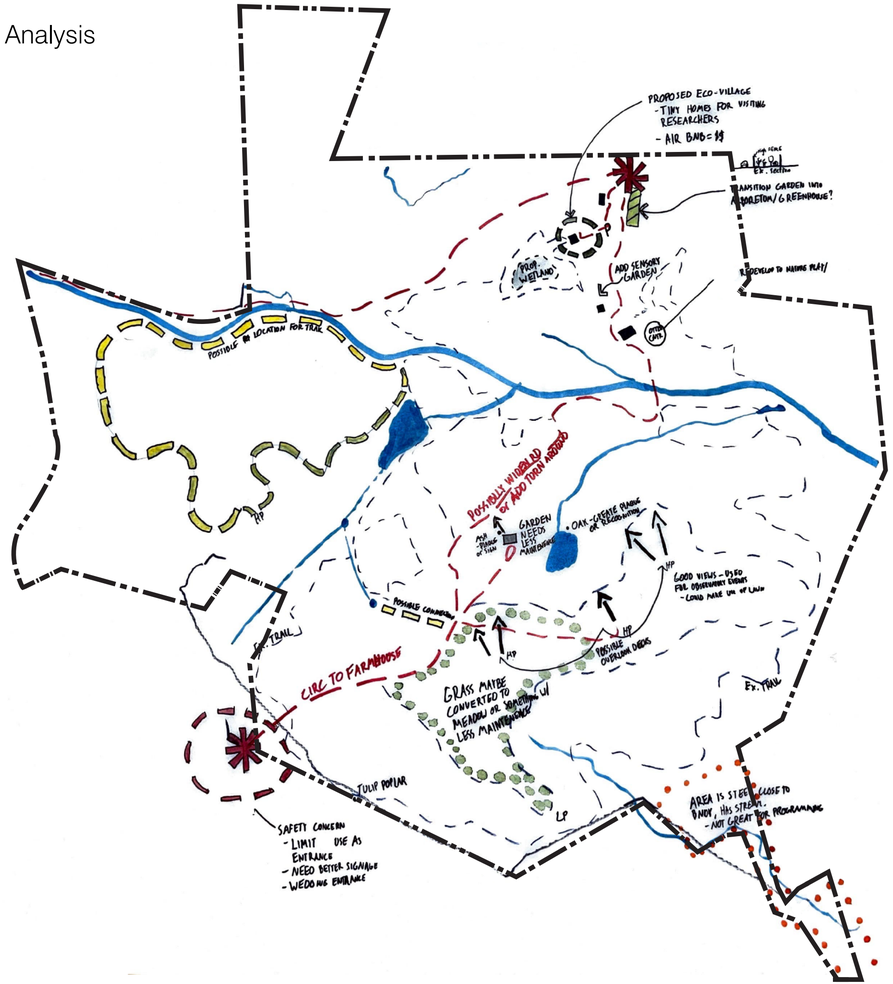



Figure 35 *Site Analysis*



## 3.4 Existing Programming

### Main User Groups

- Researchers
  - Milkweed Research
  - Wildlife Research
  - Weather Research
- Educational
  - University of Lynchburg
  - Astronomy
  - Local Bedford schools (field trips)
  - Local Colleges
- Visitors
  - Recreational (camping, fishing, hiking)
  - Weddings
  - Star Gazing
  - Bird watching
  - Horticulture enthusiasts
  - Nature photography
  - Art
  - Nature play
  - Company Retreat

### Application to Design Research

- Programming is mostly human based. Programming for the nonhuman must be designed and integrated with the human program.

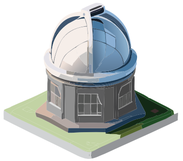
- Spaces should be designed with sociability in mind. I.e. there must be resting spots that encourage social interaction and resting spots for a more private experience.

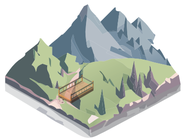
- An appeal to all user groups and balance between passive and active programming is essential for the successful design of the site.

### Passive Programming


Formal Garden Viewing


Resting Spots


Star Gazing


Sightseeing

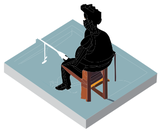

Campfire


Informal Garden Viewing


Semi-private Dining

### Active Programming


Nature Play


Fishing


Hiking


Wildlife Viewing


Camping


Wading in River


Social Dining


Wedding

Figure 36 *Claytor Turkeys*

# 04 Ecological Framework

# 4.1 Introduction

After initial research and analysis, it was imperative to understand the different ecologies making up the site. Ecologies is a vague term, but in this case it meant breaking down factors such as what vegetation grows in different places, which species appear on the site and where, the hydrological characteristics, and micro climates within the site. After analyzing these factors, the project can be narrowed down into key species to focus on very intensively instead of many species very poorly. Similarly to designing for humans, designing for wildlife can be very difficult as you may intend for a certain species to utilize the space, but it is nearly impossible to predict whether or not the species will actually use the space.



# 4.2 Dominant Ecologies

What is a Dominant Ecology?

These studies intend to form an overall analysis of vegetation masses, open spaces, rock outcrops, water, wildlife, topography, and density of the existing areas in order to create a design that increases the chances of a connection occurring between human and non human. This is the beginning of the development of a mass/space plan that forms the basis of a design before beginning to look at site details. (Placing Nature: Culture and Landscape Ecology by Joan Iverson) Nassauer)

Why Dominant Ecologies?

Designing for a connection between human and the non human poses many challenges. One of which is that even with perfect design, it is impossible to determine whether or not a species will inhabit the intended space. By identifying and analyzing the existing dominant ecologies of the landscape, one can start to gather a better understanding of what is on the site and which species to target.

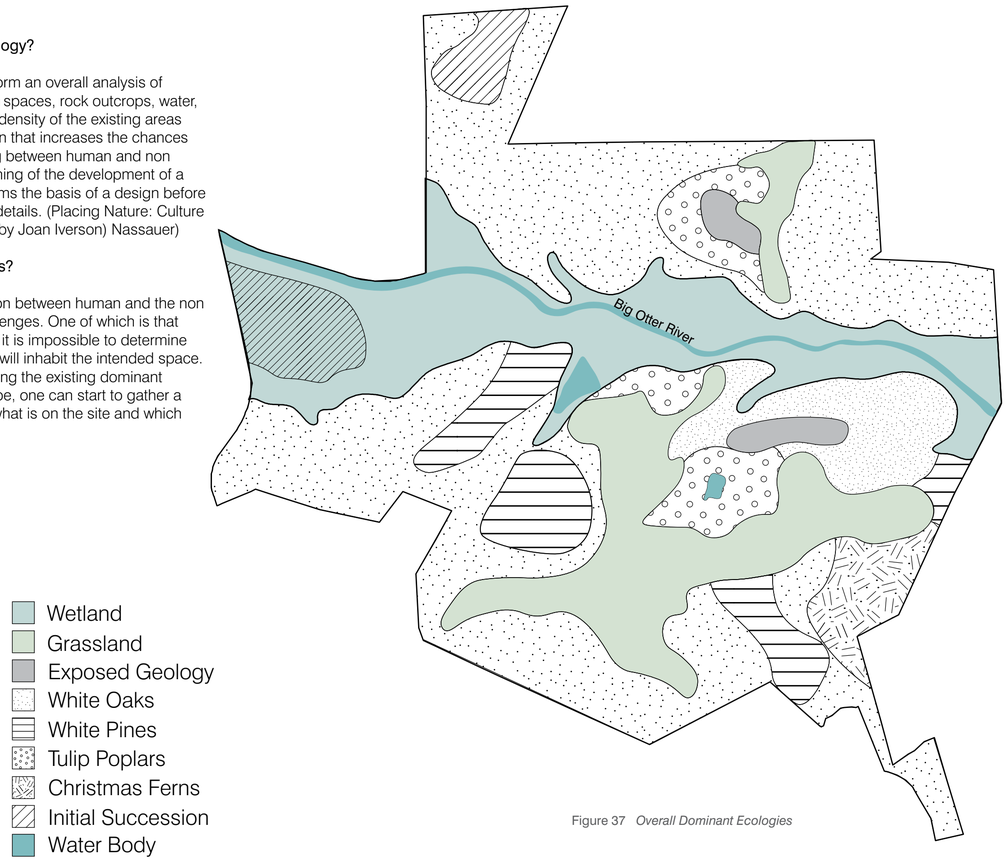
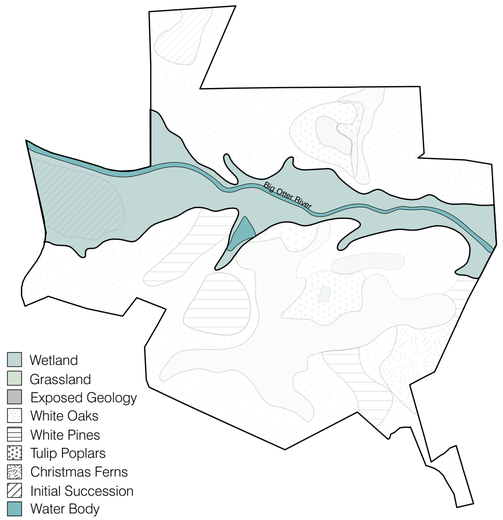



Figure 37 *Overall Dominant Ecologies*

# Claytor's Dominant Ecologies
## Wetland




### Typical Wetland Section

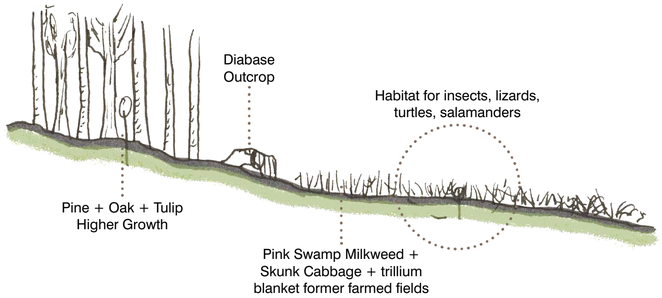
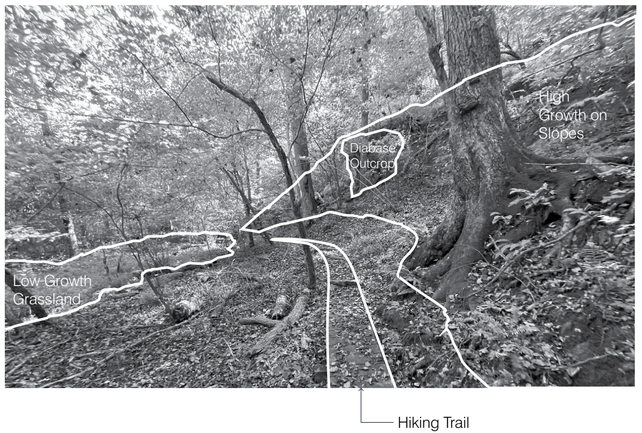



Figure 38 *Wetland Section*

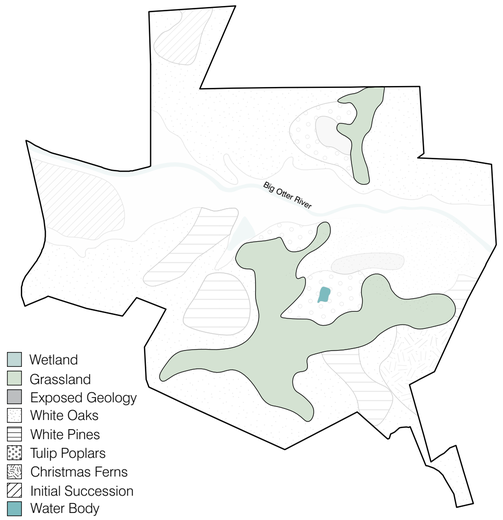



### Application to Design Research

- Design should follow the natural growth habits of wetlands with the hierarchy of growth.
  - The low growth grassland provides a moist landscape with wider viewsheds, more sunlight and wildflowers.
  - The natural curved path created by the slope creates a darker and colder habitat.
  - A wall created by an outcrop of gneiss formed 200 million years ago provides structure for the slope and a micro habitat for insects.



# Claytor's Dominant Ecologies
## Grassland




### Typical Grassland Section

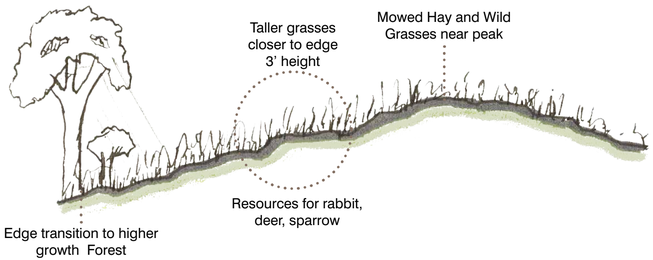
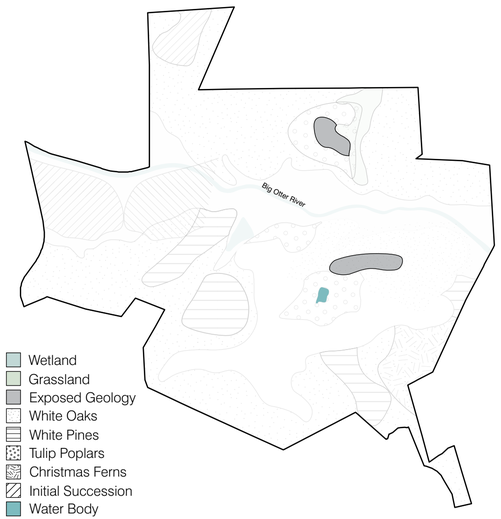



Figure 39 *Grassland Section*


### Application to Design Research

- Ecologies left unmaintained provide more opportunity for habitat, resources for wildlife, and therefore more interaction between human and nonhuman)
  - Design maintain a balance between edge typologies. The higher growth for larger species habitat, mid growth for food and small species habitat, and low growth limited to space guiding human path making.

# Claytor's Dominant Ecologies
## Exposed Geology




### Typical Exposed Geology Section

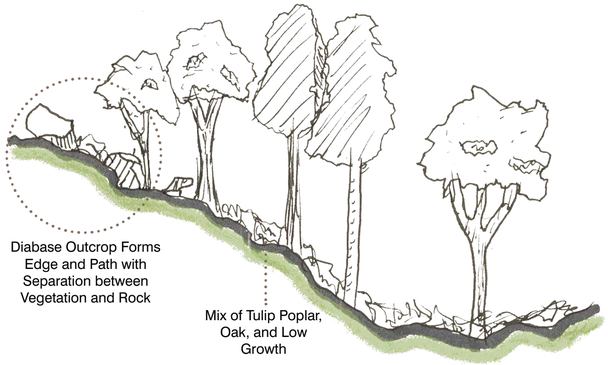
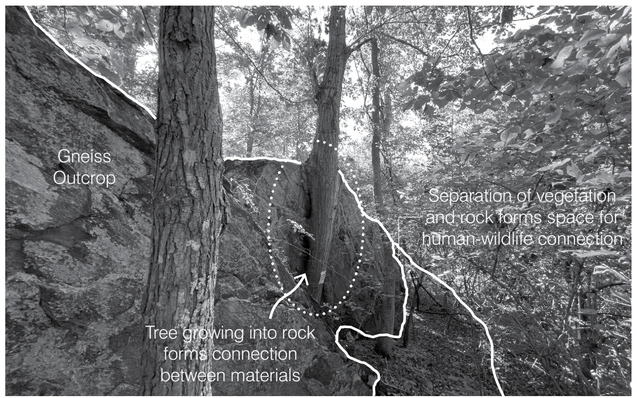



Figure 40 *Exposed Geology Section*

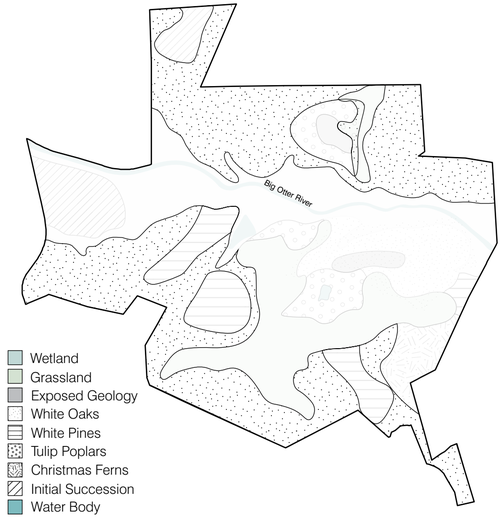



### Application to Design Research

- The geomorphology of Claytor creates an opportunity for unique experiences for interaction.
  - The history of the site being located along the Grenville Orogeny offers valuable educational experiences.
  - Large rock outcrops offer cold moist spaces for species such as the Spotted Salamander
  - A separation between the edge of rock outcrop and the low growth forest provide a connection space.



