Parasitos: Reimagining a Northern Hydroelectric Landscape

by

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A Practicum submitted to the Faculty of Graduate Studies of

The University of Manitoba

in partial fulfilment of the requirements of the degree of

MASTER OF LANDSCAPE ARCHITECTURE

Department of Landscape Architecture

University of Manitoba

Winnipeg

PARASITOS

Reimagining a Northern Hydroelectric Landscape

MATTHEW PETERS - 2022

Pumphouse - Pinawa Dam Provincial Heritage Park - i

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Acknowledgements

I would like to express my deepest appreciation to Karen Wilson Baptist, my academic advisor and chair of my committee for her invaluable patience, feedback, and guidance. I also would like to express my deepest gratitude to my other two committee members, Jean Trottier and Cheryl Oakden, who generously provided their time, energy, and expertise in helping me finish this practicum.

I am also grateful to all the experts I consulted with throughout researching and creating this practicum, who inspired my design decisions and provided invaluable technical knowledge.

Lastly, I would like to extend my sincere thanks and gratitude to my friends and family, with special thanks my wife Lynette Ens, for supporting me through this process and providing unending emotional support.

1 - Reservoir

A reservoir is the body of water a hydro-electric dam relies on to function. Its size, depth and/or velocity contains the potential energy needed for electrical output. Like a dam's reservoir, there is a large potential pool of knowledge and potential projects to focus on as a landscape architect. Following is the idea I have chosen to focus on at this moment, before the next project comes along.

Prelude

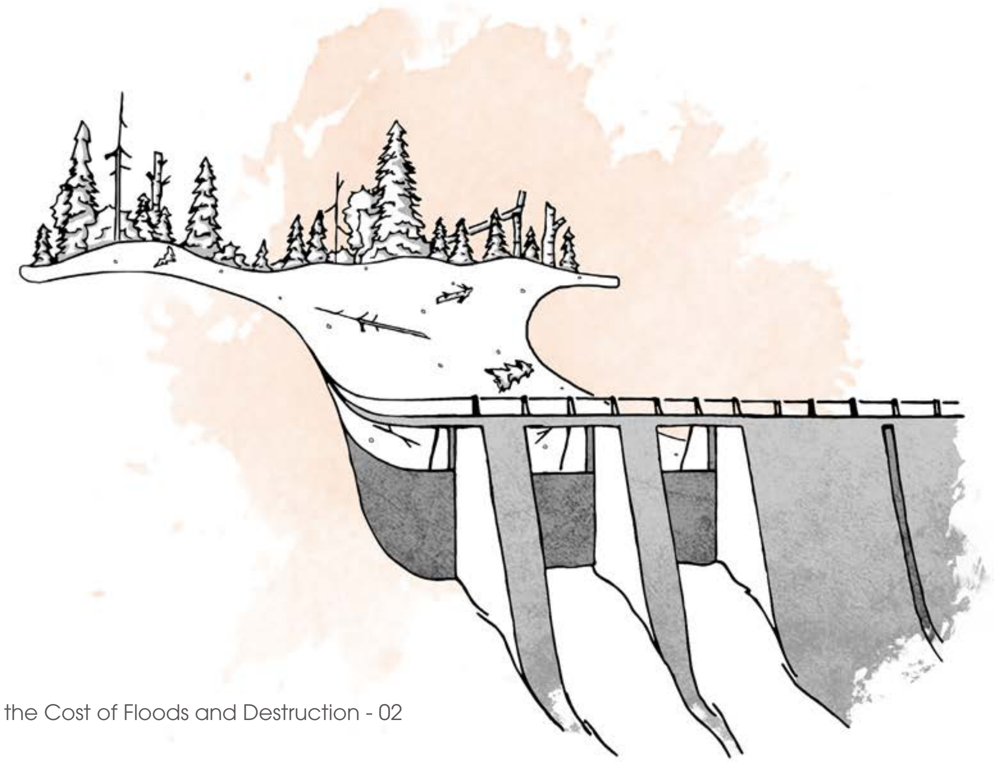
We are taught that people require three necessities in order to survive: air, water, and food. Most Canadians are fortunate enough to have access to an abundant supply of both clean breathable air, and drinkable water. However, access to food, let alone healthy food, is not a guarantee. It is not something a person can necessarily take for granted in Canada. Acquiring food can be difficult for some, which can be attributed to both financial circumstance and geographical location.

Financial circumstances can hinder one's access to adequate food, however access to adequate healthy food can prove to be more expensive in some conditions, leading to health related problems disproportionality affecting lower income individuals (Sowerwine, 2019, Council of Canadian Academies, 2014). In large cities or urban centres, economies of scale solve some of these issues as shipping mass quantities of fresh food reduces prices. However, remote or rural locations far from distribution lines and low in population cannot benefit from such opportunities. Location increases the cost of acquiring adequate healthy food and essentially forces lower income individuals to consume unhealthy, prepackaged, processed foods that are easier to transport and stay edible for longer.

To bring this into focus, let us contemplate the acquisition of food in present day Manitoba. Most Manitobans head to their supermarket of choice to stock up on food for the coming days, week or even longer. It is as simple as heading to a massive indoor warehouse, where each and every option is conveniently brought together in one place in order to create an efficient food acquisition process. This

Figure - 01

An example of the paradoxical nature of food transportation to naturally bountiful in traditional food locations



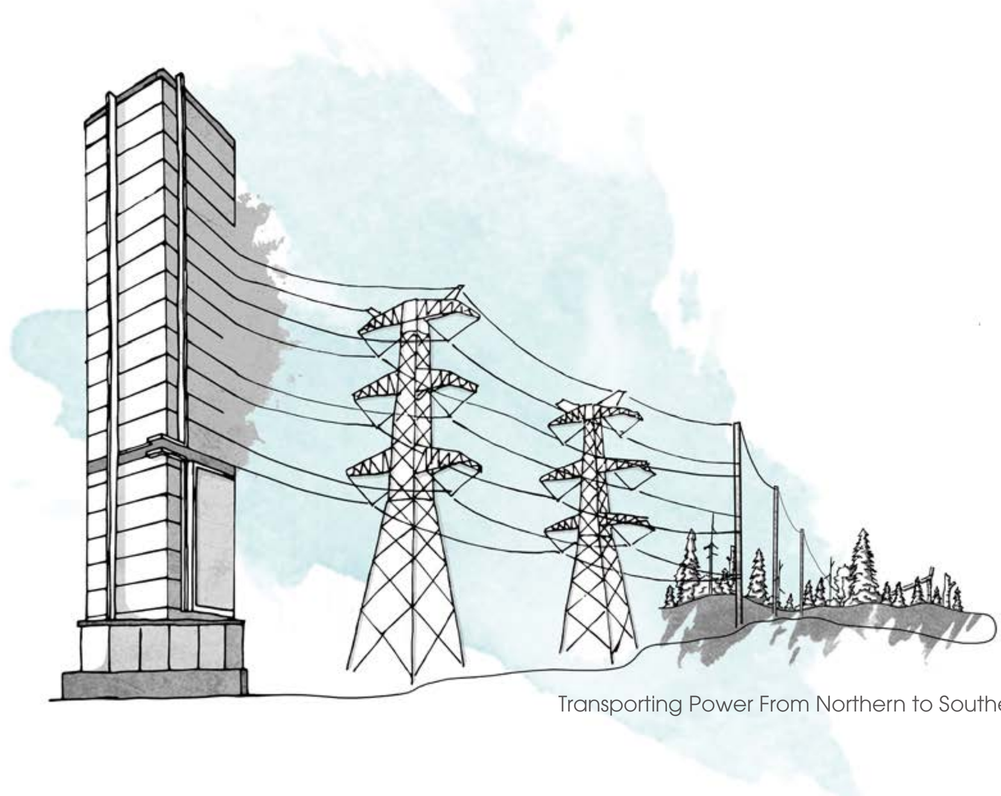
Hydro Power at the Cost of Floods and Destruction - 02

common practice works well in densely populated places such as Manitoba's south, where transportation infrastructure can readily supply supermarkets, keeping prices reasonable and providing peace of mind to residents as there is always food available.

In northern Manitoba, current day food acquisition can be slightly different. Since the vast majority of major transportation infrastructure runs east-west across southern Manitoba, northern communities suffer from the increased cost to transport goods to their stores along the low volume north-south supply line. This is noticeably higher in perishable goods, making healthy food choices much less affordable. However, people living in this region do not necessarily rely solely on supermarkets for food. Through foraging, trapping, fishing and hunting, many northern peoples, families and communities have found success in supplementing their diets. This is especially true in some Indigenous communities where these practices are an important part of their culture (Arthurson, Personal Communication, 2020), Sowerwine, 2019). In addition to gathering important traditional foods and herbs, the process of obtaining food is a fundamental practice through which children, parents and grandparents interact. It is a way of passing on knowledge and of bonding. Furthermore, success in gathering these foods can mean abundance for family and community. Food is shared amongst a larger group of people and more than the edible parts of the animal are used. Ideally in the present day, these continued practices would supplement and create a balance with acquiring food from a local supermarket. In reality, these practices have been disrupted in many Indigenous communities, due to

the industrial infrastructure of Manitoba Hydro leading to destruction, displacement and pollution of traditional lands (Nikiforuk, 2018, Manitoba Hydro, 2014, Kulchyski, 2012).

In remote Manitoba, where Manitoba Hydro developments benefit the majority of provincial residents and directly negatively impact a small minority, does it make sense to create living conditions which are less than favourable for the few in comparison with the highly populated urban centres? Is it just to displace entire peoples, alter their landscape beyond recognition and expect them to thrive without support? Manitoba Hydro, when viewed through the lens of a resident from these communities, may be construed as a parasite, extracting resources and giving little back. The word parasite is derived from the Greek word parasitos, which means "a person who exploits the hospitality of [another]" (Merriam Webster, 2022, par. 3). The origin of the word is even more apt at describing the situation in which Manitoba Hydro has exploited the resources of northern Indigenous communities. In some circumstances, these communities are simply surviving. Indigenous communities have been given access to the bare minimum "three necessities" in order to live but not much more (Anon, 2018). How can a balance be struck once more where they are able to supplement their diets and grow their own food in addition to food imported from southern Manitoba, enabling them to thrive instead of survive? Facilitating a shift towards this reality could bring a resurgence of food security (Council of Canadian Academies, 2014, Sowerwine, 2019) and renew a sense of place for northern Indigenous communities (Relph, 1976). This is exactly what will be explored, analysed and developed in the following practicum.



Ironic Celebration of Manitoba Hydro - Charlie Johnston - 04

Statement of Purpose

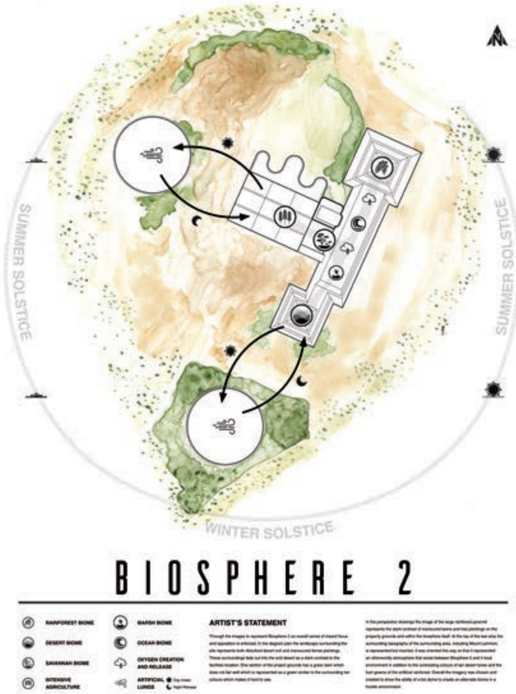
In the 21st century electricity enables almost every daily function individuals rely on to accomplish their daily tasks. Electricity is called upon to operate alarm clocks, power light fixtures, brew coffee, refrigerate your food, automate access to hot water, operate traffic lights, power computers/phones/televisions/servers and access the internet, to name only a handful of functions. In Manitoba, this revolutionary resource is primarily produced by a vast industrial network of hydroelectric generating stations heavily concentrated in the northern reaches of the province. Over the past one hundred years, a series of control structures, notably dams and generating stations, have been constructed along the Nelson River system to increase the electricity production needed to meet rising demands. As a result, the province benefits from cheap and affordable electricity generated by a renewable energy source. Although northern hydro power provides great benefits, it also creates negative effects. Communities in proximity to hydro power structures have had their way of life negatively altered, while the majority of benefits the structures provide are experienced in southern Manitoba. Primarily it is Indigenous communities that have been impacted by ongoing issues including, displacement, polluted environments, cultural obliteration and isolation. In the past three decades Manitoba Hydro has developed guidelines to mitigate these issues by working with Indigenous and other local communities when constructing new generating stations in northern Manitoba. Additionally Manitoba Hydro has retroactively begun to mitigate the damage their structures have caused communities and the environment. Unfortunately, the method through which compensation and reparations are being made is not universally successful. I propose to develop an alternative strategy which Manitoba Hydro may use to better accomplish reconciliation with communities negatively impacted by their operations.

This practicum will focus on developing a landscape system through which an impacted community and environment will benefit through integration with the very hydrological structure at the root of such impacts. This will be conducted through a systems approach, where multiple proven and tested technological and ecological systems will be researched and appropriately woven into the existing system of the generating station and the chosen community. The aim of this system will be to create food security and sovereignty in the community and to return a sense of independence to a more equitable way of life. Additionally the design will focus on how this system can benefit the ecosystem and facilitate better relationships between Manitoba Hydro and northern communities. Precedents exist that support the idea of parasitic or symbiotic relationships being appended onto generating station systems. These precedents will be studied and analysed while developing an understanding of how they work and how they were implemented in order to support the purpose of this practicum. In the case of applying these precedents to hydro-electric generating stations, I propose to capture waste heat sources generated by the Manitoba Hydro infrastructure to facilitate food generation in greenhouses and to return the adjacent scarred landscape to operation in the form of a productive community space.

