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TOURISM AND SUSTAINABILITY: STRATEGIES FOR DESIGNING ON THE NORTH SHORE OF MINNESOTA

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TOURISM AND SUSTAINABILITY: STRATEGIES FOR DESIGNING ON THE NORTH
SHORE OF MINNESOTA

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ABSTRACT

The North Shore of Minnesota boasts vast natural beauty, a plethora of recreational activities, and a thriving tourism industry. In order to protect the North Shore's natural scenery and tourism industry, sustainability and ecotourism must be heavily considered when designing here. This thesis will investigate sustainable design methods and ecotourism tactics that are specifically catered towards the North Shore. Through the design of sequential cabins, this thesis will provide a view of these methods and tactics in action. Two regions in the North Shore will be the subject of investigation, the Nearshore and Highlands, as these are the most common regions of travel from visiting tourists. The designs of these cabins will reflect the unique environment present in the Nearshore and Highland regions of North Shore, as to properly represent how these sustainable strategies can be implemented when designing while keeping tourism in mind. From literature review and case study examination, this thesis is a compiled list of methods and tactics that provide design options to reduce impact on natural scenery, are environmentally conscious, and benefit tourism.

DEDICATION

Dedicated to Grannie Annie. Your love for the North Shore, and your decision to involve me in it has forever cemented this place in my heart. I hope that you would have found this thesis interesting!

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LIST OF ABBREVIATIONS

LEED	Leadership in Energy and Environment
GSTC.....	Global Sustainable Tourism Council
BWCAW	Boundary Waters Canoe Area Wilderness
EPDM	Ethylene Propylene Diene Monomer
CO2.....	Carbon Dioxide
CCLEP	Cook County Local Energy Project

LIST OF SYMBOLS

%Percentage

1.0. CHAPTER 1

INTRODUCTION

1.1. Problem Statement

The North Shore of Minnesota has been a bastion of natural beauty for decades. Naturally, people started traveling to this area, and in 1885 the first resort was built. Quickly becoming a popular tourist destination, over the years many resorts and lodges were built to accommodate these visitors. Currently, there are plenty of resorts dotting Lake Superior's coastline, giving refuge to thousands of visitors every year. However, many of these resorts are critically void of a few important concepts: sustainable design and ecotourism principles. With the gradual development of this area, and more resorts being built, the visual contrast between the built and natural environment will become more and more apparent. With nature and outdoor recreation being the major driving force for attracting tourism in this area, the preservation of the natural scenery and environment is essential to keeping the North Shore's tourism industry alive and well. Conversely, in many areas around the globe, tourism proves to be a detriment to the natural landscape, leading to the mutual destruction of both industry and the environment. With nature being the life force of the North Shore, design strategies must be implemented that reduce impact on the natural scenery and environment while promoting ecotourism principles.

1.1.1. Research Questions

Due to the close relationship between the natural environment and the tourism industry on the North Shore of Minnesota, certain sustainable design strategies need to be formulated that can directly impact both the visual and environmental impact of the area. Firstly, the strategies that are best fit to complete both variables need to be determined. There is a plethora of sustainable design strategies that can be implemented into a design, however the specific strategies that can be utilized

in the reduction of visual impact on the environment need to be discerned. Second, relate these found strategies to the environment of the North Shore. Why it is important to use these strategies, and how these strategies can benefit this environment.

1.1.2. Proposed Outcomes

This project will aim to deliver a set or ‘manual’ of sustainable design strategies that is specifically catered to the North Shore of Minnesota and its environment. The ‘manual’ will serve as a design framework for future projects on the North Shore, providing sustainable strategies that should be heavily considered in the design process. 2 sets of rentable cabins will be designed, with the purpose of providing a visual representation of these sustainable strategies in action. As new resorts are built in the vast natural beauty of the North Shore, guidelines or ‘manuals’ outlining the design strategies and choices that should be implemented will be of great usefulness for new developments. As the relationship between the environment and tourism is so closely knit on the North Shore, this research will provide design strategies that will ensure the relationship is healthy and beneficial for both the tourism industry and environment alike. This research will also have the ability to be applied to other locations that share this type of relationship, providing a framework for how to look into these sustainable strategies.

1.2. Objective

Noting that the resorts present on the North Shore of Minnesota are severely lacking in sustainable design and are not designed with the visual impact on the scenery in mind, the purpose of this project is to provide a series of design strategies that reduce visual impact on the environment, are sustainable, and are specifically catered to the North Shore.

1.2.1 Aim

The purpose of this research is to relate sustainable design strategies to the unique environment of the North Shore. If the tourism industry and nature are to continue coexisting in the

future, sustainable design strategies must be implemented into the design process. With the goal of providing fundamental design strategies that should be heavily considered, this research will be of value to any projects being built on the North Shore.

1.2.2 Significance

This vein of research is important for both the preservation of the natural environment and upkeep of the tourism industry. With the constant march of human development, it is vital to protect our natural wildernesses in more ways than just ecological impact. We must try to preserve the views of the natural scenery, as that is what draws so many visitors to the North Shore and places alike. Through preserving the environment and scenery that is the sole reason for tourism in many places, the tourism industry will be able to coexist in harmony with the nature it owes its success to. Hopefully this research will inspire a like mindedness in other architects and designers, and provide a jumping off point to start from.

2.0 CHAPTER 2

BACKGROUND

2.1. Background

Only within the last few decades has sustainable design taken over the front seat at the forefront of architectural design. Ever so important for the protection, conservation, and benefit of the environments we build in, sustainable design is an absolute necessity in today's world. Another design strategy that is vastly underutilized is the reduction of the natural scenery our environments give us. We should not only seek to preserve the ecological aspects of our environments, but also to preserve the beauty that it holds.

Historically, the North Shore of Minnesota has provided an almost endless sense of beauty, awe, and relaxation for tourists from across the nation. Naturally, resorts and cabins were built over the years to house these tourists. What prompted me to investigate how to design lodging for these tourists was an experience which happened over many years of travel to this region. Why does each lodging option available on the North Shore stand in stark contrast against the beautiful environment surrounding them? After closer examination, an additional, considerable lack of sustainable strategies was found to be absent from their designs.

This observation is what inspired the basis of this thesis: how can sustainable design practices be employed into the design of lodging that both reduces negative impacts on the environment, while also preserving the natural beauty the North Shore provides

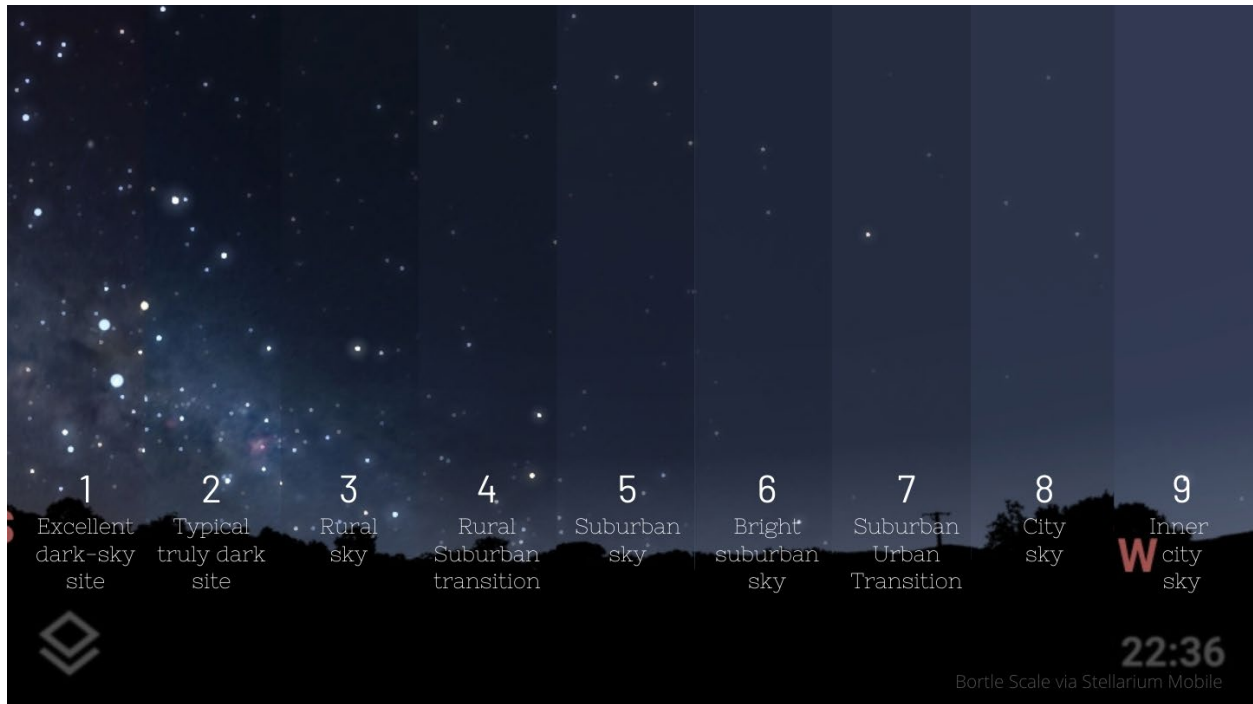
2.2. Literature Reviews

2.2.1 Light Pollution Reduction

Ever since mankind created the first fire, light pollution has been a part of our world. Light pollution has been making a steady increase in tandem with the rapid technological advancement planet Earth has and is still going through. It is a byproduct of our thirst for advancement and expansion and has continually presented more issues as time passes. Affecting every populated area on the planet, what is seen when looking at the night sky, or rather what is not seen, makes the issue apparent. According to an article from National Geographic, ‘Skyglow’, the term used to describe brightening overpopulated areas, affects 80 percent of the global population. This phenomenon, caused by streetlights, car lights, commercial lights, and residential lights, is responsible for extinguishing the natural beauty of the night sky. Apart from especially bright solar bodies, it is nearly impossible to view the vast array of stars that would normally be seen in naturally dark conditions. Not only does it affect the visibility of the night sky, but light pollution also directly impacts human and environmental health. Artificial light conflicts with the natural brightness of the

sun and hinders the production of melatonin through the circadian cycle which can lead to weight gain, job performance issues, and even cancer (Faid, Shariff, & Hamidi 2019). The effects on the environment, however, are much more widespread. Changes in behavior, reproduction, and predation have been observed in birds, insects, amphibians, and reptiles and are all direct consequences of light pollution (Longcore & Rich, 2004). In addition to the negative effects mentioned beforehand, artificial light is a blot upon the natural beauty of the environment. In an environment that is further away from larger cities, this is even more apparent. The site chosen will be located in the Superior National Forest and next to the Boundary Water Canoe Area Wilderness. The International Dark-Sky Association (IDA) has designated this portion of land as an 'International Dark-Sky Sanctuary'. This is defined by the IDA website as "...public or private land that has an exceptional or distinguished quality of starry nights and a nocturnal environment that is protected for its scientific, natural, or educational value, its cultural heritage, and/or public enjoyment." With this designation, the North Shore requires thorough attention to light pollution-conscious design. The average human can see candlelight from 1.6 miles away with no view obstructions, so imagine the disruption of natural beauty that can occur when there are multiple sources of artificial light dotting the landscape. The use of artificial lighting is a necessity in today's modern world, so how are we as architects able to simultaneously balance the conservation of the ecosystem, the preservation of the natural landscape, and the need for artificial lighting? There are a few methods and techniques that can be used to accomplish all of these.

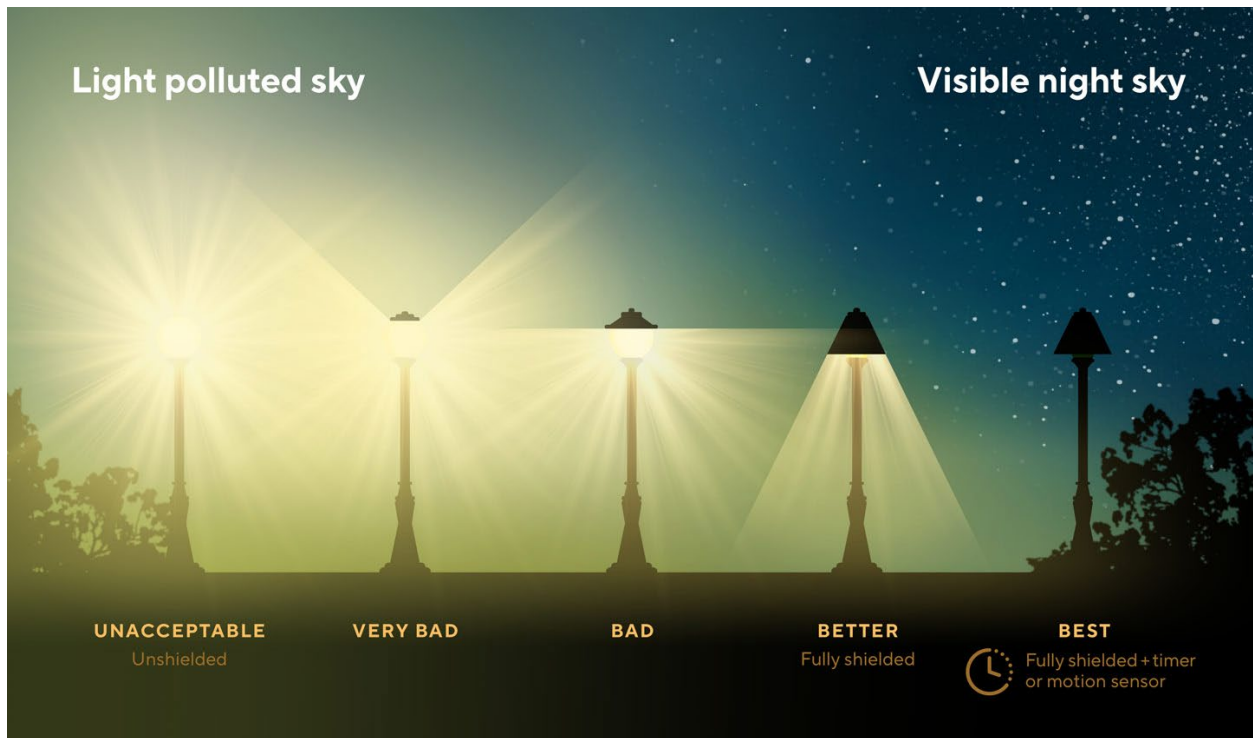
Figure 1. Skyglow over different areas of development



Note: From *Stellarium Labs*, (<https://www.stellarium-labs.com/blog/light-pollution/>)

Dark-sky compliant lighting is a term used to describe light fixtures that comply with the guidelines set by the International Dark Sky Association (IDA). According to the IDA website, several criteria must be met to be considered dark-sky compliant: restrict the amount of upward-directed light, minimize bluish light, utilize lighting controls such as dimmers, and avoid glare and over-lighting.

Figure 2. Dark sky compliant lighting



Note: From DarkSky, (<https://darksky.org/what-we-do/darksky-approved/>)

Timers and motion sensors are a valuable way to reduce light usage. These inhibit the use of light when not needed, and still enable the consumer to enjoy light when needed. This strategy can be employed at night, when light is more apparent on the landscape, and when light pollution is most noticeable.

Blinds are one of the easiest and most surefire ways to reduce light pollution. The most effective blinds are opaque blinds, which prohibit any interior light from trespassing outdoors. Some blinds can be set to an automated system, raising and lowering depending on the time. This method is a great way to reduce the impact on the surrounding landscape and environment.