# Claytor's Dominant Ecologies
## White Oak




### Typical White Oak Section

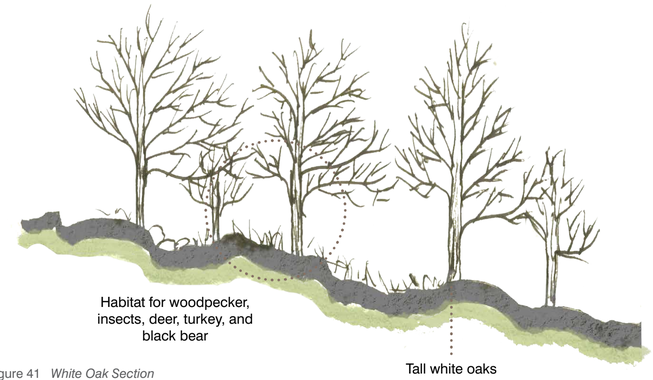
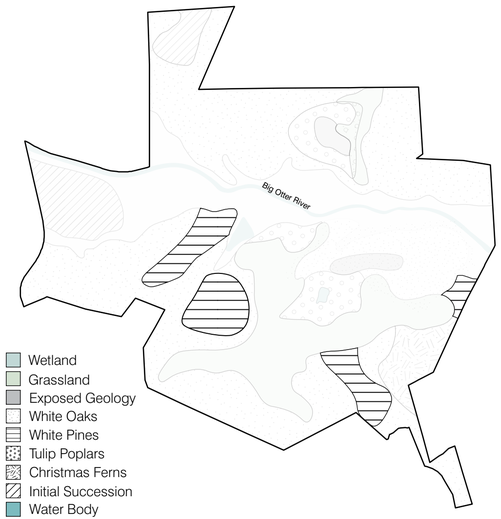



Figure 41 *White Oak Section*


### Application to Design Research

- These white oak forests provide acorns and habitat for a variety of mammals on the site and create opportunity for viewing foraging species.
- Leaving logs of fallen trees is valuable for providing nesting habitat
- These forests become barren in the winter and provide for viewing deep into the forest.

# Claytor's Dominant Ecologies
## White Pine




## Typical White Pine Section

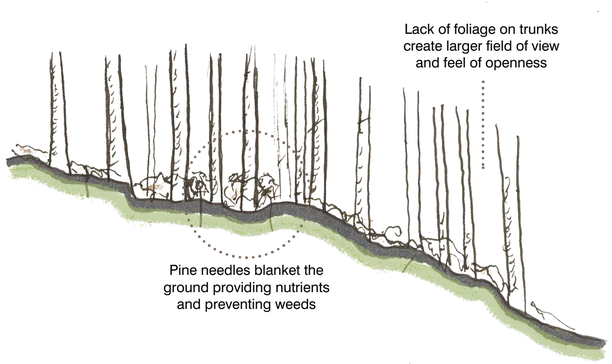


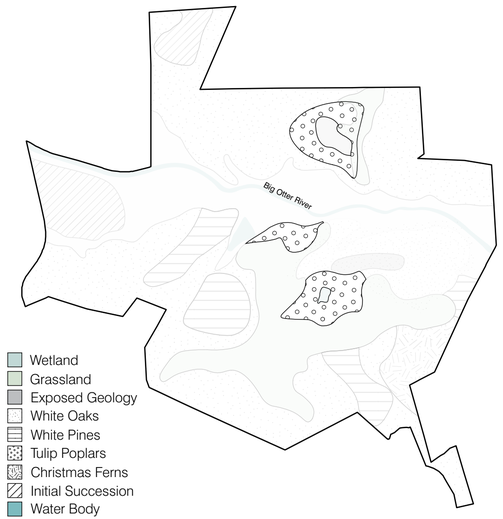

Figure 42 *White Pine Section*


## Application to Design Research

- Design should take advantage of pine needle covered forest floor.
  - The pine needles create a softer and quieter surface that limits spooking critters and provides a sensory experience.
- The tall trunks provide viewing through forest without a canopy blocking the view and should be utilized for habitat watching.



# Claytor's Dominant Ecologies
## Tulip Poplar




## Typical Tulip Poplar Section

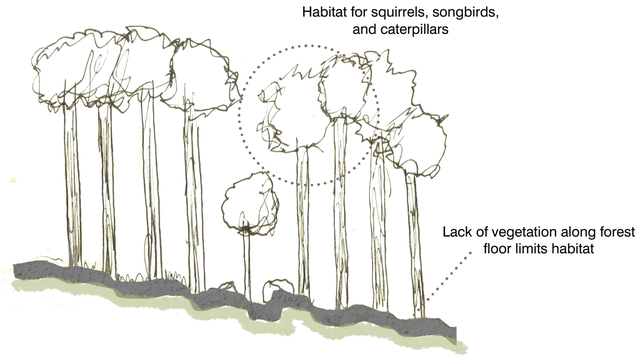
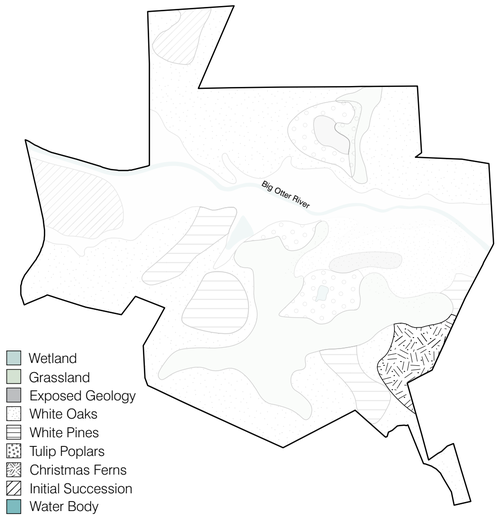



Figure 43 *Tulip Poplar Section*

## Application to Design Research

- Large tulip poplars on the site provide a densely covered forest with great habitat for songbirds, caterpillars, and squirrels
- With the dense canopy the forest floor is barren. Possible logging or controlled burns may help to rejuvenate forest health.

# Claytor's Dominant Ecologies
## Christmas Fern




### Typical Christmas Fern Section

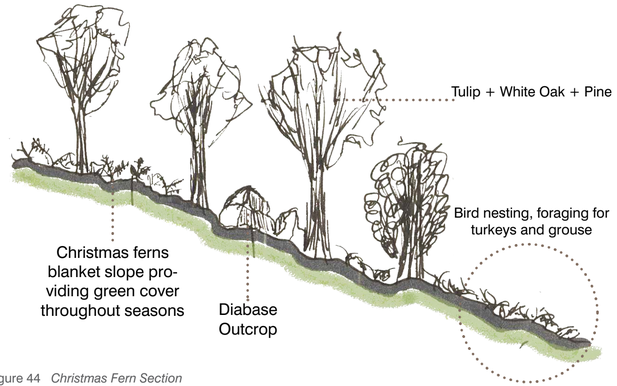


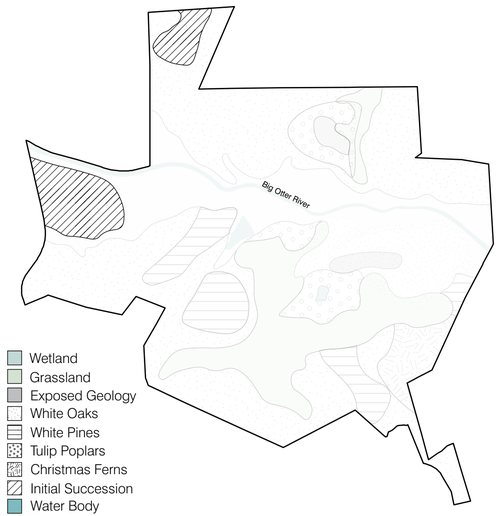

Figure 44 *Christmas Fern Section*


### Application to Design Research

- Christmas ferns occur naturally throughout the site and help with soil stability
  - Grows more in areas with more shade (can be used into design areas with older growth but need for foliage as ground cover)



# Claytor's Dominant Ecologies
## Initial Succession




### Typical Initial Succession Section

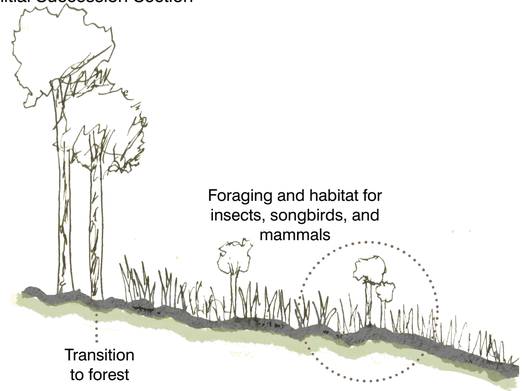
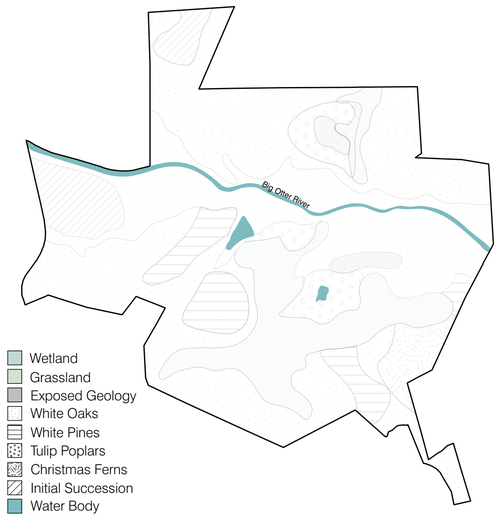



Figure 45 *Initial Succession Section*


### Application to Design Research

- Initial succession areas create an opportunity for the creation of habitat. Design should create a plan for the pruning of invasives, and a strategy for a healthy transition into forest or meadow.
- These areas provide a large habitat for insects and attract song sparrows providing opportunity for habitat viewing.

## Claytor's Dominant Ecologies
### Water Body




### Application to Design Research

- Waterbodies provide habitat and drinking for many species in Claytor. Water also draws people in for viewing and recreation. These attractions create opportunity for

Typical Water Body Section

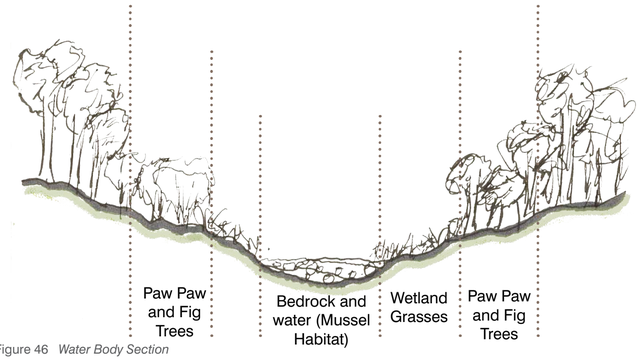



Figure 46 *Water Body Section*



## 4.4 Species Selection

After the ecological analysis of the site, enough resources were gathered to select the key species for a design solution. This process involved research of the existing species on site through applications such as "INaturalist" and "eBird" as well as species seen on site that would indicate a synanthropic nature.

Synanthropic species were a main requirement as a design for interaction of human and non human would require species that had the ability to be near humans. With a large site and the varying ecologies, it was also a goal to select species that live within differing ecologies to create a trail system that passes through the different habitats and spaces.

# Birds

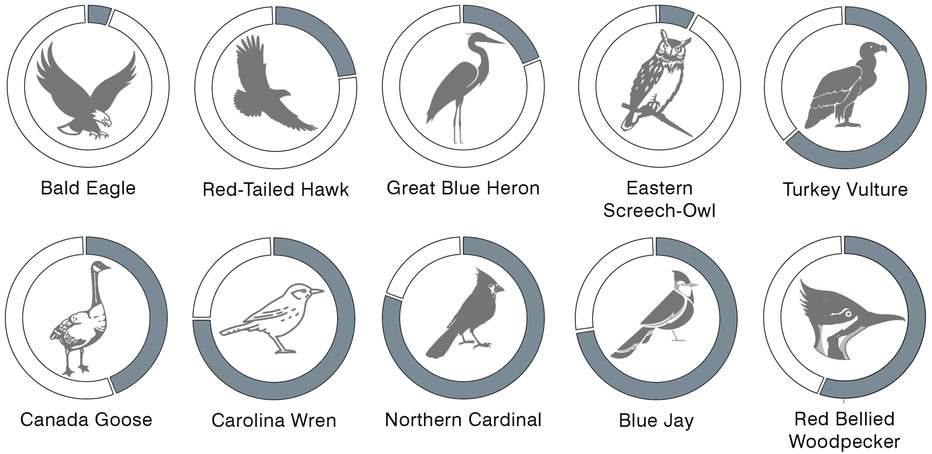



Figure 47 *Bird Inventory*

Birds present possibly the highest chances of interaction between human and species. Their synanthropic nature allows a symbiotic relationship with humans through elements such as bird feeders, nesting boxes, or bird baths. Bird watching creates a mysterious experience traversing the site and opportunities for designs of observation areas or framing views through detailed design.



# Wetland Species

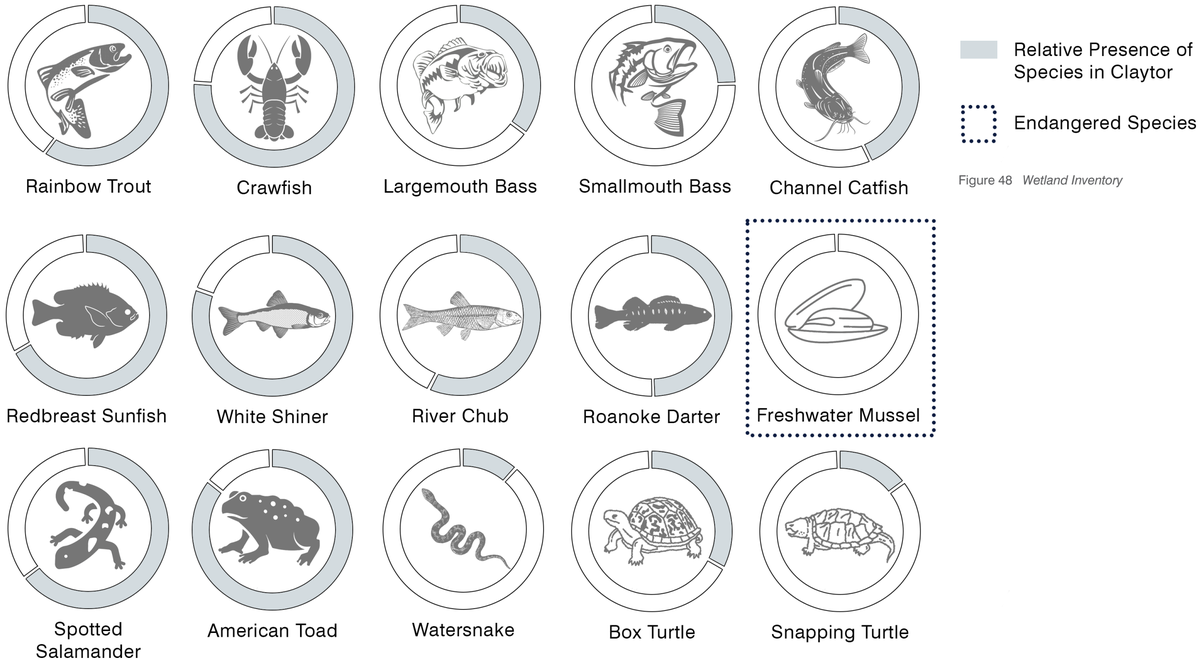



Figure 48 *Wetland Inventory*

Wetland species pose a very different opportunity for interaction with humans. The Big Otter River runs through the middle of the site and creates fishing opportunities with trout and sunfish often caught. With freshwater mussel populations declining all over the country, this site creates a great opportunity for creating habitat from this river bringing fresh water down from the Peaks of Otter.