Figure - 04

Demonstrating the misunderstanding of current conditions in northern Manitoba as a result of Hydro development

Topics Case Study #1 - 05



Topics Case Study #2 - 06

Inspiration

Throughout my studies in Manitoba, I was continuously made aware of the radically inflated prices of perishable goods carried in northern communities in Manitoba. It seemed that after discovering this seeming injustice, that also made appearances in news articles over the years, that the problem would be properly addressed at some point. When I began exploring food generation in harsh climates as the topic I wanted to pursue for this practicum (see for example: Elkaim, 2016, Whitehouse, 2018 and Sjoberg, 2015), I had been reminded previously of this issue and its negative impacts such as food insecurity and increased health issues, and how little had been done to rectify it. Having briefly researched bio-domes and closed system tests linked to the landscape, I began researching the issue and to see what Landscape Architecture could lend in tackling the situation.

After initial research it became evident that northern Manitoba was indeed receiving support in regards to imbalanced issues facing their communities (Hutchison, Personal Communication, 2019, Manitoba Hydro, 2014) but some issues still persist (Council of Canadian Academies, 2014). Additionally the terrain altering actions of Manitoba Hydro became all the more apparent in how they have contributed to the issue of food insecurity and negative health effects (Manitoba Hydro, 2015, Brandson, 2018). These are the reasons for how I became interested in a parasitic form of landscape architecture that would prey off the waste resources of hydro-electric generating stations and benefit local communities. Only once the many possibilities of waste heat capture from hydro-electric generating stations became an option did this practicum begin to shift towards food generation as the primary function of a possible intervention

Figure - 05, 06, 07

Prior research and diagrams about bio-domes and closed systems

Topics Case Study #3 - 07

and facilitator.

Some communities in northern Canada have already begun to develop small greenhouses and bio-domes in which they successfully grow food for their community such as in Churchill (Whitehouse, 2018, MacIntosh, 2018). These operations are important as precedents due to their successful impact on food security. However I will be exploring, through a systems approach, how scaling up hydro facilities as productive landscapes will generate agency and growth within communities and offset the wider systemic environmental issues created by generating stations.

Methods

Descriptive Strategies will be the primary method through which preliminary research into the subject will be conducted, which involves research into the greenhouses, Manitoba Hydro and Indigenous communities as well as relevant technologies. Through this method a complete narrative gathered from a variety of sources (communications, books, government documents, news articles, maps, websites etc.) about the area will be ascertained. A simulation approach, described by Linda Groat and David Wang (2013), will further this research in the form of diagrammatic drawings. These drawings will model the chosen site's existing system and interactions between the ecological environment and the generating structure. A literature review will enhance the research process into the selected site and create a deep understanding of the approach being used. The review will focus on Manitoba Hydro development, history of northern Indigenous peoples and food security as well as the ecological and cultural impact of hydro-electric structures and environmental systems both pre and post hydro-electric disturbance.

Concluding Commentary

Overall the goal of this practicum will be to explore the issues northern Indigenous communities face as a result of hydro-electric development, and synthesize a method to facilitate food security for these communities through systems-integration with the hydro-electric network creating a mutualistic relationship that by definition no longer only benefits one, but both entities (Merriam Webster, 2022). The aim is to alter the imbalance between Manitoba Hydro operations and northern communities shifting from a parasitic relationship to a mutualistic one.

2 - Intake

The intake on a hydro dam is where the water is brought to a point for use in generating electricity. Out of the vast reservoir, a small sum of its total volume of water is funnelled and channelled, to be used in creating energy. This chapter will be the intake, through which the required knowledge will be acquired in order lay the basis for analysis and design.

Introduction

This chapter will explore the background of the work this practicum has set out to accomplish through a literature review. In order to explore enabling food security and designing a mutualistic relationship between Manitoba Hydro and an affected community, the history of how the current situation occurred will be important to understand. For the purposes of this practicum, Fox Lake Cree Nation has been chosen as the focus community because it is extremely remote, and because of its proximity to the largest generating station in Manitoba, Limestone Generating Station. As a result, Manitoba Hydro's development and Fox Lake's history will be important to understand before moving forward in this practicum. Additionally, due to food security being the primary focus of the practicum, its history as a concept and impact on Indigeneous peoples specifically will be thoroughly investigated.

Manitoba Hydro, an Overview

Manitoba Hydro (MH) supplies homes, businesses, infrastructure, and industry in Manitoba with electricity. The majority of this electricity is generated using hydro-electric generating stations situated on waterways throughout Manitoba. Of these many generating stations, the largest, and most important in terms of generating capacity, have been constructed in northern Manitoba, deep into the Canadian Shield (Hutchison, Personal Communication, 2019). Canadian Shield, a rocky undulating boreal ecosystem, has an abundance of natural topography and powerful water bodies that have attracted the majority of generating stations in Manitoba due to their cost-effectiveness when it comes to electricity production. This cost-effectiveness is mainly due to the power of the Nelson River, accentuated by carefully placed control structures to reverse the Churchill River and increase the potential for hydro generation (Hutchison, Personal Communication, 2019). As a result, Manitoba Hydro development has yielded great benefit to the province and the people it serves as a utility (Hutchison, Personal Communication, 2019). However, hydro-electric generating stations have irreversibly altered the ecosystems in northern Manitoba, and fundamentally changed the way of life for Indigenous peoples across the northern region through displacement, and restrictive living conditions (Manitoba Hydro, 2014). In order to understand the impact of and the power generating system in Manitoba on a deeper level, the following is a brief history of Manitoba Hydro development as well as the environmental and Indigenous impacts it has and continues to generate.

Figure - 12,13

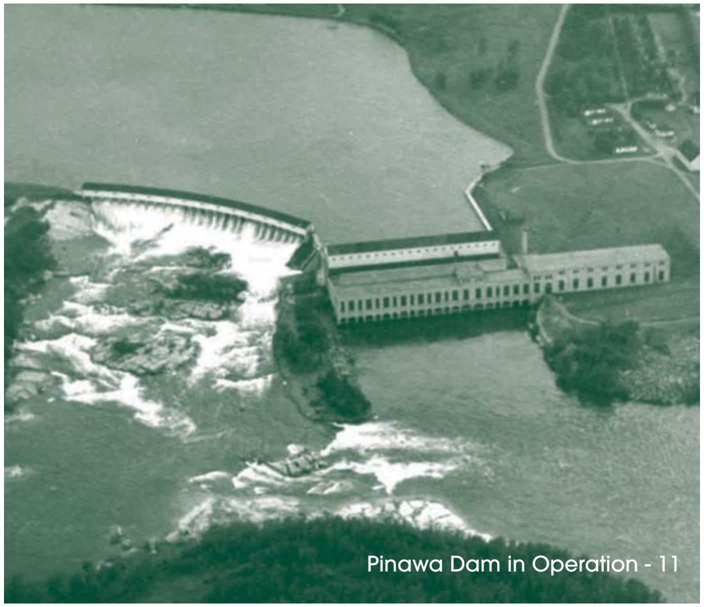
Current major Manitoba Hydro infrastructure and impacted watersheds

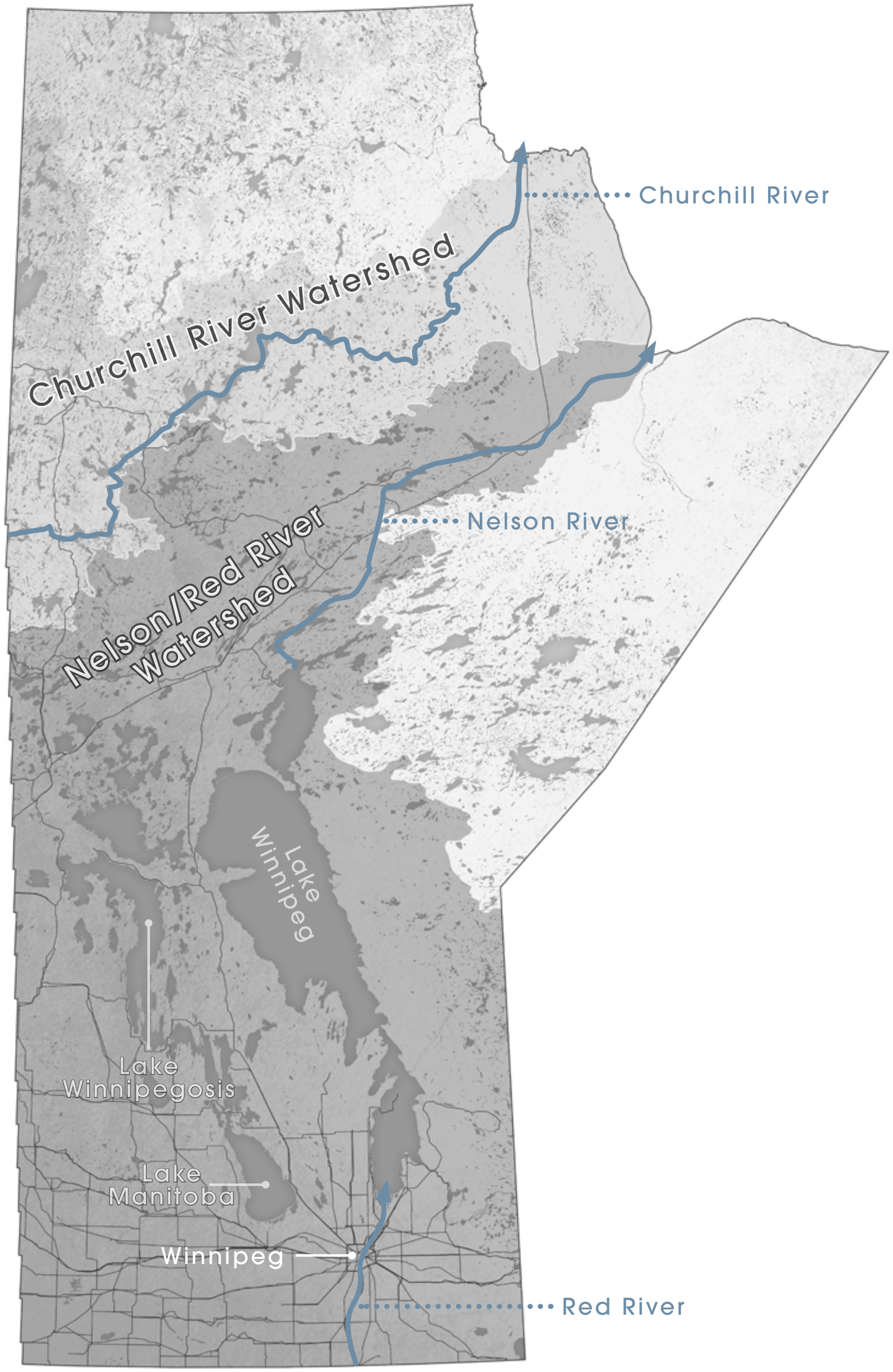
Electricity in Manitoba, a Brief History