The type of light bulb used when lighting an area is quite important. The factors to consider when selecting a bulb include warmth, lumen output, and bulb type. Warmth refers to the color the light emits. Cold light (bluish and white) is more likely to scatter in the atmosphere and cause skyglow, while warm light (amber) is less likely to scatter. According to the website Wyoming

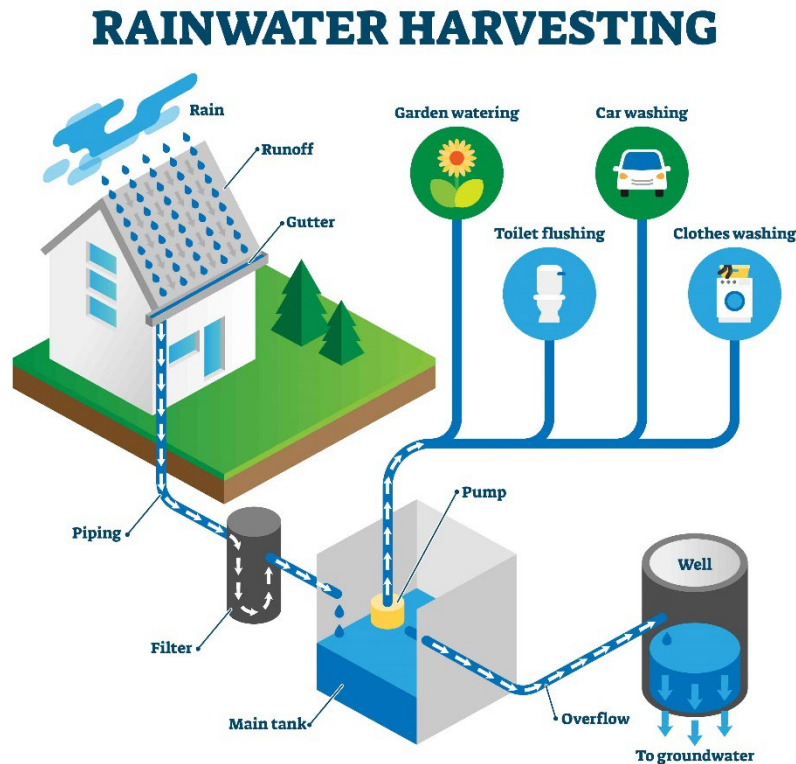
Stargazing, it is recommended to use a bulb with 2700k-3000k (warm), while avoiding anything over 5000k (cold). Lumen output refers to the brightness of the bulb. It is important to choose a lumen output that fits the task at hand, as this minimizes glare and light trespass. For example, a lumen output of 1000 or less is sufficient for any outdoor activity. The bulb type determines both variables, so considering the warmth and lumen output when selecting a bulb is crucial.

2.2.2. Water Efficiency

Access to freshwater has quickly become a major concern for humanity. With the rising population and steady decline of freshwater resources, the demand for freshwater has exponentially increased over time. Heather Venhaus mentions in *Designing the Sustainable Site* that as the scarcity and demand for freshwater continues to rise, water usage will need to be questioned and more methods of conservation will need to be implemented (161). In more developed, wealthier nations, people have easier access to water. Overuse of everyday amenities such as showers, toilets, and washing machines contributes to wasting a substantial amount of water. Irrigation systems also produce large amounts of wasted water, with over 30% of water usage in the U.S. coming from outdoor usage (Venhaus, 162). The transformation of the natural landscape into a hardscape is an additional contributor to lost water. Pavement and roofs prevent rainwater from soaking into the ground, in turn preventing groundwater recharging. Groundwater recharge is essential to the conservation of freshwater sources. According to an article published by the University of Minnesota, around 75 percent of Minnesota's population receives their water from groundwater sources, and the other 25 percent receives it from surface water sources. The North Shore is no different, with many residents receiving their water from wells, Lake Superior, and surrounding freshwater sources (MWI). To prevent the loss of freshwater resources, there are many different techniques available that can be employed.

Rainwater harvesting provides an active method of collection and reuse of water. With the benefit of increasing access to fresh water, rainwater collection should be a thoughtful consideration when designing for sustainability. The collected water can be used in a variety of ways, depending on the treatment. If the harvested rainwater is filtered through the minimum means it can be reused for irrigation and other household amenities such as toilet flushing and washing clothes (Venhaus, 169). If filtered more thoroughly, it can then be used for other purposes such as bathing, food preparation, and consumption (Venhaus, 168). The rainwater is usually collected in cisterns, which are located either outside or underground the structure. With this in mind, it will be difficult to determine the best design choice when taking the preservation of the environment and natural landscape into account. If choosing to place the cistern underground, further excavation of the site will be needed, leading to more destruction to the environment. However, placing the cistern underground will allow protection from the freezing temperatures present during North Shore winters, provided it is placed below the frost line. Placing the cistern outside will not lead to any unnecessary environmental destruction, however, it will be harder to conceal. Exterior cisterns will also be vulnerable to the freezing temperatures of the North Shore and will require maintenance to prevent the system from freezing.

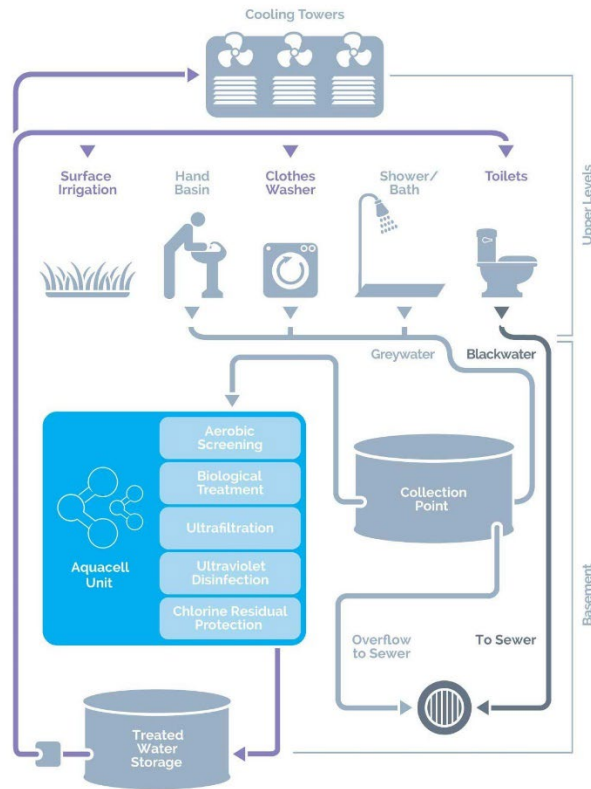
Figure 3. Rainwater harvesting diagram



Note: From Treehugger, (<https://www.treehugger.com/beginners-guide-to-rainwater-harvesting-5089884>)

Greywater is the leftover water from everyday activities such as bathing, washing clothes, and bathroom faucets. Not to be confused with blackwater, which is left-over water from toilets, dishwashers, and kitchen sink faucets as these sources can contain organic and toxic materials. According to Venhaus, there are a multitude of different benefits that can come from the reuse of greywater. Reducing the use of regular freshwater resources, greywater catchment allows for an additional water supply to be used instead of freshwater. This can be used in times of drought, or any time throughout the year. Furthermore, water bills are reduced, and awareness of water usage is increased (171).

Figure 4. Greywater catchment system diagram

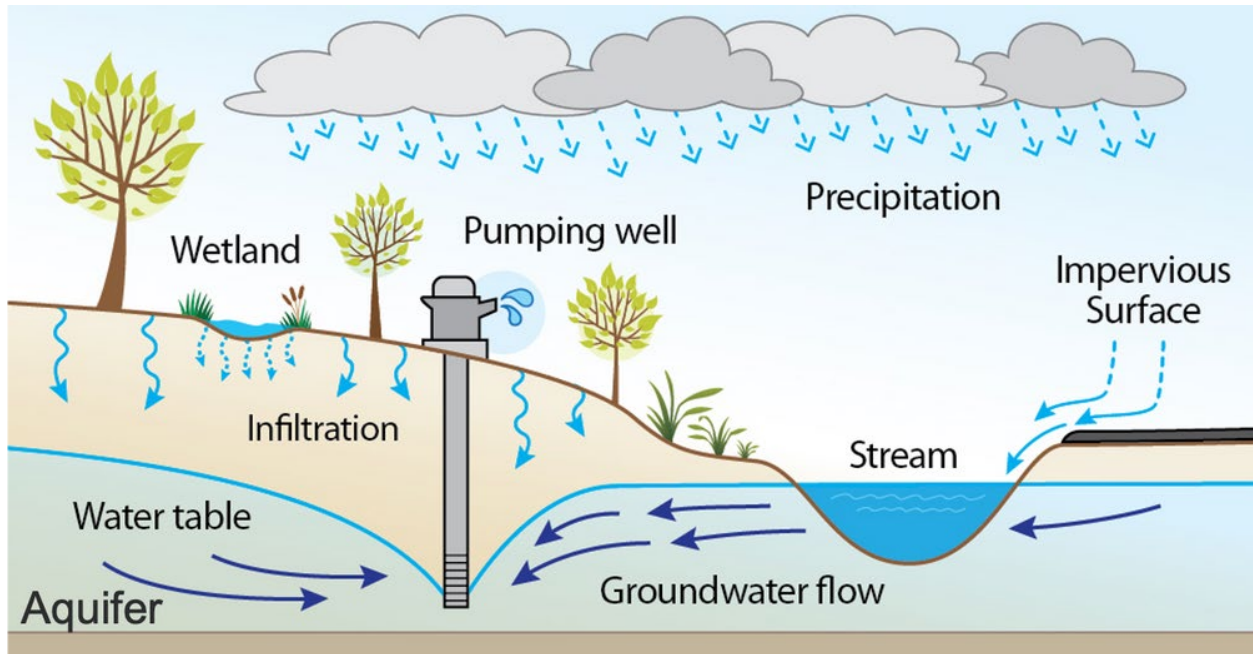


Note: From Aquacell, (<https://aquacell.com.au/2019/02/back-basics/>)

Groundwater is a precious natural resource. According to data gathered by the U.S. Geological Survey, about 26% of the water used in 2015 was from groundwater. This is apparent even more so in the North Shore, with well water being the primary source of water for most residents. Proper site development is crucial to recharging groundwater. Venhaus notes that reducing the use of hardscape surfaces allows for water to seep into the ground more easily, which leads to groundwater recharge. Shading and restoring degraded soils also allows for easier penetration of water (182). As site development is of great importance in this method, one should also note the benefits that can be gained when designing around the natural landscape. When using less hardscape materials, taking the route of minimal site disruption leads to positive effects when

protecting the natural landscape. When less of the site is disturbed (i.e., less vegetation and trees are removed) more natural elements are preserved.

Figure 5. Groundwater recharge diagram



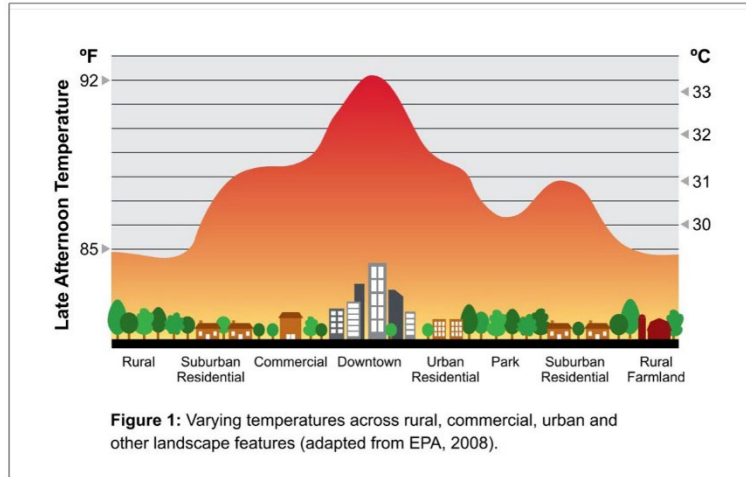
Note: From Tortilla Alliance, (<https://www.tortolitaalliance.com/post/know-your-h2o-part-v-groundwater-recharge>)

2.2.3. Heat Island Effect

As humanity expands, we continually replace our natural surroundings with artificial material. We erect buildings, roads, and other infrastructure to make our lives easier and more habitable. What has become an unintentional consequence of our desire to expand, is the heat island effect. The heat island effect is the process by which our built environment absorbs and re-emits the sun's heat far more than the natural environment does. This leads to an increased temperature in developed areas in comparison to the surrounding countryside. First studied in the 1800's, the understanding of the causes, effects, and reduction methods has increased over time (Mohajerani,

2017). There are a vast number of causes for this effect, most of which trace back to human activities. The natural environment is extremely efficient at reducing air temperature. Trees, vegetation, and water bodies all contribute to the reduction of temperature through shade and evaporation. Trees are especially adept at this, as they provide shade and absorb CO₂, making the environment cooler (Nuruzzaman 2015). During the process of development, we take away these natural systems, replacing them with hard and dry surfaces. These surfaces (pavement, buildings, homes, etc.) trap heat, reflect less solar energy, and block wind. Consequently, both humans and the environment are adversely affected. Due to the increase in temperature, humans become more susceptible to heat-related illnesses (Nuruzzaman 2015) In addition, the discomfort felt during this effect makes the use of air conditioning and other cooling methods much more common. This, in turn, requires more energy, which requires more fossil fuels to be used. This increases the expenditure of energy, while the climate declines. Northern Minnesota is not exempt from this effect, although it is less pronounced in comparison to larger cities such as Minneapolis. Cities like Duluth do experience the heat island effect, due to the increased infrastructure than the surrounding area. Although there are no cities as large as Duluth along the North Shore, the reduction of the heat island effect should still be taken into consideration as a preventative measure. Fortunately, there are a multitude of strategies that can be implemented. These strategies add to the rebuilding and preservation of the surrounding landscape, while also reducing/ preventing the heat island effect.

Figure 6. Heat island effect diagram



Note: From Green Infrastructure Toronto, (<https://greeninfrastructureontario.org/gi-asset-management-planning/urban-heat-island-effect-durham/>)

One of the most effective strategies in reducing the heat island effect is the presence of vegetation and trees. Whether that be by replanting them or just leaving them alone in the first place, vegetation, and trees are incredibly important to this process. By providing shade and reducing CO₂, the surrounding environment becomes cooler. Although planting these might be necessary for an already developed area, when possible, reduce the amount of vegetation removed when starting a new development. This is because new plants need years to grow, in contrast to the already existing plants. In addition, reducing the amount of vegetation and trees removed preserves the natural look of the landscape, and is less harmful to the environment.

Green Roofs are an amazing remedy for both reducing heat islands and camouflaging a building. Through the use of heat energy, plants keep the environment cool through the evaporation process (Nuruzzaman 2015). So, with the addition of a green roof covered in plants, the amount of heat absorbed by a structure is limited even further. With the added benefit of being able to absorb water, thus reducing the heat absorbed even more, green roofs provide an exemplary method of reducing the heat island effect. Green roofs also allow the structure to blend into its natural

surroundings much more effectively. By introducing natural plants and colors back into the design, the rigidity of a regular roof is lessened. This allows for the building to create less contrast against the natural landscape.

Evapotranspiration is the process through which water is absorbed into the atmosphere through evaporation from soil and other surfaces. Much of the hardscape surfaces we walk on are not pervious to water. Often, they are designed to funnel the water away from them, and into a drain. Because of this, the evapotranspiration process is unable to happen, leading to less of a cooling effect. Implementing pavements or surfaces that allow water to absorb into them helps keep these surfaces cool, which directly affects the temperature (Nuruzzaman 2015). The use of gravel or dirt roads can help in this process. With the added benefit of less damage to the environment through the construction process, these roads provide a more natural look.