# Mammals

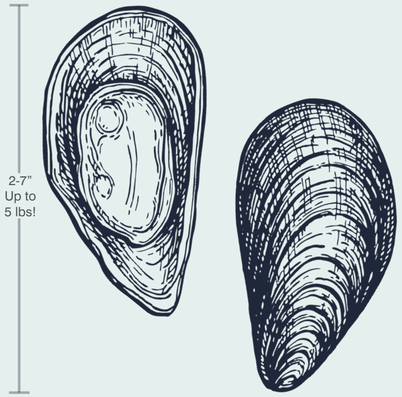

Relative Presence of Species in Claytor

Figure 49 *Mammal Inventory*

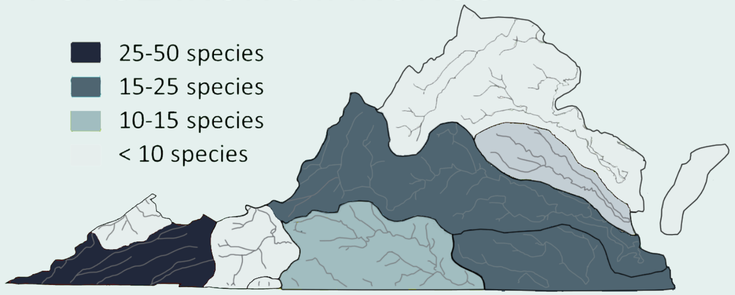
Mammals are the most common species thought of when referring to interactions with humans as they relate the closest to us. Though mammals tend to be the most frightened by the presence of humans. This site poses a view overpopulation problems. Specifically a large population of deer that are detrimental to native species of plants on the site. Planting and habitats should be design with this in mind and thought of ways to mitigate this issue.



## FRESHWATER MUSSELS
Heterodonta




## POPULATION STATISTICS




70%

OF MUSSEL SPECIES IN VA ARE DECLINING

±87 **ENDANGERED SPECIES**

±35 **SPECIES ALREADY EXTINCT**

**THREATS** WATER POLLUTION, DAMS, CLIMATE CHANGE, & INTRODUCTION OF EXOTIC SPECIES

## DID YOU KNOW??

MUSSELS CONSTANTLY CLEAN WATER FILTERING OUT BACTERIA, ALGAGE, AND POLLUTANTS!

# Spotted Salamander

Ambystoma maculatum

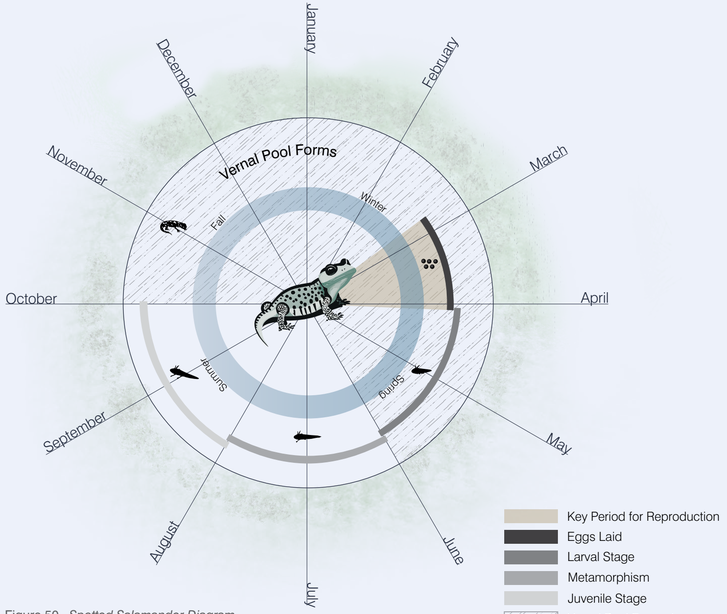



Figure 50 *Spotted Salamander Diagram*

## Habitat

For reproduction to occur, the Spotted Salamander must find wetlands that are protected from fish. These areas are called vernal pools - A temporary wetland that is seasonally flooded from fall to early spring and dries up in the summer heat. These vernal pools provide great habitat for the Spotted Salamander to reproduce safely away from fish and provides valuable resources such as fairy shrimp. Vernal pools are a rare resource and must be protected to ensure the populations of salamander.

## Species Needs

1. Proximity to Vernal Pools with Submerged Vegetation
   A. Submerged vegetation allows for egg attachment and protection
2. Loose Moist Soil
   A. The permeable skin of the salamander requires a moist site with high humidity
3. Metamorphic Habitat
   A. Once vernal pools dry up, there must be a terrestrial habitat that contains leaf cover, logs, rock, or other debris to provide protection.
4. Connection between Breeding Sites and Metamorphic Habitat
   A. The Spotted Salamander requires a safe connection between the vernal pool breeding site and their terrestrial habitats.
5. Clean Water
   A. Spotted Salamanders require relatively clean water with limited pollutants to allow for safe breeding.

## Reason for Species Selection

The Claytor Nature Center provides many great habitat opportunities for the Spotted Salamander with several preexisting vernal pools. With a decreasing number of safe vernal pools due to pollution from agriculture and urbanization. The Spotted Salamander provides opportunity for human - non human interaction in wetland areas as well as the chance of creating night time programming such as night hikes including salamander viewing.



# Red Bellied Woodpecker

Ambystoma maculatum

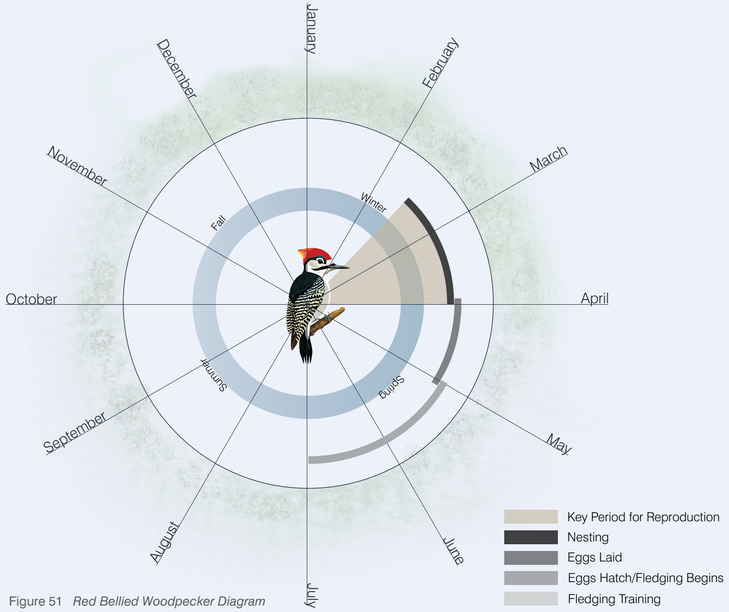



Figure 51 *Red Bellied Woodpecker Diagram*

## Habitat

The Red Bellied Woodpecker creates a new nest each year during the nesting period in late winter. The woodpecker prefers to create nests inside dead or decaying trees, bird house, or other wood poles. They have become a synanthropic species well adapted to human behavior and will even makes nests in suburban/urban areas. They have a strong ability to adapt to habitats as long as there is access to insects, fruits, and seeds.

## Species Needs

1. Nesting Sites
   A. Optimum nesting areas have mature hardwood trees, dead trees, or decaying trees.
2. Water Sources
   A. For drinking and bathing
3. Food Sources
   A. Access to insects, fruits, or seeds
4. Foraging Space
   A. Wooded areas that allow for safe excavation of bark or decaying wood

## Reason for Species Selection

The Red Bellied Woodpecker is a very adaptable species, able to live in almost any section of the Claytor Nature Center property. As you walk along a trail you can hear the sounds of the woodpecker nearly all times of the year. The acoustic abilities and adaptability enable this species to create a great opportunity for connective spaces between human and woodpecker.

# Freshwater Mussel

Unionidae

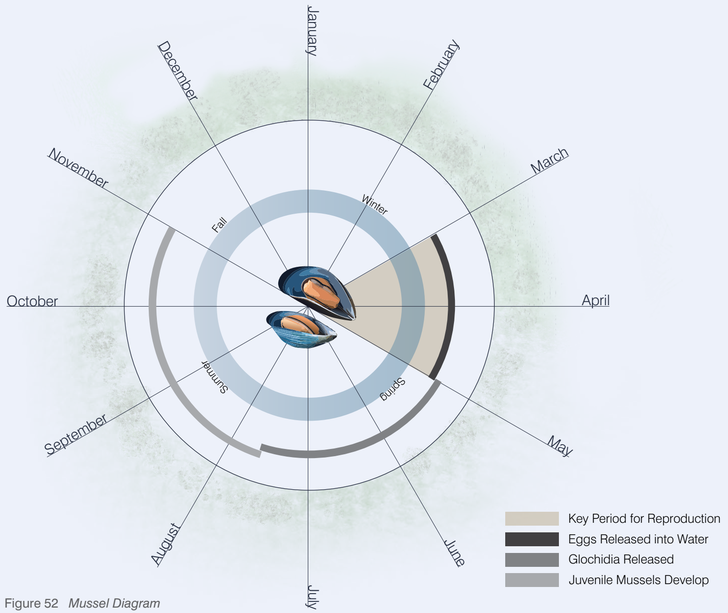



Figure 52 *Mussel Diagram*

## Habitat

The Freshwater Mussel is very important to the ecosystem, but a very sensitive species to habitats. Mussels require very clean, flowing water for the species to survive, although with a healthy population the mussels will keep the water healthy. The habitat must also contain a enough substrates for the mussel to attach to, a healthy population of fish to serve as host for eggs, and also protection from predators. Eddys (pools of water created by whirlpools that slow the current) provide a healthy environment for mussels because they provide shelter from strong current, substrates for attaching, and increased oxygen supply.

## Species Needs

1. Clean Water
   A. To survive, the Freshwater mussel needs clean, flowing, oxygenated water.
2. Stable Substrates
   A. Rocks, gravel, or debris provide habitat and an anchor for mussels.
3. Host Fish
   A. Reproduction of mussels requires glochidia (fertile eggs) attaching to gills of fish while developing.
4. Protection from Predators

## Reason for Species Selection

The Big Otter River provides clean water flowing from the Peak of Otter with plenty of bedrock useful as stable substrates. Freshwater Mussel species in the United States have been declining at rapid rates, and without intervention they will continue to become extinct. Mussels are important to our freshwater ecosystems and at Claytor provides an opportunity for research and interaction with methods of protecting the species. The Virginia Department of Wildlife Resources has focused efforts in the conservation of the species throughout the state with tracking and monitoring constantly. The Claytor Nature Center is a good candidate for further push into conservation in Bedford, Virginia.



# Song Sparrow

Melospiza melodia

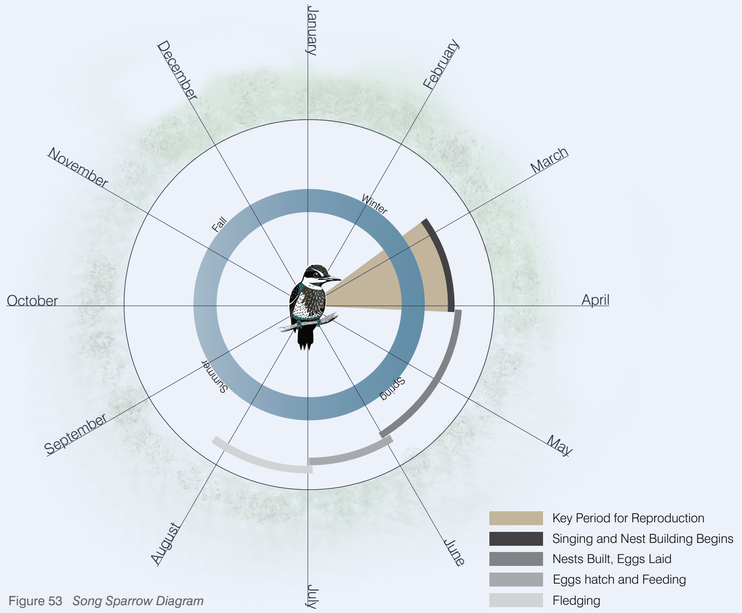



Figure 53 *Song Sparrow Diagram*

## Habitat

The Song Sparrow inhabits transition zones of the landscape where the forest may meet grassland or wetland. These edges provide varying needs of the sparrow including nesting in dense land cover, foraging for insects in open spaces, and water. Song Sparrows are a well adapted synanthrope that can live in any ecology in the Claytor Nature center and live amongst humans.

## Species Needs

1. Social Interaction
   A. Species is very social in nature and is important for communication and finding mates
2. Water
   A. Clean water for drinking and bathing
3. Food Sources
   A. Song Sparrows diet consist of a wide range of insects, seeds, fruit, grass, and small invertebrates
4. Varied Vegetation
   A. Song Sparrows thrive in environments with a balanced access to dense cover, long grasses, and wetland
5. Nesting Material
   A. Abundance of grasses and branches to use for constructing nests

## Reason for Species Selection

The Claytor Nature Center provides great habitat for the Song Sparrow including a range of dense tree cover, to grassland, to wetland and the Big Otter River. Song Sparrows adaptive nature and ability to be a synanthrope allows opportunity for interaction between bird and human. Claytor hosts many feeding opportunities with a range of insects, caterpillars, paw paws and more.

# 4.5 Symbiosis of Flora and Fauna

While it is difficult to design for a non-human and know whether they will inhabit the space or not, creating a symbiosis between flora and fauna can increase these odds. This section breaks down each species and studies their prey and predators to create a planting list intended to attract the species. This study not only looks at what they eat, it is a holistic approach of what their prey needs for survival as the greater ecology is an ever changing, and delicate system.

## Spotted Salamander

The spotted salamander will inhabit and breed in vernal pools after the first warm rain of the spring. These delicate habitats provide a haven for salamanders free from predators and with plenty of food. The salamanders are carnivores and will feed mostly on snails, slugs, worms, small insects, and insects larvae. An important aspect of these pools though is a balance of grasses, trees, and moss to provide oxygen, stable substrates, erosion control, and shade for the inhabitant of the vernal pool

## Flora and fauna that attract salamanders


Insect Larvae


Worms


Slugs


Snail


Amphibian Larvae


Small Insects


Cardinal Flower


Swamp Milkweed


Paw Paw


Blue Flag Iris


Common Rush


Moss


Switchgrass


Weeping Willow


Stable Substrate

Red Bellied Woodpecker

Most of the woodpeckers diet consists of insects including spiders, beetles, ants, and caterpillars. Although these woodpeckers tend to not eat grass, their prey relies heavily on grassland and therefore a planting mix of grasses will lead to an increase in woodpeckers. Decaying wood and hardwood trees provide nesting sites while fruit trees and nuts provide foraging.

## Flora and fauna that attract woodpeckers


Small Amphibians


Insects


Decaying Wood


Worms


Beech


Maple


Oak


Kousa Dogwood


Serviceberry


Chokeberry


Big Bluestem

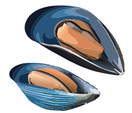

Switchgrass


Prairie Dropseed


Indiangrass



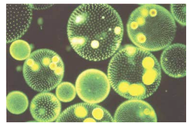
Freshwater Mussel



Freshwater mussels are a delicate species and require an optimal environment to ensure their survival. They require clean water, but with a balance of detritus (debris), phytoplankton, bacteria and algae. While they mussels will eat detritus, algae, and bacteria, they will also fail to survive if there is too much of one. Eddies are a great microhabitat for these mussels as they provide pockets of cleaner water, stable rocks for laying eggs, protection from predators, and increased oxygen.

## Flora and fauna that attract mussels


Detritus


Phytoplankton


Stable Substrate


Eddy


Algae


Bacteria

Song Sparrow

Song sparrows are opportunistic and will pray on a variety of insects including caterpillars, beetles, spiders, grasshoppers, and worms. When insects are not as available they will feed on seeds, grains, wild berries, and small weeds. Planting an array of native grasses will appeal to many insects at Claytor and will therefore draw in song sparrows.