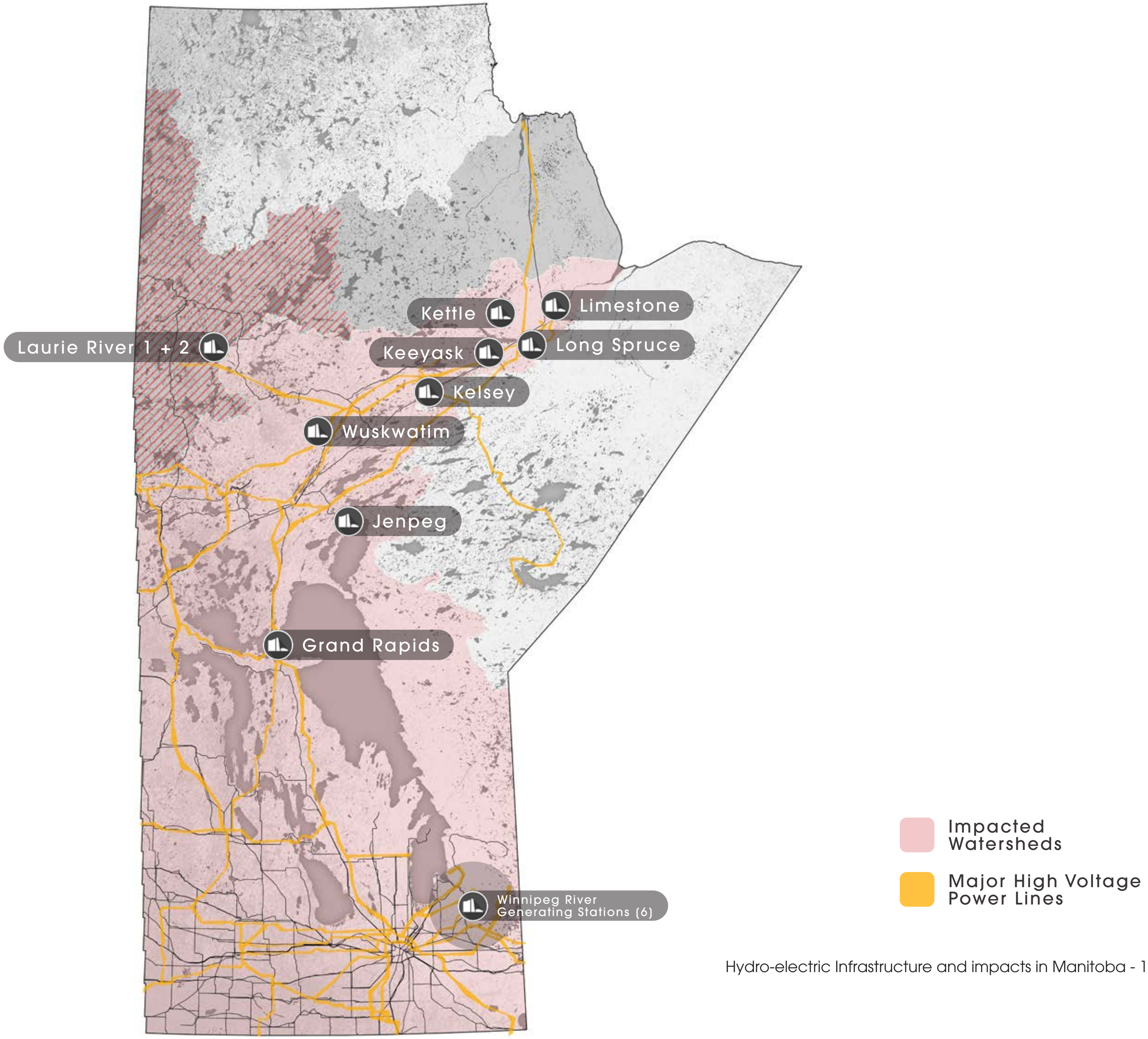
Electricity generation in Manitoba began in the late 1800's with the incorporation of the Manitoba Electric & Gas Light Company in Winnipeg. Soon after electric lighting was used to replace gas throughout the streets of Winnipeg and to power streetcars. This was accomplished through the operation of steam engines located in Winnipeg, and although relatively small in scale compared to today's electricity fueled world, electricity had officially come to Manitoba (Manitoba Hydro, n.d.). By 1889, electricity was being generated and supplied to towns and cities across southern Manitoba by organizations such as the North West Electric Company LTD., or the Brandon Electric Light Company LTD. (Manitoba Hydro, n.d.). However, these locations were still serviced by relatively small and localized generating plants. As demand for electricity continued to rise, high output electricity generation became the focus in Manitoba and led to the development of larger capacity power plants. As a result, in 1900, the first hydro-electric generating station in Manitoba began operation, providing electricity to Brandon from the Minnedosa River (now known as the Little Saskatchewan River). The success of this generating station set a precedent in the province which led to an influx of new hydro-electric plants throughout the early 20th century. The Manitoba Power Commission, was established in 1919 through new provincial legislation and began constructing new generating facilities as well as acquiring ownership of existing ones as a centralized electrical utility through amalgamation.The Manitoba Power Commission continued to increase the generating capacity in the province in this way until the 1950's when they expanded operations into northern Manitoba in cooperation with the newly minted Manitoba Hydro-Electric Board by constructing massive hydro-electric generating stations to meet the ever increasing electrical demand. Shortly after the expansion into northern Manitoba, the provincial government formed Manitoba Hydro by combining the Manitoba Power Commission and the Manitoba Hydro-Electric Board into one entity to oversee all power generation in Manitoba in 1961. The companies who became Manitoba Hydro were able to expand operations into the north due to the desire of the remaining Indigenous Peoples residing there for inclusion in the Federal treaties their southern kin had acquired, which resulted in the remaining non-signatory Indigenous communities being given the opportunity to adhere to Treaty 5 (Filice, 2016). As a result they were given similar treaty conditions in exchange for yielding to the arrival of hydro development in their region. At times, ongoing construction of generating stations were put on hold as demand plateaued after the industrious boom following the end of World War II (Hutchison, Personal Communication, 2019). However, demand always returned, and construction of new hydro-electric generating stations continues to this day. The network of northern generating stations led to massive success by Hydro as a supplier of cost effective and dependable electricity (Hutchison, Personal Communication, 2019). Through multiple amalgamations and mergers, Manitoba Hydro has become the sole electricity utility in the province after a cummulative century of operation. Manitoba Hydro now manages the entire province's electrical load and sells excess electricity to other provinces and states, reducing the cost to Manitobans (Hutchison, Personal Communication, 2019). This success however, comes with a price. The massive electrical generation currently occurring in the north ultimately results in detrimental environmental impacts and, the decline of health and wellbeing in local northern communities.


Brandon Thermal Plant - 10


Installation of Power Lines - 09


Pinawa Dam in Operation - 11


Churchill River
Churchill River Watershed
Nelson River
Nelson/Red River Watershed
Lake Winnipeg
Lake Winnipegosis
Lake Manitoba
Winnipeg
Red River



Hydro-electric Infrastructure and impacts in Manitoba - 13

Environmental Impacts of Hydro Power

Negative environmental impacts are not often associated with hydro-electric generating stations (Rupert, 2014). It is likely that being labelled as a renewable power source hydro-electric generating stations are mistakenly lumped in with other sources of green energy, such as wind and solar. In broad terms, green energy is considered to be generated while having negligible or no impact to the environment (Nikiforuk, 2018). However, this is not the case with hydro power. While not as damaging as fossil fueled energy generation, hydro-electric generating stations generate a myriad of environmentally damaging effects. The reason for this misconception can be tied to the lack of direct evidence of environmental impacts, as there is no visibly obvious discharge of pollution or by-products coming from the dams themselves (Rupert, 2014). However, they do exist, and the impacts, although not as visible as other methods of electricity generation, are heavily felt in the northern region and immediate watersheds. These impacts vary in scale and intensity due to a variety of factors. To mention a few, the size of the dam, existing river conditions, location, type of generation or generation process, etc, can all affect the environmental impact outcomes of a generating station. Taking these factors into account can make the resulting impacts minimal or manageable if considered from the outset (Hutchison, Personal Communication, 2019). However, this newer knowledge does not change the impacts still impacting the environment from the majority of Manitoba's existing generating stations. The effects of these environmental impacts in Manitoba are still being felt by the local environment which include contributions to climate change and the destruction of ecosystems and loss of biodiversity.

In the case of climate change impact, hydro-electric generating stations contribute in two major ways. One is in the creation of the structures themselves. Constructing a hydro-electric structure, especially the kind that span and dam large powerful rivers, generate a large carbon footprint in the mobilization, clearing of land in preparation as well as the large investment of concrete into the controlling structures (Rupert, 2014). For example, a study in China found that the construction materials creation, transportation and implementation alone can equal 56% of the total carbon footprint during the life cycle of the dam (Zhang, 2015, p.857). In applying Zhang's case study to the largest dam in Manitoba (Limestone Generating Station), the material carbon footprint is equivalent to approximately 1,000,000 tonnes of CO2 (Zhang, 2015, p. 856-857). The other is in the widespread change to the regional landscape through flooded and drained lands. These impacts negatively impact many aspects of the immediate environment around the hydro-electric structures, however the flooding and draining of previously otherwise dry or submerged lands both releases long resting sediments into the river and dries out potentially ancient carbon sinks respectively. In Quebec for example, the initial flood induced carbon emissions as a result of dam construction and implementation, has been found to be 15-77% higher than an equivalent thermal power plant (Teodoru, 2012, p.11). The flooding of lands results in unwanted sediments and minerals seeping into the river or reservoir, harming the ecosystem as well as creating uncontrolled erosion in landforms and environments with inadequate natural erosion control in the form of riparian forests (Hutchison, Personal Communication, 2019)). As a result, Manitoba Hydro constantly needs to monitor the mercury levels in all water bodies associated with hydro-electric generating stations as this is one of the primary issues that occurs stemming from the construction and subsequent flooding of a hydro dam (Manitoba Hydro, 2015). This is a direct result of reservoir creation and flooding of previously unsubmerged lands (Manitoba Hydro, 2014, p.81). Mercury is deposited naturally in the soil via the carbon cycle, accentuated through the burning of fossil fuels globally, and the flooding of these lands releases it into the ecosystem where it impact the food chain (Lockwood, 2016). Additionally, the drainage of carbon sink heavy ecosystems catalyzes the release of long sequestered carbon into the atmosphere and disrupts the natural carbon system (Hutchison, Personal Communication, 2019)). Overall, Manitoba Hydro's developments over the last century have created these issues for large portions of the province's northern landscape, displacing ancient shorelines and releasing harmful elements, and as a result altered the endemic balance of the boreal shield ecosystem.

The destruction of ecosystems and resulting loss of biodiversity is another effect that hydro-electric generating stations in Manitoba create. A large portion of this effect is linked to the flooding and draining of lands as previously discussed (Nikiforuk, 2018). As these long-standing ecosystems are altered or eliminated, through flooding and draining, the biodiversity they once supported suffers as a result of habitat loss (Rupert, 2014). It is well known that species will die out or be displaced as a result of these changes stemming from the wake of constructing new generating stations. According to Manitoba Hydro's recent Regional Cumulative Effects Assessment, biodiversity has been impacted the most along the shoreline conditions, and as a result habitat and biodiversity loss have been heavy in these impacted areas (2015). It is also important to note that shoreline conditions, although a small area compared to the entirety of the region, are the most important habitats as many animals use them as corridors of travel, or to find the majority of their sustenance (Manitoba Hydro, 2015). A broader impact can be found in species with migratory patterns or that interact with the river itself. Generating stations, which dam rivers and water bodies, sever established migratory routes for fish, birds, and mammals, and force beavers inland (Manitoba Hydro, 2014). Finally, hydrological control structures divide upstream and downstream environments and block common river crossings by making the water too wide for local and migratory animals including moose and caribou to cross (Rupert, 2014., Manitoba Hydro, 2015).

Keeyask Dam Under Construction #1 - 14

Keeyask Dam Under Construction #2 - 15

Robert Spence Working His Trapline - Aaron Elkaim - 16

Societal/Cultural Impacts of Hydro Power

Hydro-electric projects affect nearby residents and communities. Although some impacts are tied to the environmental effects mentioned previously, the additional socio-economic issues stemming from hydro-electric structures have heavy consequences as well. In the following paragraphs these impacts will be articulated and expanded upon. As they are explored, it is important to understand that although these impacts were known (and have continued to be known), nearby communities have been compensated very little in the past for their troubles (Hutchison, Personal Communication, 2019). Recently, Manitoba Hydro has made effective efforts to begin repairing the damage generating stations have caused to these communities. Going past merely monetarily compensating the communities, Hydro has begun to form bonds with and to help to improve the quality of life these communities deserve and desire (Hutchison, Personal Communication, 2019)). Recent efforts by Manitoba Hydro show promise that future hydro-electric projects could focus on mitigating past negative impacts. However, communities are still feeling the impacts from existing generating stations and multiple courses of action are needed to compensate these wronged peoples. These impacts consist of societal, cultural and personal wellness issues and are a result of remote environmental effects.

The societal impacts of hydro-electric generating stations can be both positive and negative. Positive impacts include job creation and access to greener continuous electricity as opposed to remote diesel power-plants (Hutchison, Personal Communication, 2019)). However, job creation has a temporary positive impact as the job capacity shrinks to a small number on site once construction ends. Negative impacts consist primarily of community relocation and economic changes on a societal level. Some hydro-electric projects displace multiple communities due to flooding caused by the constructing of mega structures. Other times jobs and community economic structures are altered due to the elimination of access to certain industries (such as fishing or logging). For example, members of Tataskweyak Cree Nation who once made a living by fishing on a commercial scale, have had to abandon the career due to the declining fish population and quality stemming from the long term impacts of Manitoba Hydro's development (Elkaim, 2020). In northern Manitoba, this has especially impacted Indigenous communities such as the Nisichawayasihk, Norway House and Fox Lake Cree Nation (Brandson, 2018, Arthurson, Personal Communication, 2020). These communities are a few examples of how Indigenous peoples in Manitoba have been negatively impacted by Manitoba Hydro and their increasing development over time. In order to fully understand why the effects of such development on these Indigenous communities is unjust, the story of how electrical generation broke ground in their territories should be explored.

This story begins with the signing of Treaty 5. The promise of resource extraction in northern Manitoba is one of the main factors for why Treaty 5 was created in the first place (Filice, 2016). Soon after the signings of the four previous treaties, Indigenous communities of northern Manitoba began seeking out a similar deal after seeing the benefits their neighbours to the south were enjoying (Filice, 2016). At first they were unsuccessful, due to the fact that the federal government had no immediate incentive in acquiring such a treaty. The area was not ideal for agriculture and would only be an asset in the future for resource extraction. As a result the Indigenous people who initially signed Treaty 5 had far less negotiating power which resulted in a far lower compensation package for those communities than their southern neighbours (Filice, 2016). For example, each Indigenous family bound to the agreement received a quarter of the land when compared to the families of Treaty 3 and 4 (Filice, 2016). Many Indigenous communities did not initially sign onto Treaty 5 because of the terms or because they were not invited to do so (Filice, 2016). However, when the feasibility of high capacity hydro-electric electrical generation was proven and highly desirable, the government vigorously sought out the remaining northern Indigenous communities to adhere to the treaty. Following becoming a signatory of Treaty 5, Indigenous communities were displaced into living within strict reserve limits where they were still free to hunt fish and do as they pleased, however the government reserved the right to development on their land as long as they properly compensated the communities signed to the treaty. Additionally the structure of their society was altered as a result of "opening up" northern Manitoba to be industrially exploited, including the development of vast hydro-electric generating systems, such as the flow reversal of the Churchill River and heavy damming of the Nelson River (Hutchison, Personal Communication, 2019)) as well as the steady and regulated supply of foreign supplies such as alcohol (Filice, 2016). The impact of displacement, resulting in a change of societal functions, began to alter the very essence of who the community signatories of Treaty 5 were as a people. Overall the impact is well summed up by Chief Chris Baker's (of O-Pipon-Na-Piwin Cree Nation) powerful response regarding Manitoba Hydro's displacement of his community "These things are hidden and covered, and not very many Manitobans realize the devastation that occurred and what took place, and the disruption of our lives" (CBC, 2018, par. 18).

