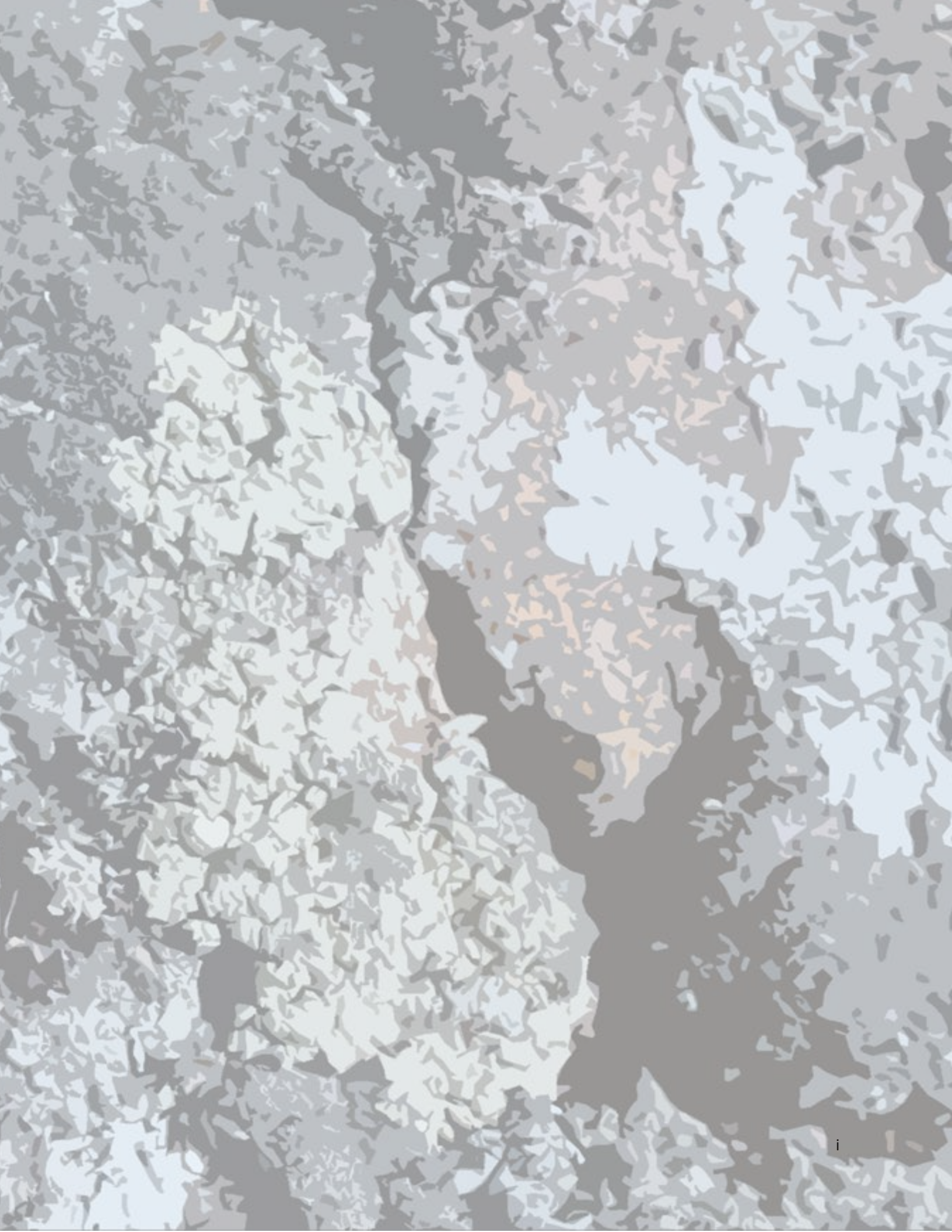




Sustainably Symbiotic:
A Study Using Lichen Biomimicry to Design
a Sustainable Multi-Use Campground in
Cavalier County, ND
Thesis Design by Xantippean Lonewolf



SUSTAINABLY SYMBIOTIC

A Study Using Lichen Biomimicry to Design a Sustainable Multi-Use Campground in Cavalier County, ND

A Design Thesis Submitted to the
Department of Landscape Architecture
of North Dakota State University

By

Xantippean Lonewolf

In Partial Fulfillment of the Requirements
for the Degree of
Master of Landscape Architecture

Primary Thesis Advisor

Secondary Thesis Advisor

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THESIS ARCHIVAL NOTE

The following thesis project, entitled *Sustainably Symbiotic: A Study Using Lichen Biomimicry to Design a Sustainable Multi-Use Campground in Cavalier County, ND*, was composed over the course of the 2022-2023 academic school year. The Thesis Program, as contained here, was initiated, and completed in the fall semester as a part of the LA 763: Landscape Architecture Thesis Research and Programming course. Supplemental material, including the Thesis Boards and the Thesis Presentation documents, were generated in the spring semester as a part of the LA 772: Landscape Architecture Graduate Thesis Design Studio. Any inconsistencies between the different documents, in terms of research and design, should be excused per the evolution of the project across the two semesters.



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The Proposal

Thesis Abstract

Evaluating if designing a multi-use campground using biomorphic design relating to LICHEN could benefit the overall camping experience. The Pembina Gorge near Walhalla, North Dakota was determined as the design setting. The analysis exploration hopes to provide proficient lichen inspired campground layouts and design methods by utilizing characteristics of native lichens and the geographical and geological areas lichen thrive on. Using ArcGIS layers created from research, I will design a sustainable and educational lichen-style campground that informs users with wayfinding signage that are directional, regulatory, identification based and informational. Interpretative signs will connect users with historical and educational photos of native lichen and vital habitats, how lichens can teach us to detect air pollution before reaching dangerous levels, and how we can use native lichen design principles to design sustainably. On the ground site investigating and photo analysis of lichen species and ecosystems will possibly verify online research creating a symbiosis of mutual data. Interactive lichen displays configured to design principles of the five senses: vision, hearing, smell, taste, and touch could offer top experiences if applied correctly. Extended research using similar campground case studies will help build a design narrative capable of sustainability through camping experience and land management. Final design model will be concluded once all needed information regarding the project is collected and studied. Although findings would vary depending on location and lichen species, this methodology could be applied to any location wanting to explore sustainable campground development. [ABSTRACT FROM AUTHOR]



Thesis Narrative

In today's time- I've seen acres in the hundreds turn from bare soil to native trees and grassland, and at the same time- have seen hundreds of acres of native trees and grasslands be removed for agriculture. As a person who enjoys the outdoors and survives on agricultural products, I support both nature and agriculture.

Better understanding these two, I believe finding a mutual connection between them can bridge the gap of food shortages and still provide ample outdoor space for generations to explore. The goal of this thesis is to design a sustainable multi-use state campground in the Pembina Gorge area near Walhalla, ND where land has changed from native woods and prairie to farmland and now back to a mix of native and invasive plant material. With the site already located, finding a model to base new research from should be local to site. Again, looking for something that relies on mutual symbiosis, I was drawn to the lichen. Diving deeper into the makeup of lichen you can find that it requires two living organisms (algae and fungus) to work together to survive harsh environments they thrive in.

Biomorphic design principles of this mutual relationship will be compared to current state park sustainable design methods or lack thereof to see if further advancement in sustainable campground design is possible.

The use of lichen biomimicry design principles in state park campground master planning.

As you travel outdoors, take a moment to look closer than before and discover the world of lichen. Once you find a lichen habit, record your findings, and take photos of specimen and habitat. Once photos are compiled, a process called biomorphic design begins. Lichen in this research have major roles-

Layout form

Design Principles

Planting pattern

Can the structure of native crustose, foliose, fruticose lichens create sustainable well-planned campgrounds of National & State Park quality? Photo matching values. Raster files-pixels. Also take valued site pic for land use/vegetation and contours, then match up with macro and micro lichen photos. With a few similar matches of contours/ elevation and land use, lichen design principles will be implemented. Will it be a good design?

Can using the growth structure/characteristic of lichens be used to establish a native planting plan? Matching a native plant with a similar growth structure as a native lichen species and so on. ~Scrub Oaks and Fruticose lichen~- imagine flying as you walk through the trees, look down and around, it's actual lichen. Many kinds grow, form, exist. The closer we look, the more we see. As if we were flying over P.G. Do you see what I see? Section Cuts of lichen, woods start to grow. Followed by shrubs and fruit trees. Wildlife starts to appear. -Xan Lonewolf.

Can using the different symbiotic structures of algae and fungus in crustose, foliose, and fruticose lichen be compared and matched to current sustainable design methods or ideologies to design a low impact multi-use sustainable campground in Pembina Gorge?

Would these lichen design principles also correlate with building architecture, interior design, or evening engineering?



Typology

National & State Parks

Reasons for interest

- Equity between nature and agriculture.
- Health- physically and mentally.
- Sustainable design potential.
- Educational opportunities to users. Example (Lichen Societies involved with schools).
- Focus will be on the sustainable practices and spatial programs of existing state campgrounds.



Typological Research

Main focus

1. Sustainable practices used for campgrounds- photo identification study of online posted reviews and campground information, once collected will compare to SITES rating System. Sites is a sustainability-focused framework that ushers landscape architects, engineers and others toward practices that protect ecosystems and enhance the mosaic of benefits they continuously provide our communities, such as climate regulation, carbon storage and flood mitigation. (SITES, 2022).
2. Activities and amenities present on sites- photo identification study of online reviews, maps, and informational sites. What makes a good site- views, aspect, shade, space, and so on.
3. Spatial programs of campground layouts to understand how much space is needed for different typologies of campsites. The goal of this research is to find the average number of spaces and amenities for the selected thesis site. The lichen structure will determine campground layout with the aid of spatial program analysis numbers.

Case Studies

1. Icelandic State Park, Cavalier, ND- North Dakota Parks & Recreation.
2. Little Missouri National Grassland, Buffalo Gap Campground, Sentinel, ND- USDA & Forest Service.
3. Turtle River State Park, Grand Forks, ND- North Dakota Parks & Recreation.
4. Black River State Forest, Black River Falls, WI- Wisconsin Dept. of Natural Resources.
5. Beltrami Island State Forest, Bemis Hill Campground. Warroad, Minnesota- Department of Natural Resources.
6. George Washington State Forest Horse Trails/Camps,
 - a. Stony Brook Horse Camp, Bear River, Minnesota
 - b. Togo Horse Camp, Togo, Minnesota.

Icelandic State Park (912 Acres), Cavalier, ND- North Dakota Parks & Recreation. About 41 Acres +/- Campground Land Use



147 modern campgrounds (electrical), with 9 being group sites. 38.2 Acres

10 primitive campgrounds. 2.88 Acres

Campground host, Amphitheater (2), Comfort station (3), Vault toilet (4), Trailer dump station, Playground (4), Cabin (3), Boat ramp, Fishing, Dog Park, and Parking (2).

Outside camp boundaries

Near Lake, walking trails (4 miles), gift shop, interpretive center, picnic Shelter, Restroom/Change House, Meet Hall, Point of Interest (Gunlogson Homestead/Gunlogson Nature Preserve 200 Acres), Canoe/Kayak Access, Swim beach, Concessions, Pembina Machinery Exhibit and Museum. Non-motorized multi-use trail. hiking, cross-country skiing, biking, and snowshoeing. Near paved non-motorized multi-use trail.

Little Missouri National Grassland, Buffalo Gap Campground, Sentinel, ND- USDA & Forest Service.

About 12 Acres +/- Campground Land Use



36 modern campgrounds, with one accessible.

Flush toilets, vault toilets, shower house, potable water, RV dump station, large group pavilion, picnic tables and fire rings.

Outside camp boundaries

Walking trails.

Turtle River State Park, Grand Forks, ND- North Dakota Parks & Recreation.

About 41 Acres +/- Campground Land Use



71 modern campgrounds, with 3 being group sites. 22 Acres

10 primitive campgrounds. 19 Acres

Campground host (2), Amphitheater (1), Comfort station (1), Vault toilet (3), Trailer dump station, Tent campground (3), and Parking (6).

Outside camp boundaries

Near Lake, office & visitor center, fishing, playground, walking trails (12 miles), gift shop, picnic Shelter, picnic area, dog park, Cabin, and Point of Interest (CCC Dam). Non-motorized multi-use trail. hiking, cross-country skiing, biking, and snowshoeing

Black River State Forest (68,000 Acres), Pigeon Creek Campground, Black River Falls, WI- Wisconsin Dept. of Natural Resources.

About 13.64 Acres +/- Campground Land Use



38 Primitive campgrounds, with one accessible.

Ranger Station, Restroom (3), Trash Dumpster, Drinking water.