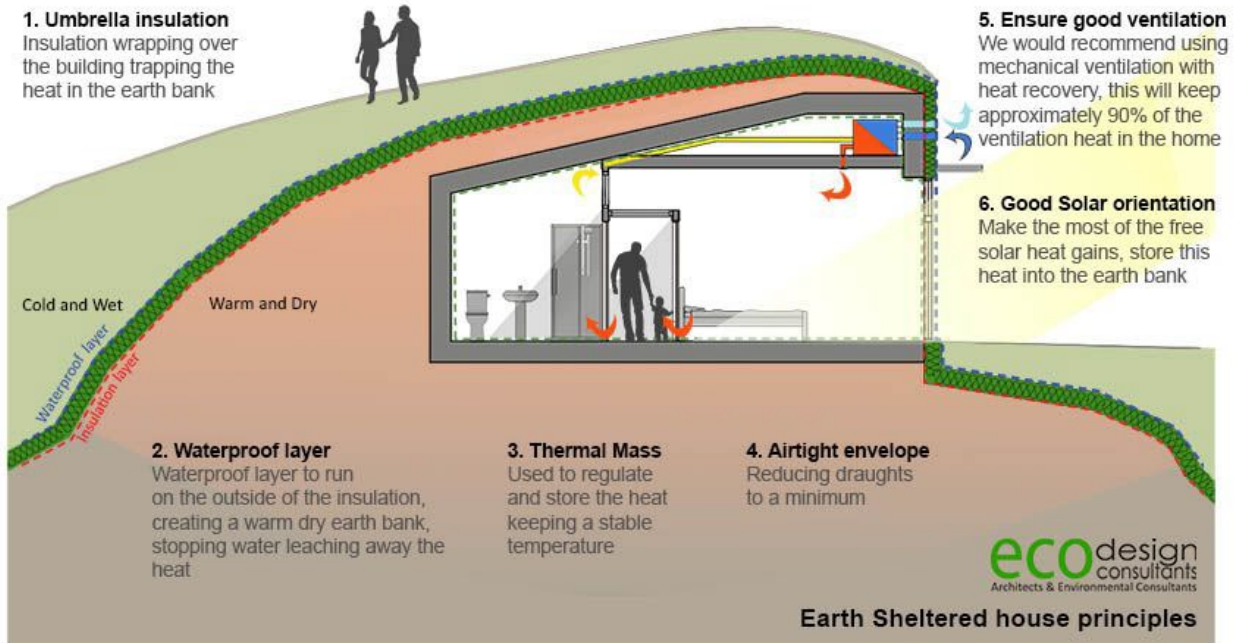
2.2.4. Energy Efficiency: Building Envelope

According to the U.S. Energy Information Administration, in 2022 16% of U.S. primary energy consumption came from the residential sector, with most of it being from fossil fuels. The burning of fossil fuels releases greenhouse gasses, which according to the United States Environmental Protection Agency, “is the most significant driver of observed climate change since the mid-20th century.” To reduce fossil fuel usage, energy efficiency is taken into great consideration when designing sustainable residences. A major focus point in this venture is the design of the building envelope. The building envelope is the barrier between the interior of the structure and the exterior. There are two types of strategies when improving the energy efficiency of a structure, which are active and passive (Sadineni, 2011). Improving energy efficiency in the building envelope is classified under passive strategies, and is a popular method (Sadineni, 2011). An efficient building envelope can impact the energy usage in heating and cooling systems, leading to a reduction in energy

consumption. The building envelope should be heavily discussed and considered when designing a structure, as it can affect energy costs and help reduce environmental impact.

An exciting method of building envelope design involves the use of the earth. Called earth-sheltering, it is a method that revolves around the full or partial coverage of a structure with earth. Earth-sheltered homes have been proven to be a sustainable construction option by regulating the thermal transmittance of heat much more efficiently than traditionally constructed homes (Asachi, 2014). An article titled *Efficient earth-sheltered homes* from the Department of Energy, adds a list of benefits that include decreased vulnerability to extreme weather conditions, low maintenance, and soundproofing. The appearance of an earth-sheltered home adds relevance to the goal of blending into the landscape. When covered in earth, a structure is able to effectively blend into the contours of the landscape, reducing the contrast between the built environment and natural surroundings. With the benefits of low environmental impact, quality of life improvements, and being less detrimental to the natural views, earth-sheltering provides an ideal strategy for this project.

Figure 7. Earth Sheltering Diagram



Note: From Eco Design Consultants, (<https://www.ecodesignconsultants.co.uk/portfolio-items/the-bletchley-project/>)

2.2.5. Renewable Energy

In 2022, Minnesota was determined to have received 27 percent of its electricity through coal power, and 18 percent through natural gas (U.S. EIA). Although this was the first year that renewable resource usage had surpassed coal usage, with 31 percent, fossil fuels are still heavily prevalent in the production of electricity (U.S. EIA). With fossil fuel usage still rampant, ‘green’ energy provides a clean, renewable source of energy. Renewable or ‘green’ energy is defined as an energy source that replenishes over time, does not diminish in quantity, and provides environmental benefits (U.S. EPA). For example, the sun, wind, organic plant matter, moving water, and heat from the earth all classify as renewable sources of energy. These resources provide no emissions and

create low to no impact on the environment. With the current energy crisis, renewable energy sources will become much more commonplace in the future, or even required. According to the United States Environmental Protection Agency, around 40 percent of the energy consumed in the U.S. is used for electricity. Access to electricity is incredibly important in today's society, and most people cannot live without some form of it. In Cook County, where the site will be located, the majority of energy used for electricity is outsourced from elsewhere. Recently, Cook County has opted for a more sustainable form of electricity, with the Cook County Local Energy Project (CCLEP) promoting the increased use of renewable energy (CCLEP). Renewable sources of energy provide a consistent source of electricity for everyday usage, without unwanted carbon emission and pollution. With the needs of the consumer, protection of the environment, and preservation of the natural landscape to balance when designing around energy sources, several options can be considered.

By far the most abundant and readily available renewable energy source, solar energy is the most popular form of renewable energy (Panwar, 2011). Normally harvested through the use of solar photovoltaic systems (solar panels), solar panels provide both advantages and disadvantages regarding the objective of this research. For starters, a large surface area is required to produce a sufficient amount of energy (Panwar, 2011). This can hamper efforts to reduce the visual impact on the land, as the panels need large open spaces to harvest solar energy efficiently. There is also the factor of increased maintenance, as they must be cleared of dust and debris to function effectively. The North Shore has excessive tree coverage, meaning to effectively harvest solar energy a sizeable number of trees will need to be removed, harming the natural views of the landscape. The North Shore is also covered in snow during the winter season, which means constant removal of snow from the panels will be required. Although the most abundant renewable resource, site location

should be taken into consideration when determining the use of solar panels. Cook County, the area the site is in, has also recently been pushing for more solar power usage.

On the rise in popularity, the harvest of wind energy has expanded from large wind turbines into smaller, more residential-friendly units. With a variety of different designs, ranging from traditional to newer, vertical rotation designs, there are a multitude of benefits that come with using wind energy. Utilizing the vertical plane, these turbines generally do not consume much space when installed unless multiple different units are installed. According to the U.S. Department of Energy, the benefits include lowering the cost of your electrical bill and an uninterrupted electricity supply during power outages. With the added benefit of reducing carbon emissions, wind energy can provide great benefits to its users. However, wind turbines are quite noticeable. The height at which they are installed and the constant rotation prove to be distracting, especially against the backdrop of a natural landscape. Recently, there have been efforts to reduce the visual pollution that wind turbines produce through the use of biomorphic design. Noticeably, the French company New World Wind has developed ‘Aeroleaf’, a wind turbine that has been designed to mimic the look of a tree.

2.2.6. Ecotourism

Since the idea of it was conceived, the definition of ecotourism has been heavily discussed, revisited, and revised. As time has passed, our idea and understanding of ecotourism has grown. At its ‘conception, the widely accepted definition was given by Ceballos-Lascurain as: “Travelling to relatively undisturbed or uncontaminated natural areas with the specific objective of studying, admiring, and enjoying the scenery and its wild plants and animals, as well as any existing cultural manifestations (both past and present) found in these areas” (Ceballos-Lascurain, 1987, p. 14). Recently, the definition has expanded. According to the International Ecotourism Society website, ecotourism is defined as “responsible travel to natural areas that conserves the

environment, sustains the well-being of the local people, and involves interpretation and education” (TIES, 2015). Over time ecotourism has shifted towards not just the act of interacting with nature and culture but actively participating in conservation, education, and economic benefit of the local area. At present, the essence of ecotourism is a form of travel/tourism that promotes limiting negative impacts on the environment and local communities, while also focusing on environmental and cultural education of tourists. Throughout every understanding of ecotourism, many of the themes remain constant. The theme that will be focused on in this thesis will be environmental conservation.

Tourism plays a key role in both the environment and economy of the North Shore. Providing a rich cultural heritage, vast natural beauty, and numerous recreational activities, the North Shore draws hundreds of thousands of tourists every year. Providing thousands of jobs and generating millions of dollars, tourism to the North Shore is essential to the well-being of its community. With this in mind, combining ecotourism practices with sustainable design methods is a great concept to implement when designing on the North Shore.

2.3. Gap Identification

Research into sustainable design strategies and ecotourism principles related to the specific region of the North Shore of Minnesota.

2.4. Project Type

The proposed typology for the ‘resorts’ in the North Shore of Minnesota is a series of cabins aimed at utilizing catered sustainable design strategies that reduce ecological and visual impact on the environment. These types of cabins, while promoting sustainable design practices, will still give the full benefits that tourists visiting the North Shore will expect. Cabins and resorts already located in the North Shore provide a list of benefits such as proximity to activities, comfortable living spaces, and breathtaking views of nature. With tourists visiting for the sole purpose of enjoying the various

activities associated with the unique nature present in this region, these resorts make sure to provide a plethora of diverse ways to engage in these activities and with nature.

2.5. Project Issues

2.5.2 Reducing Visual Impact

The tourist lodging present on the North Shore of Minnesota disregards the visual impact they have on the natural scenery of the environment. With there being such a close bond between the views of the natural environment and the tourism industry of the North Shore, designing with the reduction of visual impact is crucial for giving tourists an enhanced experience.

2.5.2. Sustainable Design Methods on The North Shore

Tourist lodging on the North Shore severely lacks any attempts at employing sustainable design practices. This presents challenges in determining which sustainable design methods can simultaneously reduce ecological impact while reducing visual impact on the natural scenery.

2.5.3. Challenges facing the North Shore of Minnesota

Design strategies can be employed at any time in a project but may not have a specific reason as to why. Determining the reasoning for employing these strategies in the North Shore of Minnesota is crucial to giving purposeful decision-making while designing.

3.0 CHAPTER 3

METHODOLOGY

3.1. Approach

The first step in the research process is to determine which sustainable design strategies are the most pertinent to this project. Thoroughly examining criteria and corresponding design strategies from the sustainable design entity LEED and the sustainable tourism entity GSTC and

analyzing which criteria overlap and can directly affect the visual impact of a design on a landscape will determine which criteria are researched further. Further research will include relating the issues these criteria and design strategies are trying to combat to the North Shore, and how to implement them into the design of the rentable cabins. Relevant case studies will also be investigated, to determine which similar sustainable design methods were incorporated into their designs.

3.1.1. Data Collection

There is a variety of different data needed to accomplish the goal of this project. Reliable design criteria for determining the sustainability of design will need to be acquired. Both LEED and GTSC have world renowned criteria for meeting sustainable design and tourism destination standards. After acquiring these criteria, design methods for meeting these criteria will need to be investigated, to determine their effect on the impact on the visual scenery of the environment. Reviewing each criterion and the common methods of how to meet their standards will accomplish this. Finally, through literature review and case study assessment, the reasons for and methods by which these design strategies will be implemented will be researched.

3.1.1. Analysis

After reviewing LEED stainable design criteria and GSTC destination criteria, I was able to develop a matrix as to which criteria overlap and can affect the views of the natural scenery.

Figure 8. A matrix depicting the correlating criteria between LEED and GSTC

LEED Criteria	GSTC Criteria 'Light and noise pollution'	'Water stewardship and wastewater'	'Protection of sensitive environments'	'Energy conservation'	'GHG emissions and climate change mitigation'
'Light Pollution Reduction'	☑				
'Indoor Water Use Reduction'		☑			
'Heat Island Reduction'			☑		
'Optimize Energy Performance'				☑	
'Renewable Energy Production'					☑

Note: *The checkmarks signify which criteria correlate. Graphic created by Luke Madson*

As seen in the matrix, the common criteria themes observed include light pollution, water use, environmental protection, energy performance, and greenhouse gas reduction. After identifying these criteria, through review of relevant sources I have ascertained which design strategies should be implemented, and the reason for implementing them.

3.1.3 Conclusion

The key elements of the research are the multiple relevant sustainable design methods that can be incorporated into projects designed on the North Shore. The design strategies related to light pollution, water use, environmental protection, energy performance, greenhouse gas reduction, and why they are important regarding the North Shore are all showcased. Ecotourism principles and

sustainable design strategies must work together to ensure a future for the North Shore environment and tourism industry. Man-made environments are proven to impact the natural environment in various ways, so thoughtful design needs to be a necessity when designing here. Luckily, the puzzle pieces are all set out, they just need to be put together. Through research detailing why the design strategies need to be considered and how to implement them, a framework for how to design around natural views is presented. As the nature of the North Shore and the nature of locations around the world continue to drive tourism, we as architects need to make a priority of utilizing sustainable design practices that reduce our impact on the natural scenery of the environments we design in.

3.2. Project Location (Larger Scale)

The North Shore is designated into three distinct categories: the Headwaters, Highlands, and Nearshore. With the Headwaters being mostly comprised of the Boundary Waters Canoe Area Wilderness and Superior National Forest, and also being far removed from any forms of conventional civilization, this project will focus on two sites, one located in the Highlands, and one located on the Nearshore. Lutsen, the town where both sites are located, has both the Highlands and Nearshore categories within it. Lutsen is located in Cook County Minnesota and has a population of 225 people (*Census Reporter, 2022*).