## Flora and fauna that attract song sparrows


Seeds


Insects


Grain


Redbud


Viburnum


Serviceberry


Elderberry


Prairie Dropseed


Switchgrass


Purple Coneflower


Black Eyed Susan


Sunflower

Figure 54 *Song Sparrow Sighting*

# 05 Concept Development

## 5.1 Introduction

This chapter begins to explore how the research can be applied to a form of design of the Claytor Nature Center. A series of design typologies contributed to an overall learning as my initial solutions were based on a humans perspective.

After taking a step back and focusing on what the species of focus need, I developed examples of habitat first and then applied the human programming elements as a way to think non-human first. While the final design intent is a codesign of the human and non human, this way of testing out elements helped to break from traditional human first design.



## 5.2 Probability of Encounter

Figure 55

Traditional Space for Humans

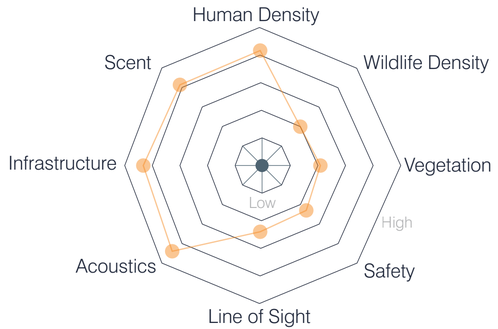



Figure 56

Traditional Space for Wildlife

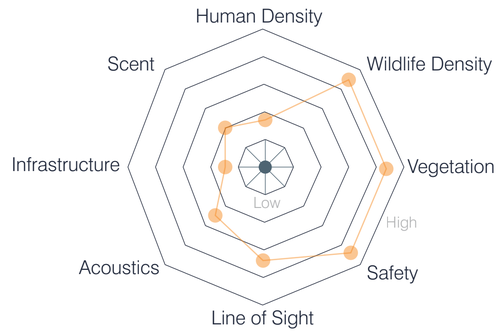
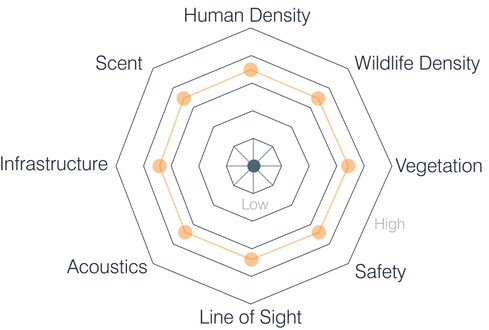
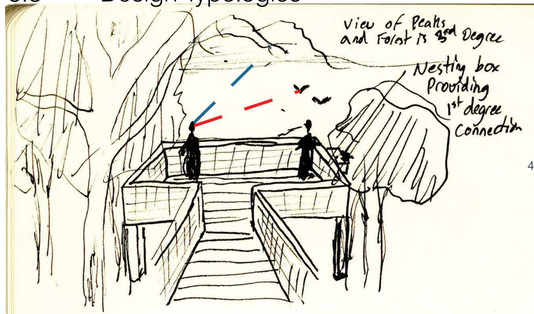



Figure 57

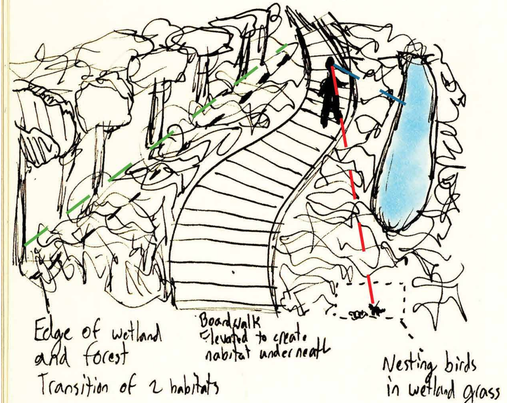
Synanthropic Space




This use of this metric allows for the measuring of a space for how likely an encounter is to occur between human and wildlife. A shape (orange line) that leans to the left side (figure 1.0) is likely to be a space design mainly for humans and unlikely for use by wildlife. A shape that leans to the right (figure 1.1) on the other hand is mainly used for wildlife. Both of these do not provide the optimal conditions for encounters to occur. The design of spaces within this project aim to create a balanced synanthropic space (figure 1.2) in which human and wildlife are one. This metric is used to as an experimentation method in which various designs will be tested in terms of how likely they are to generate encounters and which species they are beneficiary for.

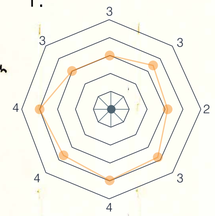



**1 - Overlook + Tertiary Trail**

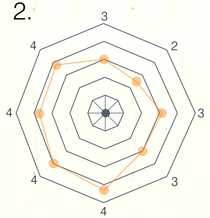



**2 - Elevated Wetland Boardwalk**

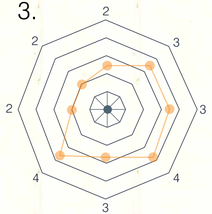
1.



2.



3.

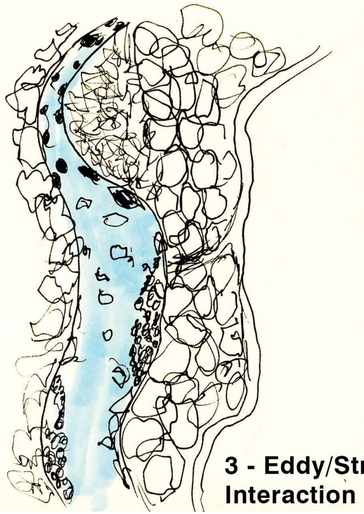


1st Degree Connection
- Direct interaction
- Feeding ducks

2nd Degree Connection
- Seeing animals in their habitat
- bird flying in air

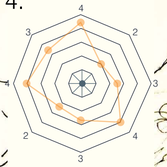
3rd Degree connection
- Indirect
- Seeing marks on tree from deer the rut

Primary Trail
Secondary Trail
Tertiary Trail



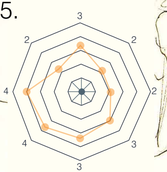
**3 - Eddy/Stream Interaction**

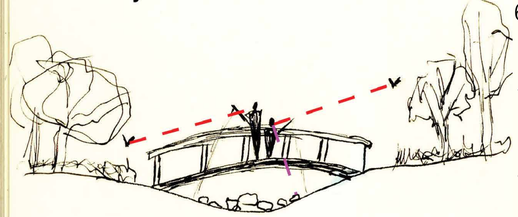
4.




**4 - Tiny Home with Wildlife windows**

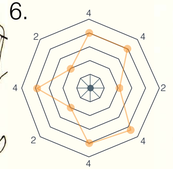
5.





**5 - Fishing Pier/Bridge**

6.



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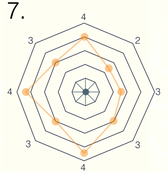
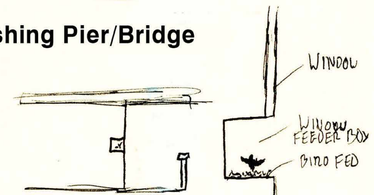
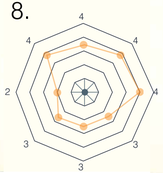
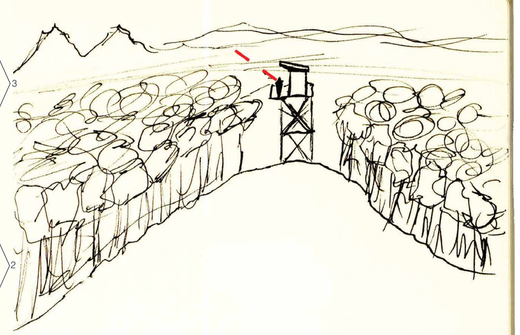





**6 - Window Bird Feeding Box**

8.

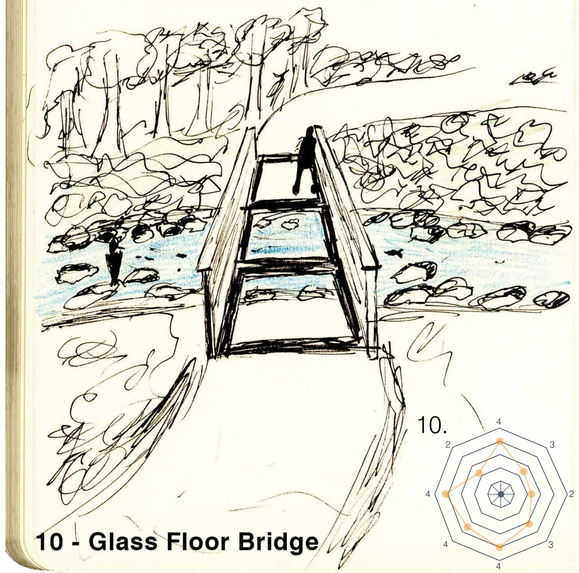




**7 - Observation Tower**

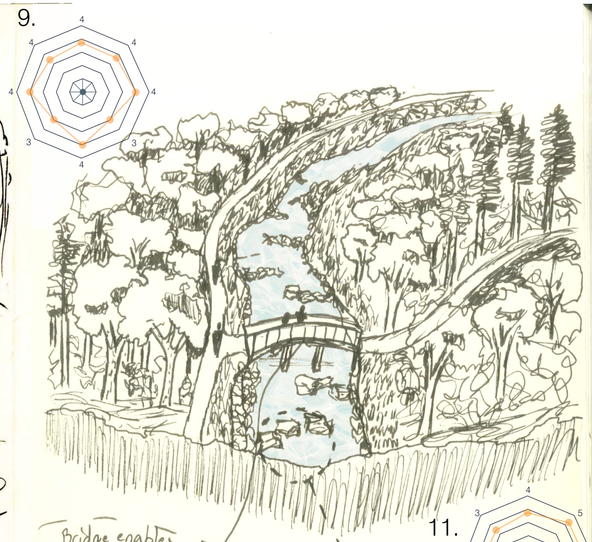

**8 - Meadow Trail with Varying Edge Typology**


9 - Overlook/Territory

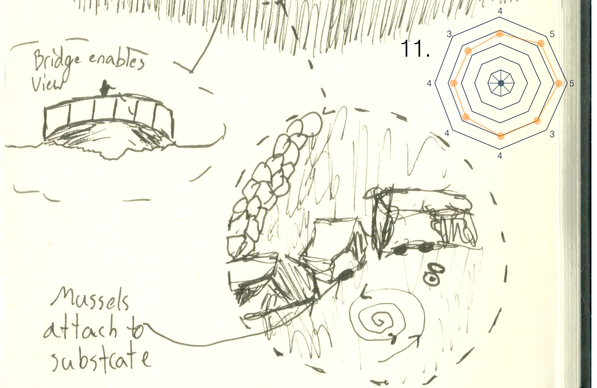


10 - Glass Floor Bridge

9.

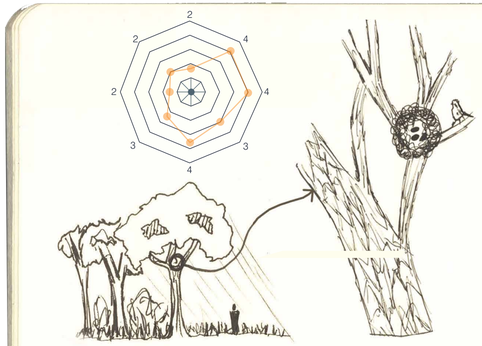


11.