Outside camp boundaries

Near Lake, drinking water, Hand launch, Firewood, Beach access, Parking, fishing, playground, walking trails, picnic area. Non-motorized multi-use trail- hiking, cross-country skiing, biking, and snowshoeing

Beltrami Island State Forest (703,382 Acres), Bemis Hill Campground. Warroad, MN- Department of Natural Resources.

About 6.5 Acres +/- Campground Land Use



4 Primitive Equestrian sites.

6 drive in sites.

Vault Toilet (2), picnic tables (6), garbage cans, drinking water, hitching post (4), sledding and Parking.

George Washington State Forest (320,534 Acres). Horse Trails/Camp #1.

Stony Brook Horse Camp, Bear River, MN- Minnesota Department of Natural Resources. About 17.2 Acres +/- Campground Land Use



15 Primitive Equestrian sites, which one is an accessible site, and open area for group camping.

Vault Toilet (3), Well, manure bins (5), registration area, transfer platform, garbage dumpster and Parking.

Outside camp boundaries

Near Lakes, walking/ horse trails, and picnic Shelter.

93,200 acres- DNR Forestry

199,700 acres- Itasca County

93,100 acres- Private landowners

George Washington State Forest (320,534 Acres). Horse Trails/Camp #2.

Togo Horse Camp, Togo, MN- Minnesota Department of Natural Resources.

15 Acres +/- Campground Land Use



14 Primitive Equestrian sites, which one is an accessible site.

Vault toilet (3), Well, drinking water, Trailer dump station, manure bins (4), kiosk/register, firewood bin, transfer platform, garbage dumpster, and Parking.

Outside camp boundaries

Near Lakes, walking/ horse trails, picnic Shelter, and picnic area.

Shared trails (horse and Thistledew ATV Trails).

93,200 acres- DNR Forestry

199,700 acres- Itasca County

93,100 acres- Private landowners

Project Elements

Dog Park

Cabin

Trailer Dump Station

Well/Drinking water

Vault Toilet

Comfort Station

Amphitheater

Playground- Lichen structure

Parking

Group Site

Primitive Site

Modern Site

Campground Host Site (Park Ranger)

Sculptures- in the shape of Prehistoric animals (covered in lichen).

Attached to trails.



The Users

Information from case studies and online research will help solidify users.

Outdoor Enthusiasts

Campers

Hikers

Kayakers

Mountain biking

Skiing

Hunters

Equestrian

Off-highway vehicle users.

- Bird watchers

- Lichen hobbyist

- Photographers



Project Emphasis

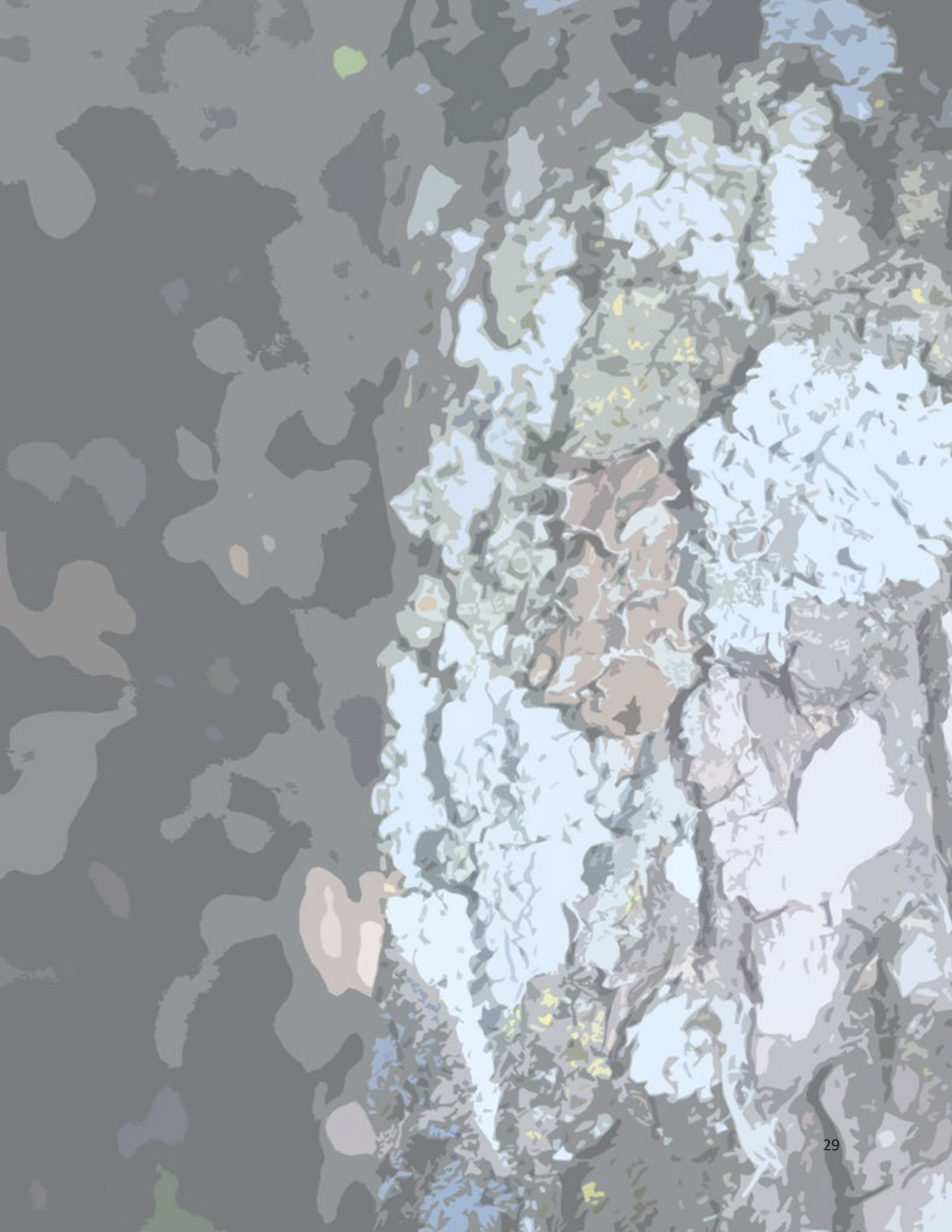
To understand campground program elements by base map analysis, online research of campsite reviews and photo identification.

Understanding the lichen design principles to help design a sustainable campground.

Providing a design methodology to mend nature and agriculture (permaculture/microclimates)..

Giving back to the community through educational learning.

Providing habitat for wildlife through sustainable lichen styled landscapes.



Design Intent

Evaluating if designing a sustainable multi-use campground using bio-inspired design relating to LICHEN is beneficial for the overall camping experience?

Research

First one must understand the words sustainable, sustainability, bio-inspired design, and biomimicry.

What is sustainable?

- The ability to be maintained at a certain rate or level.
- Sustainable techniques
- Sustainable agriculture
- Sustainable methods relating to lifestyle.

What is sustainability?

- Fulfilling the needs of the current generations without compromising the needs of future generations, while ensuring a balance between:
 - economic growth
 - environment care
 - social well-being.

What is bio-inspired Design?

Taking an idea from nature and finding a way to improve on it for your own purpose.

What is biomimicry?

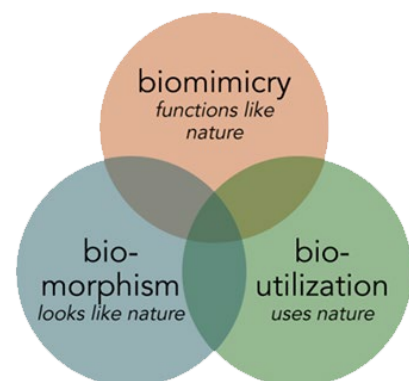
Copying directly from nature.

Three types of biomimicry.

Design (form and shape)

Process (ex. photosynthesis in a leaf)

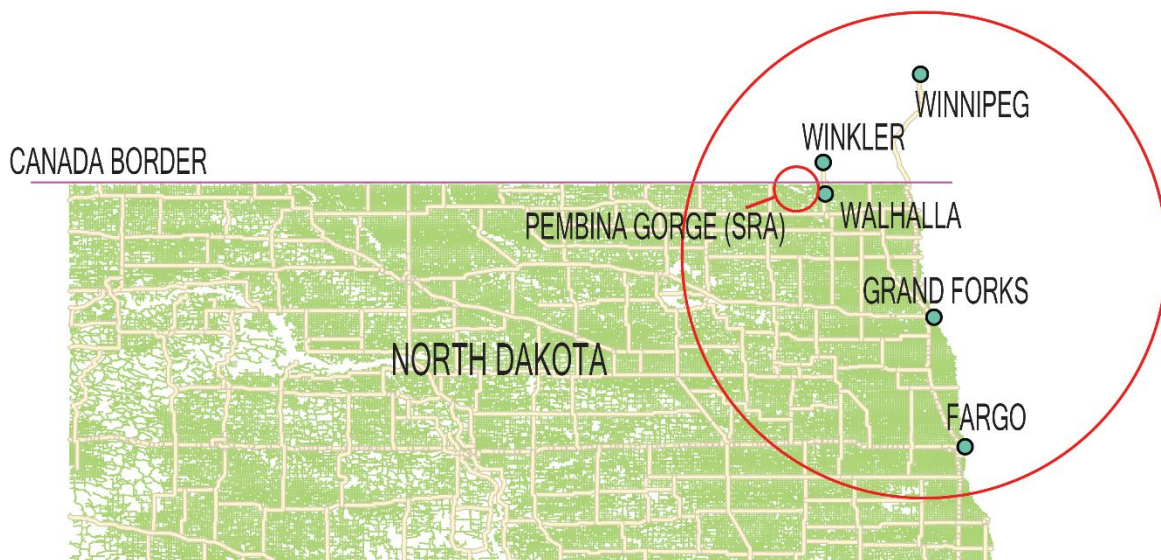
Systems (mimicking at an ecosystem level like building a nature inspired city).