The cultural impacts generated by Manitoba's hydro-electric projects are some of the most damaging for local people. Important destinations and landmarks to the local people are altered or destroyed, and the traditions that accompanied them are lost or never recovered (Manitoba Hydro, 2015). In Split Lake, elders have commented about how, due to the polluted and rip-rap edged waterbodies, the upcoming generations will never be able to enjoy the shoreline in the way that they did, playing, swimming and catching crayfish (Elkaim, 2020). Manitoba's northern Indigenous communities feel this impact specifically through the loss of traditional hunting/trapping routes and important cultural destinations. Fox Lake Cree Nation's

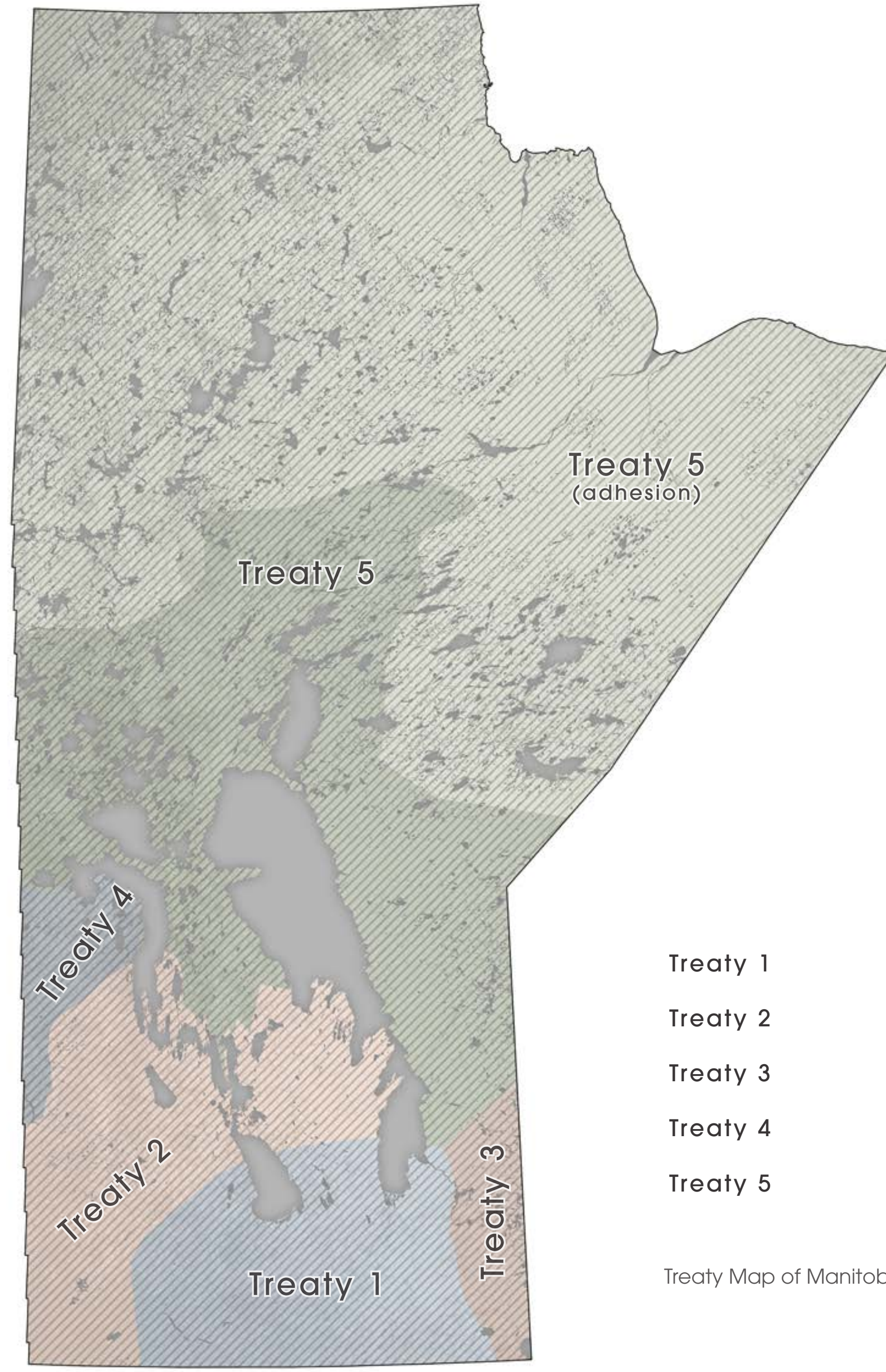
Figure - 17

Treaty map of Manitoba

peoples state that they and their ancestors have always called the Nelson River and surrounding area their home, their place of being (2015). As a result of the massive hydro-electric network of structures in northern Manitoba, the Nelson River Basin and more specifically the river itself is now unrecognizable to the communities. The river used to be pristine, and a source of sustenance. Today, it is full of sediments, harmful minerals and debris (Manitoba Hydro, 2014). The river used to naturally eb and flow in according to the yearly conditions. Now the water levels are heavily controlled to create a steady and efficient source of power for the electrical grid with few benefits to the local community (Hutchison, Personal Communication, 2019), Manitoba Hydro, 2015, Rupert, 2014). Access to the river is no longer the same. Flooded and drained lands make interacting with the river through canoeing, boating, snowmobiling and hiking difficult if not dangerous due to increased debris in the water and ice freeze less consistent or observable (Manitoba Hydro, 2015). Traditional routes and destinations, now lost, once allowed communities in the past to interact and form strong bonds intergenerationally within and between families by hunting, fishing and gathering alongside one another (Sowerwine, 2019). This is a common thread in traditional Indigenous cultures: the passing of knowledge from the elderly or older generations is what helps to bind society and people together. When these aspects of Indigenous culture are compromised, the bonds between families and with neighbours are weakened, and access to the wisdom of the older generations is severed (2019). In a conversation with Conway Arthurson, a member of Fox Lake Cree Nation, he acknowledges the changes his community has felt as a result of hydro-electric development, however he stated that he and his community strive to move on and build lasting relationships with Manitoba Hydro and the nearby community of Gillam, in order to thrive together in the future (Arthurson, Personal Communication, 2020). Fox Lake and other communities impacted by Manitoba Hydro's development are looking to the future and how they can acquire a quality of life they desire and rightly deserve as a result of the hardships imposed upon them in the past.

Personal health and wellness are also impacted by hydro-electric generating stations. The displacement of people from their homes and traditional lands is a factor affecting wellbeing in communities. Firstly, displacement of communities as the result of hydro-electric generating stations being constructed, and the resulting environmental damage, impacts people's wellbeing through loss of access to ancestral lands. Not only is displacement a temporary burden of relocation imposed upon the people of a community, the relocation of an entire community (let alone a single household) terminates a sense of and connection to home/place. A sense of place is built up over generations and is influenced by experiences and interactions occurring amongst people sharing an environment. In Manitoba's Indigenous communities who have been displaced, or had their traditional lands submerged or altered, the feeling of loss in regards to sense of place rings especially true. A teacher from Tataskweyak Cree Nation expressed that her "grandkids, will never see what Split Lake was like" as a result of extensive flooding which has submerged many important traditional places they used to enjoy, such as beaches and trails or paths to reach the water (CBC, 2018, par. 24). Furthermore, a sense of place cannot "be described simply in terms of... location or appearance" and instead is perceived through "setting, landscape, ritual, routine, other people, personal experiences, care and concern for home..." (Relph, 1976, p.29). It is important to understand this when talking about the loss of home for Indigenous communities. Loss of home can disrupt rituals, and important connections to a place, potentially leaving people without the means to ground themselves in their life and landscape, thus impacting their wellbeing (Rupert, 2014) (Manitoba Hydro, 2015). Particularly in remote communities in Manitoba, displacement and loss of one's home can have increased harmful effects on wellbeing. These effects are driven by the activities more often occurring in remote settings, such as hunting, hiking and other outdoor environmental programs.

Hunting for example both provides a means of exercise as well as a steady source of healthy sustenance (Sowerwine, 2019) (Council of Canadian Academies, 2014). After being displaced however, the unfamiliarity or lack of access to hunting routes or grounds can lead to a more sedentary life in comparison. As a result, this shift has been linked to increased rates of diet-sensitive chronic diseases and micronutrient deficiencies in northern Indigenous peoples (Council of Canadian Academies, 2014, p.21). Overall, displacement has a major negative impact on displaced communities in regards to hydro-electric development and should be thoroughly considered and planned for in order to mitigate or eliminate the issues displacement causes.



Treaty 1	1871
Treaty 2	1871
Treaty 3	1873
Treaty 4	1874
Treaty 5	1875

Treaty Map of Manitoba - 17

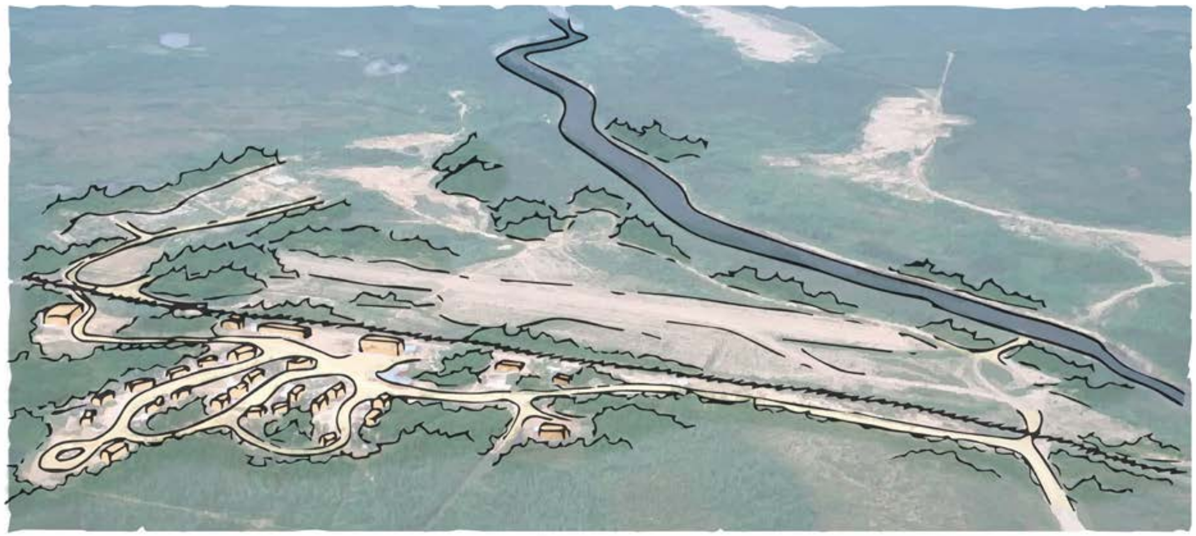
Fox Lake Cree Nation, a Brief History

Fox Lake Cree Nation (FLCN), also known as Makaso Sakahigan, is a small Indigenous community with the main reserve located approximately 40 minutes north of Gillam Manitoba. Nearby is the Limestone Generating Station, approximately five kilometers west of the community. FLCN is home to around 150 residents who live on the reserve, but community members also reside nearby in the town of Gillam, in the area surrounding the community, and elsewhere in the province, bringing the total population of FLCN to just over a thousand members (Statistics Canada, 2020). This reserve is one of the most remote in all of Manitoba and is accessed by reaching the end of one of the northmost roads of the provincial highway system, Provincial Road 290. A combination of a low resident population and being one of the most remote locations in the province makes this reserve especially susceptible to the compounding problems of hydro-electric developmental impacts and remote community issues such as food insecurity.

FLCN identifies as the descendants of the Indigenous Cree peoples of Canada (FLCN, 2015). The Cree originated in the area surrounding James Bay and have lived in the rocky undulating boreal forest spanning from northern Ontario to Alberta since the last ice age. Traditionally they were a nomadic people who followed the migrational patterns of the game animals. Moose, caribou and rabbit were the predominant prey hunted in traditional Cree communities and as a result the practice of hunting and trapping them became an important axis around which their way of life revolved (Preston, 2012, Reynar, 2015). Geese, ducks and fish supplemented their supply of food. Traditional homes were made of animal skin clad structures of various shapes and the people traveled by canoe, or snowshoe and toboggan throughout the year. During the summers they would gather to socialize as larger groups then split into smaller hunting groups during the winter months in order to efficiently hunt and gather resources (Preston, 2012).

Upon colonial arrival, many Cree chose to reside in the more western and northern extents of their traditionally occupied territories where they continued to live a life similar to before the arrival of the Europeans (Preston, 2012). Many Cree groups interacted and traded actively with the Europeans, gaining valuable resources such as horses and metal tools which began to impact society. Their society was defined by their fully committed belief that people and the natural world are inherently intertwined and that physical and mental wellbeing is found through “balance with nature” (Preston, 2012). Additionally important was the cultural view of food, and how it was a resource which they would individually share with others equally in times of famine as well as prosperity ensuring the collective survival and wellbeing of the community.

In the wake of Treaties 1-4 in the late 19th century, various Indigenous peoples, primarily in what is now northern Manitoba, expressed interest in obtaining a similar agreement to their southern neighbours and reaping the potential benefits that came with resolving land and resource ownership. In 1876 Treaty 5 was signed between the Government of Canada and the Indigenous peoples of this northern area, made up of primarily Ojibway and Swampy Cree nations (Filice, 2016). However not all people north of Lake Winnipeg were included in the treaty. Indigenous groups in the far north were considered to be “not a priority for the government” (Filice, 2016) due to the less than desirable lands they resided on in terms of agricultural feasibility and accessibility to bountiful resource extractable commodities. The Canadian Government had more negotiating power as they had less of an incentive in acquiring a treaty for these lands which resulted in the terms of Treaty 5 being far less beneficial to the Indigenous signatories than earlier treaties (as previously mentioned). Fox Lake Cree Nation was not included in the original Treaty 5. By the early 20th century, the Canadian Government became increasingly interested in the natural mineral resources of the northern reaches of Canada and sought out the unceded Indigenous Peoples to adhere to the treaty.