Figure 9. Map of the North Shore of Minnesota



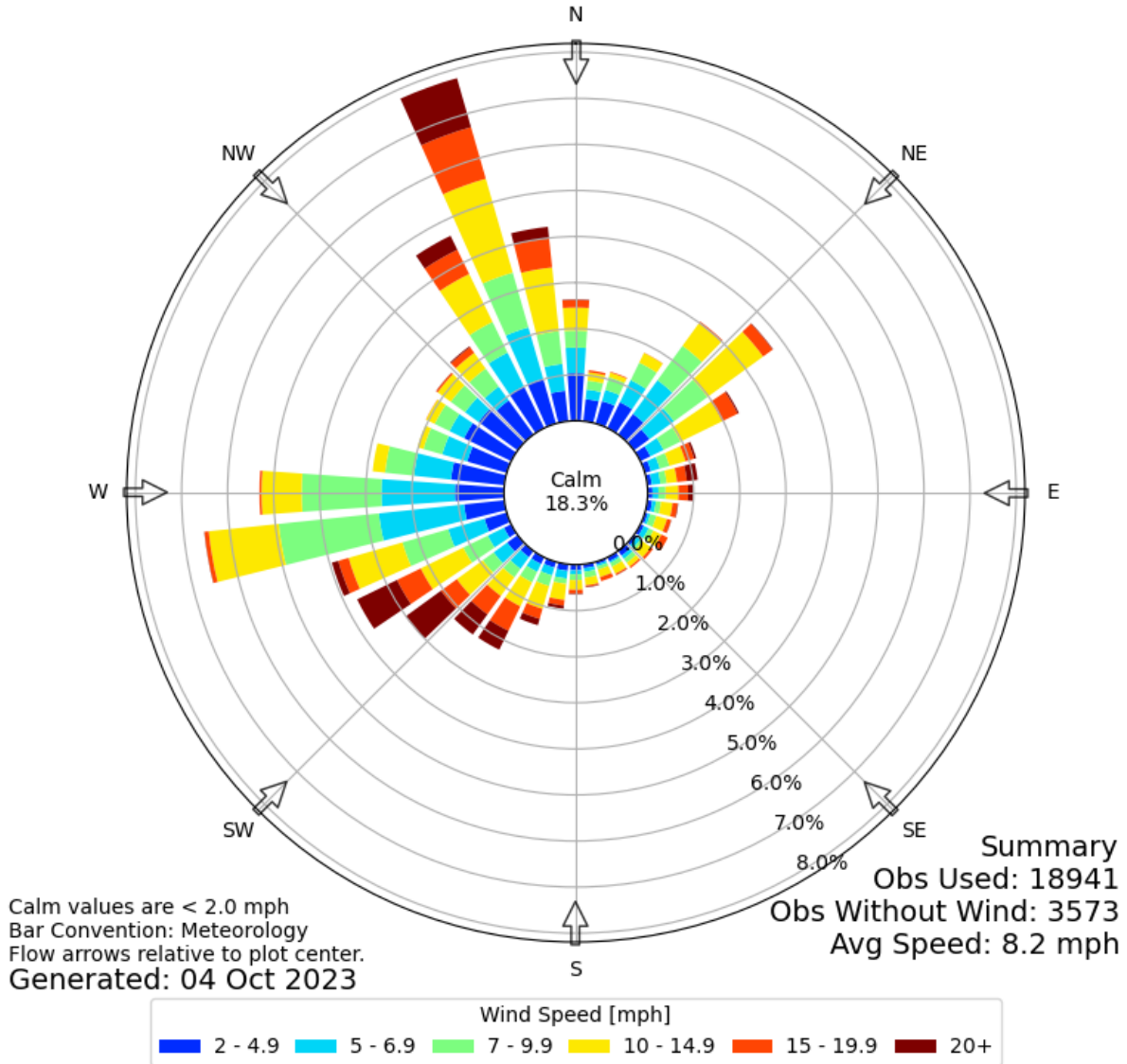
Note: *A map highlighting the different categories the North Shore is divided into. Lutsen is visible below the word 'HIGHLANDS.'* From Anderson and Fischer, *North Shore: A Natural History of Minnesota's Superior Coast*, University of Minnesota Press, pg. 4

The climate of Lutsen is characterized by its long, harsh winters and warm summers. The region experiences four distinct seasons, each with separate weather conditions. Winters are cold, snowy, and windy due to its northern latitude and close proximity to Lake Superior. Spring shows a gradual increase in temperature, with less snowfall and an increase in rain. Summer brings a thick humidity along with average mid-seventies temperatures. Autumn showcases a gradual decrease in temperature, with an increase in wind temperatures.

Figure 10. Winter wind rose of Lutsen



Windrose Plot for [GNA] GRAND MARAIS
 Obs Between: 01 Jan 1999 12:56 AM - 31 Jan 2023 11:56 PM America/Chicago
 ↳ constraints: Jan

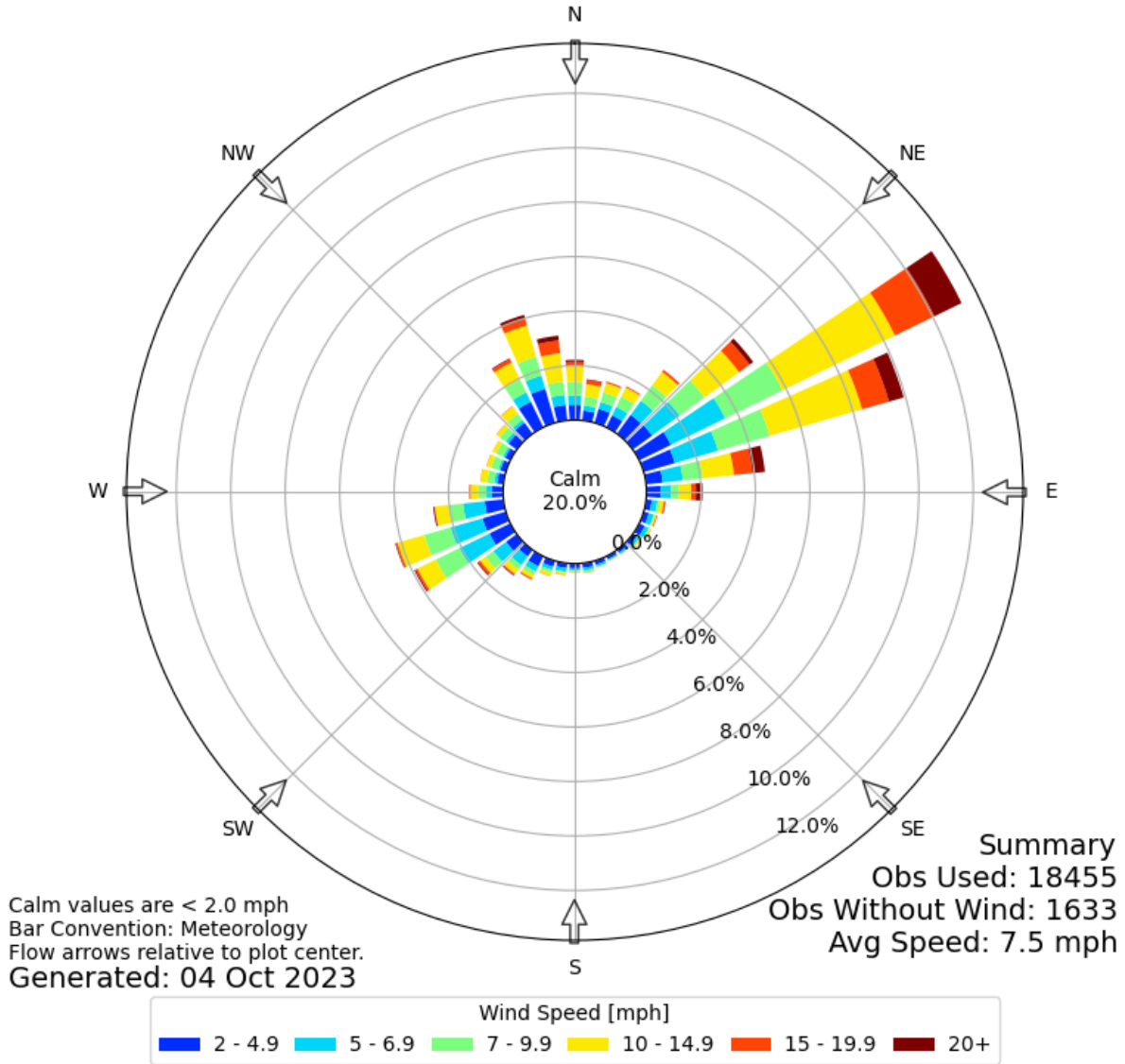


Note: The wind rose showcases the average windspeed throughout the month of January. From Iowa State University, (https://mesonet.agron.iastate.edu/sites/windrose.php?station=GNA&network=MN_ASOS)

Figure 11. Spring wind rose of Lutsen



Windrose Plot for [GNA] GRAND MARAIS
 Obs Between: 01 Apr 1999 12:56 AM - 30 Apr 2023 11:56 PM America/Chicago
 ↳ constraints: Apr

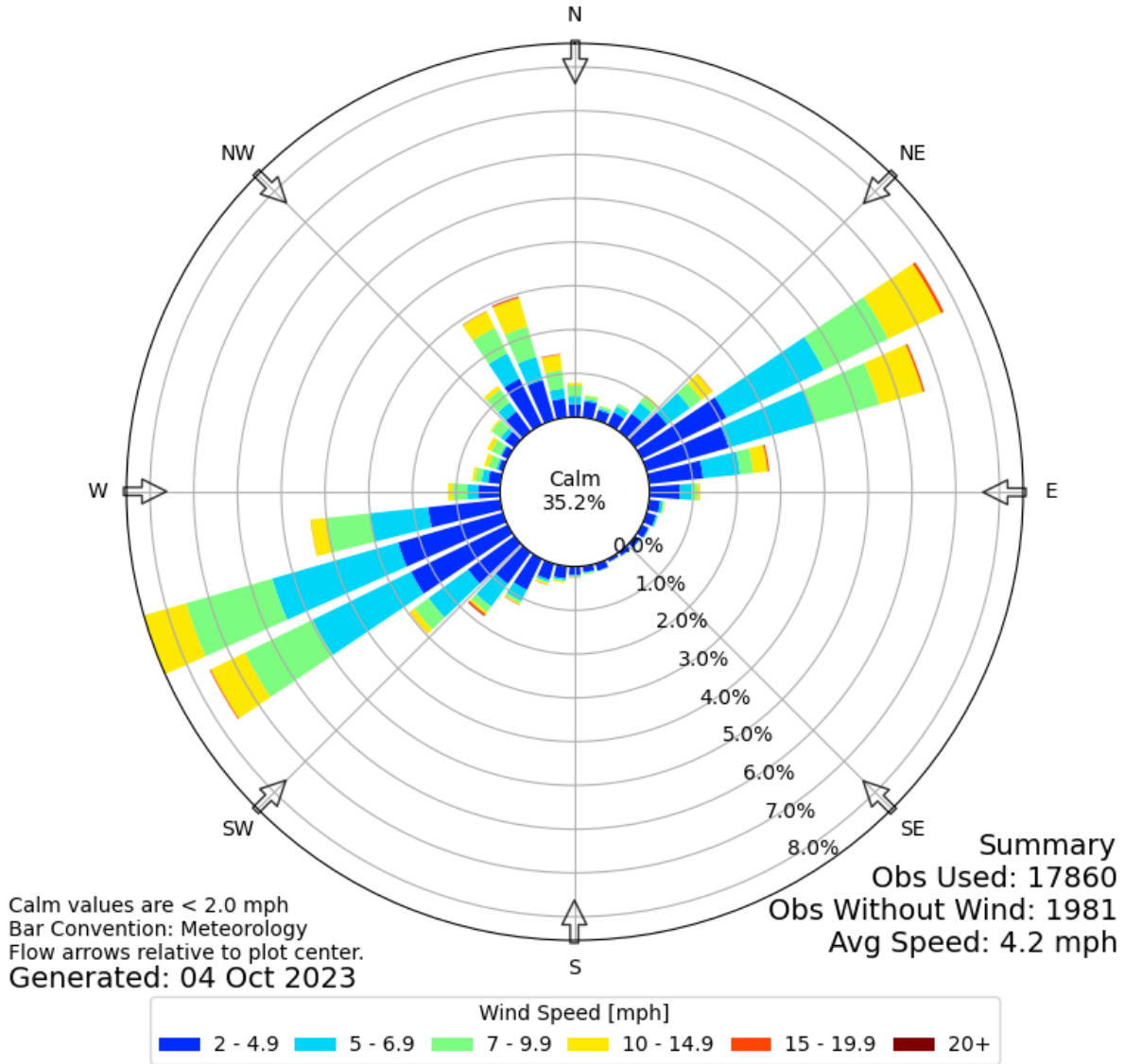


Note: The wind rose showcases the average windspeed throughout the month of April. From Iowa State University, (https://mesonet.agron.iastate.edu/sites/windrose.phtml?station=GNA&network=MN_ASOS)

Figure 12. Summer wind rose of Lutsen



Windrose Plot for [GNA] GRAND MARAIS
 Obs Between: 31 Jul 1998 07:56 PM - 31 Jul 2023 11:56 PM America/Chicago
 ↳ constraints: Jul

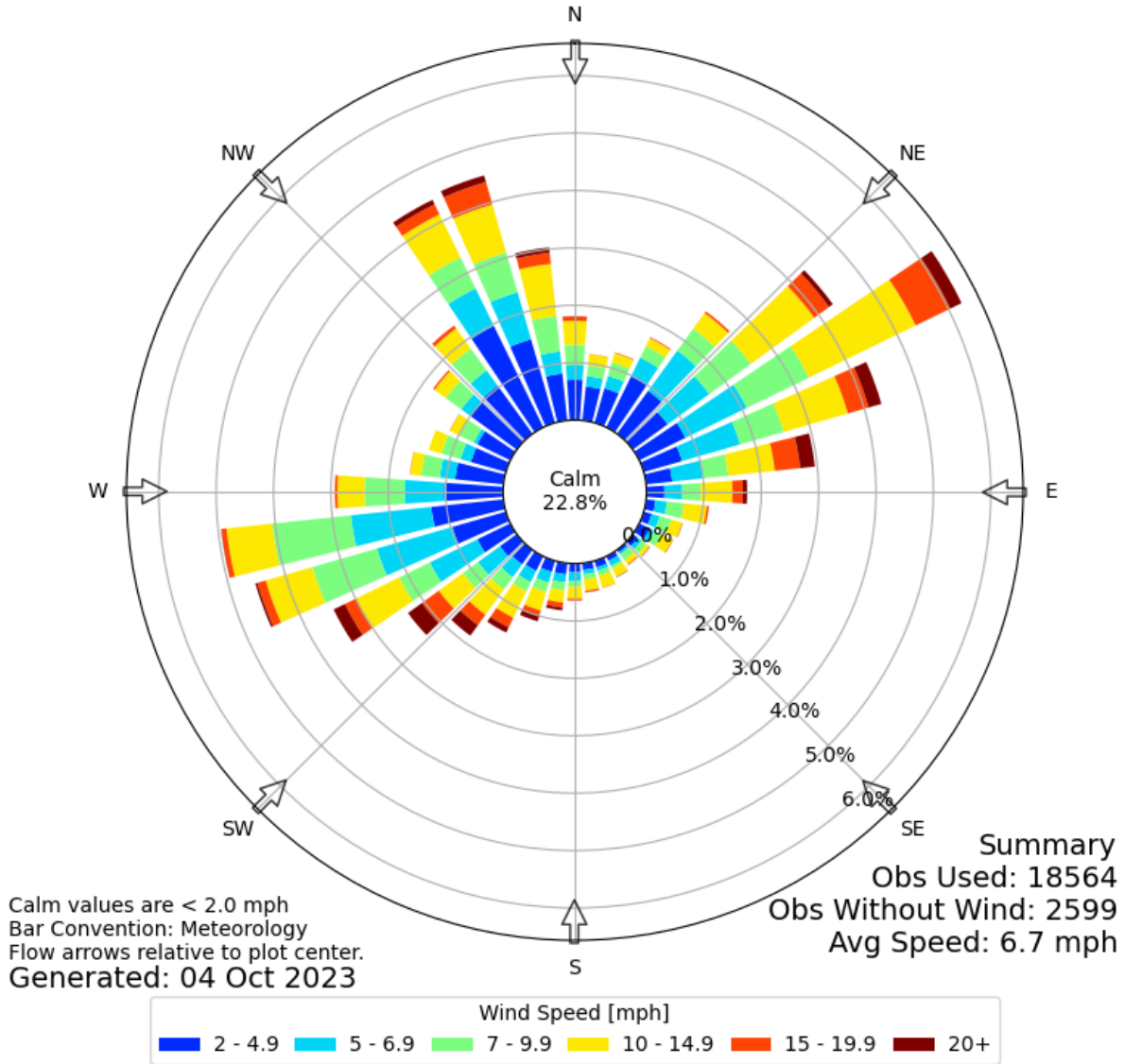


Note: The wind rose showcases the average windspeed throughout the month of July. From Iowa State University, (https://mesonet.agron.iastate.edu/sites/windrose.phtml?station=GNA&network=MN_ASOS)

Figure 13. Autumn wind rose of Luster



Windrose Plot for [GNA] GRAND MARAIS
 Obs Between: 01 Oct 1998 01:56 AM - 04 Oct 2023 01:56 AM America/Chicago
 ↳ constraints: Oct



Note: The wind rose showcases the average windspeed throughout the month of October. From Iowa State University, (https://mesonet.agron.iastate.edu/sites/windrose.phtml?station=GNA&network=MN_ASOS)