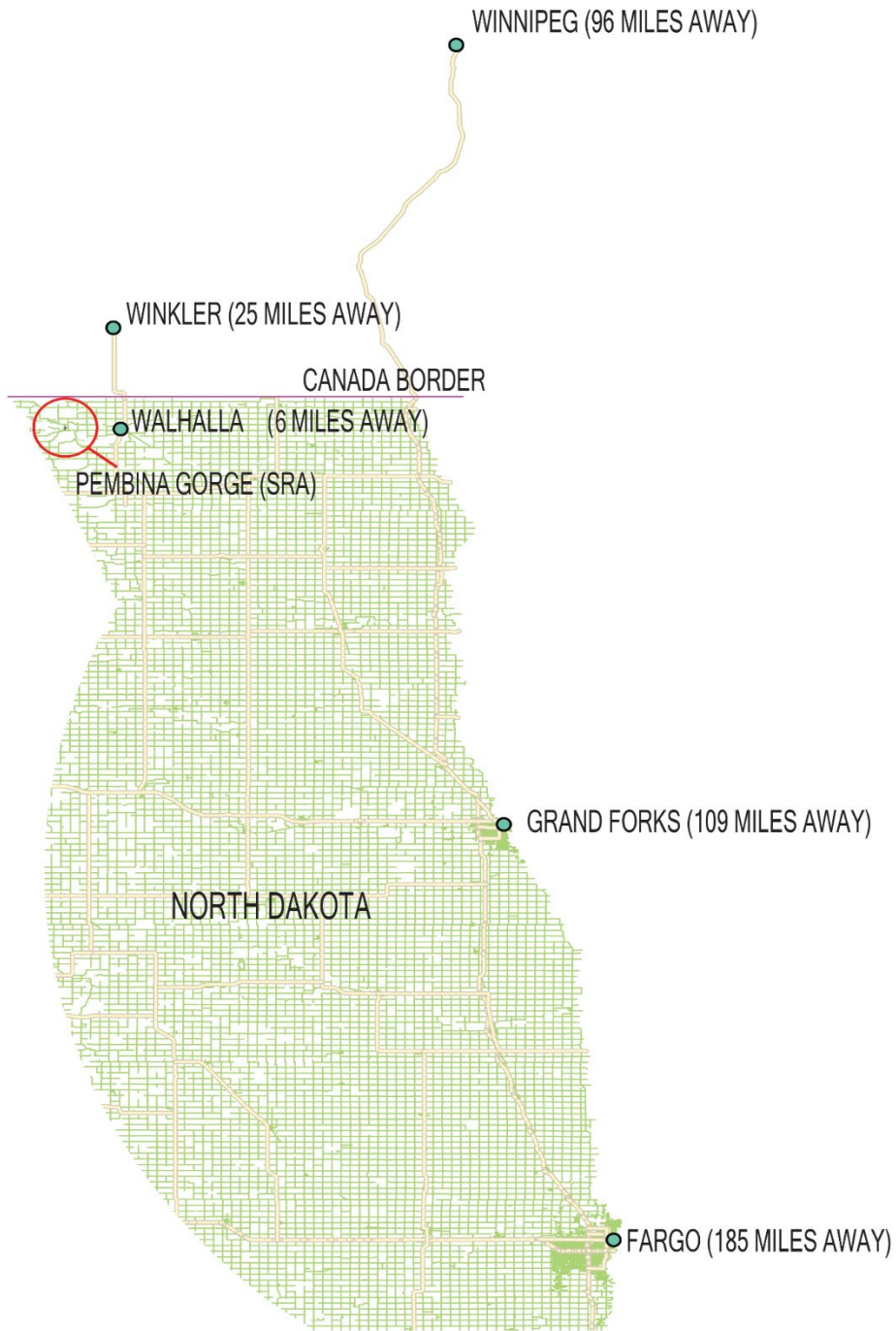


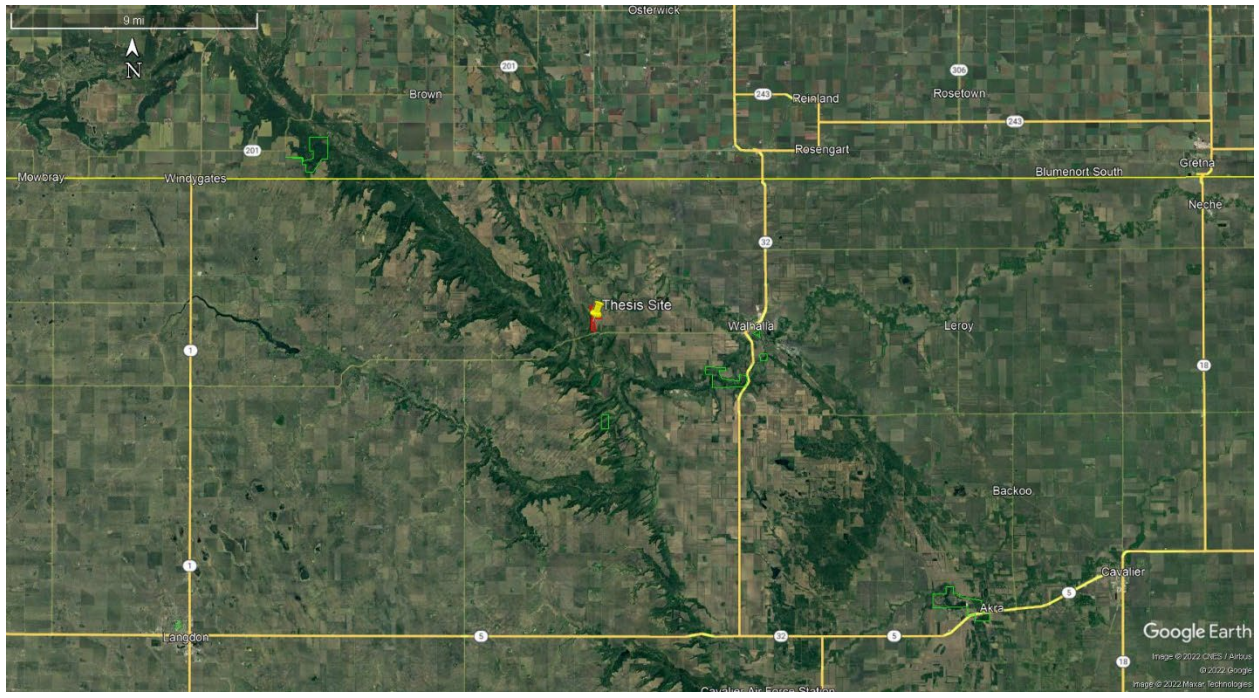
Thesis Site

The site to be used is 35 acres +/- of open land in northeast North Dakota located 5 miles south of the Canadian border and 185 miles north-northwest of Fargo. The site was chosen for its location near nature (woods) and agricultural (fields) and shows potential taking lichen design methodology and design research into consideration.

Walhalla is the nearest city located 6 miles east of the thesis site. The site sits on the edge of the Pembina Gorge. The area was established as the Pembina Gorge State Recreation Area in 2012 and consists both of public (over 2,800 acres) and privately owned land. The Pembina Gorge SRA offers over 30 miles of trails and is open to horseback riding, hiking, mountain biking, off-highway vehicles (OHV), and other outdoor activities like cross country skiing. The site area also offers opportunities for golfing, kayaking, and snowboarding.









Why Pembina Gorge?

-Passion Project

-Local project to area where I grew up.

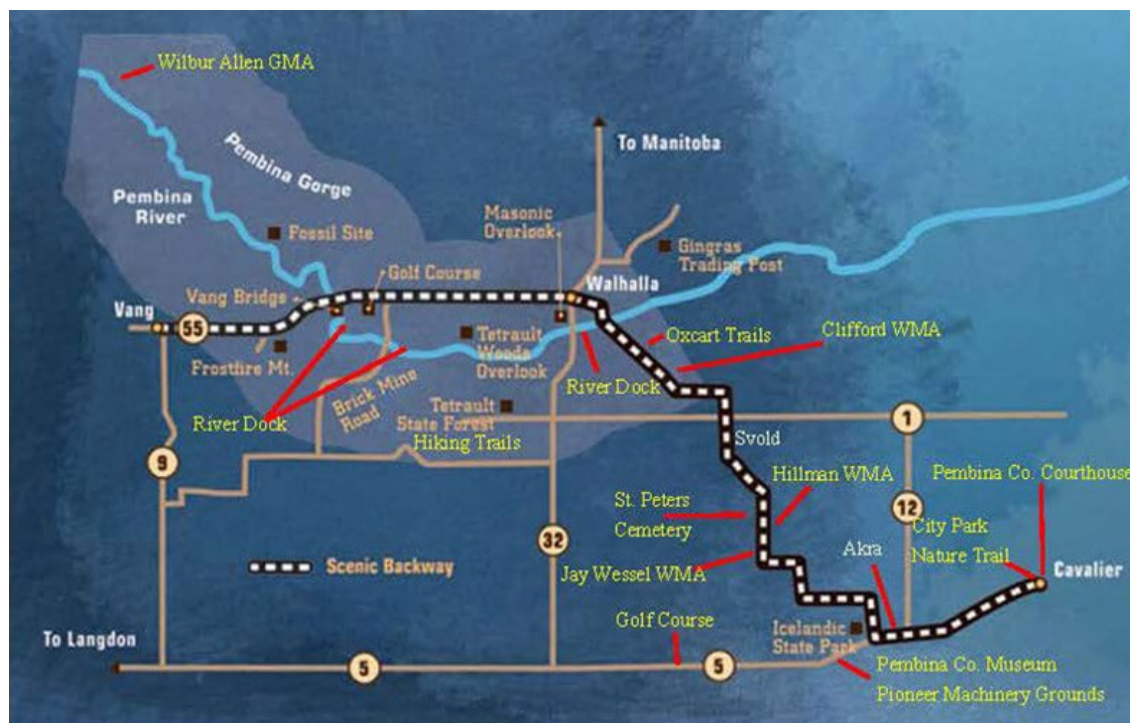
-Campground requested by community in 2014(different location).

-Project site has been underutilized state-owned land since 2012; has been slowly reverting back to native habitat- currently at the thistle regenerative stage.

-Great location for potential economic growth regarding tourism and community building.

Great Location

Located on the established Rendezvous Region Northeast Dakota Scenic Backway. Located in northeast North Dakota is a special place steeped in history, with natural resources, recreation, scenic beauty, and culture. Winding along the bends of the Pembina River you can enjoy the panoramic view of the Pembina Gorge along with the year-round recreational opportunities of the area. Beginning on Highway 55 in Vang proceeding east to Walhalla, turning southeast for 22 miles traveling past Icelandic State Park to Highway 5 ending in Cavalier. rendezvousregionmap.pdf (ndtourism.com)



Landscape Performance-Measurable Methods

The landscape performance of this campground will be measured by a few sets of standards which should solidify the end design. These standards/parameters are set by North Dakota Parks and Recreation and Sites v2. The reason for this, is to design a campground design that can be implemented anywhere in North Dakota, and because it will align with government standards- it could potentially be used with other State campground agencies with minor changes to align with variety of standards. The same with standards set by Sites v2, these standards are well known around the United States and seem to be normalized when striving for sustainability within a landscape or building design. Having two high valued standards to measure towards should help catapult this design project towards success.

North Dakota Parks and Recreation Standards

These standards are a compilation of publications through ND Parks and Recreation and will be more for a design framework rather than being obligated to do so. The publications I will be utilizing to authenticate my design theory are listed below.

-North Dakota State Comprehensive Outdoor Recreation Plan 2018-2022.

This document will help shape my design ensuring it aligns with ND outdoor recreational plans.

-Pembina Gorge State Recreation Area Master Plan, December 2014.

This document is Parks and Rec original goals with Pembina Gorge which unfortunately were not realized as of today. I plan to utilize this information to create a stronger design.

-Pembina Gorge State Recreation Area Public Recreation Survey, Aug 2014.

This document will give me a better understanding of the needs and wants of the community in 2014, ensuring an end design that the people can agree with. I hope to build upon this information and create an updated survey for the year 2023.

Sites v2

Site v2 is the most comprehensive system for developing sustainable landscapes. It is used by landscape architects, designers, engineers, architects, developers, policymakers, and others to guide land design and development.

[SiteScapes - SITES v2 \(sitescapesonline.com\)](http://sitescapesonline.com)

-Originally modeled after the U.S. Green Building Council's LEED Rating System, SITES v2 includes best practices in landscape architecture, ecological restoration, and related fields, and knowledge gained through peer-reviewed literature, case-study precedents, and projects registered in the SITES Pilot Program. [SiteScapes - SITES v2 \(sitescapesonline.com\)](http://sitescapesonline.com)

SITES v2 scorecard is a certification system that grades landscapes and buildings. Taking this into consideration it's my hope to produce a design that meets the four goals of SITES.

- Create regenerative systems and foster resiliency.
- Ensure future resource supply and mitigate climate.
- Transform the market through design, development, and maintenance practices.
- Enhance human well-being and strengthen community.








Dissemination- Publication/Funding-Criteria

The action of spreading information regarding this project design will entail an updated survey that communities can share inputs on what they see is important or unessential. The survey will help build the criteria with already set research standards, again solidifying the end design. Even though the focus of this research project is to see if lichen can help produce a sustainable multi-use campground, this part of the research takes the community into perspective- connecting the people to the project design helps ensure possibilities of actuality. Furthermore, if project research is funded by Parks and Rec, I plan to hold one or two community meetings in Cavalier County, ND where said site is located. If Parks and Rec does not take the opportunity to fund research- the community meeting will be voided and another survey will be issued to show community and others who participated the final design, which they can share their thoughts on a design created by input they provided along with the lichen research methodologies(change) and principles(unchanging) and standards set by Sites 2.0 and ND Parks and Rec. Publications used are stated above, but future publication of project depends on funding, if funding is not provided under agreement- then all rights to project will stay with design researcher of project. Only with owner (Xantippean Lonewolf) permission is design and research finding used for profit gain. Use for NDSU publication is allowed with recognition to owner of project, meaning project is only for NDSU requirement to obtain master's degree and no ownership rights are given to NDSU or its faculty. Use of final campground design for any government is prohibited unless agency contacts owner of project and compensates research and design already completed or provides owner of project with a paid landscape design position under contract. I, Xantippean Lonewolf do allow the use of lichen methodologies and principles to further create knowledge in all professions that can benefit from research findings.

Camping Framework for Design

Taking information from Pembina Gorge trail user surveys the establishment of camping types used are modern, equestrian, and primitive. To find how many spaces are needed for each camping type we need to do some calculations. Refer to examples below for steps taken. Number of acres divided by number of spaces. Do this with all case studies. Average each camping typologies to get acres used for each camping site.