Fox Lake Cree Nation, Bird Reserve - 18

Again, not all peoples were added to the treaty and Fox Lake was only added as a member of the treaty (and recognized as an independent nation) in 1947 (Fox Lake Cree Nation, 2015). Coincidentally, in the decades following, the three largest hydro-electric generating stations in Manitoba were erected in close proximity to the Bird Reserve (FLCN's main reserve). Since the dam's construction FLCN has been heavily impacted due to the subsequent loss of traditional hunting and trapping routes as well as traditionally important locations primarily due to flooding and unsafe river conditions such as increased debris and thin ice conditions (Manitoba Hydro, 2015).

Today, reconciliation efforts have begun to take effect for Fox Lake. Compensations and aid efforts have, in part, been made (Manitoba Hydro, 2014) (Arthurson, Personal Communication, 2020)) such as monetary investment into the community to help develop a school and create a community foothold in the nearby town of Gillam to facilitate interaction and engagement (Arthurson, Personal Communication, 2020). Additionally efforts are being made to work with FLCN to identify and repair severed traditional hunting, trapping and fishing areas (Manitoba Hydro, 2014, Hutchison, Personal Communication, 2019). However, these efforts fall short of facilitating the quality of life the majority of Manitobans enjoy. Monetary compensation and increased ecological efforts are far from sufficient for a community who is struggling in an isolated societal/economical environment. Fox Lake deserves more, needs more, and is actively in negotiations with how to attain a quality of life that will let them thrive and heal (Arthurson, Personal Communication, 2020)). Arthurson, believes his community can accomplish the way of life they desire through building connections and relationships with their neighbours so that all can benefit from each other's expertise, resources and future developments as he believes that northern Manitoban communities need to work with one another in order to thrive (Personal Communication, 2020).

Food Security + Remote Indigenous Communities

In 1948 the Universal Declaration of Human Rights, published by the United Nations stated in article 25 that all people have the right "...to a standard of living adequate for the health and well-being of himself and of his family..." (UN, 1948) which includes access to adequate and healthy food. Since the publication of UDHR many Canadians have come to enjoy this right and are consistently food secure. However, some people and some communities in Canada continue to struggle with providing their families with adequate and healthy food (Council of Canadian Academies, 2014). These individuals and communities are identified as being food insecure, a condition which can generate or contribute to a multitude of additional issues. In order to satisfy the human right to food, research shows that establishing food security is the most important factor and that it undoubtedly improves quality of life and comprehensive wellbeing (2014). In order to fully understand how food security facilitates the right to food we must first define what food insecurity is and the methods through which it negatively impacts people and communities. Food security is a complex concept with many factors determining whether a person or community exists within that condition. As a result, the definition of food security does not fall into "black and white" categories, meaning differing levels of food security can exist for an individual or a community.

What is Food Security

When stripped down to the core principles, food security can best be defined as being "when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life" (FAO,1996 par. 11). This is an important definition, as it states that not only is food both affordable and available, but also that food must satisfy a community's choice in food, such as having access to traditional and culturally specific foods. As a result, food security as a condition is not rectified by simply supplying a community with the required amount of food. This notion directly targets a holistic view of what it means to be healthy and as such, achieving food security in a community has been known to mend a diverse array of issues (Council of Canadian Academies, 2014) (Sowerwine, 2019). For example, a few benefits tied to establishing food security are fewer chronic diseases, better general health, wellbeing, fewer physical injuries, increased community interconnectedness, increased community identity, and increased economic stability (Council of Canadian Academies, 2014) (Sowerwine, 2019).

Food Sovereignty - Robust Food Security

Within the concept of food security, there are varying philosophies and methods through which it is accomplished. An emerging consensus amongst experts in this field is that food sovereignty as a method to achieve food security shows the most promise as a sustainable and long-term solution (Council of Canadian Academies, 2014). Food sovereignty can be defined as a community or group who has complete control over access and supply of food and can sufficiently supply themselves with healthy and culturally relevant options. As this guiding principle has gained traction, the United Nations came to endorse it as the impact and lasting effects of food security are extremely promising and, although a newer concept, the impact of food sovereignty is intensely felt in communities in which it is adopted (Council of Canadian Academies, 2014). Food sovereignty challenges the norm of food access, by taking different approaches to food distribution in communities. For example, in opposition to traditional colonial food structures in which a person works a paying job to afford food, a communal food sharing system could be more beneficial under different social and environmental conditions (Council of Canadian Academies, 2014, Filice, 2016). This may be especially true in small northern or isolated communities in Canada due to the inexistence of and lack of direct access to a traditional modern economy (Council of Canadian Academies, 2014) (Sowerwine, 2019). In these communities very few, if any people have the financial or skill related means to consistently, without assistance, acquire healthy and culturally significant food. As a result of a low population coupled with a minority of individuals able to achieve food security, the current practice of importing a majority share of an isolated community's food as a purchasable commodity is inadequate and unsustainable. This system could be improved through the continued import of food, but instead, distributed fairly amongst the community using capital from government grants or municipal assistance. However, it is still a great cost to import the entirety of a community's required food in remote locations and places remote communities in a vulnerable position in the event that deliveries are delayed or become unsustainable. Therefore using the principles of food sovereignty, remote communities should introduce local food generation efforts in order to break away from sole reliance on the import of their food supply.

Figure - 19

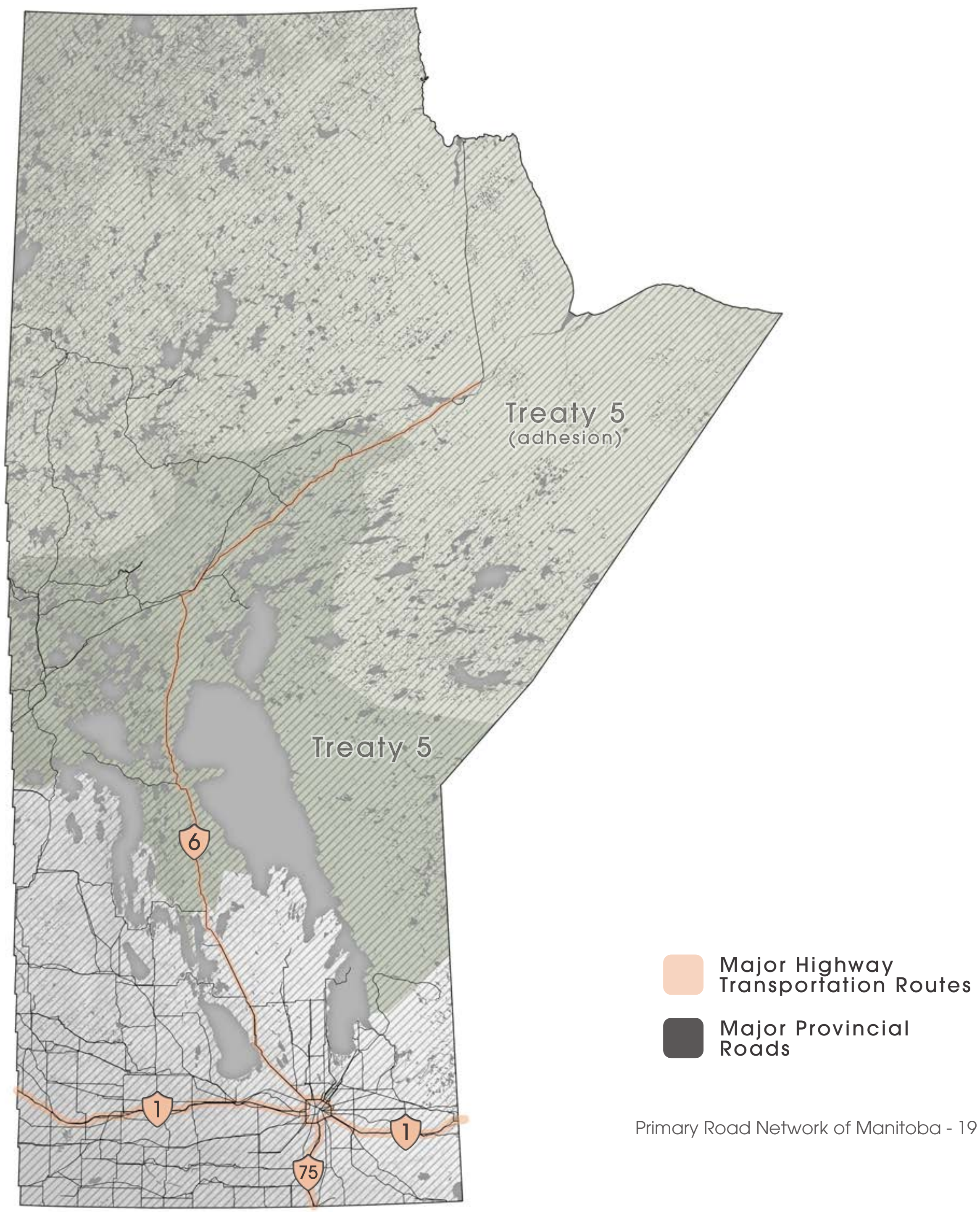
A map showing the existing transportation route infrastructure for food distribution in Manitoba

Food Security in Northern Canada

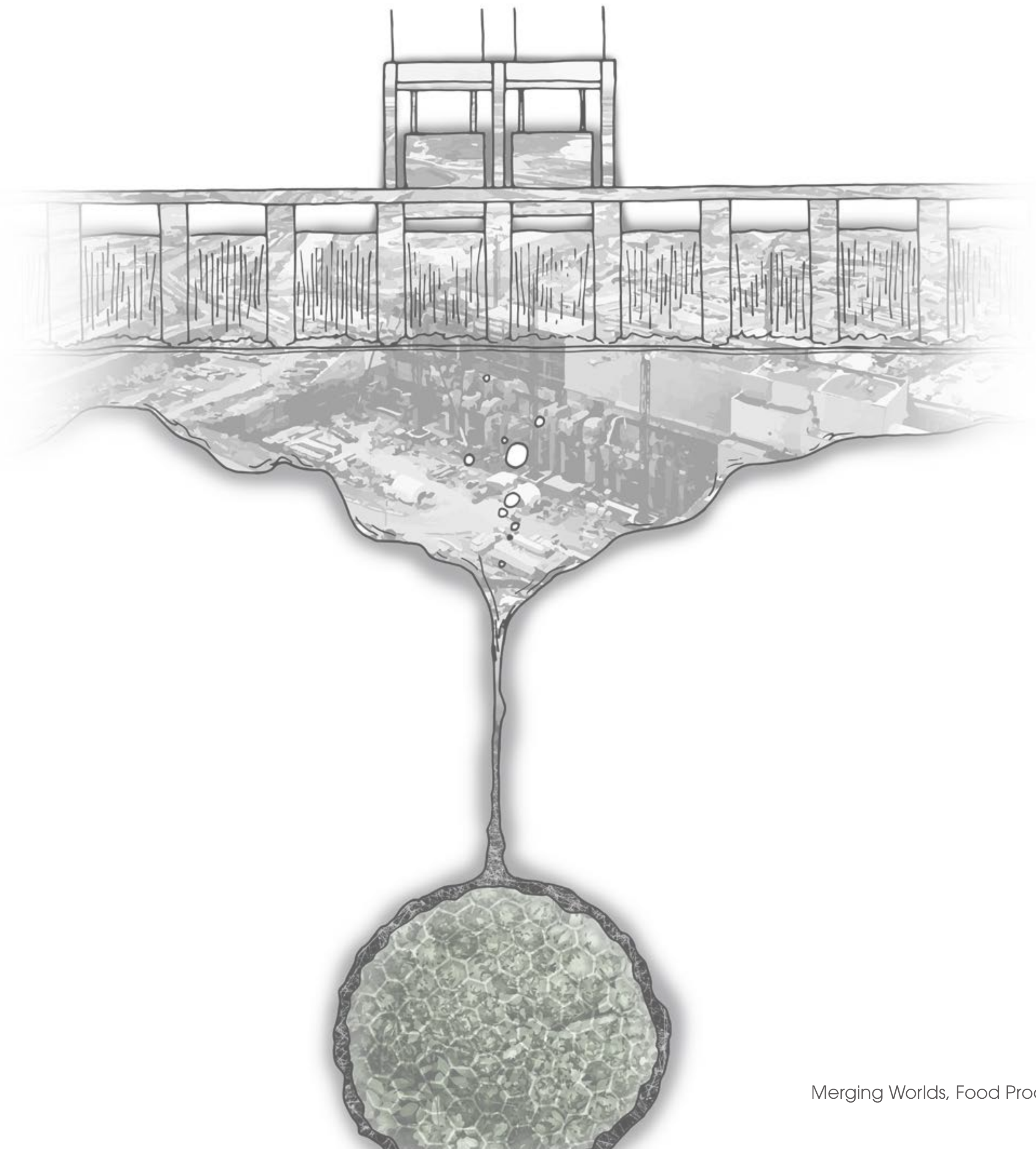
Geographical location has an impact on food security levels and has been found to directly correspond with higher levels of food insecurity (Council of Canadian Academies, 2014). Northern Manitoba falls into this category all too easily (Council of Canadian Academies, 2014). This has been found to be true when comparing northern Canadian communities to the Canadian average. Although food security levels vary based on a multitude of factors, some northern communities are considered to have less than a third of their population within the margins which are considered food secure, while the national average is above 90% (Council of Canadian Academies, 2014). This comparison reveals a major disparity in food security between southern and northern communities in Canada. As a result, the plethora of ailments, such as the increased chance of health issues, food insecurity imposes amongst communities are rampant in the north. Food insecurity and the resulting health issues have become synonymous with northern Canadian communities, however this practicum aims to use an understanding of these issues and how to facilitate food security and sovereignty in northern Manitoban communities.