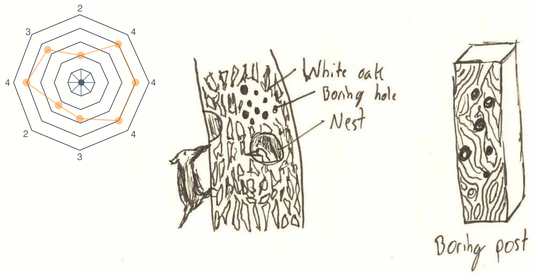



11 - Pedestrian Bridge + Mussel Habitat

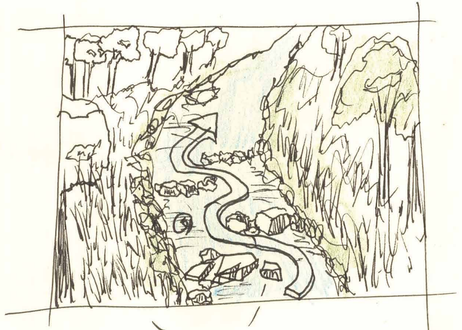




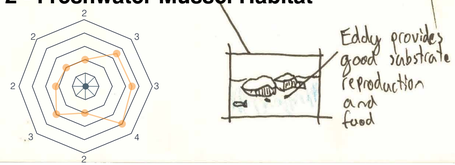
E. 1 - Song Sparrow Habitat

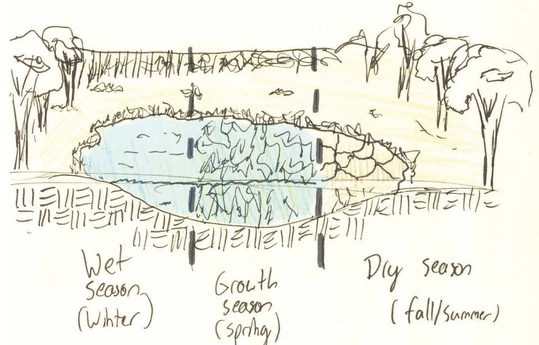



E. 3 - Red Bellied Woodpecker Habitat

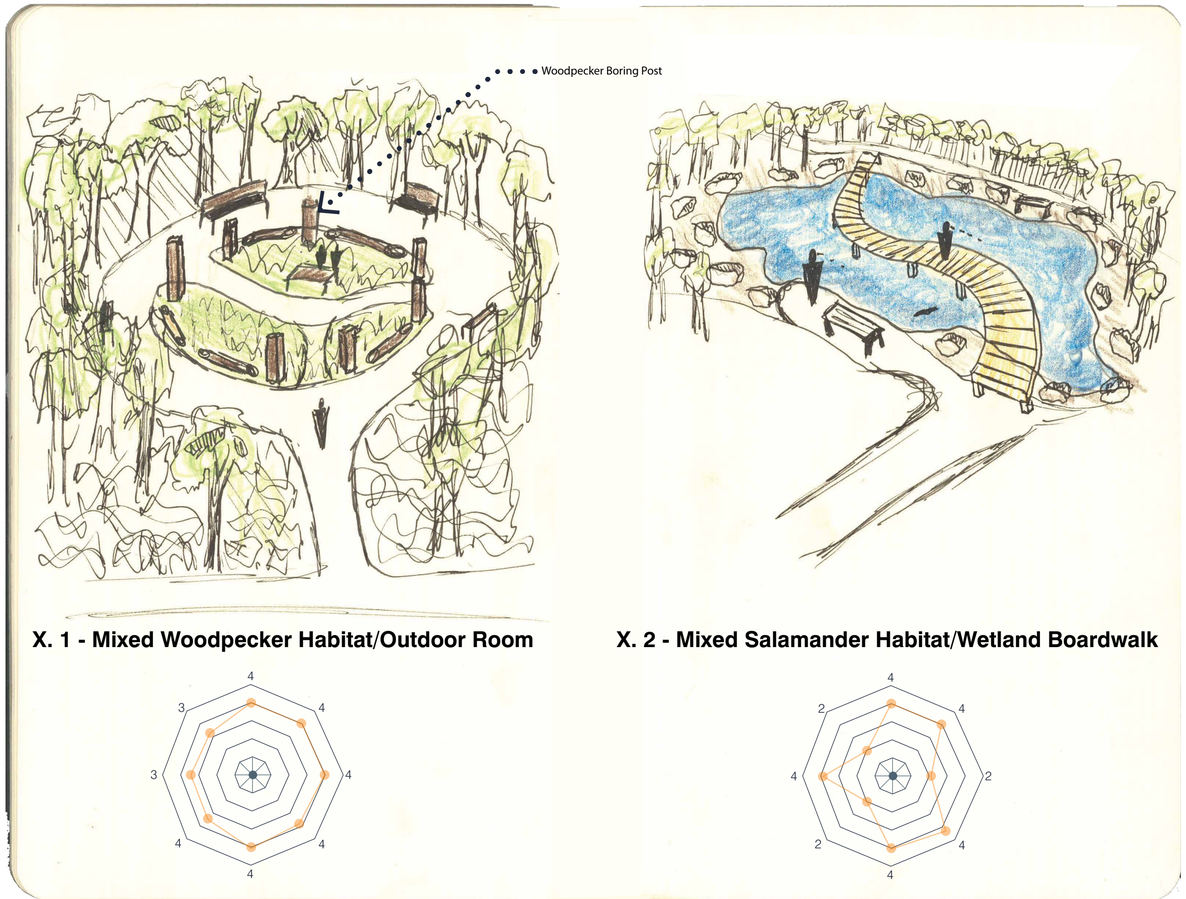


E. 2 - Freshwater Mussel Habitat




E. 4 - Spotted Salamander Habitat




**X. 1 - Mixed Woodpecker Habitat/Outdoor Room**




**X. 2 - Mixed Salamander Habitat/Wetland Boardwalk**






## 5.4 Conceptual Masterplan

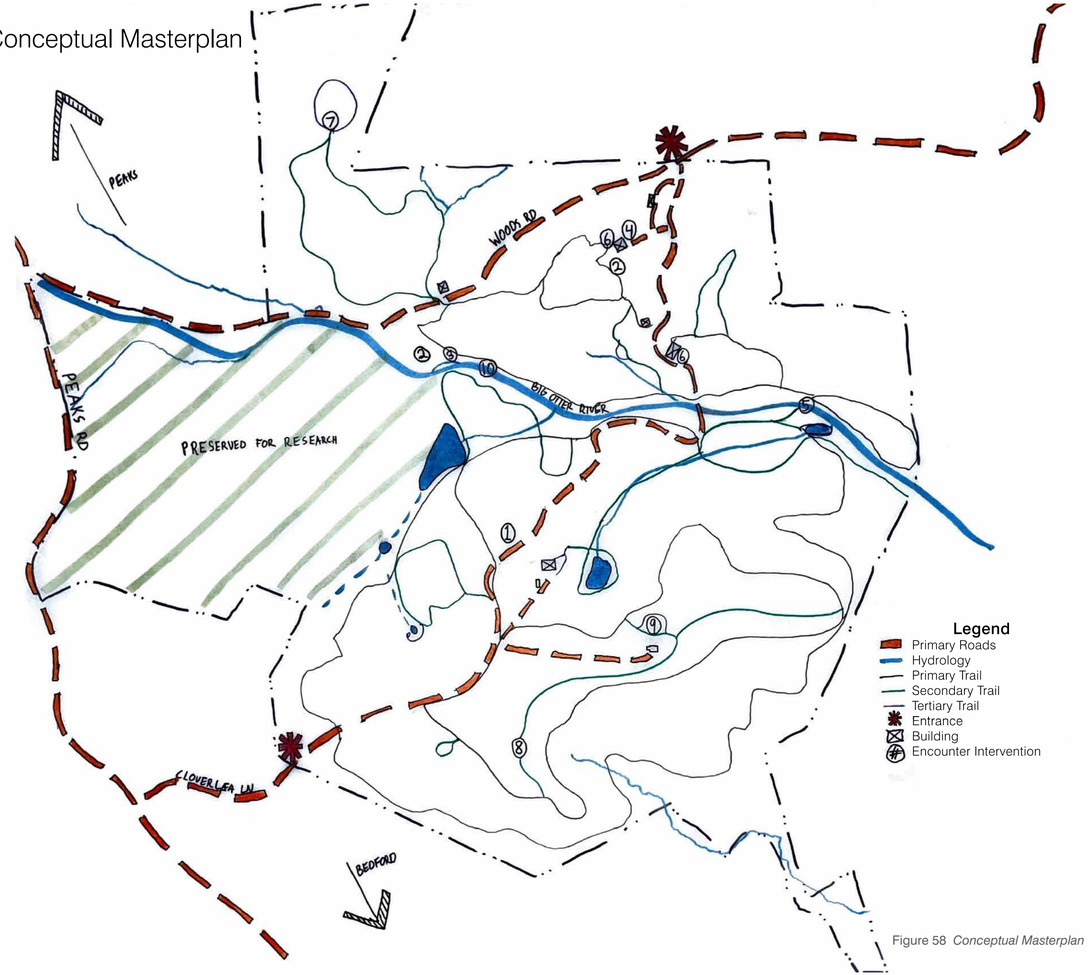



Figure 58 *Conceptual Masterplan*

## 5.5 Masterplan

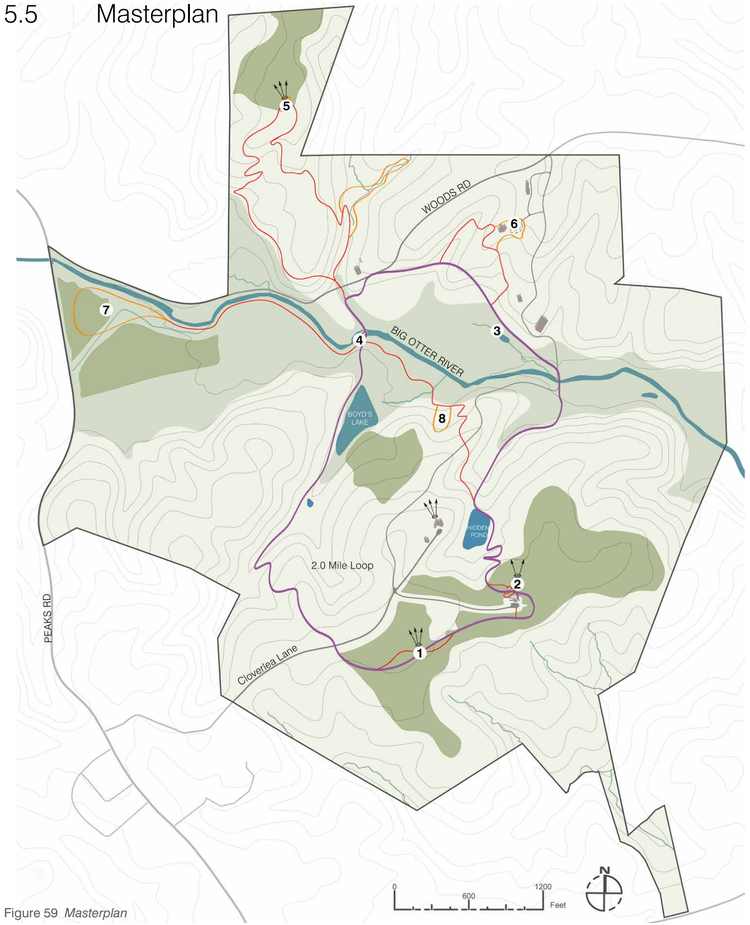



Figure 59 *Masterplan*

## KEY

Argilite Wildneress Walk
1. Peaks Pasture
2. Claytor Summit
3. Salamander Sanctuary
4. The Big Otter Eddy's

Secondary Trail
5. Bird Observation Tower

Tertiary Trail
6. Tiny Home Community
7. Cloverlea wetland Boardwalk
8. Woodpecker woods

100 Year Floodplain

Initial Succession Landscape

Waterbodies

Streams

**Primary Trail**

Main trail loop with wider paths connecting to larger system. These wider paths provide a safe feeling of a shared space of human and non human.

***Secondary Trail***

More narrow trail branching off the primary loop, leading to intentional spaces. Medium width trail induces feeling of a transition into more wild space.

**Tertiary Trail**

Small trails branching off secondary trails taking users to intentional habitats. These most narrow trail widths provide more of a feeling that you are in a space for wildlife.

Figure 60 *Trail Hierarchy*

Figure 61 *Diabase Outcrop*

# 06 Claytor Eco-Trails

# 6.1 Inspiration

Figure 62 *Mont-Evrin Park*

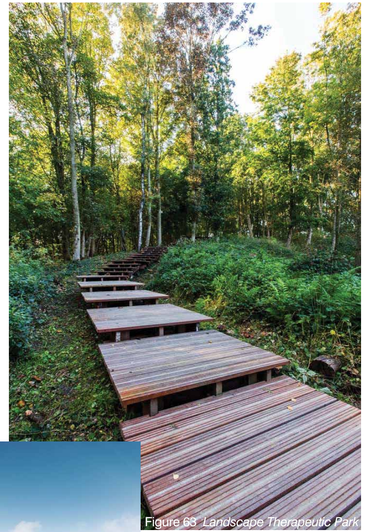


Figure 63 *Landscape Therapeutic Park*

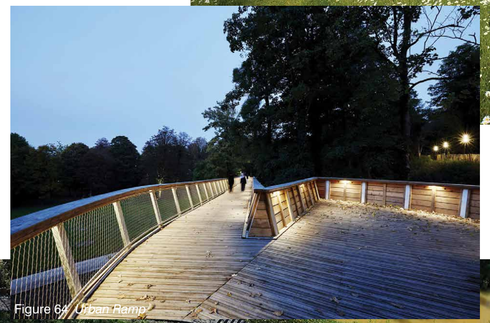


Figure 64 *Urban Ramp*

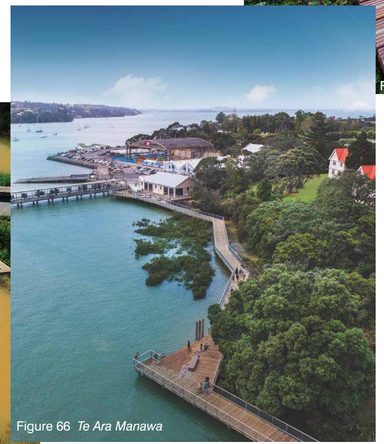


Figure 66 *Te Ara Manawa*

Figure 65 *Qunli National Urban Wetland*



Figure 67 *Strandskogen Arninge Ullna*

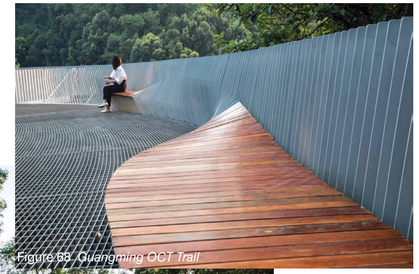


Figure 68 *Guangming OCT Trail*

Figure 69 *The Bluff*

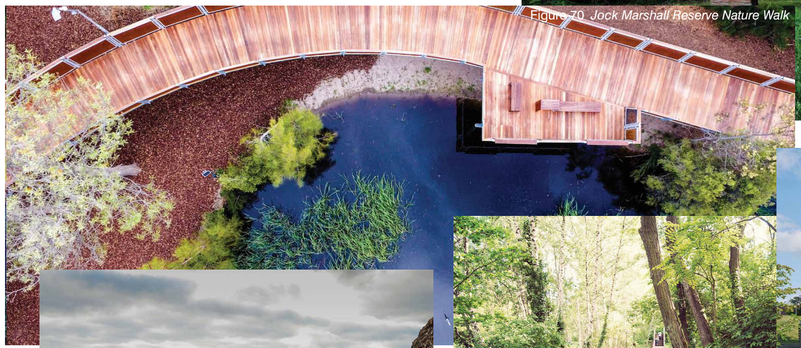


Figure 70 *Jock Marshall Reserve Nature Walk*

Figure 71 *Pedreira Do Campo*

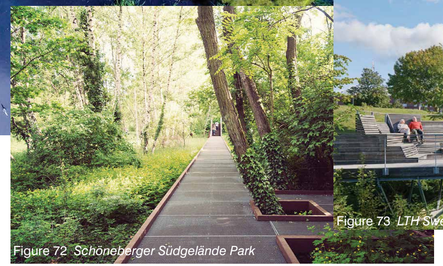


Figure 72 *Schöneberger Südgelände Park*

Figure 73 *LTH Sweden: Campus Park*

# 6.2 Primary Trail Section

This section represents the full length of the Argilite Wilderness walk (primary trail loop). This two mile trail features four interventions along the length with each intervention providing habitat or ecotones for the selected species. The dominant ecologies are present within the section with mini sections displaying how the trail would feel walking through each ecology. One of the personal goals of this project and this drawing was to try new drawing styles and get comfortable displaying any drawings, even the ones I didn't think were worthy of showing. These drawings helped to figure out the ideological reasoning behind the design. This also helped to think of the small scale interventions as an interconnected whole rather than separate parts. Although the ecologies are broken down into dominant sections, there is much cross over between every ecology the the species relationships vary across the same types of ecologies.

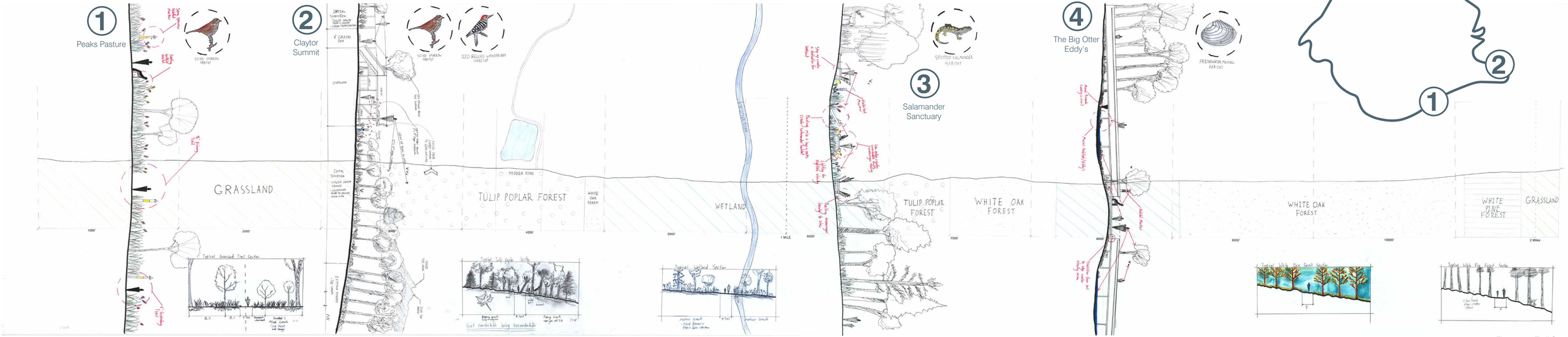




Figure 74 *Trail Section*

## 6.3 Detailed Design Language

With a large site, and the introduction of small scale interventions that had common detail elements such as boardwalks, bridges, and overlooks, it was imperative to maintain a design language. This design language aims to create the feeling amongst users that no matter where you are on the site or which habitat, there is always the sense that it is part of the whole. This is achieved through small but intentional elements such as material choices, form, or simply through habitat markers that identify habitat.