Case Studies

Icelandic State Park, Cavalier, ND 41 Acres	Turtle River State Park, Grand Forks, ND 41 Acres	Little Missouri National Grassland, Buffalo Gap Campground 12 Acres	Black River Falls, WI Black River State Forest, Pigeon Creek 13.64 Acres	Beltrami Island State Forest, Bemis Hill Campground, Warroad, MN 6.5 Acres	George Washington State Forest Horse Trails/Camps Stony Brooks Horse Camp Bear River, MN 17.2 Acres	Togo Horse Camp Togo, MN 15 Acres
						
<ul style="list-style-type: none"> 147 modern with 9 group sites @ 38.2 acres/147= .2598 acres per modern campground. 10 primitive campgrounds @ 2.88 acres/10= .288 acres per primitive campground 	<ul style="list-style-type: none"> 71 modern with 3 group sites @ 22 acres/71= .3098 acres per modern campground. 10 primitive campgrounds @ 19 acres/10= 1.9 acres per primitive campground 	<ul style="list-style-type: none"> 36 modern campgrounds, with on accessible @ 12 acres/36= .3333 acres per modern campground. 	<ul style="list-style-type: none"> 38 primitive campgrounds, with one accessible @ 13.64 acres/38= .3589 acres per primitive campground. 	<ul style="list-style-type: none"> 4 primitive equestrian sites. 6 drive in sites. @ 6.5 acres/10= .65 acres per equestrian site. 	<ul style="list-style-type: none"> 15 primitive equestrian sites with one being accessible @ 17.2 acres/15= 1.146 acres per equestrian site. 	<ul style="list-style-type: none"> 14 primitive equestrian sites with one being accessible @ 15 acres/14= 1.071 acres per equestrian site.
Modern Campground Average 0.3 Acres each site	Primitive Campground Average 0.85 Acres each site	Equestrian Campground Average 0.96 Acres each site	<p style="text-align: center;">Pembina Gorge State Recreation Area, Walhalla, ND</p>  <p style="text-align: center;">35.379 acre site divided by 3 types of camping equals 11.79 acres for each camping types to utilize.</p> <p style="text-align: center;">39.31 Modern 13.87 Primitive 12.28 Equestrian</p>			

Pembina Gorge State Recreation Area, Walhalla, ND

35.379-acre site divided by 3 types of camping equals 11.79 acres for each camping type to utilize.

- 39.31 Modern
- 13.87 Primitive
- 12.28 Equestrian

Lichen Research Framework

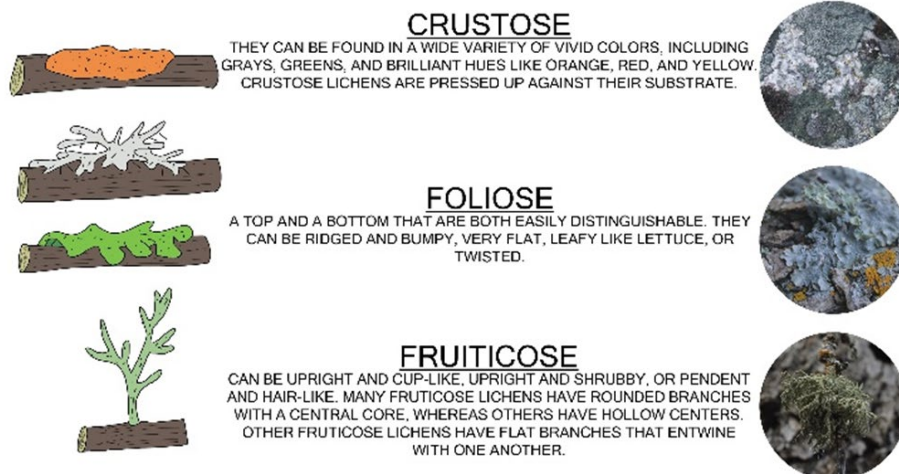
Utilizing lichen to theoretically further this project, it was essential to spend time researching this organism. Focusing on how lichen thrives in the harshest environments the earth has to offer. Research has clarified my understanding of lichen and its design purpose in nature, the potential to connect lichen to landscape design has become vast and almost never ending. Forcing the change of how I approached research and of course the project itself.

The first question that needed to be asked is, what is Lichen? Lichen is a living organism found all over the world, with more than 3,600 different species in North America alone. This small organism can be found thriving on substrate such as bare rocks, bark, and uninhabitable soils. According to Leopoldo G Sancho and the research team he worked with, proved that some lichens were able to survive the harsh effects of various wavelengths of extraterrestrial solar UV radiation.

What makes lichen so adaptable? The answer is collaboration, lichen is not lichen without the symbiotic relationship of fungi and algae. Typically, one without the other survival rates are low to none, together they are lichen- a Keystone species in most ecosystems, providing a food source and habitat for many animals in the deer, bird, and rodent family.

Collaboration is essential in all aspects of life, and in this case it's lichen and design.

LICHEN GROWTH FORMS USED IN BIOMIMICRY DESIGN PROCESS



Project Framework

- Case studies
- Lichen findings
- Public Documents
 - Pembina Gorge SRA Masterplan 2014
 - Surveys and public meetings
 - ND Parks and Rec- Grant Summary 2020
 - Pembina Gorge STA Public Recreation Survey 2014
 - SCORP (State Comprehensive Outdoor Recreation Plan 2018-2022)
 - Pembina County Strategic Plan 2019-2024
 - ND Forest Action Plan 2020
 - ND Chap 33-33-02 Trailer Park and Campground Rules
 - ND Department of Commerce Tourism 2021 Annual Report
 - Sites V2 handbook, rating system and overall goals.

All framework listed somehow helped guide this design shape, form, or process.

For example, SITES v2 states it is the most comprehensive system for developing sustainable landscapes. Originally modeled after the U.S. Green Building Council's LEED® Rating System, SITES v2 includes best practices in landscape architecture, ecological restoration, and related fields, and knowledge gained through peer-reviewed literature, case-study precedents, and projects registered in the SITES Pilot Program.

Project Objectives

-Micro-Climate Design

-Small, localized areas that differ in precipitation, temperature, and wind protection from the greater surrounding area. Plant orientation, structures, and topographic features can create microclimates. They can be naturally occurring or intentionally designed. Landscape-Water-Conservation. (2020, February 1).

For site- tree planting phases and creating thermal comfort utilizing native lichen growth patterns and trying to understand the sites desires.

-Public Hospitality

-Providing a friendly and welcoming atmosphere, a sense of caring for guests and ensuring that their needs are met. Revfine.com. (2022, September 9).

For site- focuses on the campsite pattern potential, especially when it comes to the regenerating landscape tree planting phases. Also focusing on design elements that make a well-used campground for modern, primitive, and equestrian campers.

-Regenerative Landscape

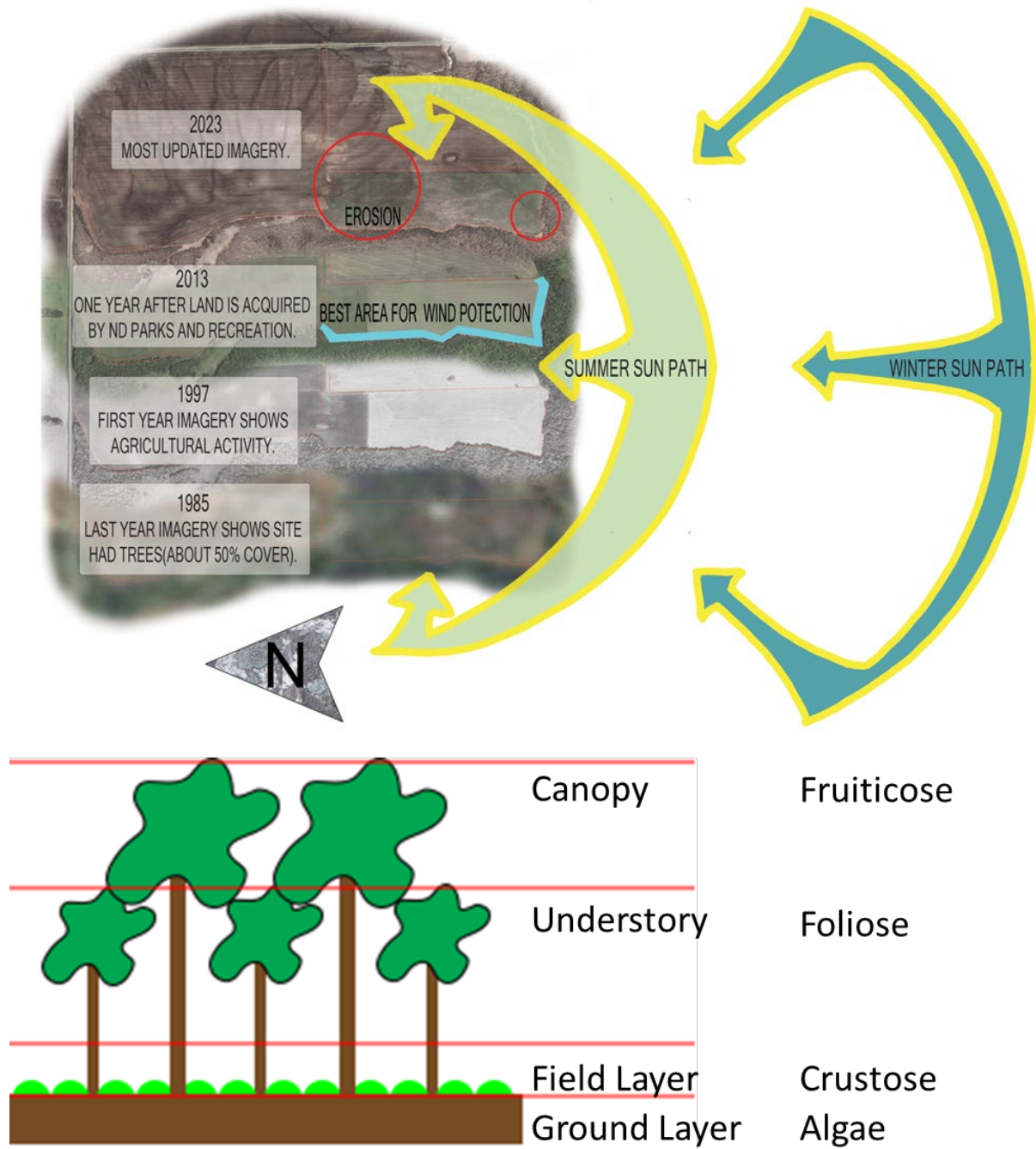
-Restoring the environment and encouraging long-term sustainability, increased biodiversity, and enhanced resilience. Brightview.com. (2023).

For site- focuses on the information found in analysis phase, understanding how the native plants grow through time and combined with lichen planting design, a three-phase grid pattern planting once established should regenerate with minimum management.

Site Analysis

Questions asked for analysis:

- What was the site prior to agriculture practices?
- What are the conditions now?



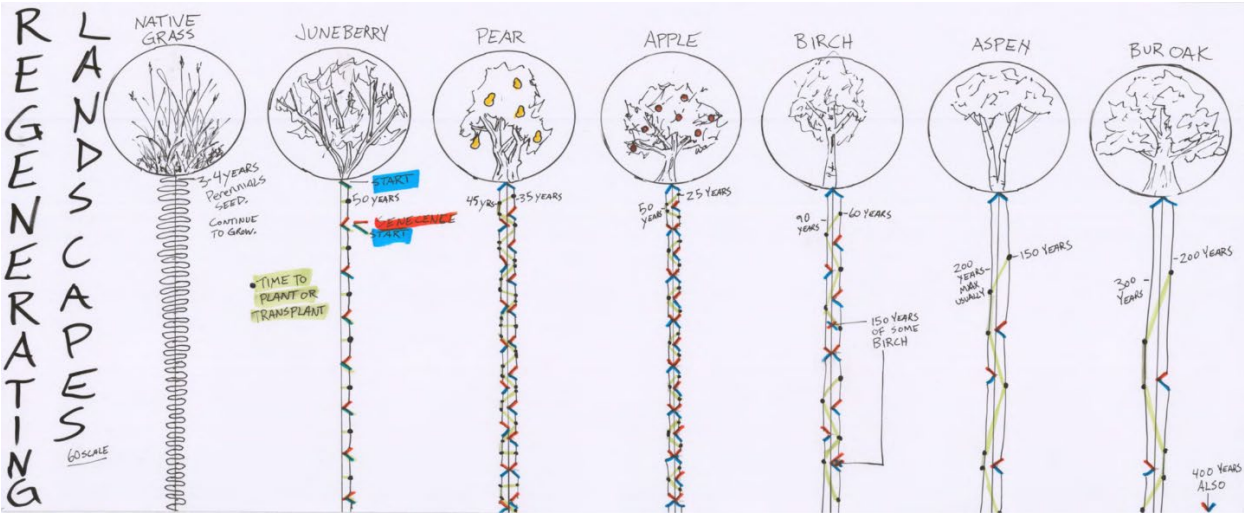
The above diagram shows ideology connecting eroded land with lichen process.

Regenerating Landscapes

Understanding trees utilized enables a regenerative landscape that once established can last for generations that allows great opportunities regarding fruits produced on site for wildlife and community activities such as cook offs using apples(fall), pears(fall) and juneberries (June/July) on site.

Apples bear fruit around 8 years old; pears bear fruit between 3-7 years old; juneberries produce around 6-8 years old; birch trees seed 20-70 years old, aspen seed 10-30 years old and oaks don't bear acorns until 30-35 years old. The prairie grass is found throughout the site and thrives where able to.

Camping plans coincide with planting phases. Changing zones with seasons and actual sites each phase, and when trees establish camping will be available on whole site but zoned for modern, primitive, and equestrian camping.