Food Security in Indigenous Communites

Due to documented issues surrounding food security in northern Canada, from the state of knowledge assessment conducted by the Council of Canadian Academies, Indigenous communities in such places will undoubtedly face similar if not enhanced issues of their own. The reason for this can be summarized in the fact that although changed forever, the culture of Indigenous Peoples is intensely tied to the land in which they have inhabited for thousands of years. This includes methods of survival, transportation, dwelling and most importantly for this practicum, the food they eat and how it is acquired. For many Indigenous communities in North America, certain traditional foods are part of everyday culture and cyclical community events (Sowerwine, 2019). Sowerwine notes the widespread loss of this tradition as one of the main causes of negative health impacts in Indigenous communities and leads to food insecurity, due to the way indigenous cultures perceive a correlation between food, stewardship of the land and personal wellbeing (2019, p.580). She observes that although the loss of traditional foods in one of these communities may compromise physical wellbeing, it also equally negatively impacts the mental and spiritual wellbeing of the people because of the social and cultural importance of a non-colonial food system. In communities such as these, where the food system and cultural practices are heavily intertwined, the need for food sovereignty is elevated. In Manitoba, some communities once operated with a certain level of food sovereignty through their access to previously abundant fish populations. In South Indian Lake, the Fisher's Association stated "The lake whitefish population has crashed, the fishery has crashed, fish quality has been downgraded, SIL [Southern Indian Lake] can be described as a welfare state and the economy is in a tailspin," in their report Manitoba Hydro promised that the fish populations would be unaffected by their development (CBC, 2018, par. 16). Traditional foods for Indigenous peoples are not just healthy and important to provide, but also a way for intergenerational interaction to naturally occur and provide opportunities to cultivate intense connections with the land (Sowerwine, 2019). Indigenous peoples would traditionally acquire food as a community, the experienced would foster the inexperienced, creating opportunities for meaningful social connection in the family and broader community. This coupled with daily interaction throughout the surrounding landscape, forms the basis for many differing Indigenous cultures and can be a gateway through which food sovereignty and security can both improve physical and mental wellbeing.



Primary Road Network of Manitoba - 19



3 - Pumphouse

The pumphouse is where the conversion happens; where potential energy, after being controlled and directed, is transformed into electricity. This chapter will be where the potential of the site, gleaned from the reservoir and focused in the intake, will be transformed - transformed into ideas, theoretical systems and methods through which the practicum will accomplish its goals.

Introduction

In this chapter, methods of accomplishing food sovereignty in integration with a hydro dam will be explored. The technology of northern greenhouses, food growth in the north, and waste heat capture precedents will be presented with the goal of applying them to the Fox Lake Cree Nations and surrounding areas.

Food Generation in Northern Climates

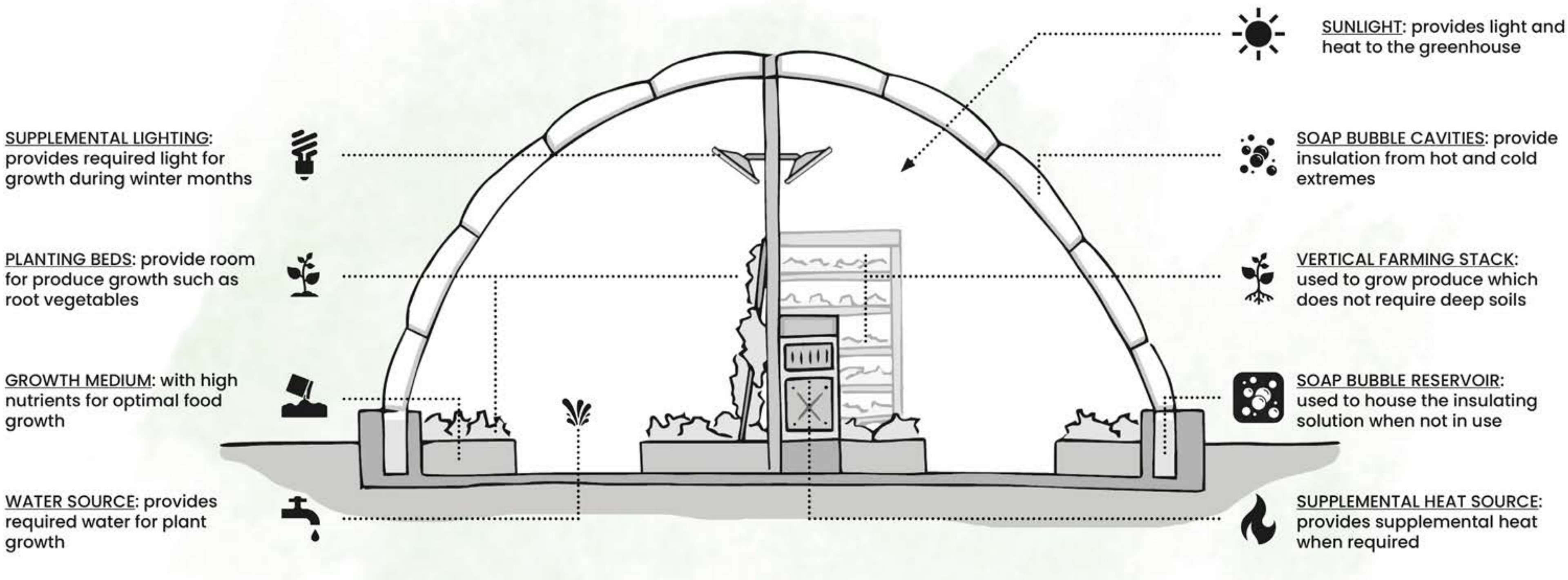
Greenhouses are well known for ideal growing conditions for commercial crops due to the highly controllable environment they create (Cordo, 2021). By implementing cladding with natural solar powered heat trapping capabilities and offering an enclosed or hermetic environment apart from the surrounding climate, they can maintain consistent indoor temperatures, irrigation quantity, safety from the elements and other outside influences (Cordo, 2021, Lera, 2006). However, greenhouse technology has its limits. Northern Manitoba climates make year round production in greenhouses very difficult to accomplish due to the harsh winter conditions and lack of sunlight (Whitehouse, 2018, Exner-Pirot, 2012). As a result, traditional greenhouses in northern Manitoba face conditions that often make them too inefficient to operate for a significant portion of the year (primarily during the coldest and darkest months)

(Whitehouse, 2018). Despite the plethora of issues facing greenhouse production and viability under these harsh conditions, recent pilot projects have found success in various climates similar to or considerably harsher than Manitoba's north. This section will explore three precedents which have allowed different northern greenhouse projects to overcome the obstacles facing them in harsh northern conditions.

In order to ascertain the elements that will be crucial in understanding how to design a greenhouse system in northern Manitoba, it is important to look at a similar successful project and determine what factors contributed to its success. By examining a project in this way, the goal is to determine what is contextually achievable. One project stands out amongst northern greenhouses, and that project is the Sauri Greenhouse Farm. The Sauri Greenhouse Farm is a project in Siberia, Russia which claims the title of achieving the first commercially operational greenhouse in a permafrost environment (Egorova, 2016). This facility was constructed in order to reduce the high cost of perishable produce imported primarily from China during the harsh winters. In this way, the issues facing the town of Yakutsk and the larger region of Yakutia, are similar to the plight of remote Manitoban communities. The viability of this commercial facility stems from accessibility to a cheap supplemental resource in order to subsidize the inherent heating qualities of a greenhouse. In eastern Russia, this resource is natural gas. Due to the large deposits of this resource in Yakutia, it is more economical to burn it for heat and lighting in order to create a functional year round greenhouse than it is to continue importing nearly 100% of their produce (Egorova, 2016). After completing the first phase of their facility, with a growing space of one hectare, they are able to provideYakutia with 14.3% of the demand for tomatoes, 51.3% for cucumbers and 7.4% for lettuce and herbs (Egorova, 2016). The facility is planned to reach just over three hectares once each phase is complete, to better serve Yakutia's produce needs and bolster the food sovereignty for this region to support its population of one million people (Egorova, 2016). For the purposes of this practicum, natural gas is not an option due to the region in question lacking the industry and for concern over its longevity in being a heavily pollutant filled undertaking. However, this project provides a valuable lesson, in that the more localized the resources needed to run a facility of this kind, the more economical and therefore viable they become. In the scope of this practicum, the abundant and localized resource is the hydro-electric industry.

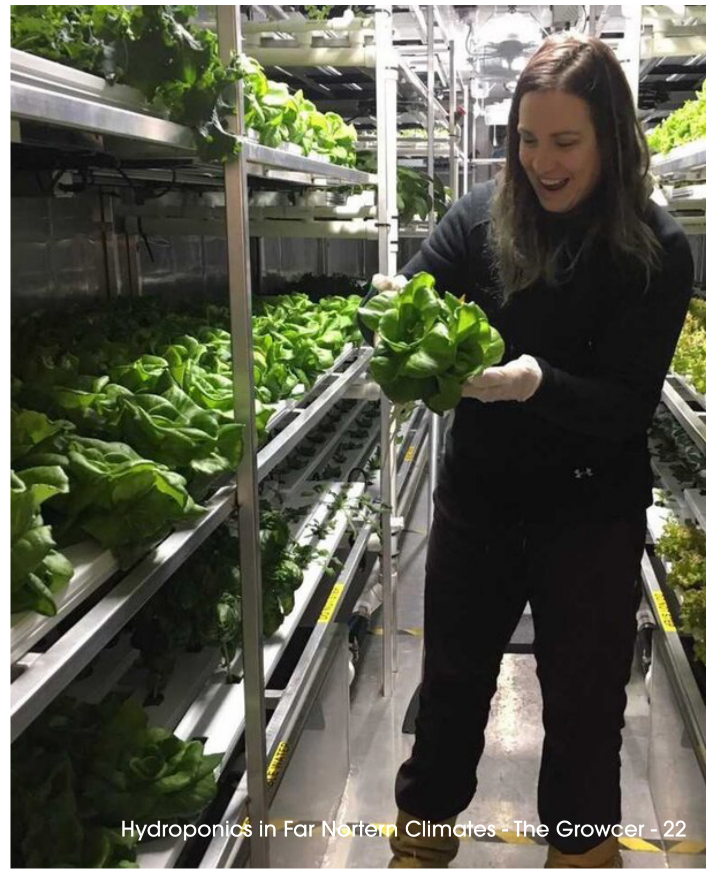
When it comes to planning for a northern greenhouse, the design philosophy of the greenhouse itself has the most impact on its success. One of the best design solutions for a northern greenhouse is the soap bubble-insulated greenhouse. Soap bubble-insulated greenhouses are designed for harsh winter climates and have accomplished year round growth in a nearly 100% passive greenhouse systems in Ontario (Lera, 2006). This is impressive due to other projects relying heavily on a secondary heat source (other than passive solar) in order to properly maintain required temperatures to avoid crop losses. In order to accomplish near passive heating, these greenhouses use a Soap Bubble-Insulation Technology as the key element to their success (Lera, 2006). Soap Bubble-Insulation works by creating a large cavity between the outside and inside plastic-polymer walls of the greenhouse.This cavity is filled with bubbles generated from a soap solution reservoir during extremely cold or hot exterior conditions in order to insulate the greenhouse. When in operation, the soap bubble technology increases the insulation value of the greenhouse wall by a factor of 15 (Lera, 2006, par. 16). This method allows for an extremely efficient exterior wall that can be used to insulate the interior during frigid winter nights as well as hot summer days and maintain an optimal temperature. When not required the cavity is then quickly drained of the soap bubble solution and the sun is able to properly penetrate the barrier and help warm the greenhouse (2006).

SOAP BUBBLE GREENHOUSE



When comparing Soap Bubble-Insulated greenhouses to other types, it holds up as the more efficient and economic option (Hanna, 2013). Due to this technology, northern greenhouses have been able to operate for up to 12 months a year in the Yukon (Lera, 2006) compared to existing seasonal greenhouses which usually only function for half the year in the north (Whitehouse, 2018). Additionally, these greenhouses use far less fuel (some secondary heating source is needed for the coldest weeks of the year) and generally become more economical after the initial extra investment in technology within a decade of use in comparison to fossil fuel powered operations (Lera, 2006). Overall, this type of greenhouse has seen success in extreme northern climates and have made local year round food generation possible in the far north. This type of technology will allow for longer growing seasons, a wider variety of crops to cover seasonal shortages, and lower maintenance costs and hours.

Another type of food generation occurring in northern Canadian communities is hydroponics, which is used as an alternative to traditional greenhouse operations. Hydroponics is a food growth system that does not use soil and instead grows vegetables and leafy greens, such as lettuce and spinach, using water and supplemental minerals alone. These operations are important to note and to explore due to their success in small communities in demonstrating both the desire for readily available fresh produce, as well as the resulting impact they have on physical health. A hydroponic operation in Churchill called Rocket Greens has been in operation since 2017 and continues to be successful at consistently selling their crops of various vegetables (Burke, 2018). Due to hydroponic operations being extremely efficient at growing specific types of produce (through water recycling and compactness) Rocket Greens has reduced the price of leafy greens in Churchill Manitoba from $7.25 to $3.99 (Burke, 2018, par. 14). A major factor in the success of Rocket Greens is the successful compactness of the hydroponics, which can be easily stacked high and efficiently fill an insulated space (MacIntosh, 2018). Overall these small food generators are important because they show proof of concept in the desire to access fresh produce as well as proof of outcome in the benefits to the community. However these types of operations do not allow for a connection to the soil or for all types of fruit and vegetable growth that communities likely require, and will likely be a good addition to a larger operation overall.