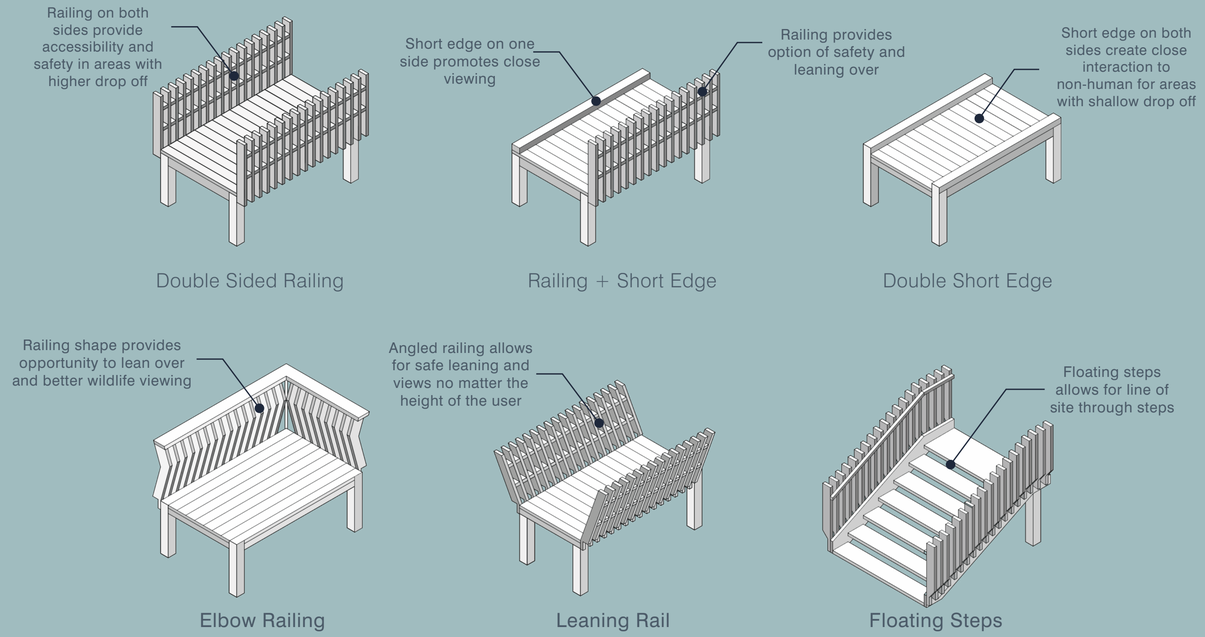



Figure 75 *Design Details*



## 6.4 Habitat Markers

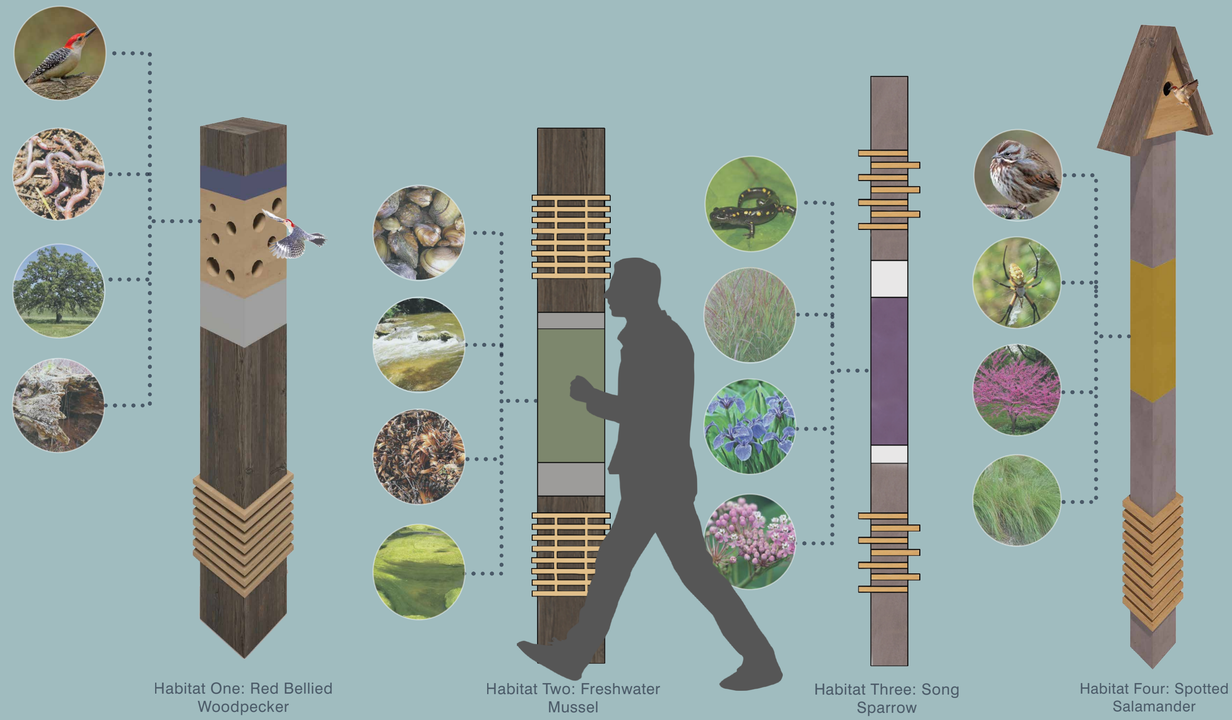
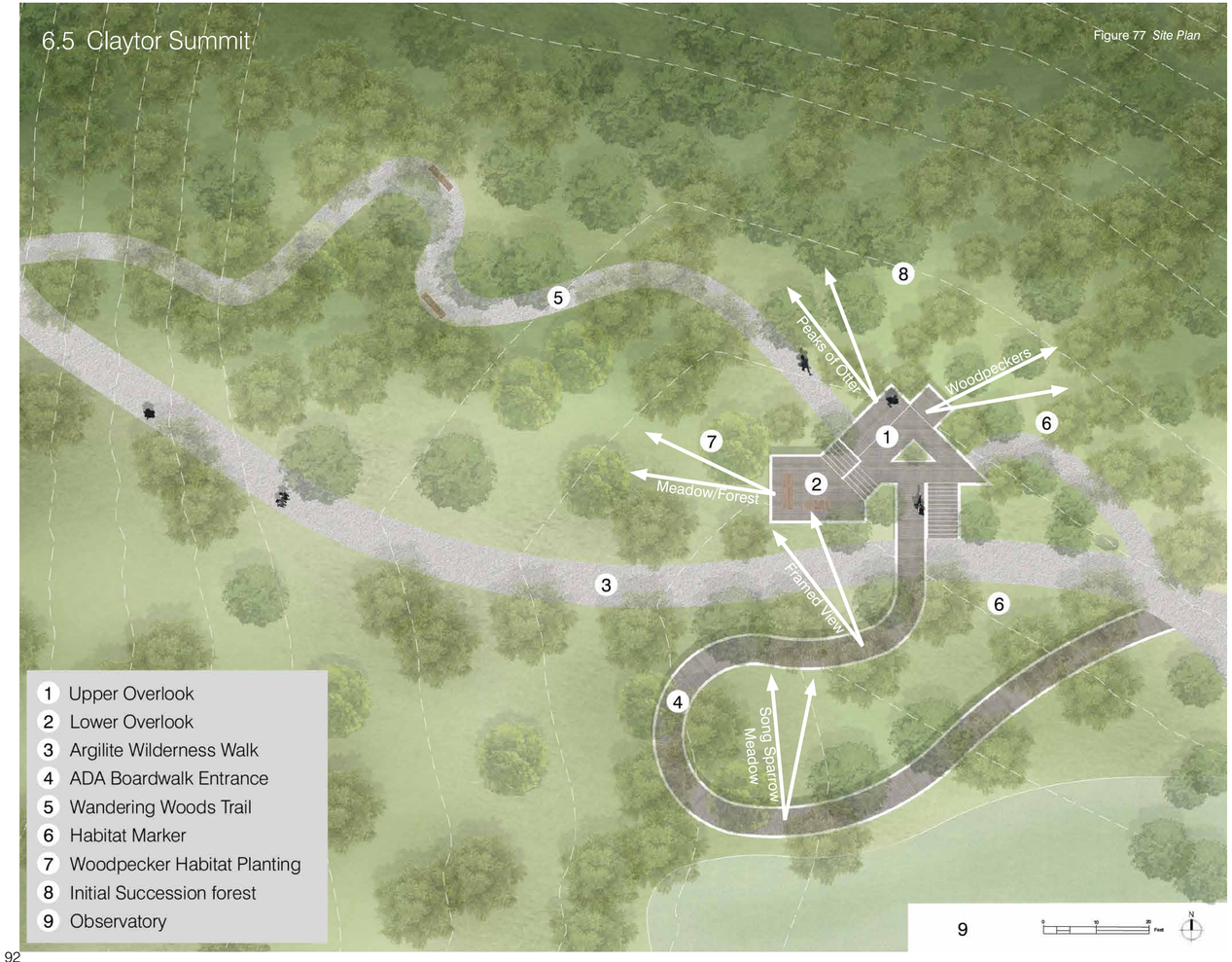



Figure 76 *Habitat Markers*

Habitat markers provide visitors with the explore the site and discover a marker for each of the four selected species. Each marker correlates with a different species habitat and can provide nesting for birds. The markers provide a programming element enticing curiosity of the markers and encouraging users to discover every habitat and be used as an educational tool.