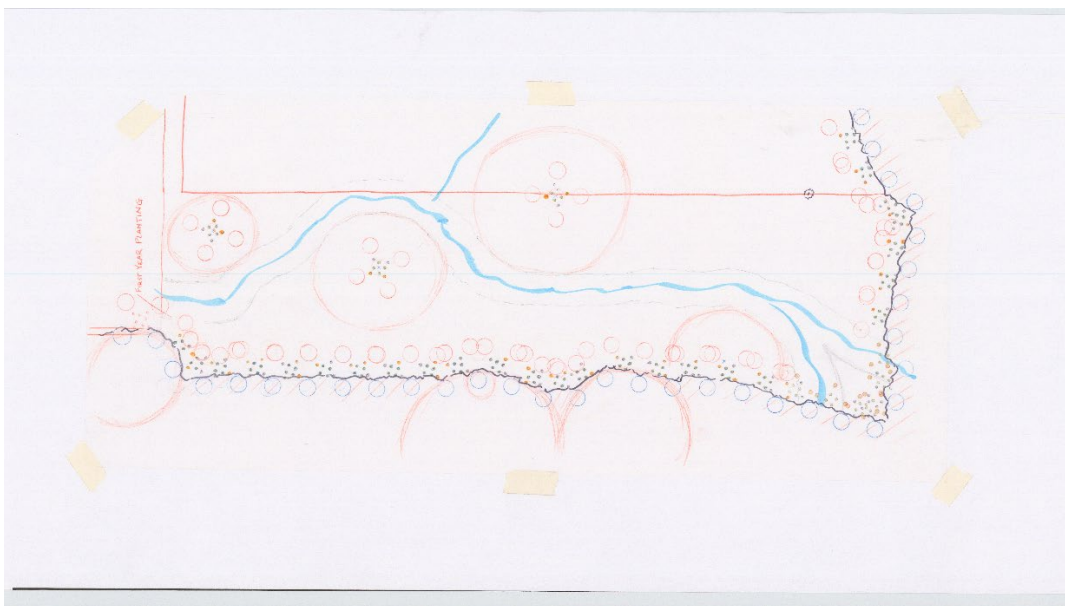
Project Design

This process is based on the connection between lichen and the overall layout/form/shape of everything included in this design with the project goals also being focused on. To do this many steps have been taken. The first thing needed to design is the planting phases of the regenerative woodland which of course would vary depending on where the site is located. This site was established using a three-phase planting, and again can vary depending on the results wanted. Establish where you think lichen would be established, by reading the land and becoming one with the growth pattern you choose.

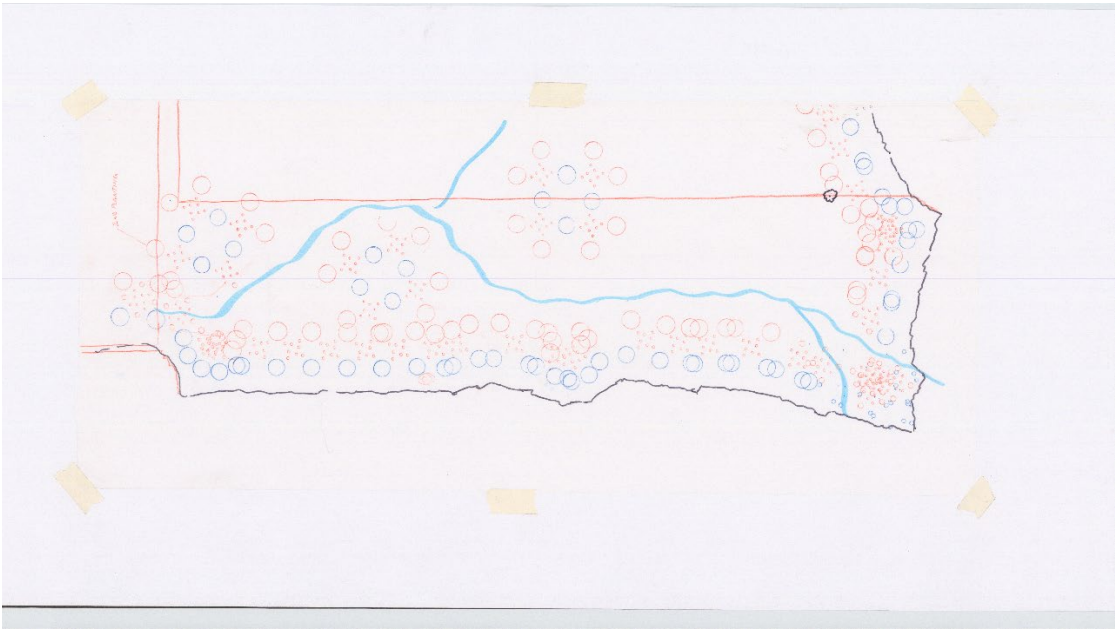
Phase One Planting with Lichens Placed on Site