Hydroponics in Far Nortern Climates - The Growcer - 22

Waste Heat Capture Systems

As a result of exploring different northern greenhouse solutions, a supplemental heat source is the main obstacle that needs to be overcome. Whether this is accomplished through a bountiful fuel source, or the need is reduced through clever design, construction, or compact efficiency, northern greenhouses will always require a supplemental heat source to remain operational throughout the year. As society attempts to move away from relying on fossil fuels, this practicum will instead be focusing on obtaining supplemental heat; hydro-electric generating stations. These giant producers of Manitoba's electricity produce heat in multiple ways, and without a direct use for it, dump it directly into the atmosphere (Lozecznik, Personal Communication, 2021). Capturing of the waste heat produced by generating stations could provide the supplemental heating source northern greenhouses need.

Hydro-electric generating stations produce waste heat in two major ways, from the pumphouse turbines, and from the adjacent converter station (Hollander, Personal Communication, 2020), Lozecznik, Personal Communication, 2021). Firstly, like all turbine generated electricity, heat is produced through the inherent friction in the process (Peters, Personal Communication, 2020). In the pumphouse of a hydro station, massive turbines are moved by water flowing through them to create electricity. As a result heat is generated and is transferred to the air. This heat is used in the winter to heat the pumphouse where employees work, yet excess heat is still vented off into the outdoors in order to keep the temperature at a comfortable level. In the summer months, more heat is vented out as the pumphouse needs less heating (2020). Additionally, the water passing through the turbines and into the downstream waterbody carries heat generated from the process (Hollander, Personal Communication, 2020)). The river does not ice over till further downstream or under the coldest conditions affecting local transportation, fishing and sensitive habitats.

The second production of waste heat is from the converter station. A converter station is where the raw electricity is first transferred to in order to be converted to a form best suited for long distance transportation along power lines to southern Manitoba and beyond (Hutchison, Personal Communication, 2019)). In this case, due to inefficiencies in the conversion process, heat is generated and directly transferred to the air via radiator fins. The amount of heat transferred to the air around a converter station has potential as a reliable heating source. Manitoba's largest generating stations, situated along the Nelson River, have more than enough waste heat to supply commercial greenhouse operations nearby (Lozecznik, Personal Communication, 2021).

Waste heat sources from hydro-electric generating stations are clearly present and have the capacity to become capturable assets. The idea is still relatively theoretical, and the feasibility of the system speculative. In order to address the question of feasibility, applicable precedents were researched in order to determine the viability and understand the results of such a system. The following is a brief analysis of similar projects which capture waste heat.

Figure - 25,26

Waste heat capture from generating station diagram

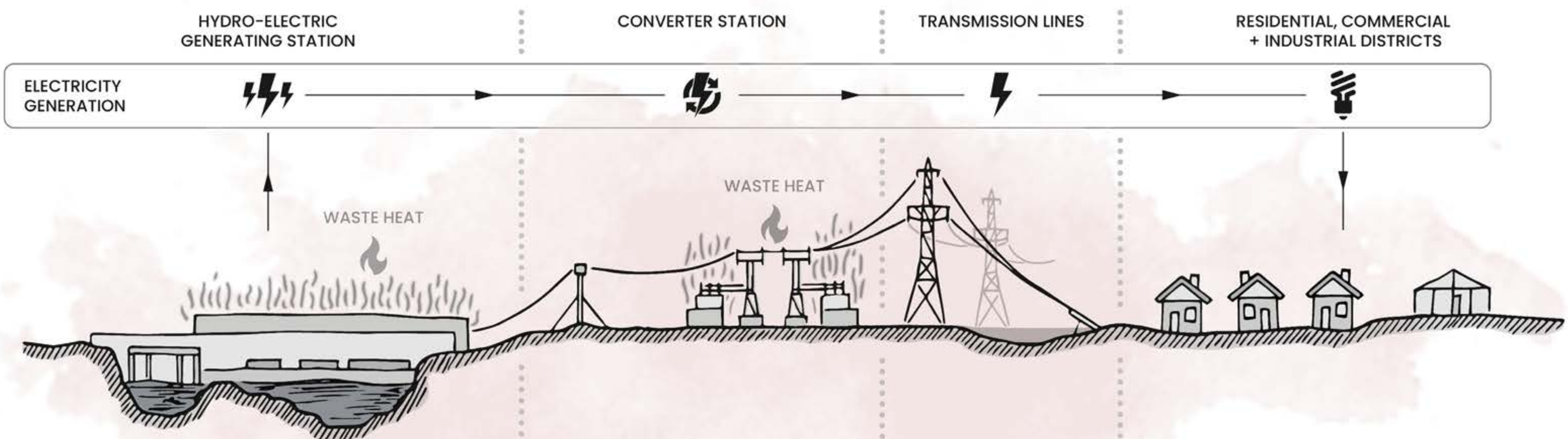
Shand Greenhouse Growing Saplings - 23

In Saskatchewan, a third of power production is generated from coal fueled generating stations, the majority of which occurs in the Estevan area (Sask Power, 2022). Due to climate change concerns, SaskPower elected to offset their carbon emissions from one of their coal field facilities called the Shand Power Station (Sask Power, 2020). In order to accomplish this, the power plant was retro-fitted with a waste heat capturing system which supplies a nearby greenhouse with warm air to grow saplings. Waste heat captured from the Shand Power Station specifically ensures that the greenhouse can operate year round, and as a result the greenhouse has grown, distributed and planted over 12.5 million seedlings since its operation began in 1992 (Sask Power, 2020, Fever, 2019). Over its many years of operations, the Shand greenhouse has provided trees to offset carbon emissions and prevent wind erosion affecting farmland through the planting of shelter belts. This greenhouse project and power plant retro-fit has been a demonstration of how to create a complex system of electricity generation that uses its waste resources by creating a mutualistic relationship between the greenhouse and the power plant. Shand lends its waste heat from its thermal plant to the greenhouse, and in return SaskPower can offset some of their emmissions as the corporation transitions away from fossil fuels. Overall, the Shand Greenhouse is an example of how to mitigate damage to the environment and benefit local communities surrounding a generating station.


Exergi District Heating in Stockholm - 24

Another relevant project is the new district heating system in Stockholm, Sweden. Stockholm Exergi is the electrical and energy utility that supplies the city, and is developing a new system to reduce energy needs. The city faces current concerns that they will soon not be able to support the growing demand for electricity as fully electric cars become increasingly popular and the city expands (Stockholm Exergi AB, 2022). In 2018, Stockholm Exergi announced a deal with a data centre company called Digiplex to capture and use the waste heat generated by large scale server farms to heat up to 10,000 homes (Young, 2018). Server farms are notorious for using a large amount of electricity, and when that electricity is generated using fossil fuels, the carbon footprint can be just as large. Through this new waste heat capture system in Stockholm, Digiplex and Stockholm Exergi are reducing their climate impact by eliminating the need, for the homes serviced, to use electrical furnaces as a source of heat. In fact, after the success of this integrated residential heating system, Stockholm Exergi plans to supply 10 percent of the city with heat for similar data centres (Young, 2018). Stockholms new residential heating system is a beacon of ingenuity when it comes to reusing a waste resource and revitalising an industry with an environmentally harmful history.

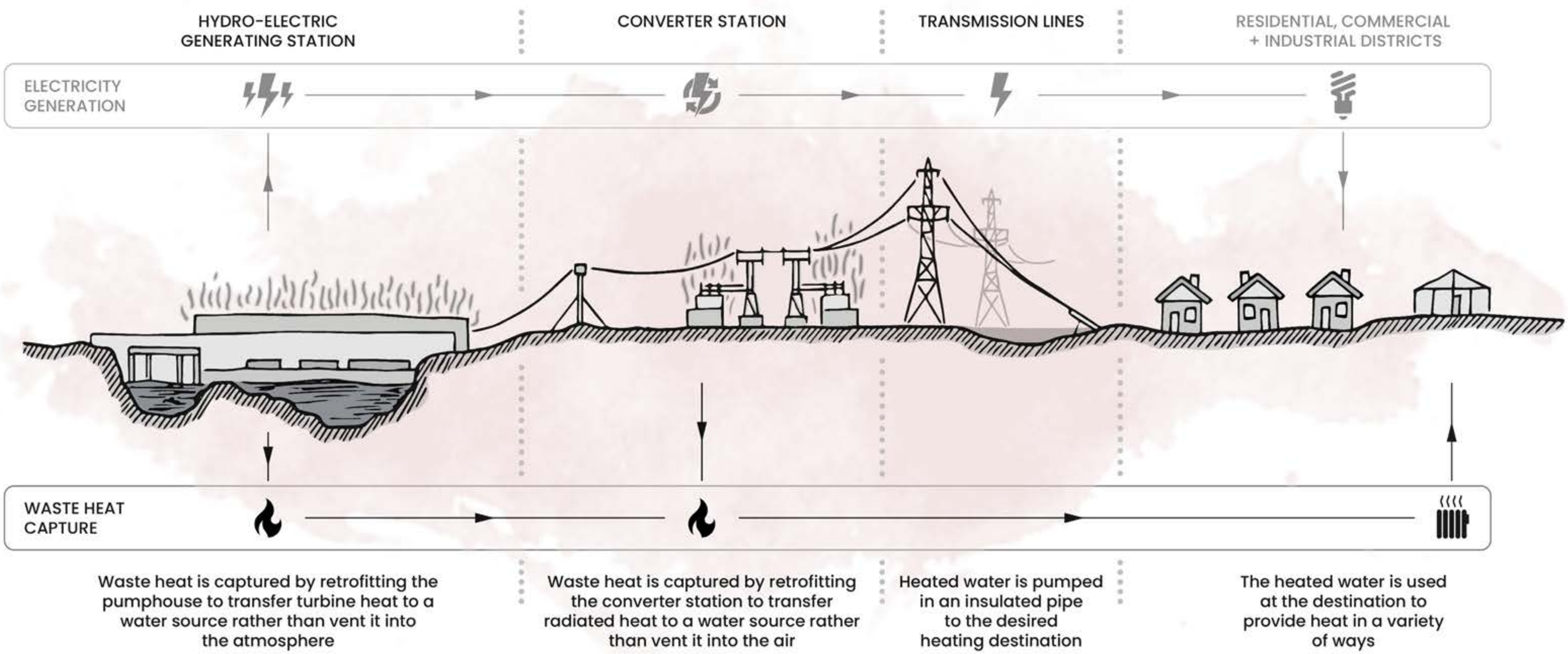
EXISTING SYSTEM



Substantial waste heat expelled from generating station pumphouse

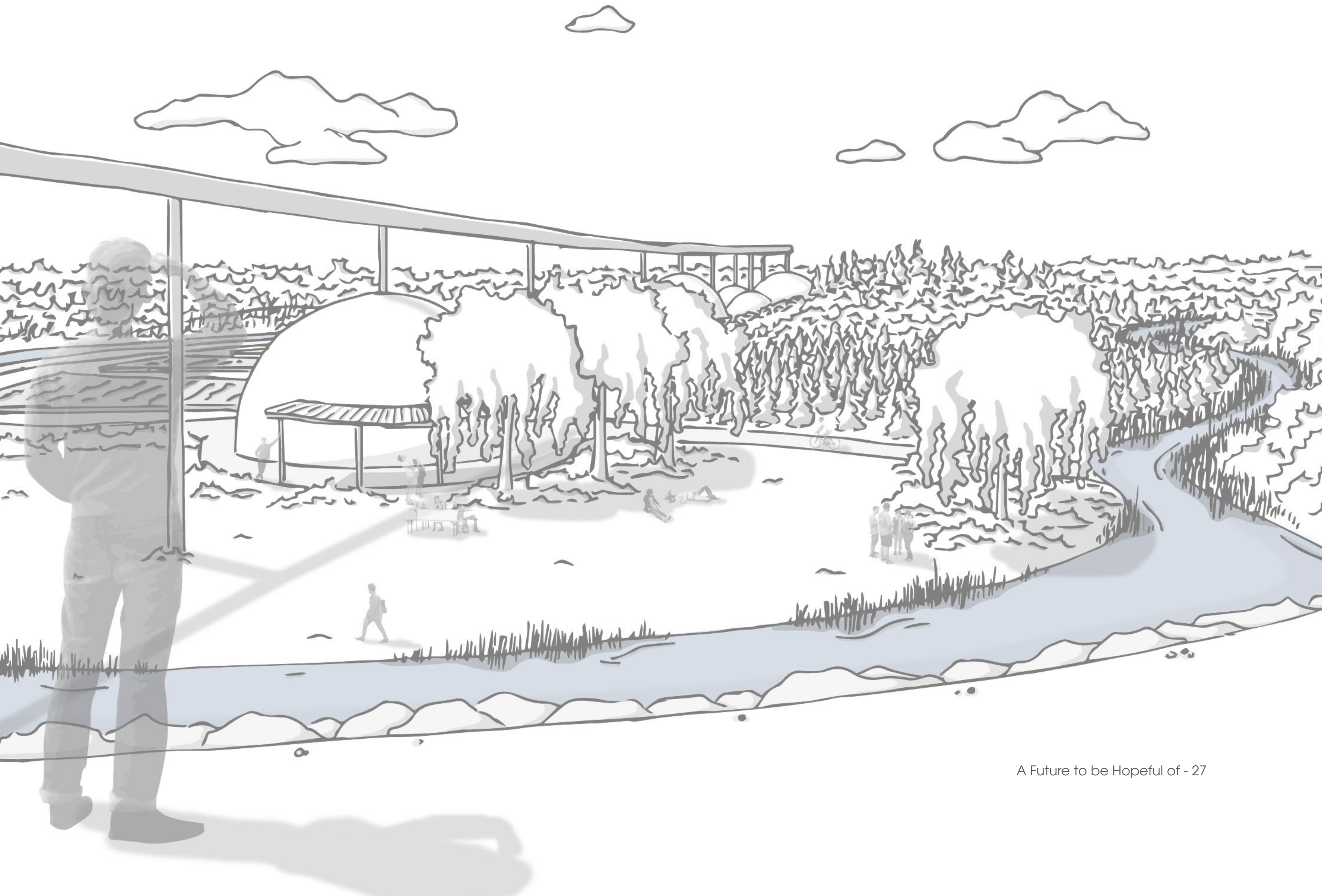
Substantial waste heat transfered to the air through the converter station process

PROPOSED SYSTEM



Overall the precedents explored demonstrate feasibility in systems capturing waste heat and successfully using it to provide a secondary service. These processes provide heat to large scale endeavours and can be extremely efficient after the initial investment is made.