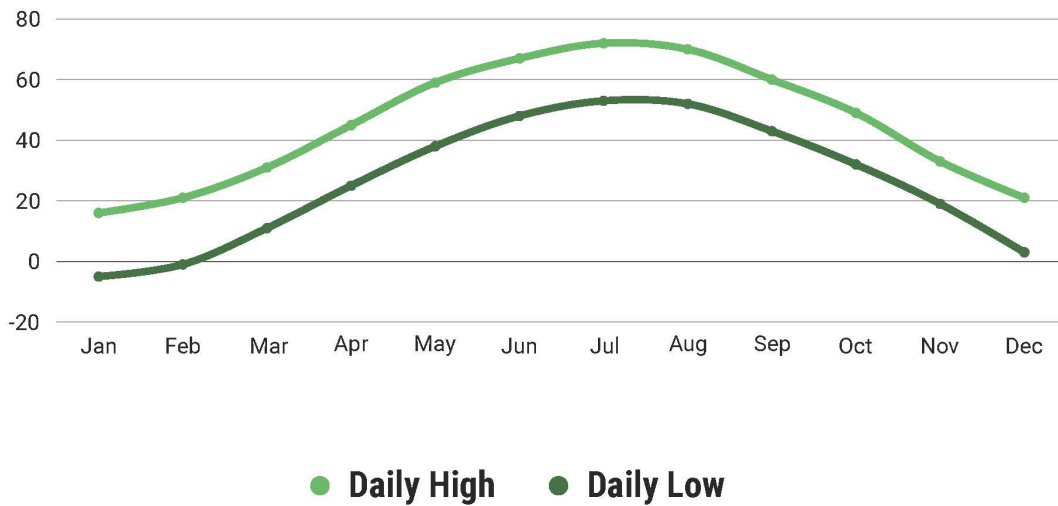
Figure 14. Average windspeed of Lutsen



Note: Graph created by Luke Madson. Data from The Weather Network (<https://www.theweathernetwork.com/us/historical/minnesota/lutsen>)

Figure 15. Average humidity of Lutsen

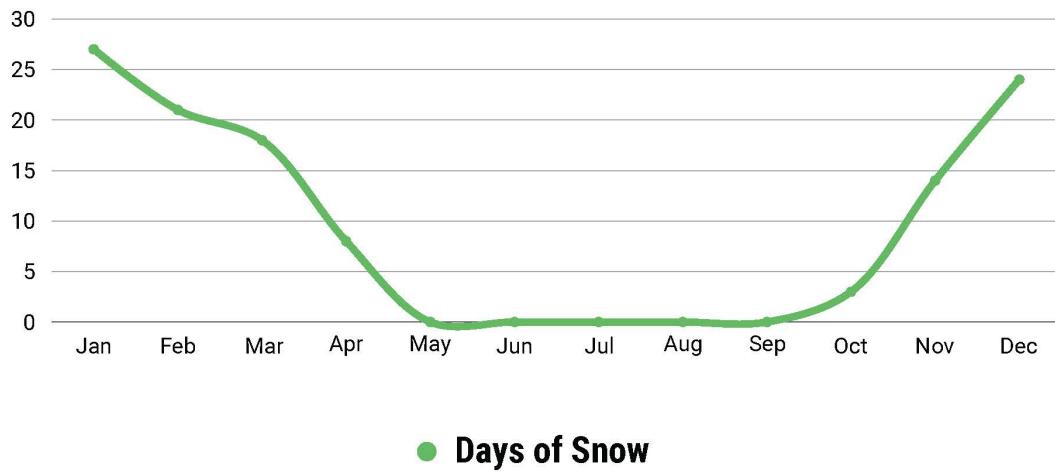
AVERAGE TEMP: LUTSEN



Note: Graph created by Luke Madson. Data from The Weather Network (<https://www.theweathernetwork.com/us/historical/minnesota/lutsen>)

Figure 16. Average snowfall of Lutsen

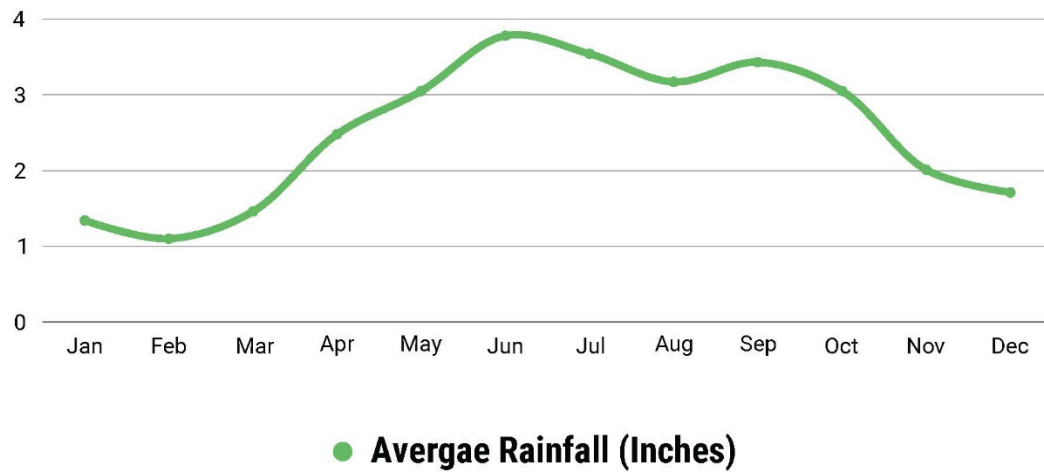
AVERAGE SNOWFALL: LUTSEN



Note: Graph created by Luke Madson. Data from The Weather Network (<https://www.theweathernetwork.com/us/historical/minnesota/lutsen>)

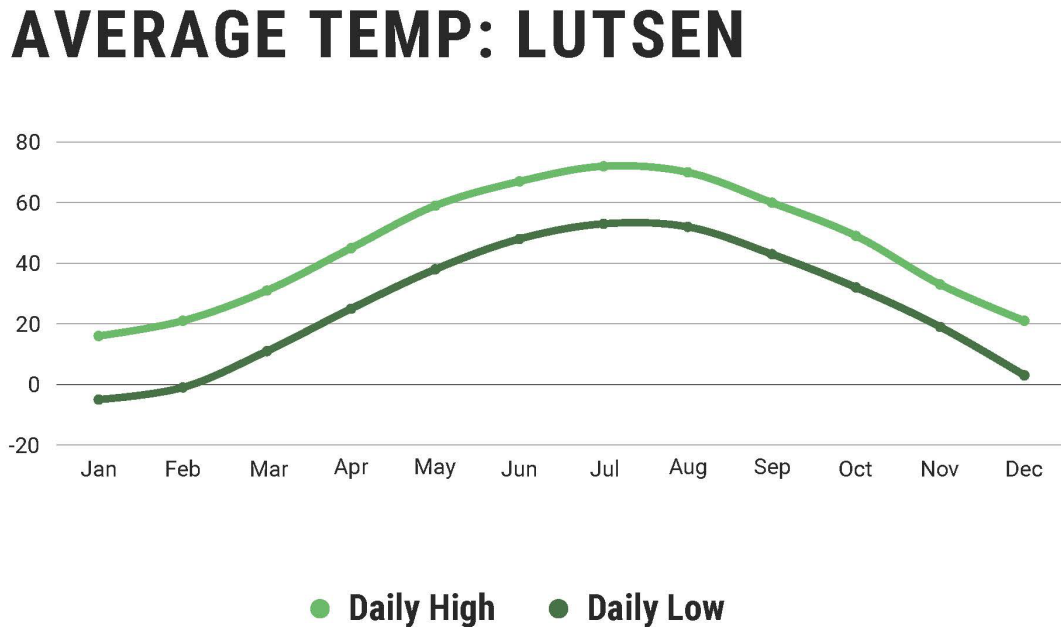
Figure 17. Average precipitation of Lutsen

PRECIPITATION: LUTSEN



Note: Graph created by Luke Madson. Data from The Weather Network (<https://www.theweathernetwork.com/us/historical/minnesota/lutsen>)

Figure 18. Average temperature of Lutsen in Fahrenheit



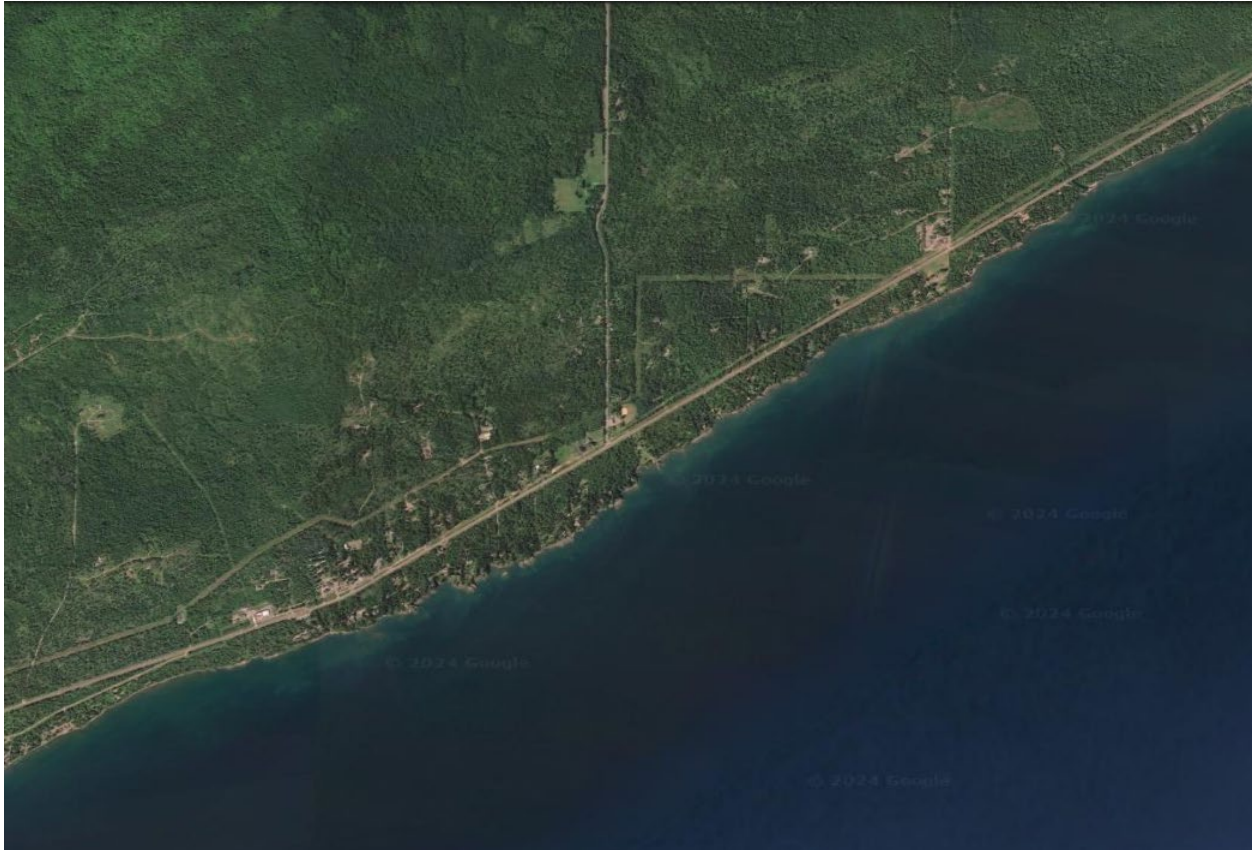
Note: Graph created by Luke Madson. Data from The Weather Network (<https://www.theweathernetwork.com/us/historical/minnesota/lutsen>)

3.3. Project Location (Smaller Scale)

The two sites selected in Lutsen share similarities and differences. For starters, the Nearshore site is situated directly on the coastline of Lake Superior. While still rural area in comparison to larger urban areas, there are far more amenities such as grocery stores, restaurants, etc. than near the Highlands site. Situated next to highway 61, the main road of the North Shore, access to these amenities will be much easier than in the Highlands site. The shoreline of Lake Superior boasts rock beaches, rocky outcroppings and cliff faces that are major attractions for

tourists. The Nearshore site will aim to draw upon these unique features, and showcase them to users who stay here.

Figure 19. A zoomed out aerial view of the Nearshore site



Note: From Google Earth (<https://earth.google.com>)

The Highlands site is situated on a peninsula located in the middle of Caribou Lake. Caribou Lake is a popular lake for tourists looking to stay in cabins that are more remote, and more enveloped in the nature of the North Shore. Lush with trees, and vegetation, the Highlands draws thousands of visitors during the Autumn months, with the goal of viewing the beautiful yellows, oranges, and reds of the color changing leaves. With waterfalls and hiking trails abundant in both locations, the North Shore is a stunning piece of natural beauty.

Figure 20. A picture of a rock beach and rocky outcroppings commonly found on the Lake Superior Shoreline



Note: *Picture taken by Luke Madson*

The Highlands site is situated on a peninsula located in the middle of Caribou Lake. Caribou Lake is a popular lake for tourists looking to stay in cabins that are more remote, and more enveloped in the nature of the North Shore. Lush with trees and vegetation, the Highlands draws thousands of visitors during the Autumn months, with the goal of viewing the beautiful yellows, oranges, and reds of the color changing leaves. With waterfalls and hiking trails abundant in both locations, the North Shore is a stunning piece of natural beauty.

Figure 21. An aerial view of Caribou Lake.



Note: From Google Earth (<https://earth.google.com>)

Figure 22. A picture depicting the vast forests found in the Highlands of the North Shore.



Note: *Picture taken by Luke Madson*

3.4 Specific Site: Nearshore

Off highway 61, the Nearshore site is in close range of many amenities and activities such as grocery stores, restaurants, Superior National Golf Course, Lutsen Ski Resort, etc. Located on land that is already owned, the premise of this project will rest on the idea of purchasing the land from its owner.

Figure 23. A zoomed in aerial view of the Nearshore site



Note: *From Google Earth (<https://earth.google.com>)*

3.4.1. Nearshore Topography

On the South side of highway 61 moving down towards Lake Superior, the decline in elevation begins gradual until the 640 foot mark, where it becomes more intense.

Figure 24. A picture depicting the topography of the Nearshore site.