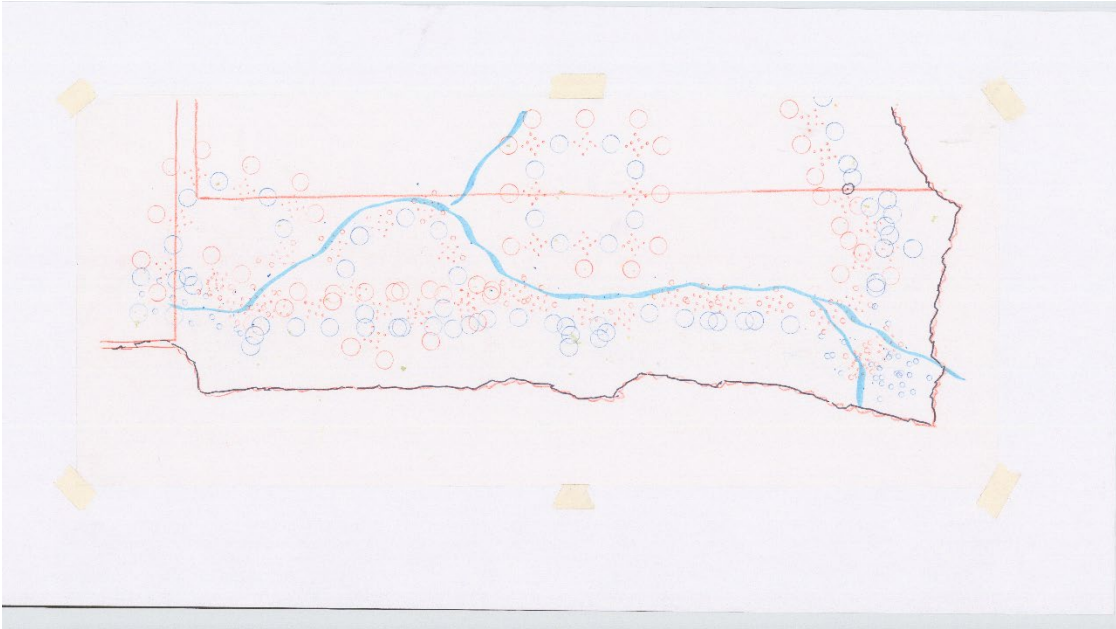
Phase One Planting



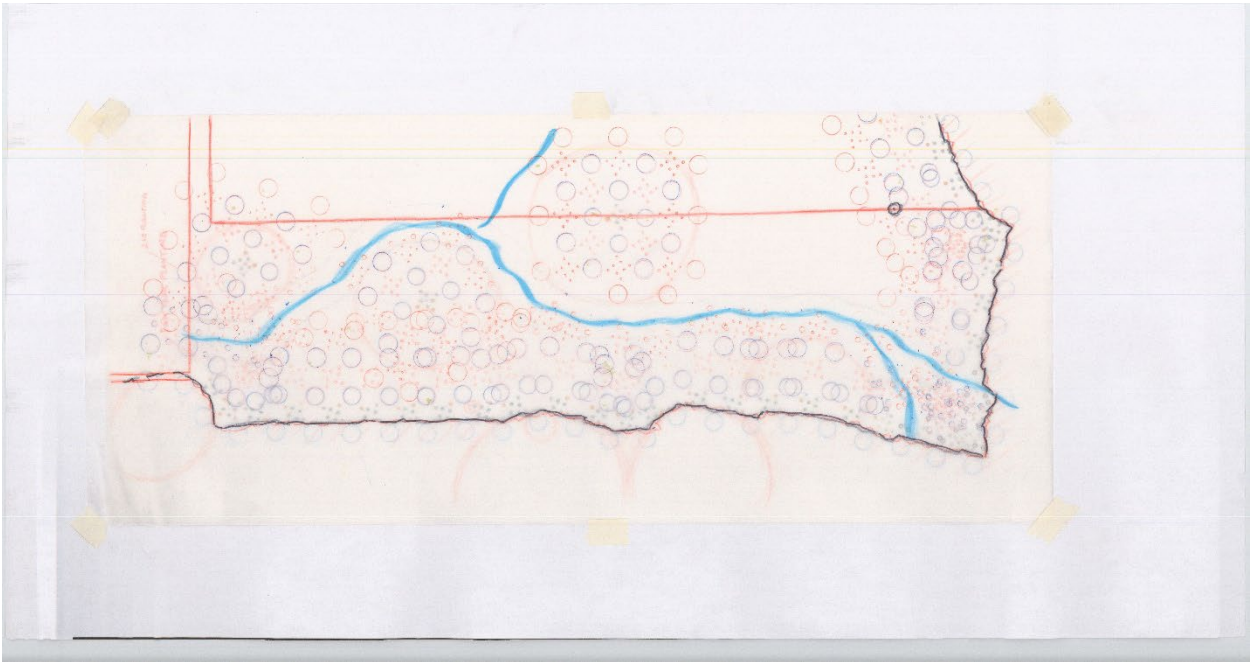
Phase Two Planting



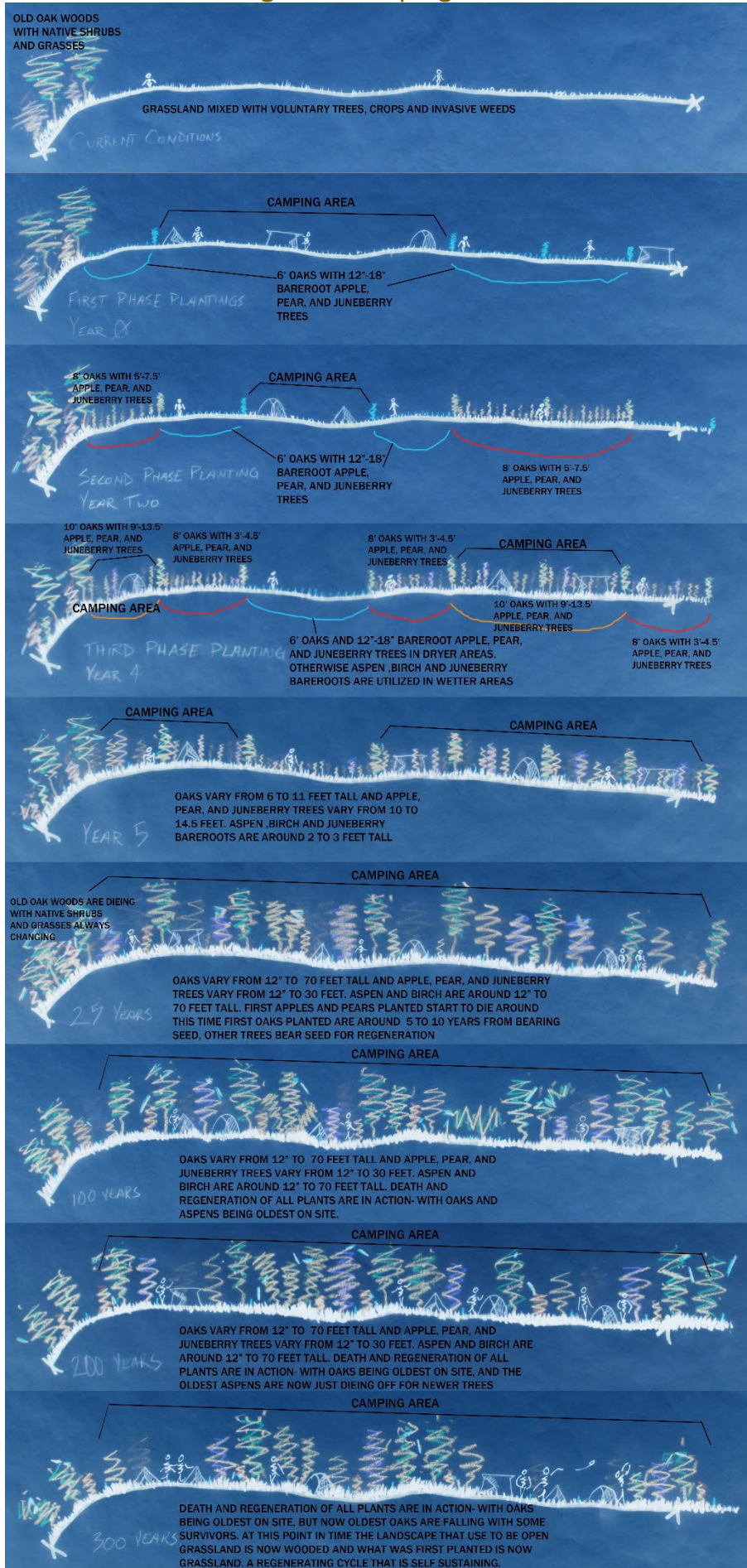
Phase Three Planting



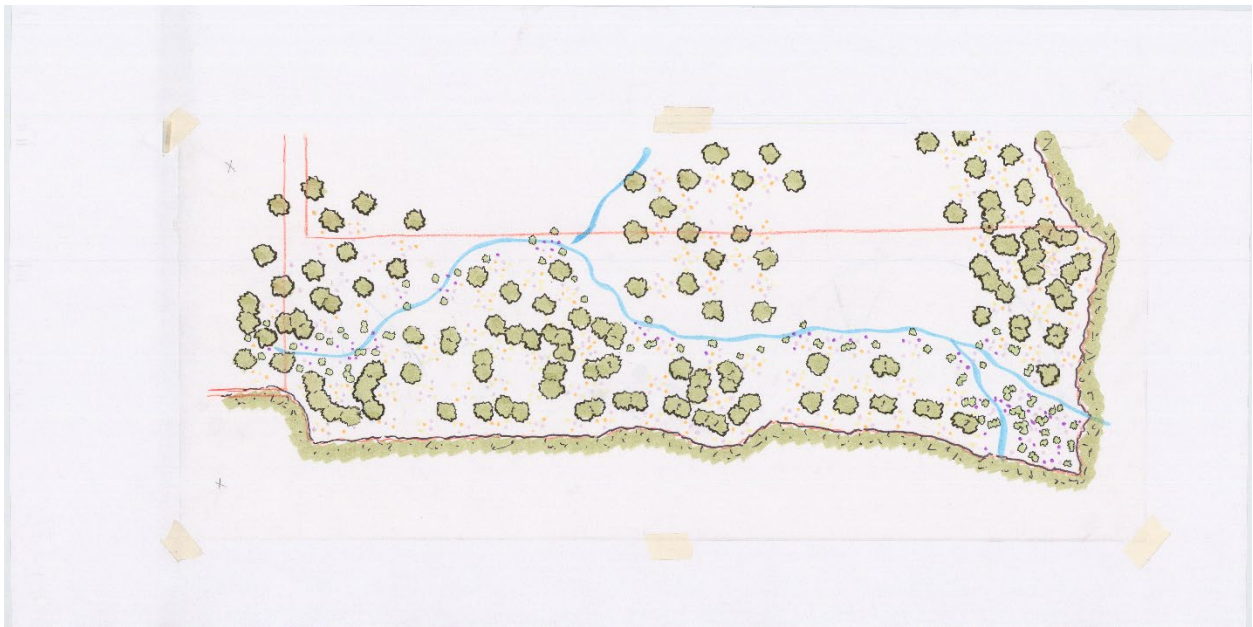
All Phase Plantings



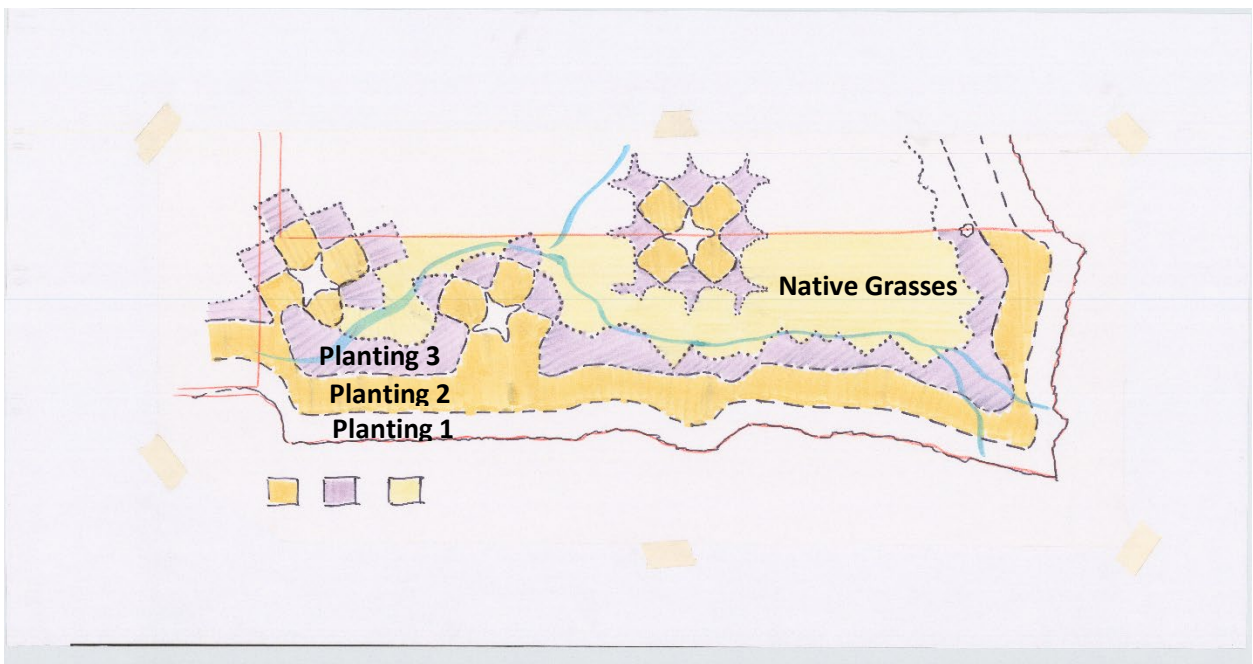
Regenerative Woodland Planting with Camping Timeline