## 6.5 Claytor Summit

Figure 77 *Site Plan*






## Claytor Summit Habitat Planting

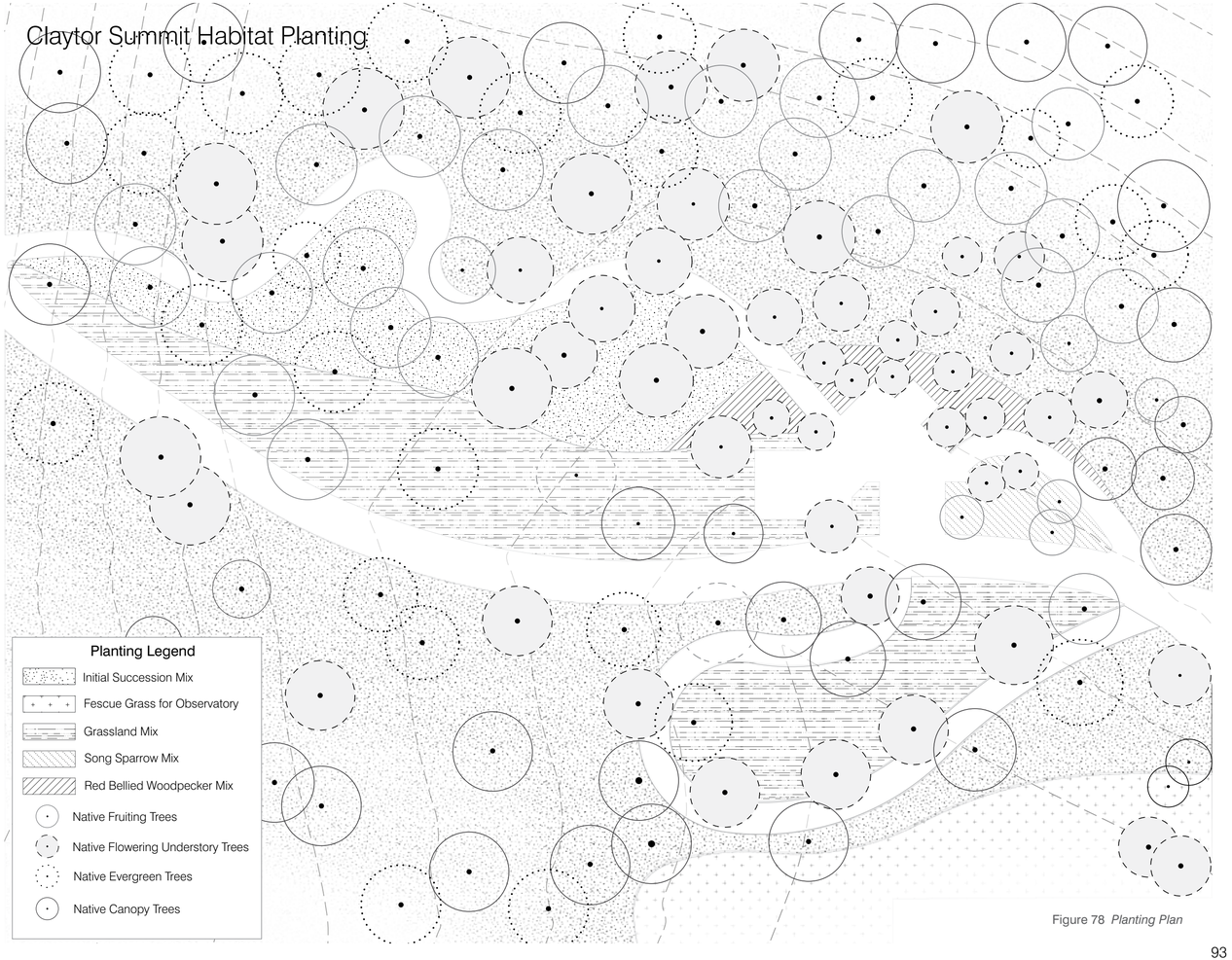



Figure 78 *Planting Plan*

# Claytor Summit Section

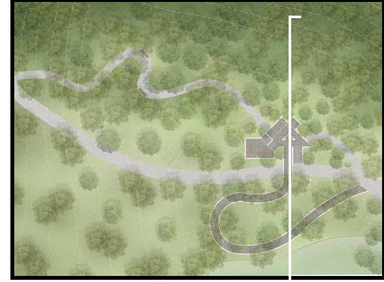





Figure 79 *Section*

# Upper Overlook (Human Perspective)

Figure 80 *Overlook Perspective*




# Boardwalk and Song Sparow Grassland Habitat (Birds Perspective)

Figure 81 *Boardwalk*

## Overlook Entrance (Human Perspective)


Figure 82 *Overlook Perspective*

## Underneath Overlook (Human Perspective)

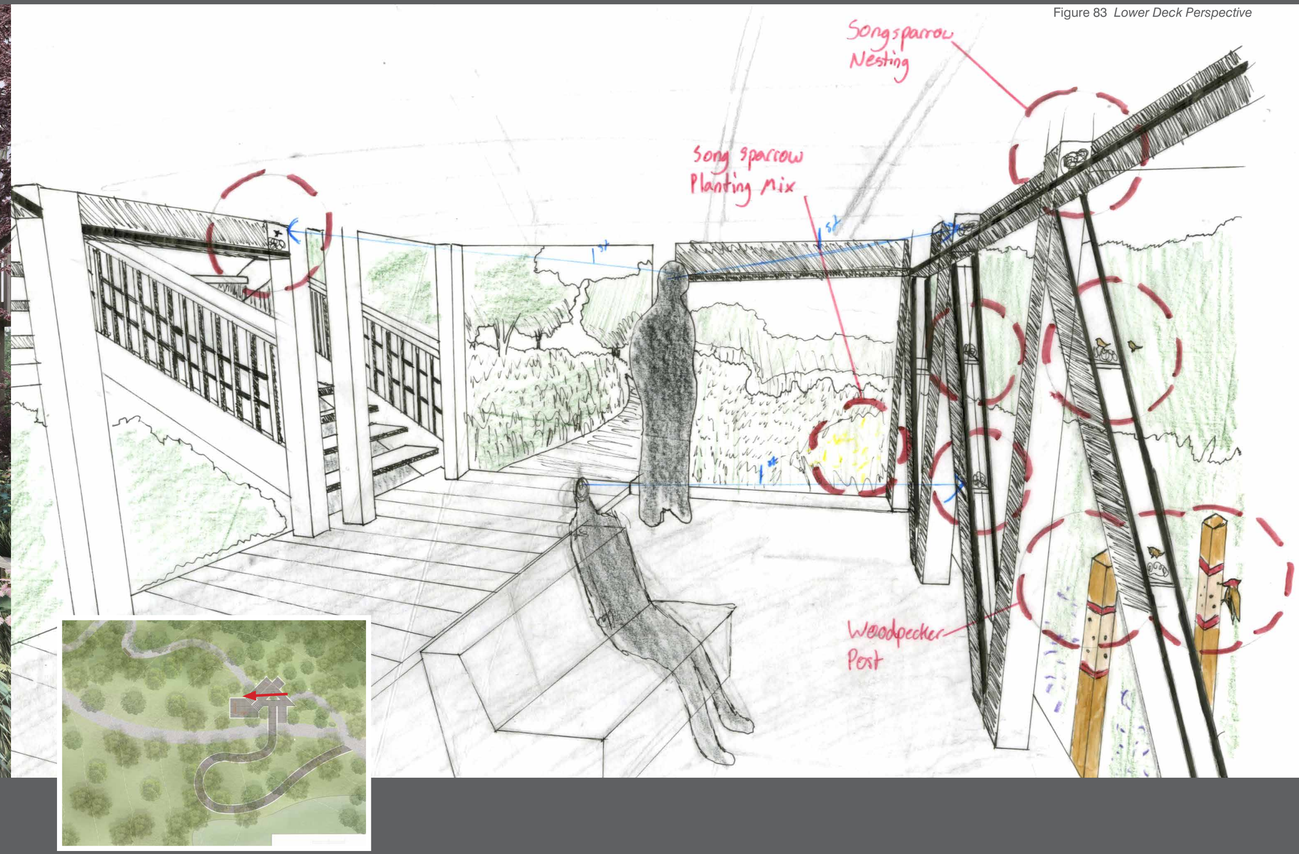
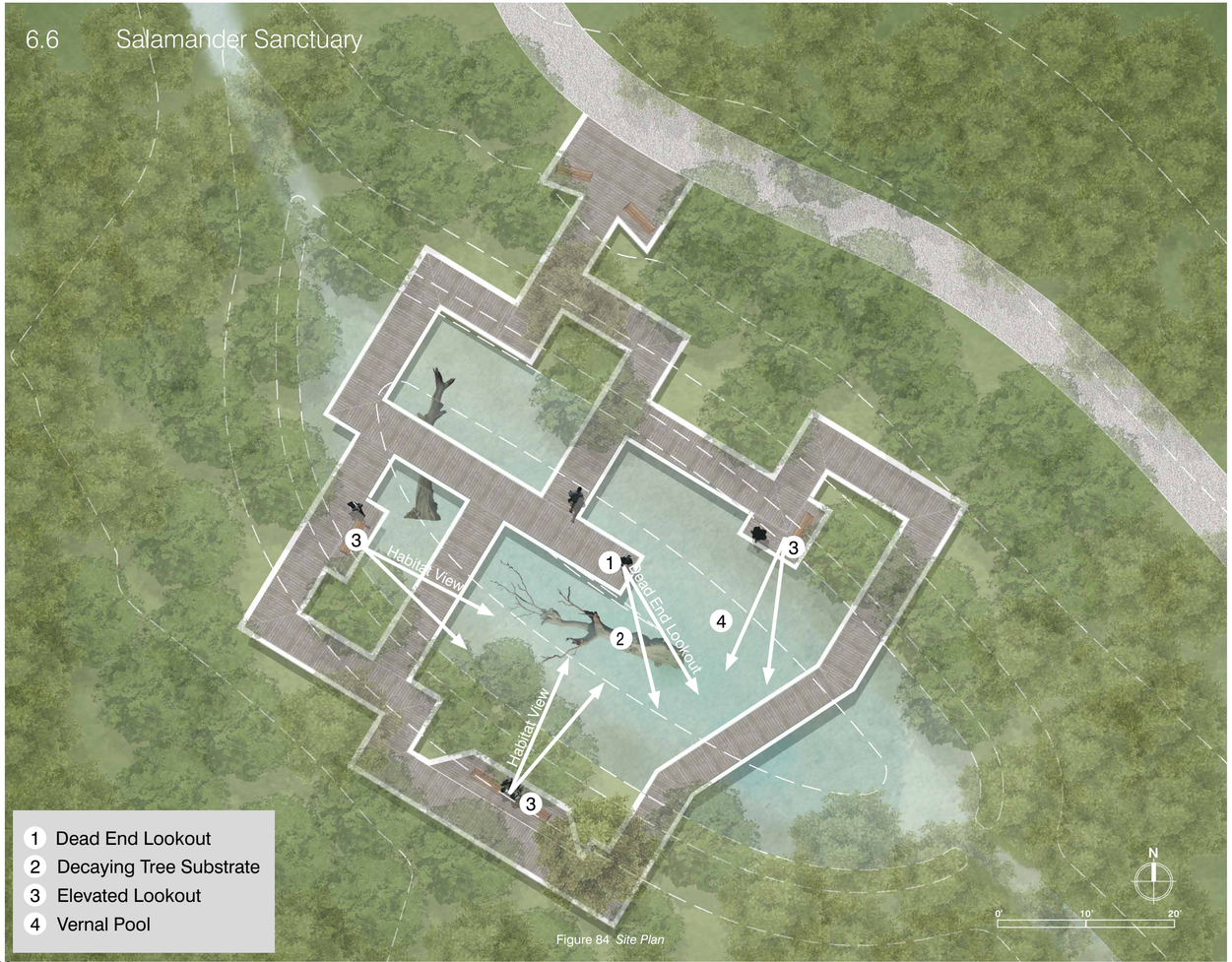



Figure 83 *Lower Deck Perspective*

# 6.6 Salamander Sanctuary




1 Dead End Lookout
2 Decaying Tree Substrate
3 Elevated Lookout
4 Vernal Pool

Figure 84 *Site Plan*



# Planting Matrix

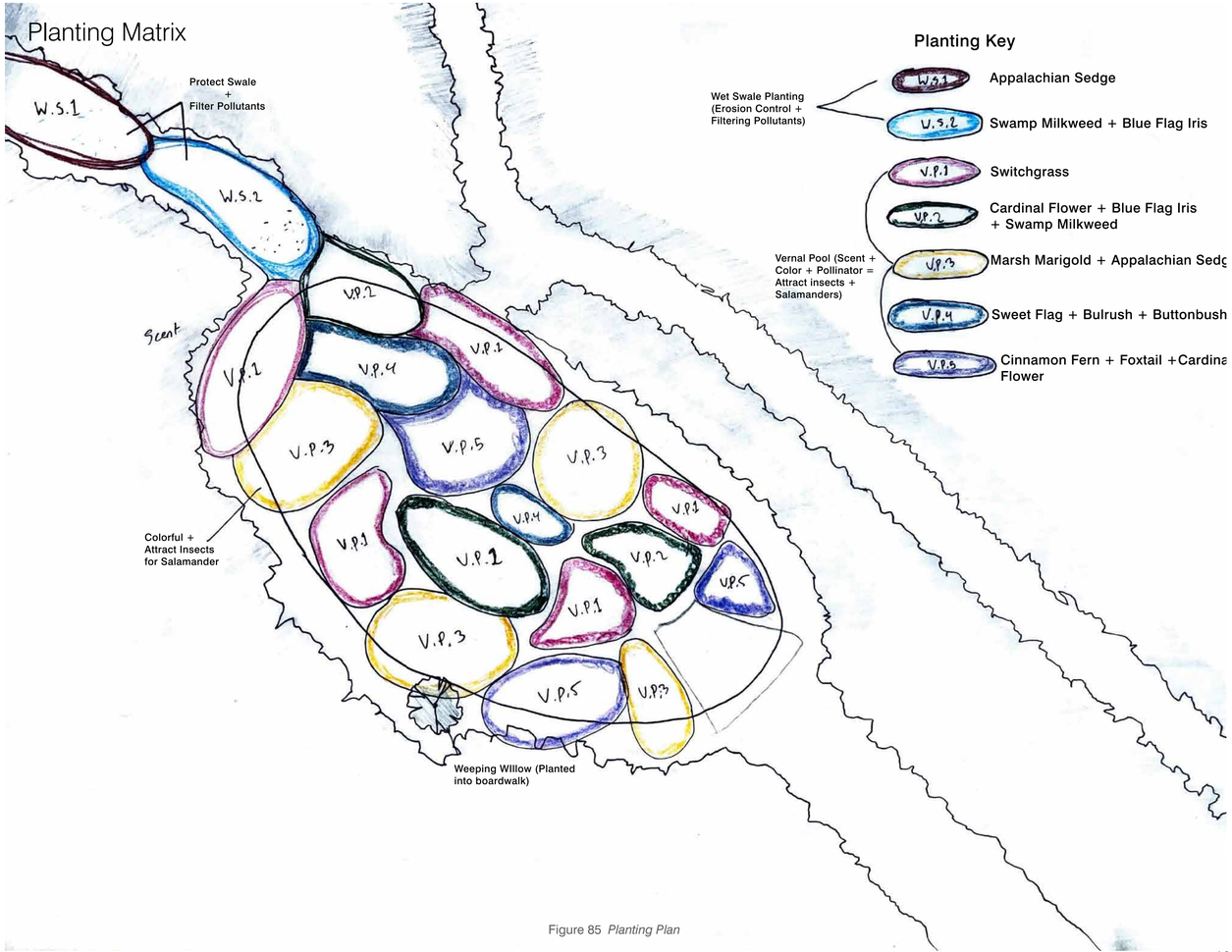



Figure 85 *Planting Plan*

Salamander Sanctuary Section

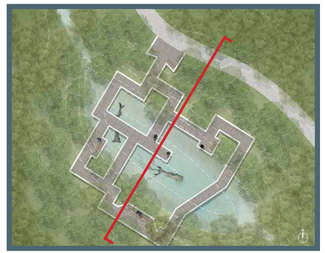





Figure 86 *Vernal Pool*

# What is a Vernal Pool?

Vernal pools are naturally occurring or artificial pools that temporarily fill up from winter rain/snow melt and dry up in the summer. They are not permanently connected to any water bodies, rivers, or streams.

Figure 87 *Vernal Pool*

Vernal Pool in Late Winter

Figure 88 *Vernal Pool*

## Why are vernal pools important?

Vernal pools provide safe habitat to many small amphibians such as salamanders and frogs. These amphibians lay eggs and grow up safely in these pools without the threat of fish. Once old enough, these amphibians will leave the pool and come back the next spring to lay eggs.

## Threats to vernal pools

Vernal pools are delicate formations that require good water quality and can easily be damaged by erosion or disturbance to vegetation or soil. Pollutants from the surrounding area can harm the pools and its inhabitants. The surrounding area must also provide optimal habitat for the amphibians once they leave the pool. These pools can be opportunities for landscape architects to create habitat as well as protect existing pools from erosion and pollutants.



Vernal Pool Boardwalk (Human Perspective)

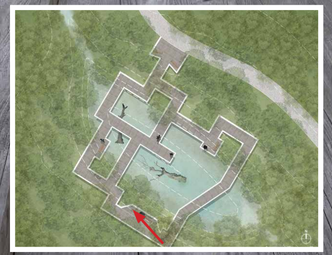


Figure 89 Boardwalk Perspective

# Nightime Vernal Pool Boardwalk (Human Perspective)

Figure 90 Nighttime Boardwalk Perspective

Nightime Vernal Pool Habitat (Salamander Perspective)

Figure 91 Nighttime Boardwalk Perspective

# 6.7 The Big Otter Eddy's

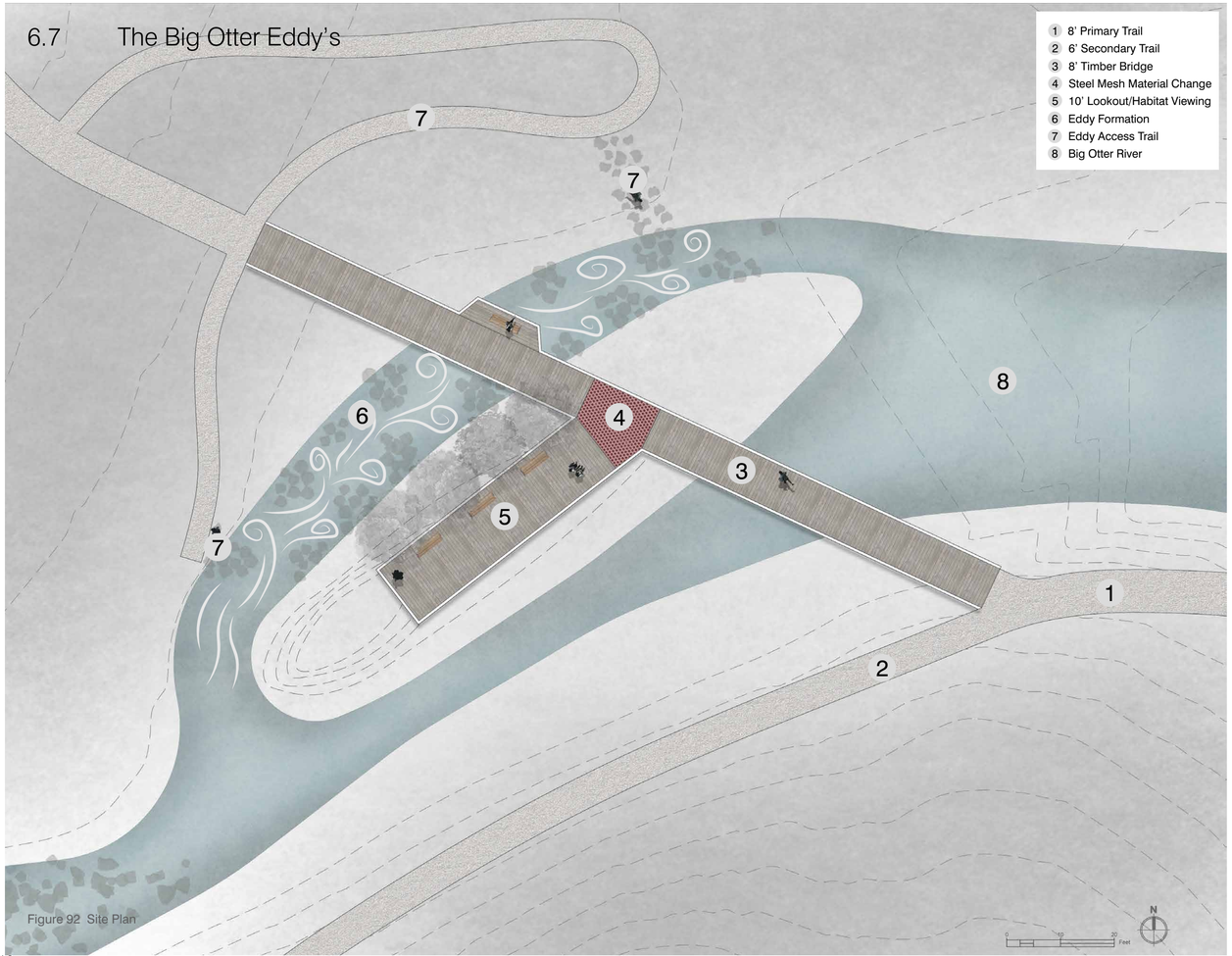
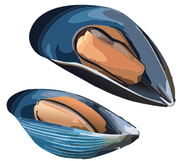



Figure 92 Site Plan

## What is an Eddy

An eddy is the circular/whirlpool movement of water in the reverse current of the main flow. Eddy's are caused by obstructions such as rocks that alter the flow of water within a stream or river.



## Threats to eddy's

In a very turbulent river or in big storms, rocks may shift and alter the flow of water. Humans can also impact the eddy's by increasing erosion, pollutants, or theft of rocks.

Figure 93 Eddy

## Why are eddy's important?

Eddy's can slow the current of a river and provide pockets of deeper water where some species can thrive. Freshwater Mussels benefit from eddy's by providing a space with cleaner water, stable substrate to attach and lay eggs, and a slower water movement that keeps them safe from turbulence.