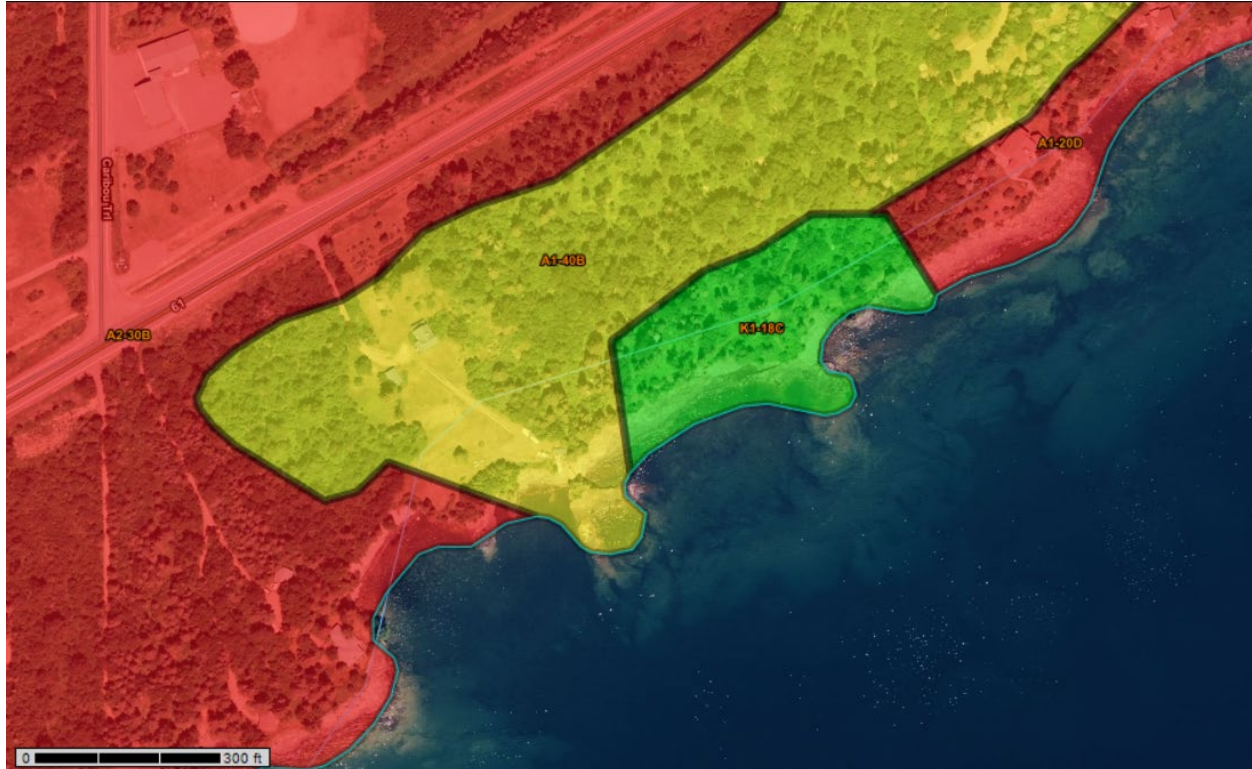


Note: From MN TOPO (<http://arcgis.dnr.state.mn.us/maps/mntopo/>)

3.4.2. Nearshore Soil Map

The design that will occur for this site will be in the green K1-18C section of the map below. Predominantly characterized as gravelly sandy loam, the design will be situated here as there is excellent drainage and structures are not limited to staying above ground, and basements can be incorporated into the design (U.S. Department of Agriculture)

Figure 25. A map depicting the different soil conditions of the Nearshore site



Note: From United States Department of Agriculture
(<https://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx>)

3.4.3. Sun Mapping

The design present in this location will make use of the views and natural light present, situating windows to receive enough sunlight.

Figure 26. A map depicting the sun path during the morning of the Nearshore site



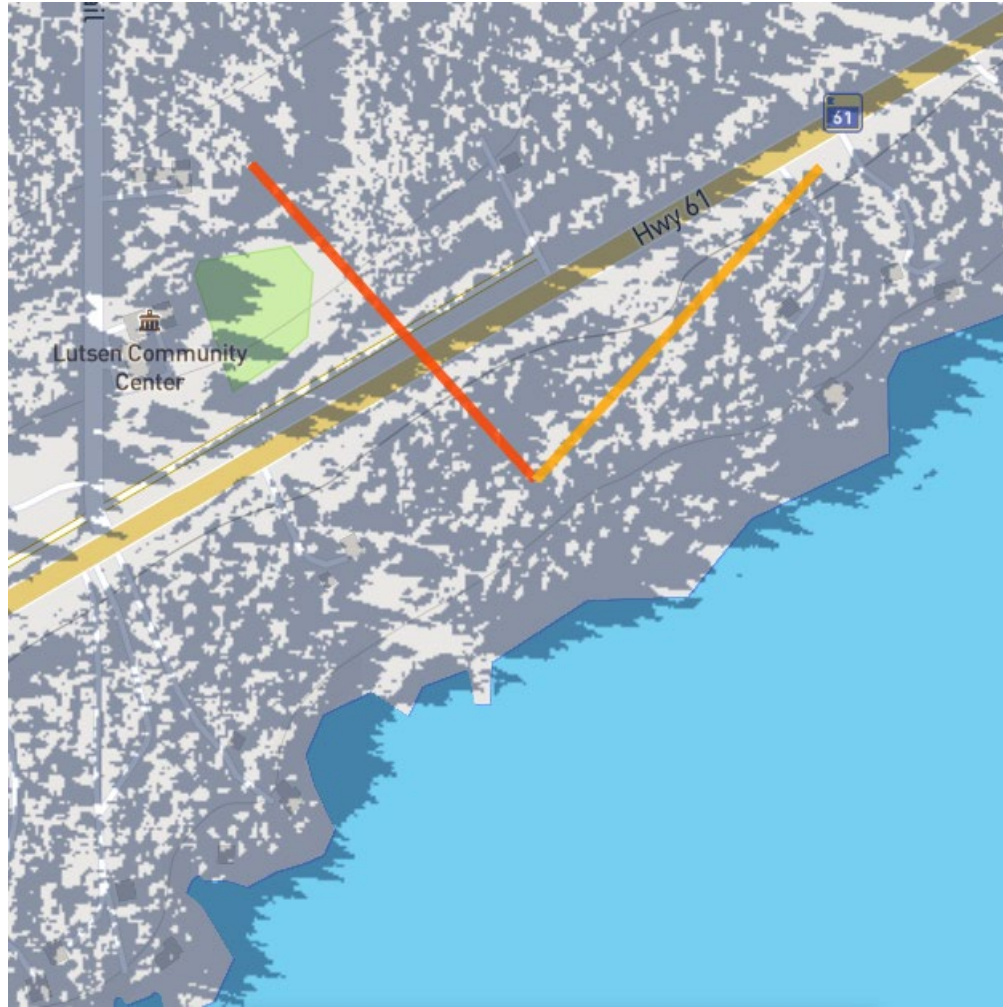
Note: The light orange line represents sunrise and the dark orange line represents sunset, moving in a clockwise direction. From ShadeMap (<https://shademap.app/@47.71473,-90.65851,14.84968z,1721094540000t,0b,0p,0m!1721038893020!1721095074866,qbHV0c2Vu!47.64694!-90.6748>)

Figure 27. A map depicting the sun path during the afternoon of the Nearshore site



Note: The light orange line represents sunrise and the dark orange line represents sunset, moving in a clockwise direction. From ShadeMap (<https://shademap.app/@47.71473,-90.65851,14.84968z,1721094540000t,0b,0p,0m!1721038893020!1721095074866,qbHV0c2Vu!47.64694!-90.6748>)

Figure 28. A map depicting the sun path during the evening of the Nearshore site



Note: The light orange line represents sunrise and the dark orange line represents sunset, moving in a clockwise direction. From ShadeMap (<https://shademap.app/@47.71473,-90.65851,14.84968z,1721094540000t,0b,0p,0m!1721038893020!1721095074866,qbHV0c2Vu!47.64694!-90.6748>)

3.5. Specific Site: Highlands

Deeper in the more rural area of Lutsen, the Highlands site does not have any immediate amenities in the surrounding area. Located on land that is already owned, the premise of this project will rest on the idea of purchasing the land from it's owner. The specific location is on the Northwest shore of the peninsula, and was selected as to provide lake views while not being impeded by the sharp increase in elevation towards the center of the peninsula.

Figure 29. A zoomed in aerial view of the Highlands site



Note: From Google Earth (<https://earth.google.com>)

3.5.1. Highlands Topography

With the site located on the Northwest portion of the peninsula, there is a gradual increase in elevation starting from the shoreline, with a steeper incline towards the hill in the center.

Figure 30. A picture depicting the topography of the Highlands site.

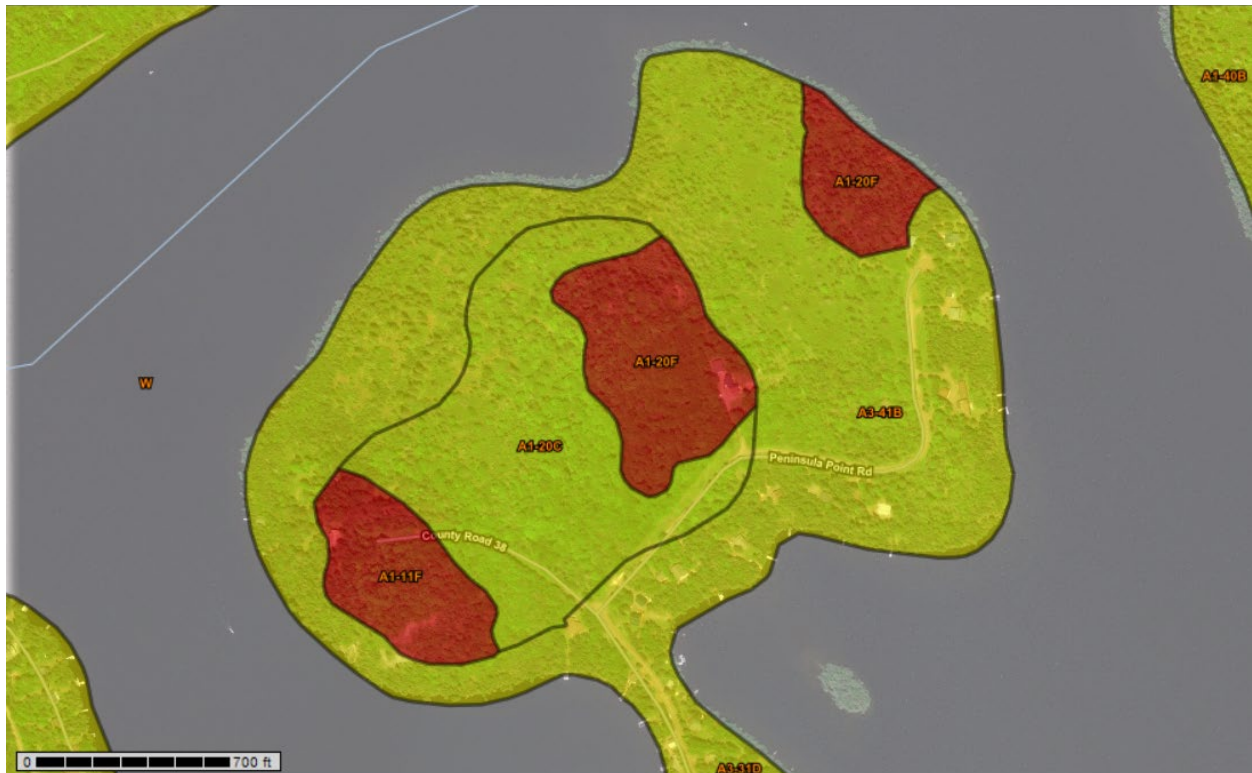


Note: From MN TOPO (<http://arcgis.dnr.state.mn.us/maps/mntopo/>)

3.5.2. Highlands Soil Map

The design that will occur for this site will be in the yellow A3-41B section of the map below. Predominantly characterized as gravelly sandy loam, this particular location is not suitable for designing with any sub-grade elements but can support above-grade elements (U.S. Department of Agriculture).

Figure 31. A map depicting the different soil conditions of the Highlands site

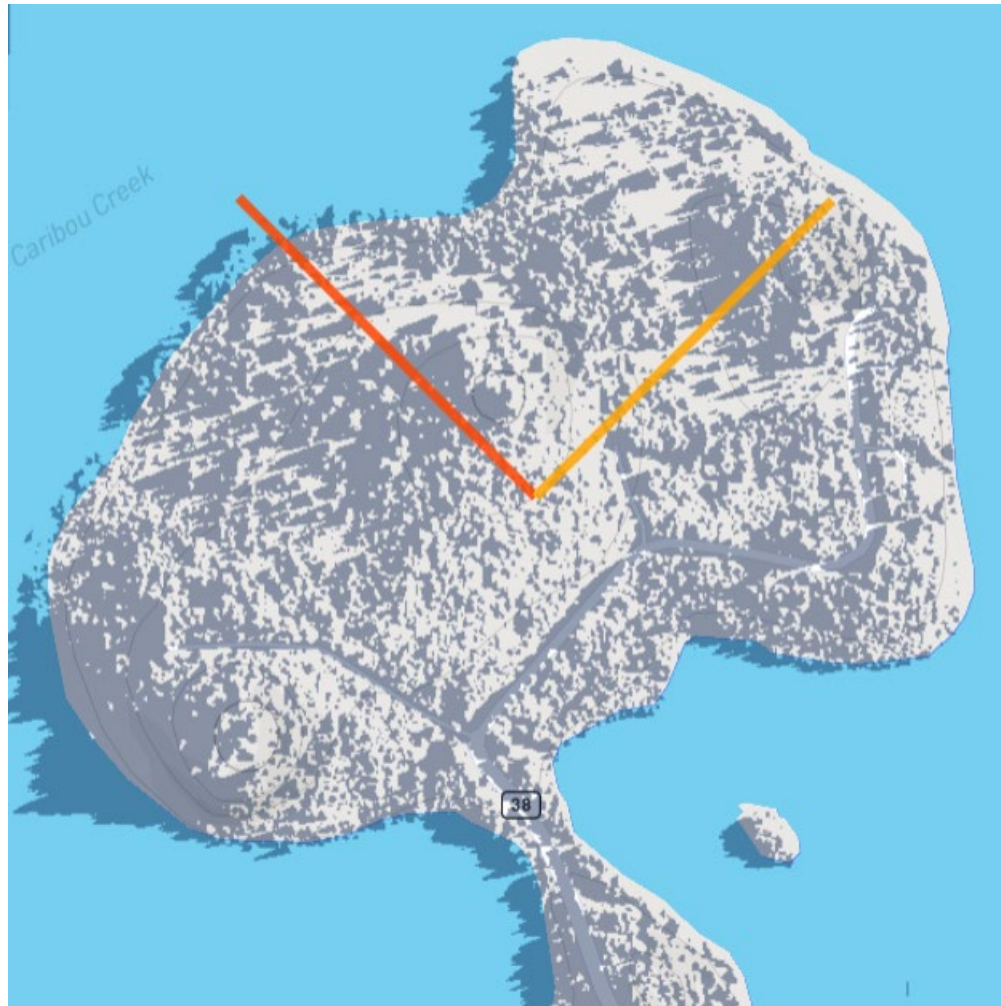


Note: From United States Department of Agriculture
(<https://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx>)

3.5.3. Sun Mapping

The design present in this location will make use of the views and natural light present, situating windows to receive enough sunlight.