Tree Planting With 15% Die Off



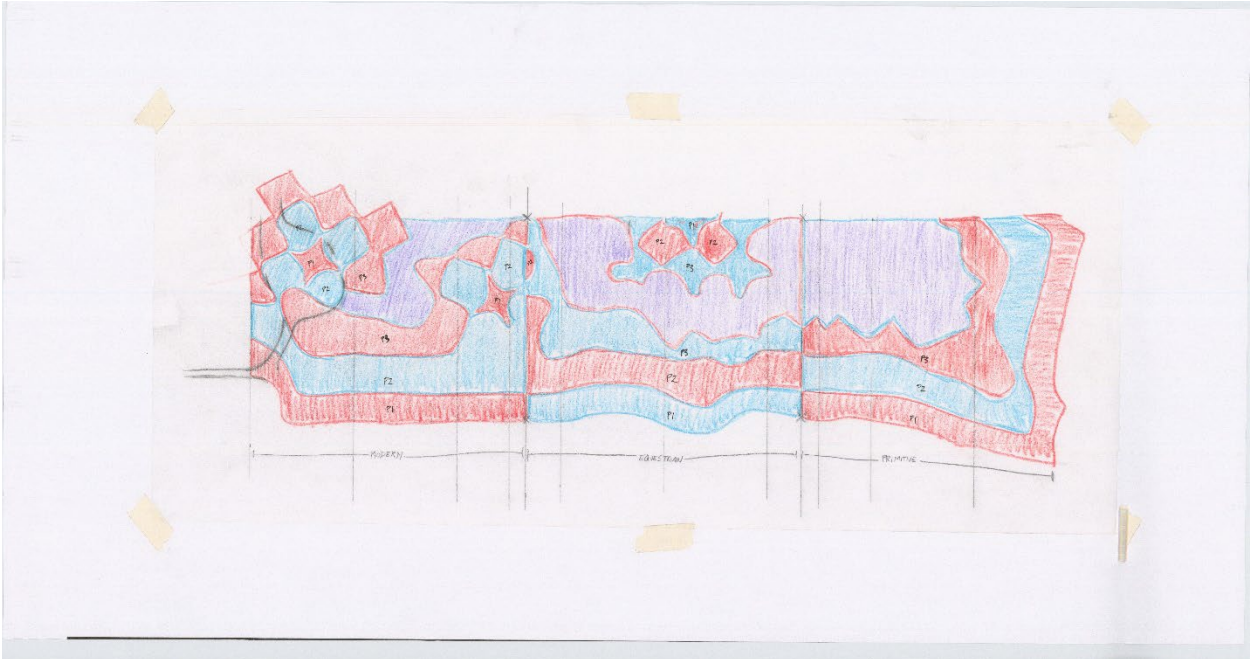
Planting Zones



Planting Zones with Trees



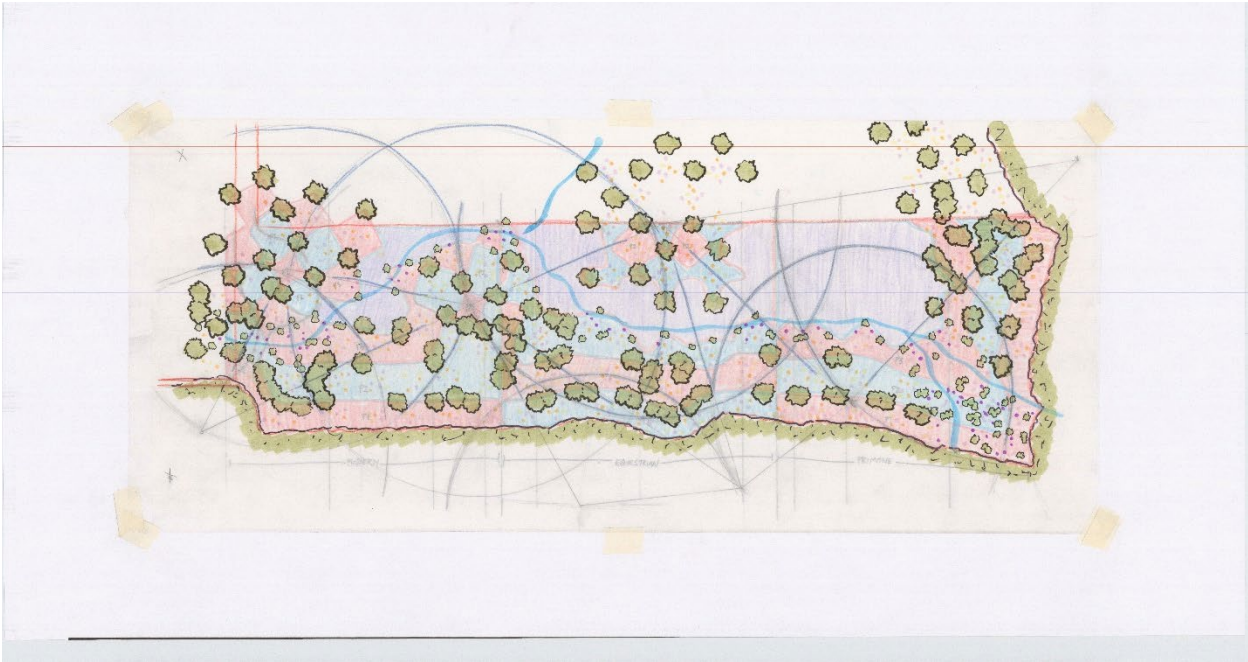
Camping Zones



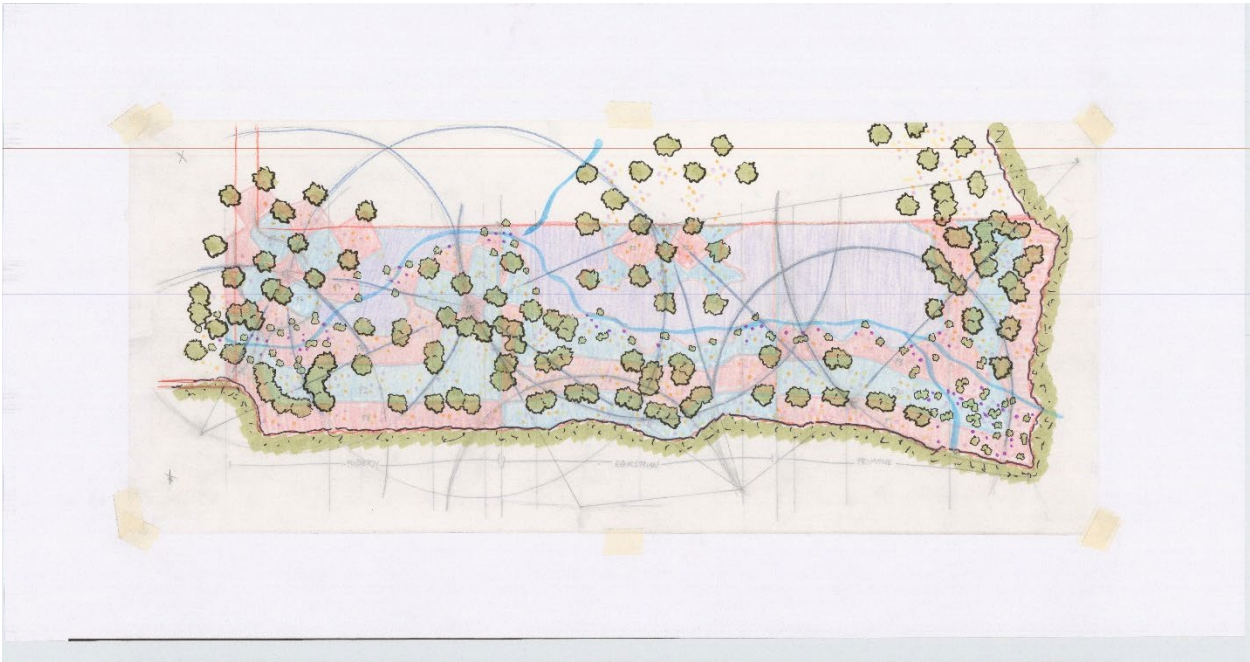
Concept Elements



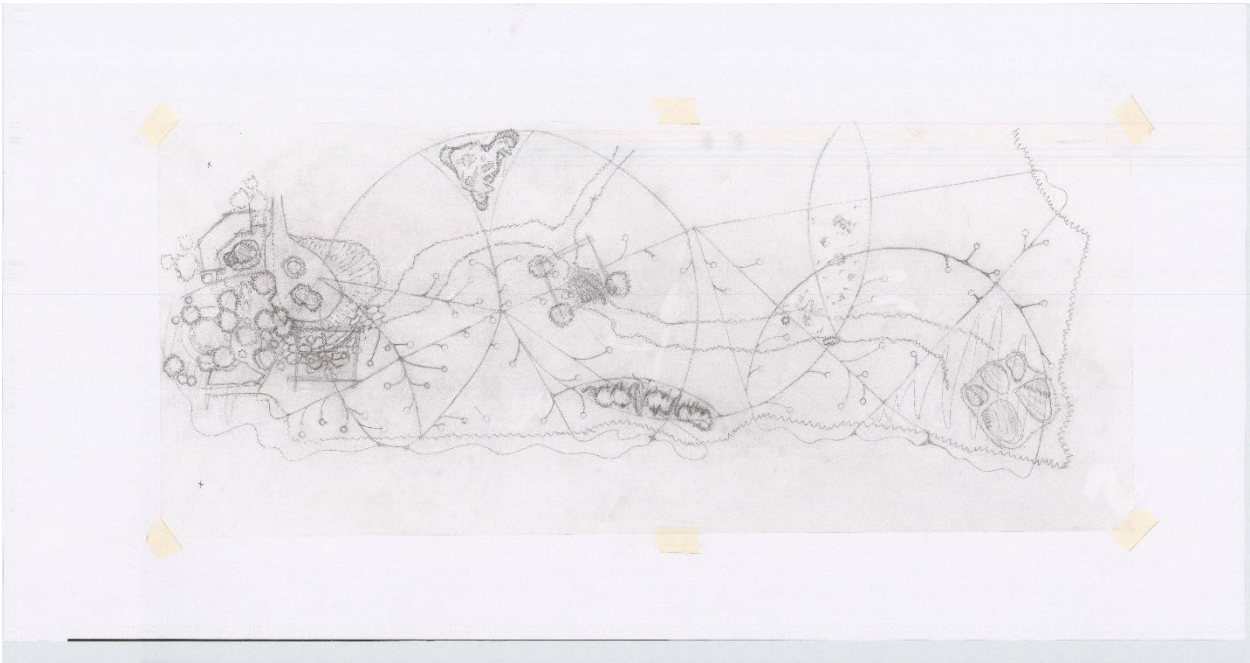
Trail Concept



Trail Concept



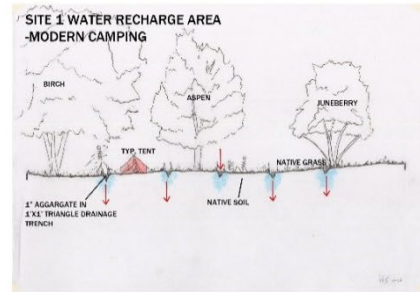
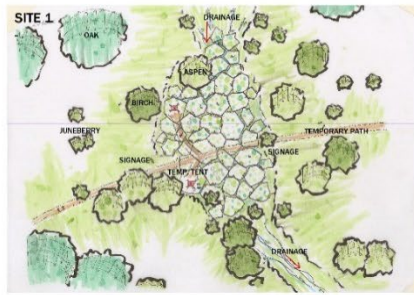
Master Plan Concept



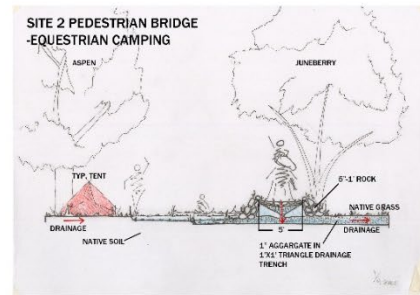
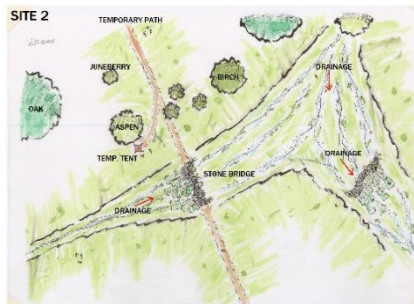
Master Plan and Trails Concept



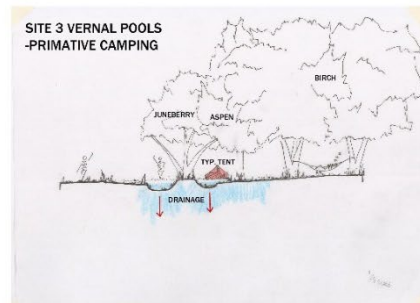
Site 1 Concept



Site 2 Concept



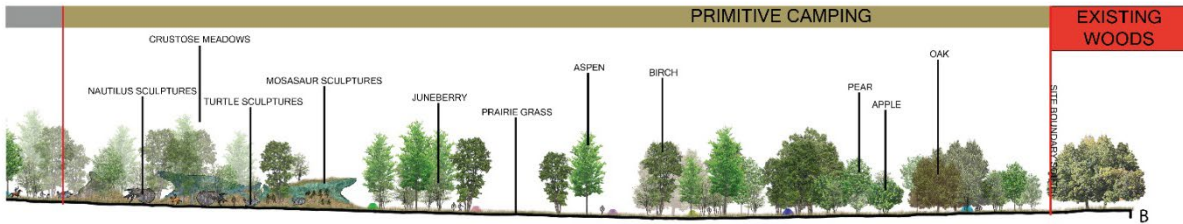
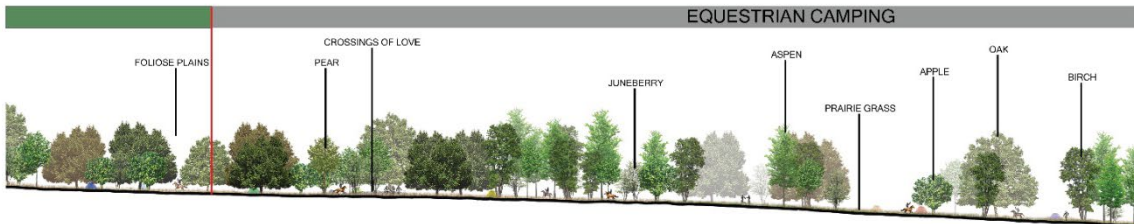
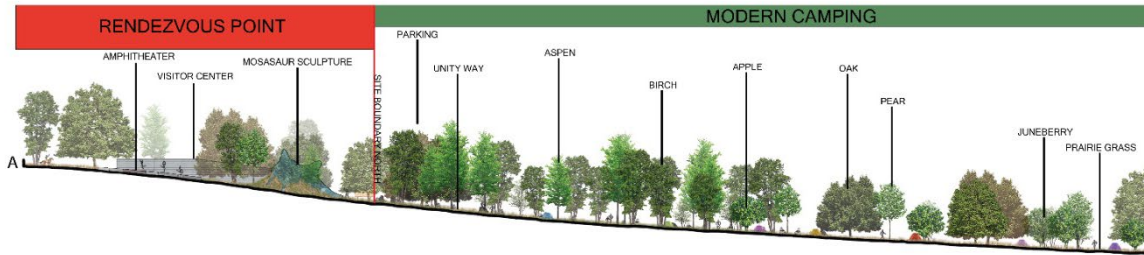
Site 3 Concept