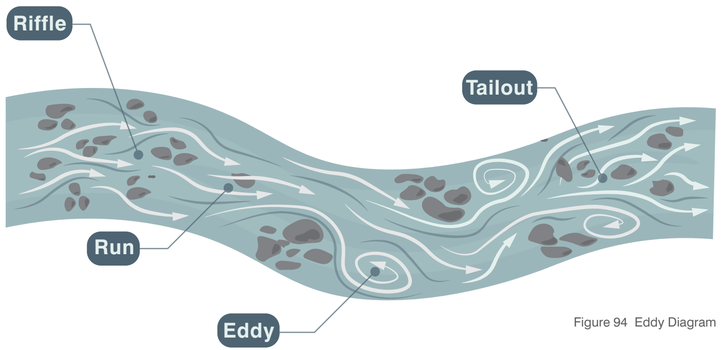



Figure 94 Eddy Diagram

Boardwalk Section

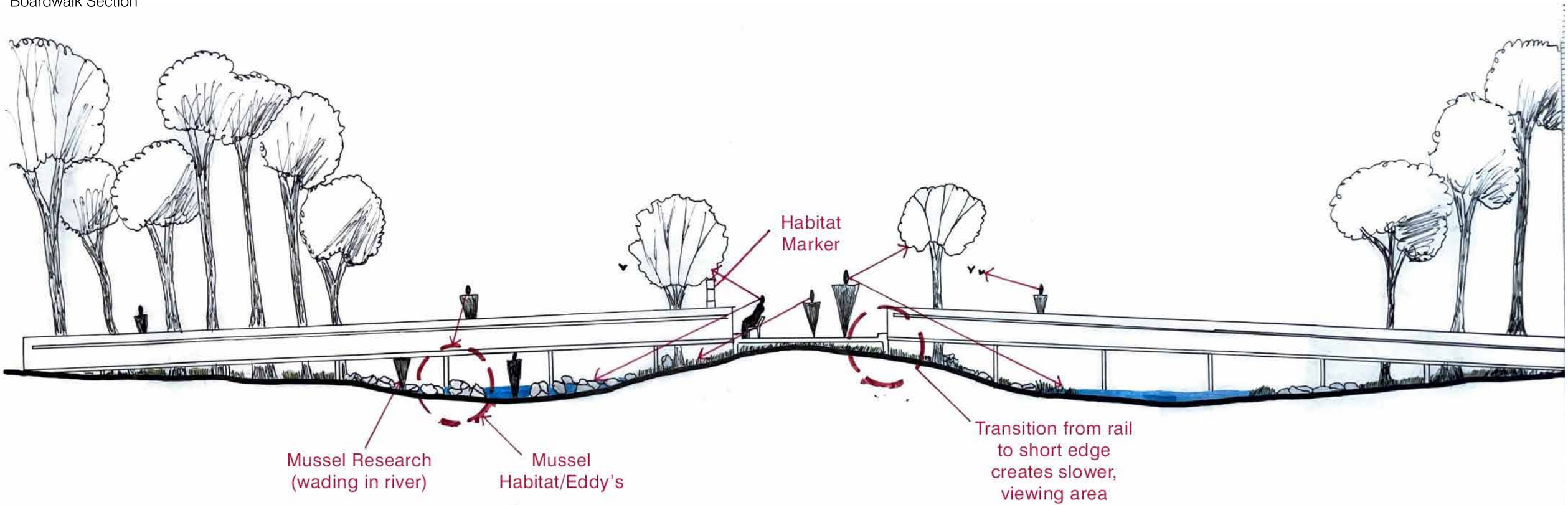



Figure 95 Bridge and Eddy Section

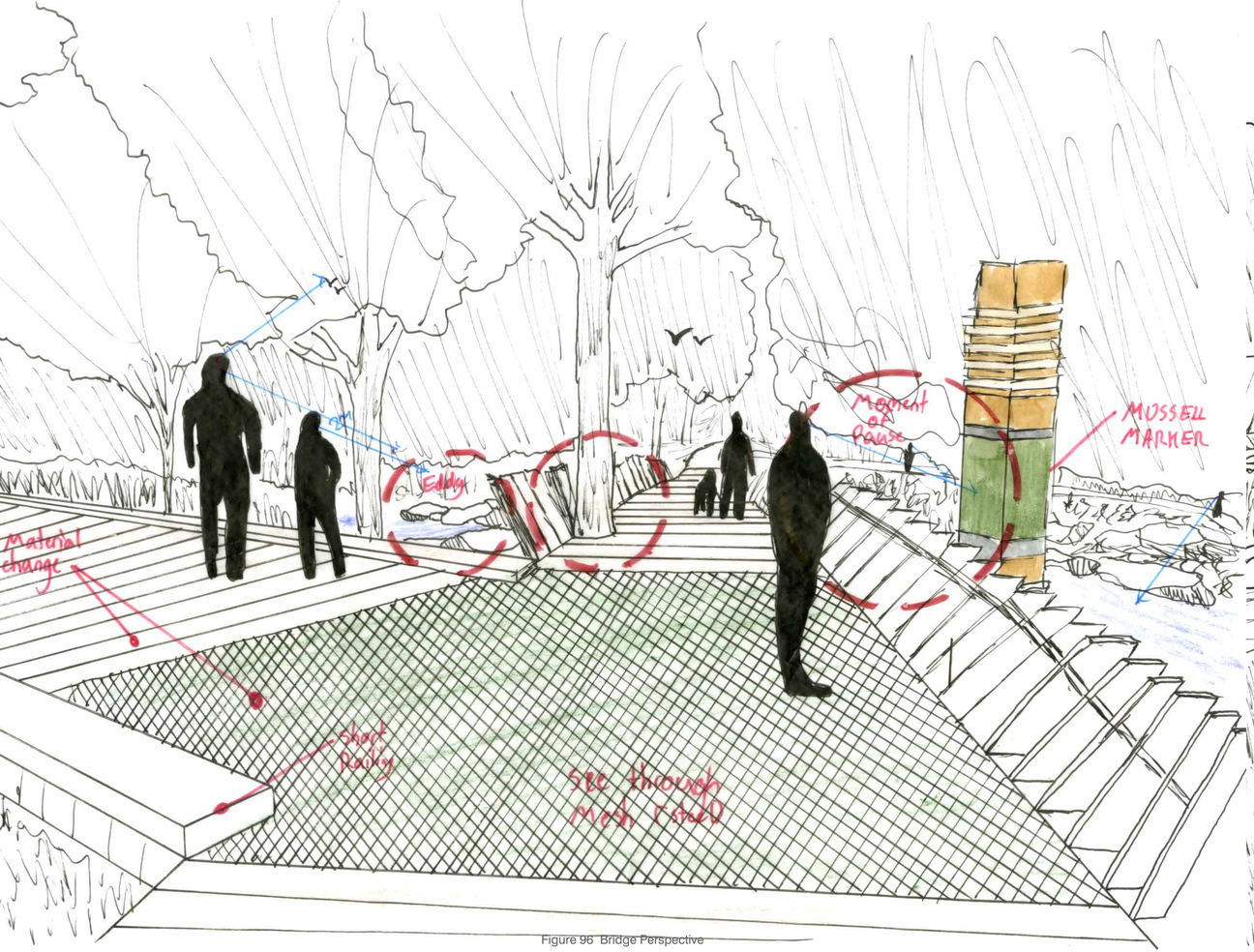



Figure 96 Bridge Perspective



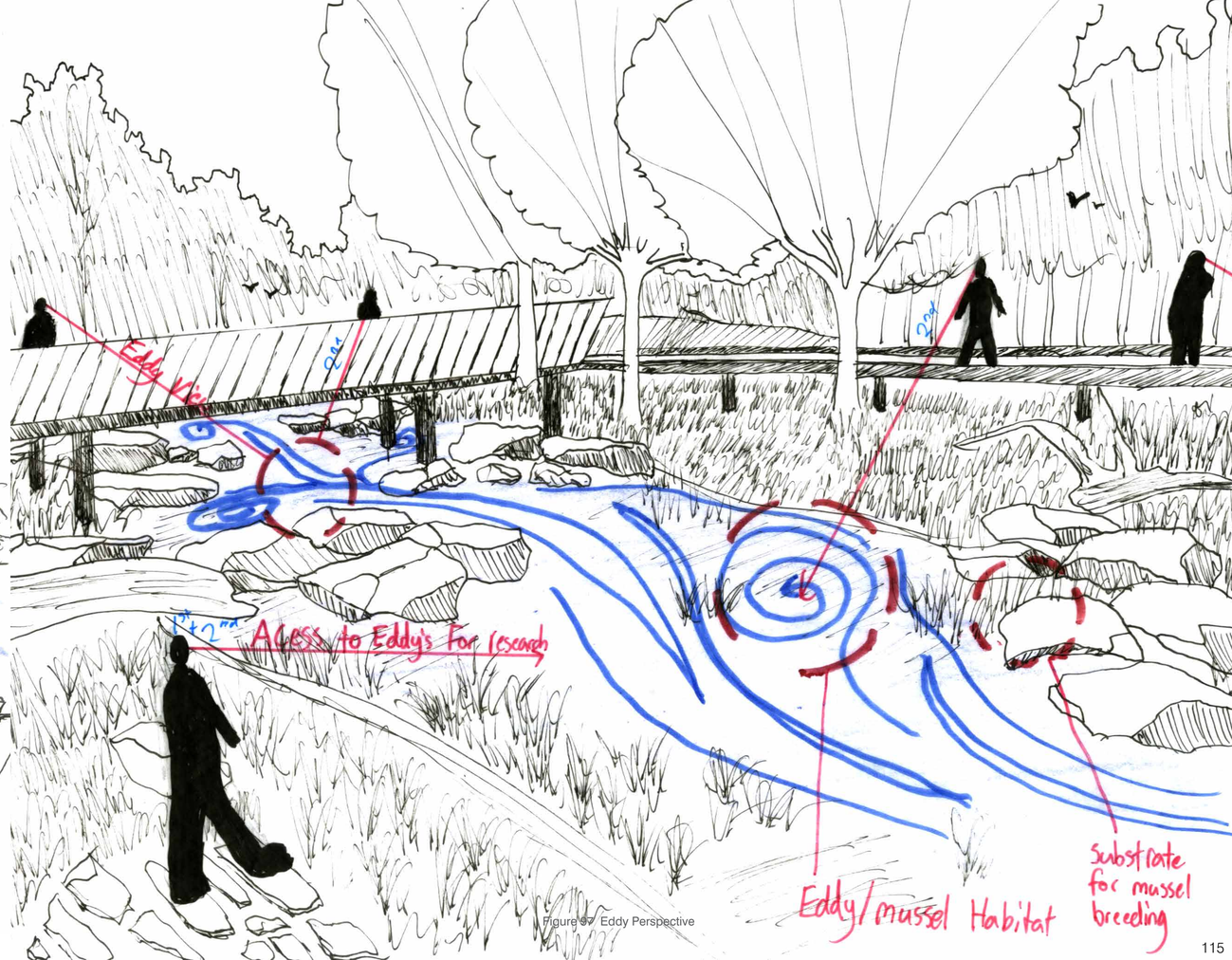



Figure 97 Eddy Perspective

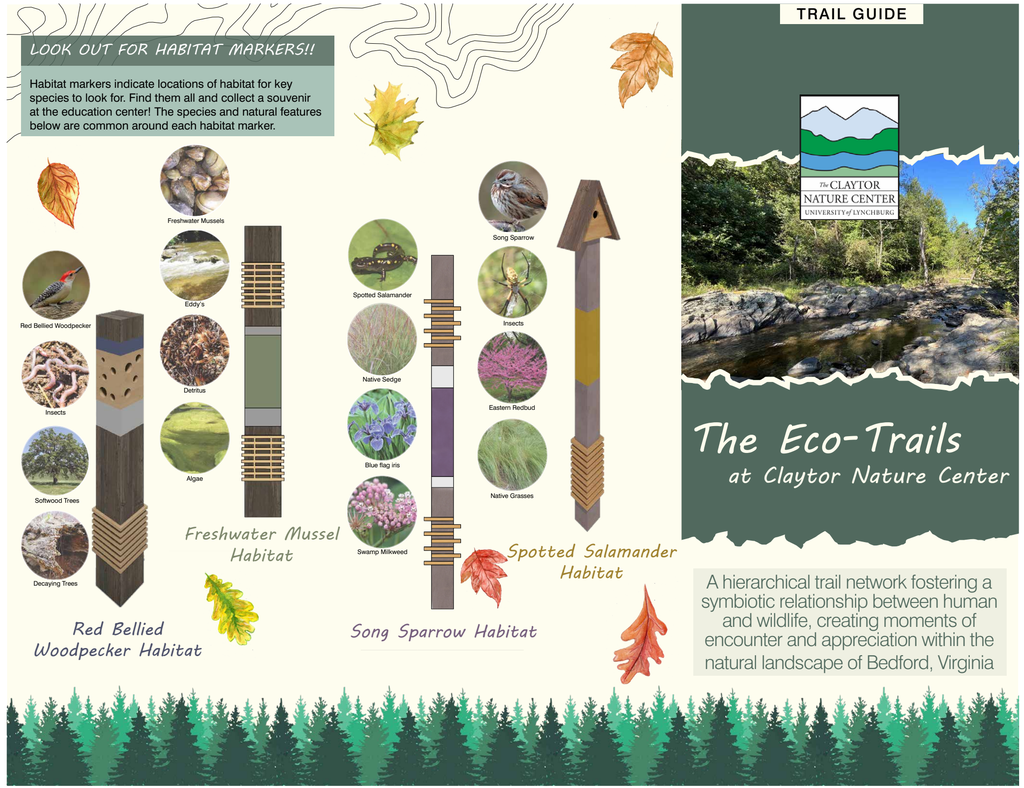



Figure 98 Trail Guide Brochure

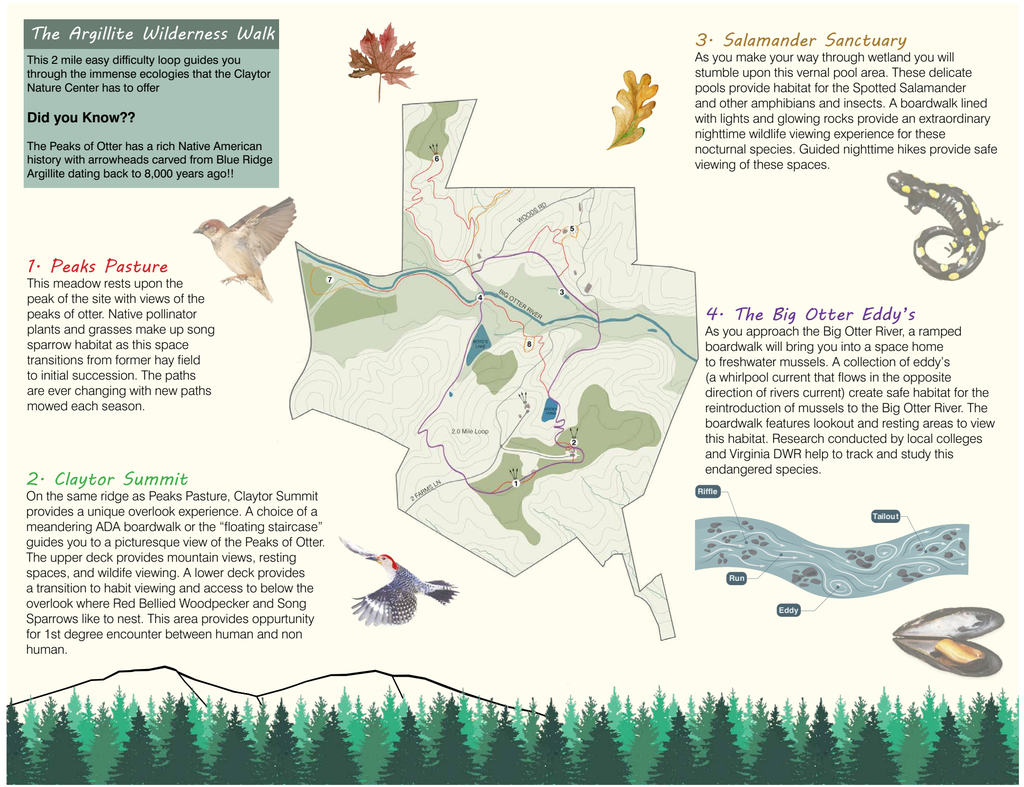



Figure 99 Trail Guide Brochure

Figure 100 Claytor Whitetail Deer

# 07 Reflection

## 7.1 Conclusion

As the human population continues to increase globally, and we continue to push into the boundaries of wild land, there is a need for the design of more than human spaces. This project aimed to attempt this type of design in a nature center with hopes of encouraging further research and applications of this topic. This project also aimed to provide the Claytor Nature Center with ideas and inspiration with how to move forward with the center and help provide design for the pursuit of grants and funding for future projects.

The findings of this research support the idea that codesigning for the non human as much as humans can contribute to a positive experience of a space. This type of design is atypical to normal projects and must provide programming for the wildlife as well as humans. These design interventions also intend for the space to work with the land instead of against it to create framed moments throughout the site that encourage slowing and appreciating the nature that surrounds us.



## 7.2 Limitations

One of the biggest limitations of this project is the fact that it is impossible to determine whether or not the selected species will use the space as intended. One of the ways to improve this research could have been to develop small scale pilot project models to test some of the designed elements. For example the habitat markers could be tested with varying colors to attract birds, material for woodpecker boring, material for deterring squirrels, or proximity to human activity.

Another limitation is the location of the site. While the Claytor Nature Center worked well for an application of the research in a more natural and rural location, it would be imperative to apply this to a more urban setting where there is usually more of a lack of attention on the non human.

Figure 101  Claytor Australian Shepherd

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## 8.2 Images

*All figures not shown are authors own


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