Figure 32. A map depicting the sun path during the morning of the Highlands site



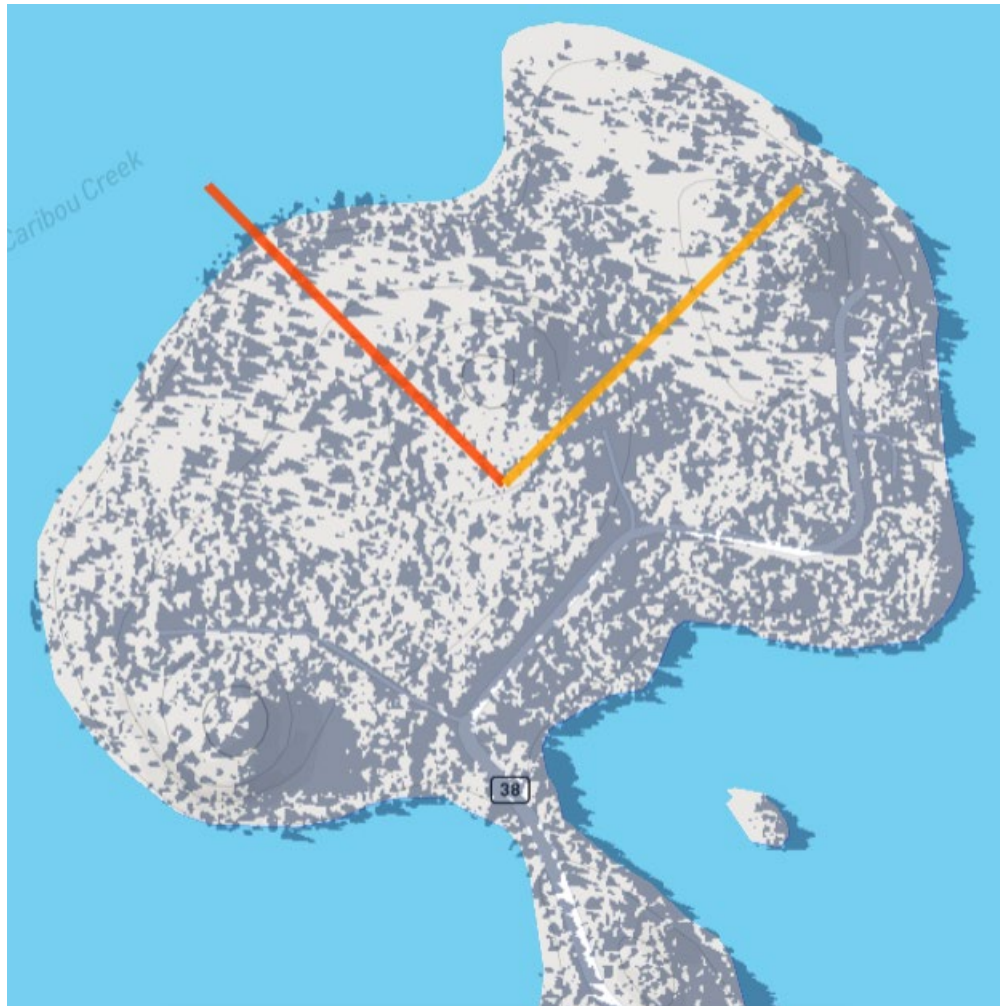
Note: The light orange line represents sunrise and the dark orange line represents sunset, moving in a clockwise direction. From ShadeMap (<https://shademap.app/@47.71473,-90.65851,14.84968z,1721094540000t,0b,0p,0m!1721038893020!1721095074866,qbHV0c2Vu!47.64694!-90.6748>)

Figure 33. A map depicting the sun path during the afternoon of the Highlands site



Note: The light orange line represents sunrise and the dark orange line represents sunset, moving in a clockwise direction. From ShadeMap (<https://shademap.app/@47.71473,-90.65851,14.84968z,1721094540000t,0b,0p,0m!1721038893020!1721095074866,qbHV0c2Vu!47.64694!-90.6748>)

Figure 34. A map depicting the sun path during the evening of the Highlands site



Note: The light orange line represents sunrise and the dark orange line represents sunset, moving in a clockwise direction. From ShadeMap (<https://shademap.app/@47.71473,-90.65851,14.84968z,1721094540000t,0b,0p,0m!1721038893020!1721095074866,qbHV0c2Vu!47.64694!-90.6748>)

3.6. Precedents/ Case Studies

3.6.1. Primeval Symbiosis- Konrad Wojcik

Figure 35. A render of Konrad's pine tree-inspired house



Note: From *Mirage Studio 7* (<https://blog.miragestudio7.com/primeval-symbiosis-single-pole-house-konrad-wojcik/4691/>)

Primeval Symbiosis combines an environmentally conscious design effort with a modern-style typography. With deforestation a widespread practice utilized in the interest of residential expansion, Konrad Wojcik sought to provide a solution which allows this expansion to continue, without the need for environmental destruction. Designed with an emphasis on producing a home that leaves no footprint on the environment around it, Primeval Symbiosis takes inspiration from perhaps the most important thing in nature: trees. Konrad recognizes the importance of trees as shelter in nature. Being the best natural protection from predators and the elements, trees provide a

place of refuge without taking up much ground space. This is precisely the reason Konrad decided to emulate a pine tree in his design.

In an effort to reach his goal of 'leave no footprint', Konrad designed the main structure to be raised into the air. A singular column, composed of glue-laminated wood, anchors the structure to the earth while providing a solid base for the rest of the home to emanate from. With the preservation of the environment at the forefront of Konrad's goal, sustainable methods are jam-packed into every design choice. From the bio digester to rainwater collection, or a geothermal heating source, Konrad takes a dedicated approach to implementing sustainability into every decision he can. He has even made a point to only use materials that are 100% recyclable. Zinc, clay-tec, paper insulation, c2c furniture are among the variety of materials utilized.

The project of Primeval Symbiosis is both a commentary on rapid environmental destruction, and the solution. With zero footprint, a 100% recyclable structure, and a form that blends effortlessly into the environment, this project is a statement. It is entirely possible to design attractive, functional, nature friendly homes without the need for deforestation and destruction.

3.6.2. Edgeland House- Bercy Chen Studio

Figure 36. A picture the Edgeland house encompassed by earth



Note: From Bercy Chen Studio LP (<https://www.bcarc.com/residential/edgeland-house>)

Reclaiming what was once a brownfield site, the Edgeland House, located in Austin, Texas, seeks to return this site to the natural environment. A brownfield is a site that was once commercially or industrially utilized, with complete disregard for the surrounding environment. Bercy Chen Studio states “Edgeland House is about healing the land and ameliorating the scars of the site’s industrial past.” With inspiration taken from the Native American pit house, the home is nestled into the earth: almost being hidden by it. Simultaneously blending itself with the natural surroundings while incorporating various sustainable design elements, the Edgeland House is a remarkable testament to what can be achieved through innovative and eco-friendly architecture.

Through numerous sustainable design tactics, the Edgeland House was certified as LEED Platinum, one of the highest achievements in green building practices. Separated into two sectors, the residence requires exposure to the environment in order to fully utilize the house. These two

halves are partially submerged in the ground, utilizing the natural heating and cooling attributes of the earth. As the house is 7 feet underground, naturally a green roof was incorporated into the design. In addition to managing stormwater runoff and adding an extra layer of insulation, the roof is adorned with a variety of native wildflowers and grasses to help preserve the local ecosystem. The roof also plays host to a system of gutters and pipes that harvest rainwater. Under the residence, a geothermal heat pump makes use of the natural heat produced by the earth to regulate temperature throughout the year.

The Edgeland House is evidence that environmental responsibility and modern architecture can be unionized in harmony with each other. Not only does this project succeed in reclaiming the site for nature, but it proves that the built environment does not need to be a detriment to the natural environment.

3.6.2. The Pierre- Olson Kundig

Figure 37. A picture showcasing The Pierre encompassed in rock



Note: From Olson Kundig (<https://olsonkundig.com/projects/the-pierre/>)

The Pierre, located on San Juan Island, Washington, is an incredible example of integrating architecture and the site. The name "Pierre," French for stone, is a commentary behind the core of this project: celebrating the site. Encased in a stone outcropping, The Pierre seeks to immerse itself into the natural contours of the land. From certain vantage points around the site, the house appears to fade into the landscape. Not only does the house conform to the contours of the landscape, but it actively integrates the essence of the site into its design. The profuse use and consideration of the site when designing this project lessens the divide between nature and manufactured constructions.

In many ways, The Pierre encompasses everything about the site. Deliberate design choices integrate the house deeply into the landscape. Rough materials, a green roof, and carefully curated foliage all complement the site, further blurring the distinction between the natural and built

environment. In addition to enveloping the residence, the site provided elements that were also used in the construction and design of the house. When excavating the site to fit the house design, the leftover rock was crushed into aggregate and inserted into the concrete flooring. Portions of the rock even extrude into the interior of the house, combining both natural and artificial spaces. Fireplaces, hearths, and sinks are carved directly from existing stone, with even some rooms being completely composed of it.

The Pierre pushes the boundaries of site integration in architectural design. Through various methods, both the natural and man-made features of the residence are united in harmony. This project highlights that a site should be treated as a source of inspiration, not just as a location to build upon.

4.0. CHAPTER 4

RESULTS AND CONCLUSIONS

4.1 Final Project Description

The final cabin designs from both sites are designed with the environment of the North Shore at the forefront of decision making during the design process. In an effort to accommodate more visitors, but without compromising the ecological and visual impact of the environment, both sites are home to multiple cabins, with the Highlands site having 11, and the Nearshore site having 9. Each site will be owned by one of the many resort companies present on the North Shore, who will be responsible for renting and maintaining the cabins. For waste removal, the Nearshore site will have a dumpster present, which will be removed by the local garbage removal company. The Highlands location will rely on the occupants removing their own waste, a common practice on the North Shore for rural homes, so as to not disrupt any natural wildlife or pose any threat to the

environment. Due to a majority of North Shore tourists visiting to gaze at Lake Superior and other bodies of water (Anderson and Fischer, 226), both sets of cabins are directionally situated to allow for maximum views of their respective bodies of water.

Delivering on a more modern A-frame esq design, the Nearshore cabins harbor unique design choices. Entering from the second floor, one will find the first floor to be completely encased in earth. The roof is clad in shale stone tiles, reminiscent of the rocky cliffs and outcroppings present on the lake shore. Combining both earth sheltering and a conscious material pallet, these cabins sink away from view into the hillside they are placed on. Each cabin will be two stories, with the second story being 15 feet tall, and the first story being 10 feet tall. Each cabin will be 1460 square feet, with enough amenities to accommodate a medium-sized family while keeping them comfortable. These amenities include: a deck, three sleeping areas, two bathrooms, kitchen, living space, dining area, storage area, and mechanical room.

Figure 38. A picture of cliff faces that can be observed along the North Shore Superior Coast



Note: *From North Shore Explorer Mn (<https://northshoreexplorermn.com/crystal-cliffs-tettegouche-state-park/>)*

The Highland cabin design is inspired by Ojibwe architecture, who historically inhabited the land for hundreds of years, specifically reminiscent of the Ojibwe drum lodge and its many sides. The geometrical moss cladding seen enveloping the building is designed after the Ojibwe symbol for the thunderbird. Covered in moss, the Highlands cabin delivers a more traditional cabin interior, with an exterior that blends into the surrounding forest. Each cabin will be two stories, with both stories being 11 feet tall. Each cabin will be 1255 square feet, with enough amenities to accommodate a medium-sized family while keeping them comfortable. These amenities include: a deck, three sleeping areas, one bathroom, kitchen, living space, dining area, storage area, and mechanical room.

Figure 39. A picture showing an Ojibwe drum lodge



Note: *From (Nabokov & Easton, Native American Architecture, Oxford University Press, pg. 71)*

Figure 40. A picture depicting the Ojibwe symbol for the Thunderbird



Note: From *Anishinabe Lacrosse*. *Anishinabek Nation authorizes AB use of Thunderbird symbol* (<https://anishinabeagaadovenin.org/news/f/anishinabek-nation-authorizes-use-of-thunderbird-logo>)

4.2. Reduction of Ecological and Visual Impacts of the Minnesota North Shore

The Nearshore and Highland cabins are host to a variety of different sustainable design strategies aimed at mitigating the ecological and visual impacts of the North Shore. Each specific strategy is specifically catered to the North Shore and is based on the matrix provided earlier in this report.

To combat light pollution, both cabins will use glazed surfaces sparingly, as to reduce the amount of outwards projected light. For the Nearshore design, only the Southern face of the cabins will include windows, with 4 small skylights present on the roof. For the Highlands design, there are

no skylights present, and the use of windows on the southern face of the cabin is reduced. The use of lighting on the exterior portions of both sites is only present on the main entryways, as moonlight and vehicle headlights are sufficient to navigate throughout the site during the night. In both designs the reduced use of windows, the use of dark-sky compliant lighting, warm colored bulbs with appropriate lumens, and timers, the amount of light projected into the sky is heavily reduced and the observation of these lights across the landscape is minimal.

To improve water efficiency, both the site and cabins of the Nearshore and Highland locations are designed to promote groundwater recharge. Incorporating sloped roofs and restricting the hardscape surfaces present in the design of the cabins themselves allow for water to return to the ground more easily through natural means. Instead of traditional paved roads, the use of dirt roads leading to the cabins on both sites allows for water to seep through them, again promoting groundwater recharge. With the reduced use of hardscape surfaces and implementation of dirt roads, both the site and cabins are also able to stand out less against the environment. Both sites will also include indoor greywater catchment systems, as harboring them indoors prevents the additional need for site disruption.

In order to reduce the heat island effect and reduce visual impact on the environment, both sites once again make use of the reduction of hardscape surfaces and dirt roads. By allowing water to naturally interact with the landscape and undergo the evaporation process, the surrounding atmosphere is cooled. Specifically in the design of the Highlands location, taking the place of traditional green roofs, the moss cladding enveloping the cabins is an additional tool utilized to help reduce the heat island effect. A list of benefits the moss cladding provides is: the retention of moisture, the decrease of carbon dioxide in the atmosphere, a significant decrease in weight compared to traditional green roofs, the ability to go dormant during cold months and re-emerge when it's warm, and minimize the visual impact on the environment through the use of naturally

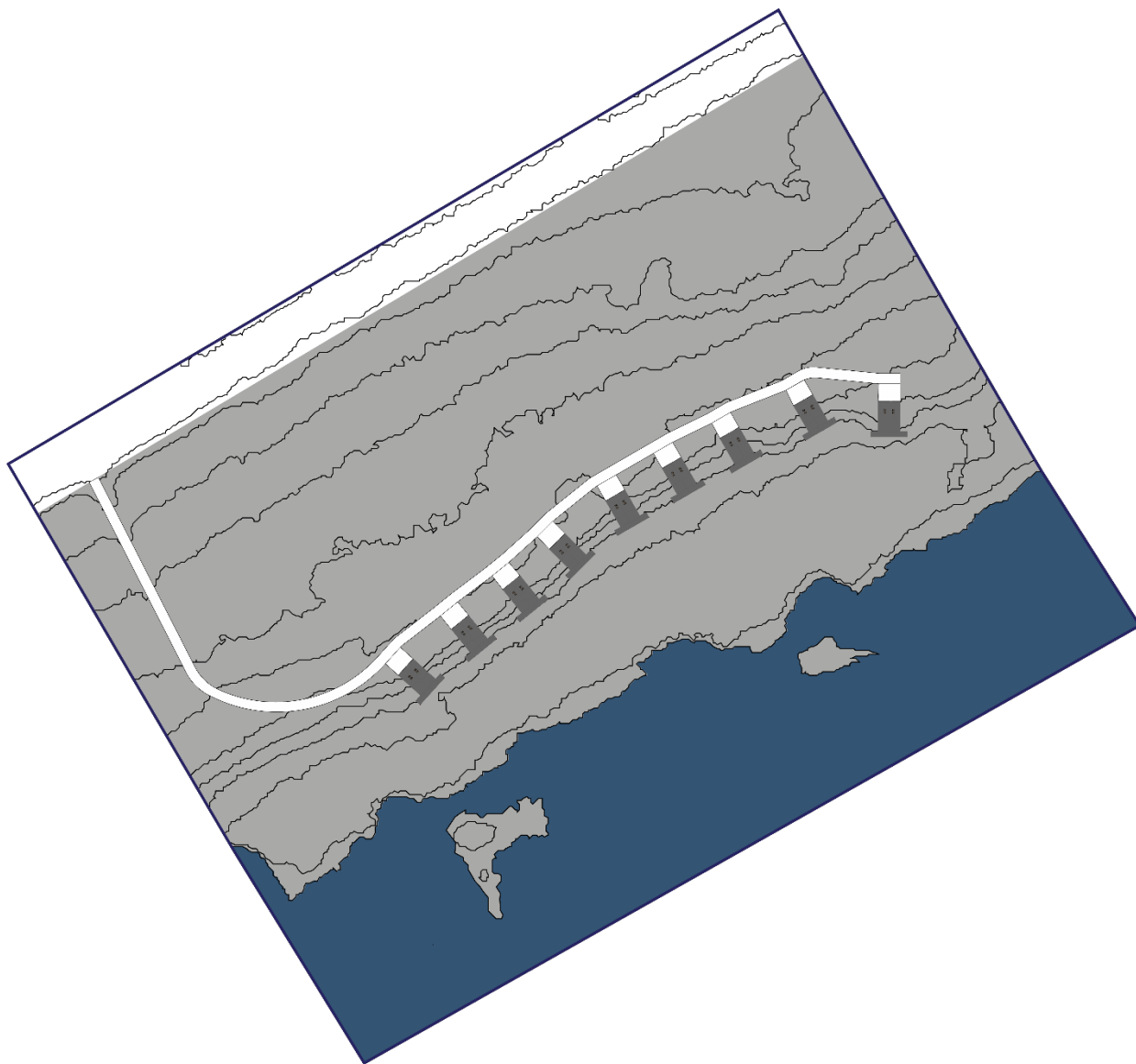
occurring vegetation. Both sites will also remove trees and vegetation when necessary, as this will aid in the goal of heat island reduction and will lead to less disruption of the natural landscape.