Master Plan

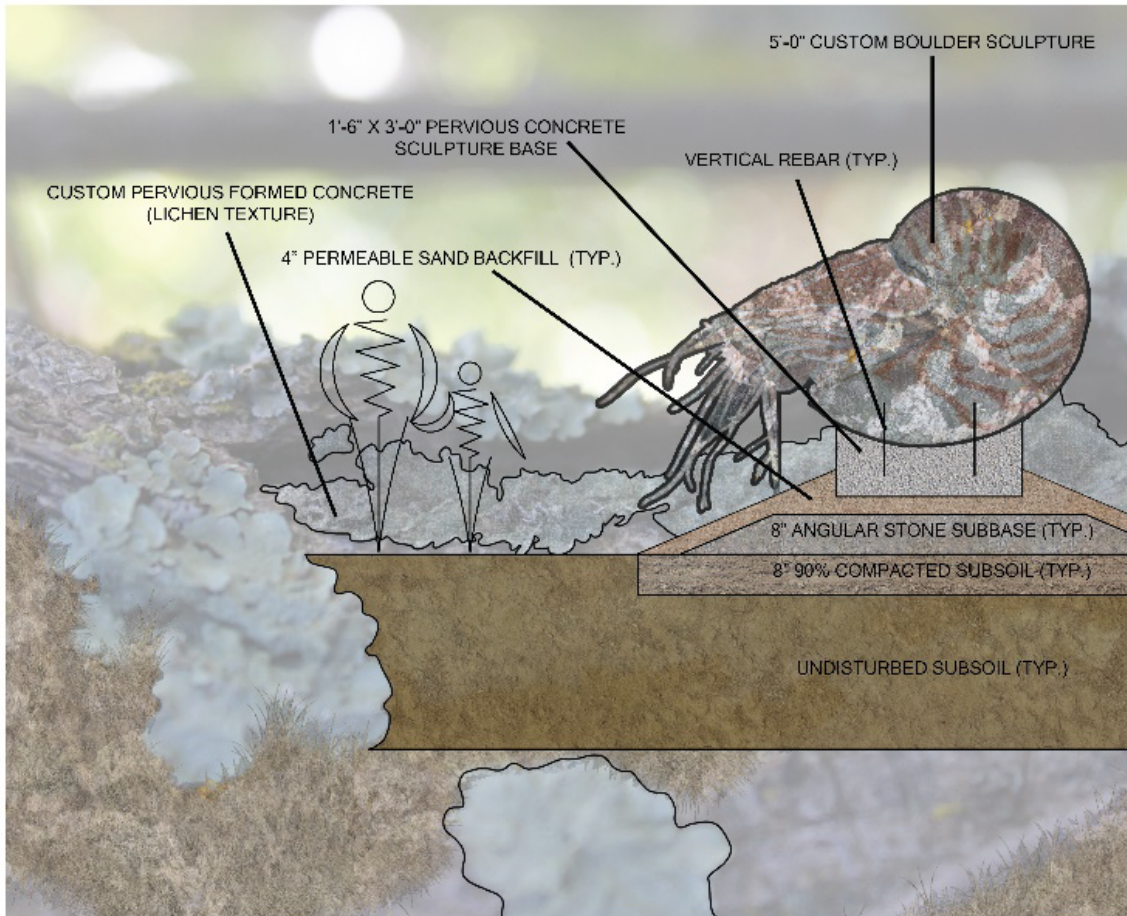


NORTH SOUTH CAMPGROUND CENTERLINE SECTION EAST FACING NO SCALE



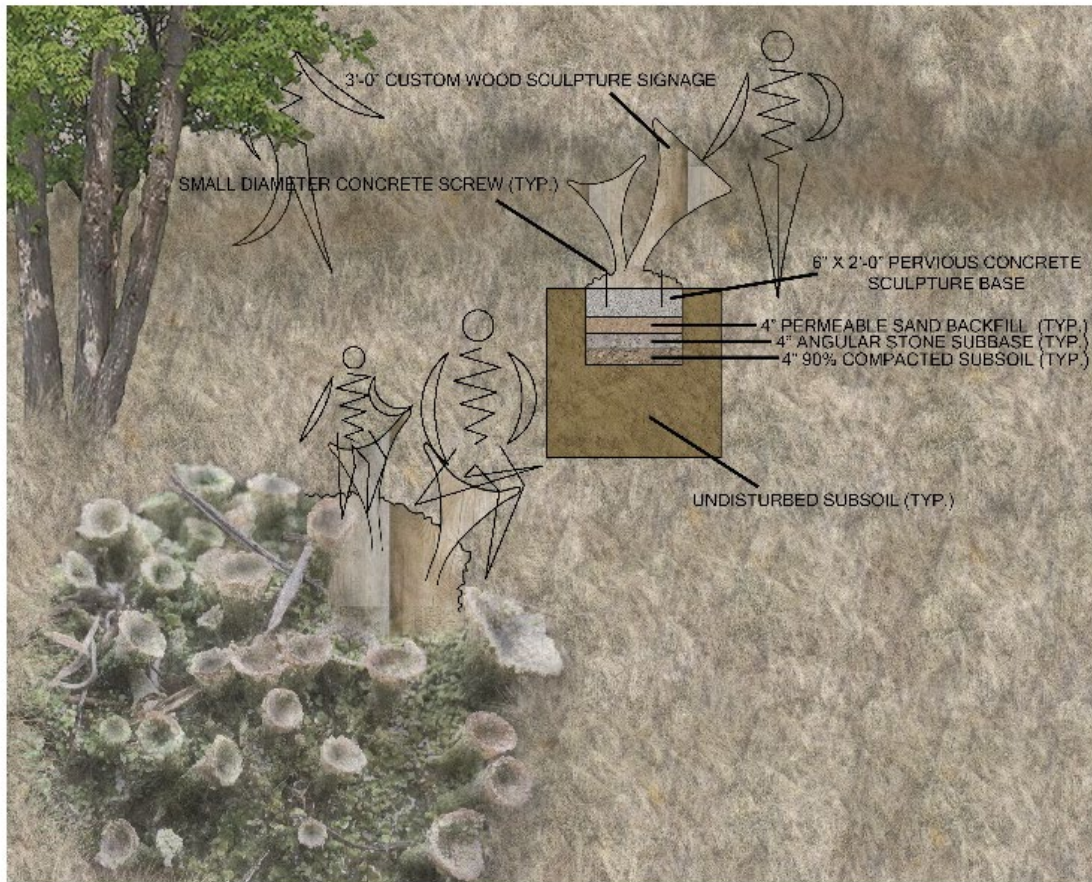
NAUTILUS SCULPTURE

THE NAUTILUS IS ONE OF SEVEN ANIMALS IMPLEMENTED IN THE CAMPGROUND SCULPTURE DESIGN. DURING THE LATE CRETACEOUS TIME ABOUT 80 MILLION YEARS AGO. THE WESTERN INTERIOR SEAWAY COMPLETELY COVERED NORTH DAKOTA AND WAS INHABITED BY MARINE REPTILES SUCH AS MOSASAURS, PLESIOSAURS, AND TURTLES, FISH, AND SHARKS WERE ALSO FOUND IN THE AREA. PEMBINA GORGE IS CURRENTLY ONE OF FOUR FOSSIL DIG SITES IN NORTH DAKOTA. IMPLEMENTING LIFE SIZED SCULPTURES INTO THE CAMPGROUNDS NARRATIVE CONNECTS THE USERS TO THE AREAS HISTORY. CREATING A STRONGER COMMUNITY THROUGH SHARED EXPERIENCE AND MEMORIES. ALL MATERIALS USED IN THE MAKING OF ANIMAL SCULPTURES ARE FOUND LOCALLY AND CREATED BY LOCAL ARTIST.



INFORMATIONAL LICHEN SCULPTURE

THROUGHOUT THE CAMPGROUND, LICHEN SCULPTURES ARE PLACED IN AREAS WHERE SIMILAR LICHENS ARE KNOWN TO BE FOUND. THESE INFORMATIONAL SCULPTURES HELP USERS UNDERSTAND THE LICHENS THAT ARE FOUND IN THE AREA, WHILE CONNECTING USERS TO NATURE THROUGH THE ADDED USE OF SEATING AND OTHER LANDSCAPE ELEMENTS SUCH AS BIRD BATHS. ALL MATERIALS USED IN THE MAKING OF LICHEN SCULPTURES ARE FOUND LOCALLY AND CREATED BY LOCAL ARTIST.



Rendezvous Point

A meeting area found at the entrance of the campground where visitors can truly understand what the Pembina Gorge area has to offer. Users of the site will be able to find information on the campground and surrounding area by using the information board, here brochures, campground maps and other informational sources will be provided. Other important information can be found inside the visitor center, where tours and recreational equipment can be provided to add to the Rendezvous experience. The Rendezvous Point is an area where visitors are encouraged to socialize, share experience and song. The Rendezvous Point has ample space for public activities, with landscape elements such as an eighty-foot lichen covered Mosasaur sculpture, lichen inspired amphitheater, horse corral to the west, and green space with seating availability. The point is an essential aspect of the site's success, here public hospitality is a main priority for the success of the Campgrounds sustainability. Other than public hospitality the Rendezvous point is the beginning area to the sites micro-climate design and regenerative landscape process.

Unity Way

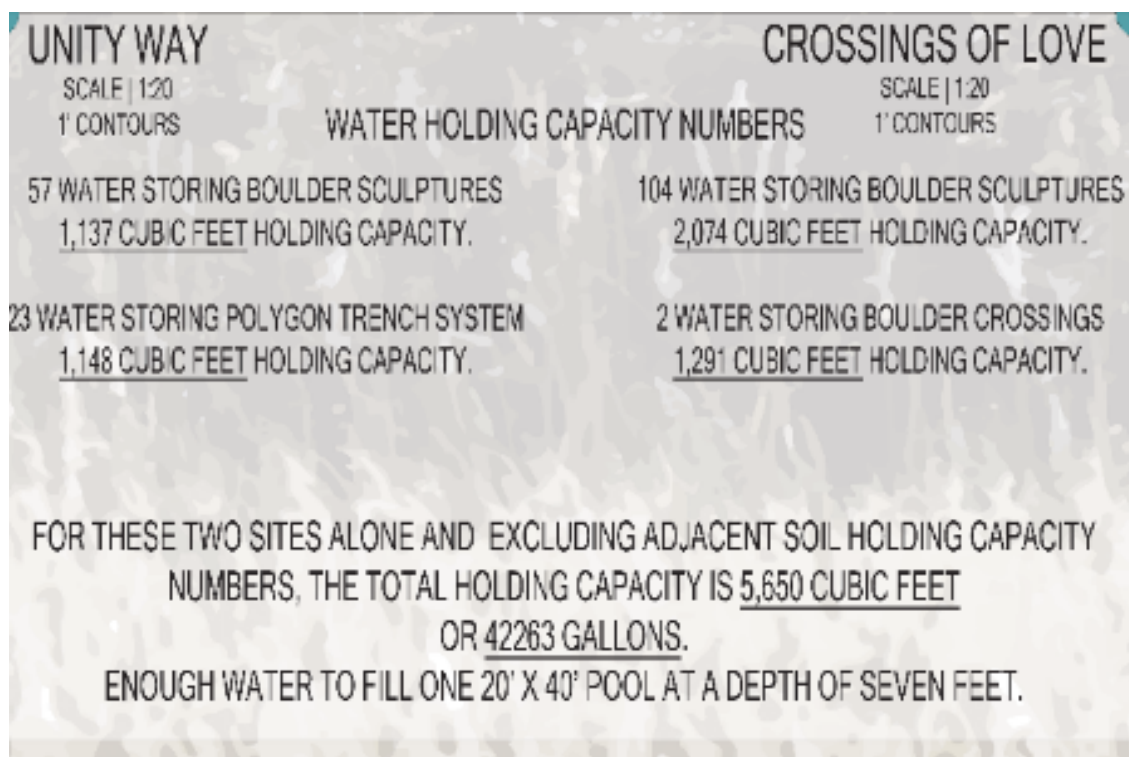
Located in the modern camping area, unity way provides users the option to camp near the parking area and the Rendezvous point. This area of the campground consists of more trees than open prairie making the micro-climate temperature 2–9°F lower. Utilizing the campground map, users would understand that modern trail signage is not part of this design, the use of primitive rock sculptures depict where water Regenerative sites are located. These boulder sculptures are also perfect areas for different lichens to thrive on, adding to the landscape. Unity way is a slow-release water storage landscape design, that Mimics the 2d form of Crustose lichen in structure. The regenerative aspect of this design is the ability to store large amounts of water that the trees and other plants can slowly utilize, while recharging the aquifers within the area. This process is very similar to how lichen and water naturally work. When it rains the fungal part of lichen opens allowing the algae to collect water. The lichen will also collect water and once swollen enough the lichen closes back up continuing to protect the algae. This stored water is then used by the algae to create food (sugars) for the fungi. Creating a symbiosis relationship.

Crossings of Love

This area of the design is in the transitional zone between modern and equestrian camping. Crossings of Love is an area that continues to put effort in the three project goals, utilizing the same large boulder sculptures, visitors know this is another water regenerative area and an important aspect of campgrounds success. The difference with this design is the implementation of two large crossings made up of dry stacked boulders, that store and control water flow, but not to the extent of total blockage. The micro-climate temperature of this area is warm during sunny days being in a pocketed open prairie. With the large boulder sculptures near, humidity levels will vary changing the micro-climate of the area-giving users extra options regarding finding the perfect camping spot to enjoy with family and friends.

Vernal Pools of Hope

This area of the campground is located at the most southern part of the design, in the Primitive camping area. The vernal pool of hope is another key element in the water regenerative design and the site's last defense to store large amounts of precipitation. This area of the design is most primitive and, in a sense, most magical. In this perspective the Use of the lichen inspired wood sculptures for informational signage and seating seems to add to the magic, allowing users the option to relax, ponder, and absorb the restorative benefits the pools of hope have to offer. With this area of the campground seeing less human engagement, animal activity will be most abundant, allowing visitors to experience the Pembina Gorge wildlife and a chance to become one with nature.



Appendix

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Conclusion Statement

Overall, I am pleased with the end results of this sustainable multi-use campground. Having the ability to utilize my skills to create such a project and seeing the end results of how lichen can be used to benefit such a design is astonishing to say the least. I have learned so much regarding synthetic patterns, organic forms, design frameworks, public hospitality, micro-climate design, regenerative landscapes and sustainable processes and methods. This project has pushed my limits in creativity and knowledge. Even though my research from the first semester has dramatically changed, I would not say it changed for the better, but only changed in the way of how I got to the result. Utilizing lichen biomimicry, the way I have is one of many ways to create such a design. The universe is vast, and still the same patterns are replicated to create different shapes and forms, including the human body. All I did for this project was find those patterns and replicate them into a design that connects with my passion and that's to regenerate rather than destroy.

Future of Design

I hope a few things come from this project. The first thing is the possibility of design built upon the knowledge I have shared. If new knowledge can come from this style of design, then I will be happy- especially if it is put towards major dilemmas that we see on earth such as flooding and desertification that are caused by poor human development and greed. Lastly, I will continue to research lichen and other connecting life to find answers to help heal the earth one design at a time. Find those patterns and utilize them, once you truly understand yourself then you should be able to understand life and the patterns all around you.

The future of this campground design at this point is up in the air and hopefully one day it will be actualized with my presence.

Studio Experience

2nd Year

Fall- LA271 | Introduction to Landscape Architecture | Kathleen Pepple

Tea House | Moorhead, MN

Urban Farm | Fargo, ND

Spring- LA272 | Parks and Open Space | Dominic Fischer

Red Raven Coffee Pocket Park | Fargo, ND

Wolsley Park | Winnipeg, MB

Viking Ship Park | Moorhead, MN

3rd Year

Fall- LA 371 | Site Planning and Design | Jay Kost

MidAmerica Steel | Fargo, ND

Spicy Pie Plaza | Fargo, ND

Spring- LA 372 | Community Planning and Design | Anna Maria Visilia

Re-Imagining NDSU Campus | Fargo, ND

Dennis Mary Kay Lanz Design Competition | Fargo, ND

4th Year

Fall- LA 471 | Urban Design | Dominic Fischer

Lower Eastside Intervention | Manhattan, NY

Spring- LA 472 | Ecological Design | Morgan Kollman

Scottsdale Arizona Canal Park | Scottsdale, AZ

5th Year

Fall- LA771 | Performance Based Design | Matthew Kirkwood

North Country Trail Spur | Medora, ND

Spring- LA772 | Landscape Architecture Graduate Thesis Design Studio

Thesis Project- Sustainably Symbiotic | Pembina Gorge, ND

About the Author

Just another speck in a vast universe, a speck with passion to regenerate rather than destroy.

Hometown: Anywhere with good friends and family.