Through the use of earth sheltering, the Nearshore cabin design is able to increase its energy efficiency. The thermal regulation properties of the earth will help in the regulation and storage of heat within the cabins. The added benefit of employing earth sheltering into the design is the diminished visual impact on the surrounding environment. The earth surrounding the cabins allows for an easier transition between the natural and built environment, blending the two together.

The solar panels present in the design of both the Nearshore and Highland cabins aid in the reduced use of non-renewable energy, mitigating the emittance of greenhouse gasses. Both designs position the solar panels in positions to best receive sunlight, as informed by the sun pathing. During months of snow, the resort company that owns the sites will be responsible for the removal of snow from the solar panels, as to allow them to efficiently draw energy from the sun. Although the solar panels may require the removal of trees to be efficient, the amount will be minimal and the benefits of renewable energy will offset this.

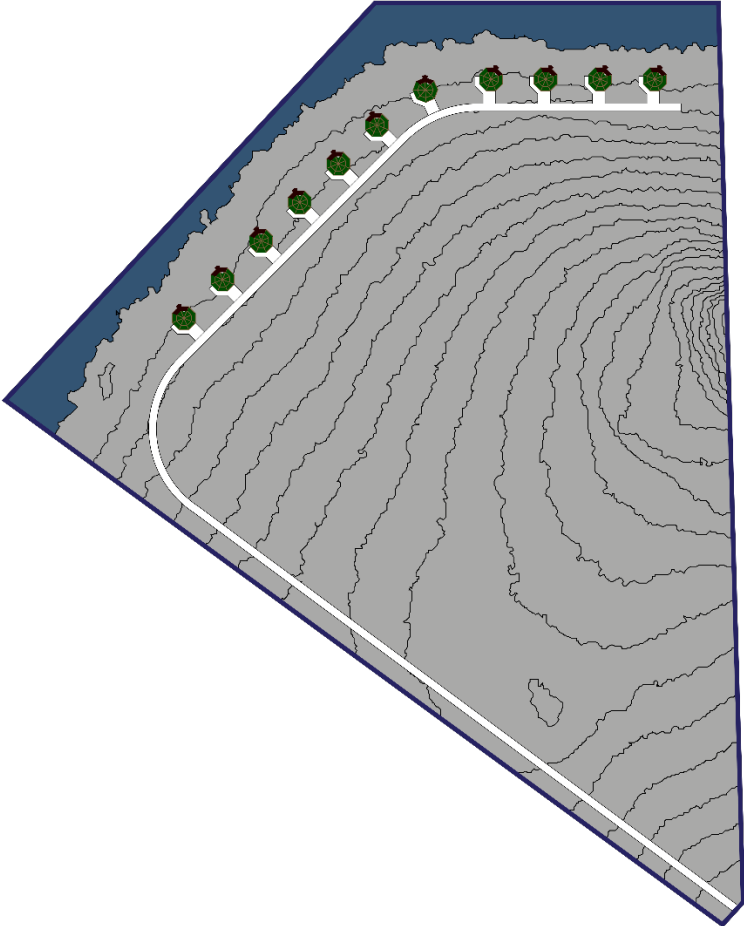
4.3. Project Design and Documentation

Figure 41. A graphic depicting the Nearshore site plan



Note: If a compass were placed on the page, the North arrow would be pointing directly to the top of the page. The cabin layout within the site is situated between the 630-foot and 620-foot contours (visible in the 'Specific Site' section), as this provides a hill steep enough to set the cabins into in order to provide earth sheltering benefits. The entrance to the site makes use of an already present road, with an extension into the interior of the site. The cabins are each 50 feet apart. Image created by Luke Madson.

Figure 42. A graphic depicting the Highlands site



Note: If a compass were placed on the page, the North arrow would be pointing directly to the top of the page. The cabin layout within the site is situated between the 1380-foot and 1390-foot contours (visible in the 'Specific Site' section), The entrance road to the site is positioned off an already present road, The cabins are each 50 feet apart. Image created by Luke Madson.

Figure 43. First level floorplan of a Nearshore cabin



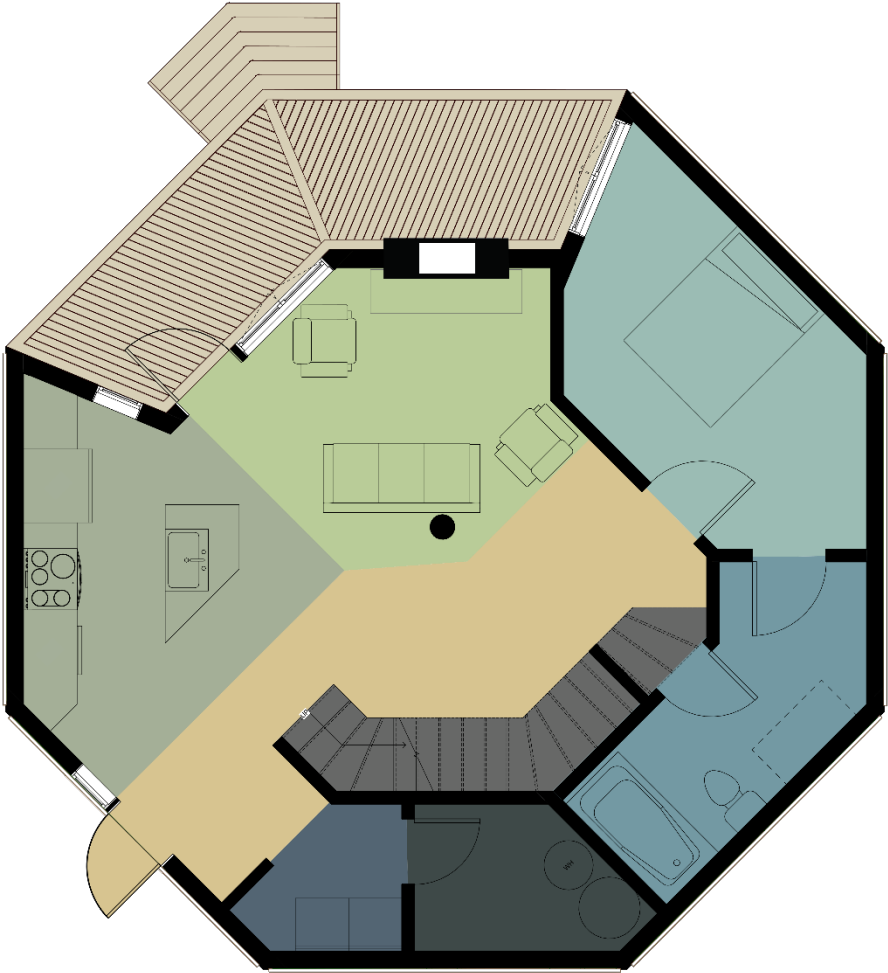
Note: If a compass were placed on the page, the North arrow would be pointing directly to the top of the page. Image created by Luke Madson

Figure 44. Second level floorplan of a Nearshore cabin



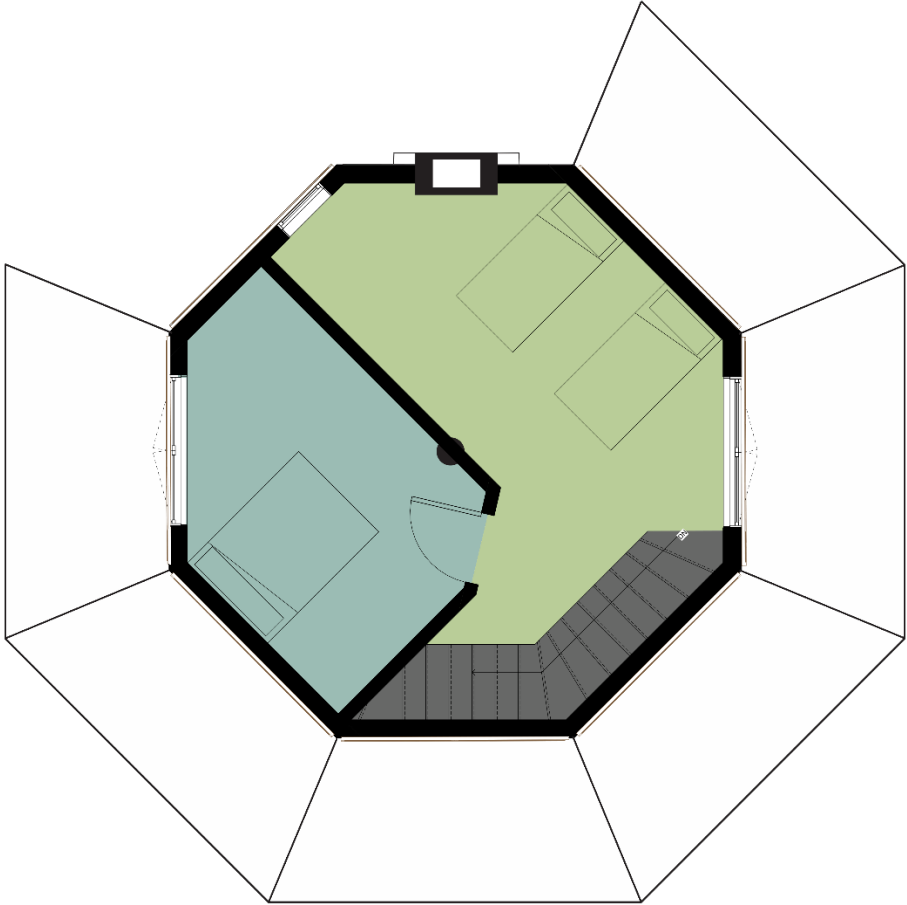
Note: If a compass were placed on the page, the North arrow would be pointing directly to the top of the page. Image created by Luke Madson

Figure 45. First level floorplan of a Highland cabin



Note: If a compass were placed on the page, the North arrow would be pointing directly to the top of the page. Image created by Luke Madson

Figure 46. Second level floorplan of a Highland cabin



Note: If a compass were placed on the page, the North arrow would be pointing directly to the top of the page. Image created by Luke Madson

Figure 47. Isometric view with sectioned portion of a Nearshore cabin



Note: See the reduced window usage, reduced use of hardscape surfaces, dirt road, earth sheltering, and solar panels.
Image created by Luke Madson

Figure 48. Isometric view with sectioned portion of a Highland cabin



Note: See the reduced window usage, reduced use of hardscape surfaces, dirt road, moss cladding, and solar panels.
Image created by Luke Madson

Figure 49. Redner of a single Nearshore cabin



Note: Set during the summer. Image created by Luke Madson

Figure 50. Render of series of Nearshore cabins



Note: *Set during the winter. Image created by Luke Madson*

Figure 51. Redner of a single Highland cabin



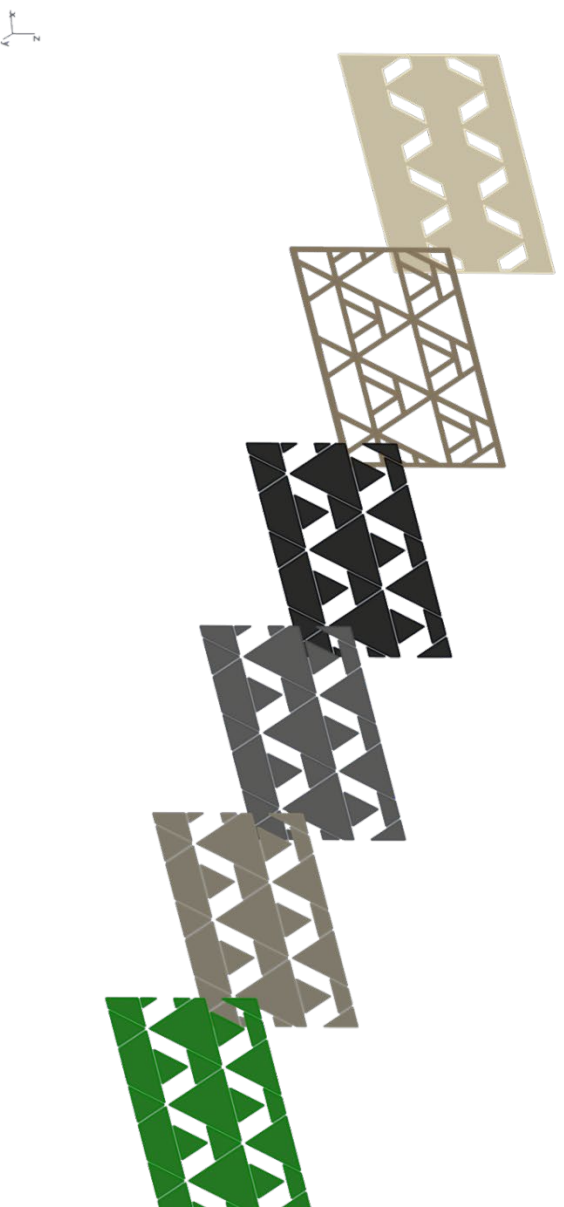
Note: Set during the summer. Image created by Luke Madson

Figure 52. Render of series of Highland cabins



Note: Set during the winter. Image created by Luke Madson

Figure 53. Moss panel construction



Note: In order from left to right: 1/2 inch plywood, 2 inch wood frame, 1/4 inch EPDM rubber, 1/2 inch Enkamat drainage layer, 1/4 inch synthetic felt capillary mat, moss. Image created by Luke Natson

4.4. Conclusions

The design for both the Nearshore and Highlands cabins succeeds in the projects goals of implementing sustainable design features into tourist lodging that reduces negative impacts on both the ecological and visual aspects in the environment of the North Shore of Minnesota. By incorporating sustainable design methods that are instructed by relevance to the North Shore, and are guided by natural materials, the designs for both sets of cabins are able to provide a more environmentally friendly lodging option while reducing the impact the built environment can have on the views of the natural landscape.

The facade of both designs highlights a conscious material pallet informed by the environments that surround them. With the natural colors the shale stone roof present on the nearshore design provides, it becomes harder to distinguish between the cabins and the cliff faces

and rocky outcroppings present along the coastline of Lake Superior. The moss cladding surrounding the building envelope of the Highland cabins provides more natural elements and depth to the design, enabling the cabins to become less distinguishable against the landscape it inhabits.

The relevant sustainable design strategies presented in this produce a ‘manual’ that should be referenced when building on the North Shore. Each strategy is directly linked to the unique environment present on the North Shore. Each strategy also comes with direct benefits to the visual impact on the landscape. These strategies both enhance the occupants experience when inhabiting the cabins, while simultaneously reducing negative impacts on the environment.

In conclusion, the Nearshore and Highland cabins successfully showcase a ‘manual’ on what specific sustainable strategies should be heavily considered when designing on the North Shore, why they should be implemented, and different methods on how to incorporate them. This design showcases that ecotourism and sustainable design methods should be united on the North Shore, and why it is so important that they are. With nature at the epicenter of importance on the North Shore, it is imperative that projects located within this region utilize these methods, as the tourism industry and nature of the North Shore of Minnesota directly influence each other.

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