Lastly, how will the waste heat from a hydro-electric generating station be accomplished? The method is quite simple in theory, and would need further study and testing if implemented. Simply put, instead of venting or radiating heat and transferring it to the atmosphere, the pumphouse and/or converter station would be retrofitted to envelop the areas producing heat and transfer it within the envelope to air or water to be transported via an insulated pipe. Afterwards it would be converted at the selected site in order to heat the greenhouses. After consulting Stan Lozecznik, an engineer who has conducted a feasibility study into the same system, the maximum distance captured heat could be made to travel would be well beyond the distance from the nearest Hydro-electric generating station and the Fox Lake reserve (2020). Overall, waste heat capture from hydro-electric generating stations is not only viable, but seemingly something that should be encouraged. It is a resource falling by the wayside, and has the potential for many applications in the future of the province.



4 - Outflow

Introduction

As a result of background research and technical information gathering, the practicum results in this chapter of production; production of a conceptual design to facilitate food security and other needs in Fox Lake Cree Nation. As a culmination of background research and technological understanding, this chapter begins with developing an approach to site design and then implementing the conceptual system devised earlier in the practicum through site selection, site analysis, conceptual design/programming, and a final site design.

In order to develop an approach to design the end result to this practicum, a main focus and direction for the programming and purpose of the site as an environment was sought out and determined. In conversation with development leader Conway Arthurson (2020) from Fox Lake Cree Nation, one thing he stressed as a main goal for the future of the community was to create strong lasting connections and relationships through programming. Their goal of connections and relationships starts within their community, bringing all generations together through activities such as community gardens and other small projects. Additionally their goal extends to their neighbours, who they see as crucial communities to foster connection and relationship in order to create a network of trust and camaraderie in tackling issues they all face as northern remote communitie.Through talking about the subject of food growth and generation in northern communities such as Fox Lake, he also identified that their community was well aware and concerned about their food insecurity issues. Again his view of the potential outcome of a food generation project was focused on the people, both in his community and their surrounding neighbours. Arthurson saw it as a great opportunity to focus on first creating intergenerational relationships that had suffered in recent years for Fox Lake, and second in bringing the nearby town of Gillam and workers at the three nearby Hydro stations together, through sharing of fresh produce, day to day programming and seasonal events. As a result of this conversation and coupled with background research in this practicum, my approach to design became clear; the project was to be a multi-faceted and robust food production landscape while facilitating events and learning integral to building intergenerational and neighborly relationships. This was to be accomplished by healing part of the scarred landscape created in the construction of a hydro dam through soil generation, reforestation and returning it to a functioning landscape to both feed and connect Fox Lake and, in the future, their neighbours.

In this chapter, the practicum will cover the progress and methods used from the developed approach to the final site design through site selection/analysis, conceptual design and programming.

Site Selection

Surrounding Fox Lake Cree Nation is a landscape of rocky boreal forest/swampland with sporadic surface quarries along the banks of the Limestone river upstream from the Limestone Generating Station. Although not unusual for a landscape surrounding a generating station in this area on the Nelson River, the close proximity of a small community such as Fox Lake creates an interesting dynamic between the impacts of the generating station and the community. As previously mentioned, the various operations, such as stone acquisition resulting in abandoned quarries, and other operations undertaken to construct the generating station, scar the landscape not only visibly, but through disrupting migratory routes and habitats in the region. As a result, selecting a site for the final outcome of this practicum in the form of a site design hinges on analyzing the surrounding area between and around Fox Lake Cree Nation as well as the Limestone Generating Station. This analysis will focus on existing and abandoned operational sites, infrastructure and leftover scarred areas of the landscape. In response to this analysis and identifying resources needed to operate the proposed approach to the site design, a single site will be chosen to analyze to design within.

Operational sites were identified in the surrounding area and include current and abandoned residential communities, abandoned communications infrastructure, and electricity infrastructure such as the generating station itself and the nearby converter station. Represented below each of these entities, is their general relevant resource sources to be used in determining an ideal site location. Analysis of note in this area is the abundance of water as a resource as well as existing operating sites with access to a variety of transportation infrastructures.

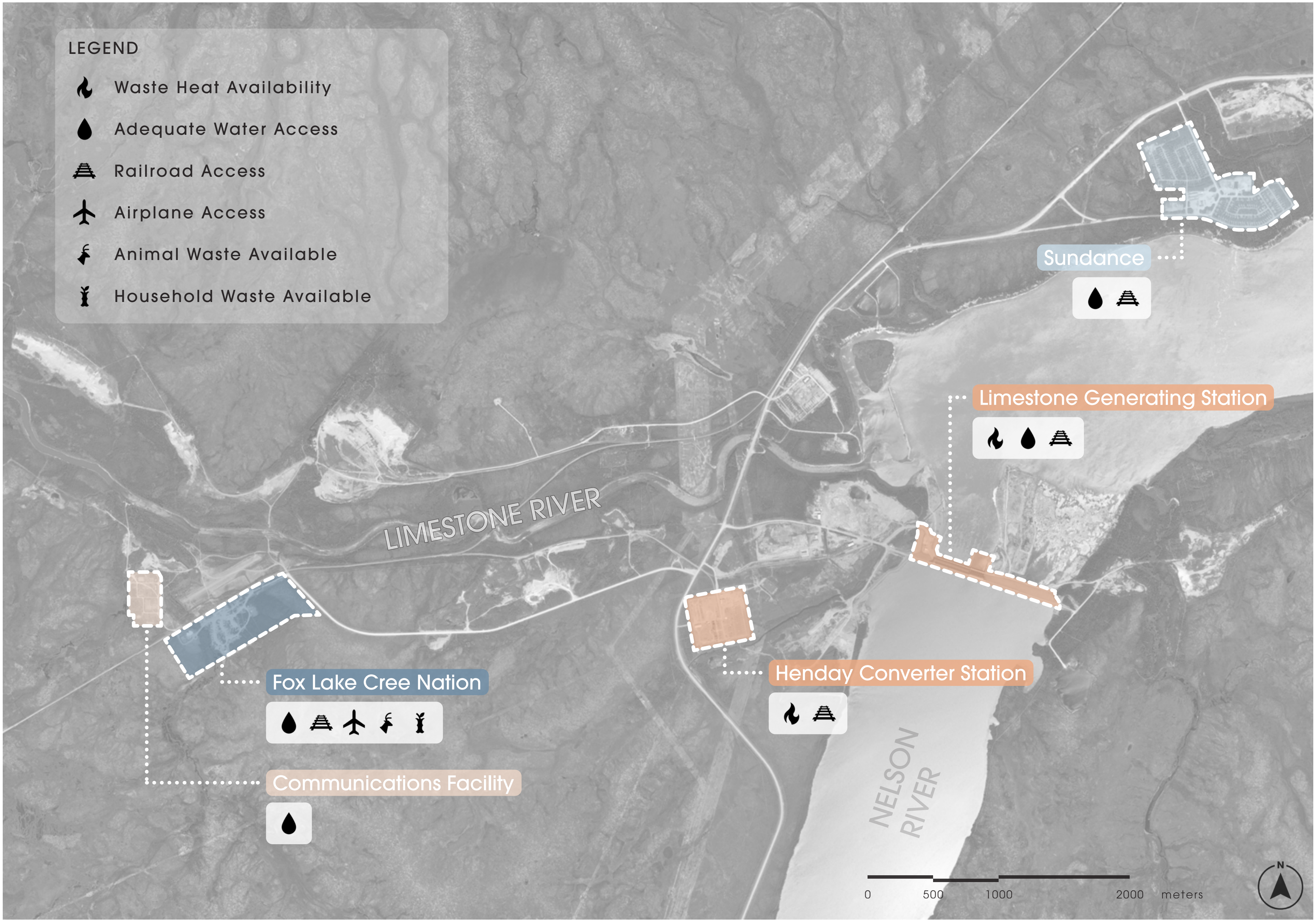
Transportation infrastructure was identified next in the area. It is made up of an interconnecting road network linking the abandoned quarry sites as well as the major operational sites. Additionally rail transport arrives from the south along Fox Lake's north-western border continuing towards the town of Churchill, far to the north. The rail branches south of the Limestone River in order to connect to the Henday Converter Station and Limestone Generating Station. Due to the close proximity of rail in both Fox Lake and some of the surrounding quarry sites, it could present an opportunity for efficient transportation of materials to use in a potential site, such as waste products for composting, as well as future exportation of food if the site expands its operations in the future.

Finally, the major scars on the landscape were identified as ideal locations for the site design itself. These included abandoned quarry sites, and staging areas for the construction or maintenance yards of the Limestone Generating Station. It is important to note in this section of the analysis that only a few of the locations highlighted are easily accessible or along ideal travel routes for people to access the future site.

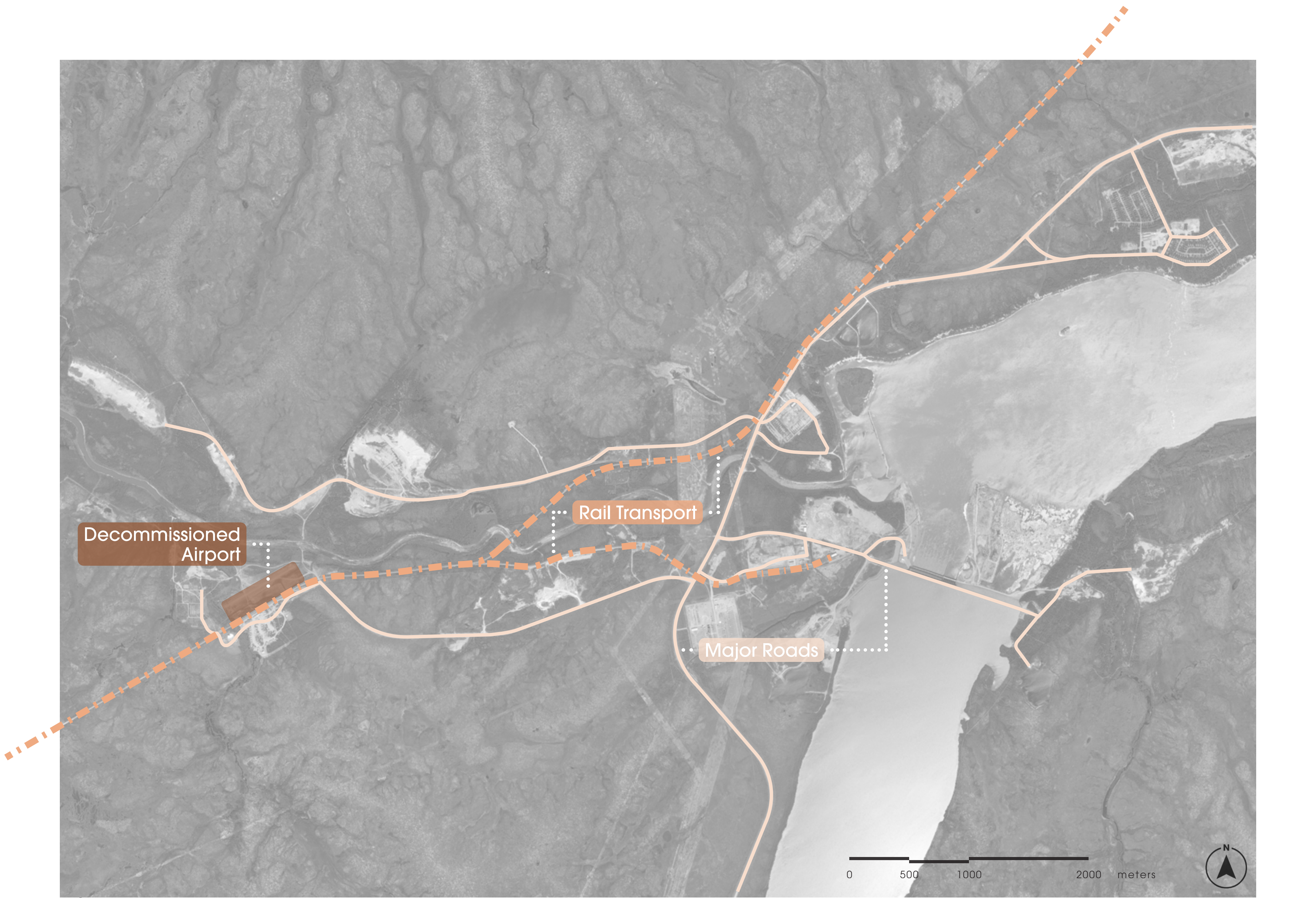
In addition to the general area analysis conducted a set of criteria to aid in proper site selection was devised based on the ideal conditions for immediate and future use on site. These criteria include:

- Size + scarred area available for development
- Close proximity to an adequate water source
- Close proximity to road + rail infrastructure
- Within the feasible heat capture radius of 5km (Holländer, Personal Communication, 2019)
- Close proximity to Fox Lake Cree Nation reserve

Using these criteria and the area analysis, the site directly between Fox Lake Cree Nation and the Limestone Generating Station was chosen to be used for the sake of this practicum. Being only a twenty minute walk and less than five minute drive from Fox Lake Cree Nation, as well as having access to all the major resources needed for a productive landscape, this location made for an ideal site for this practicum.

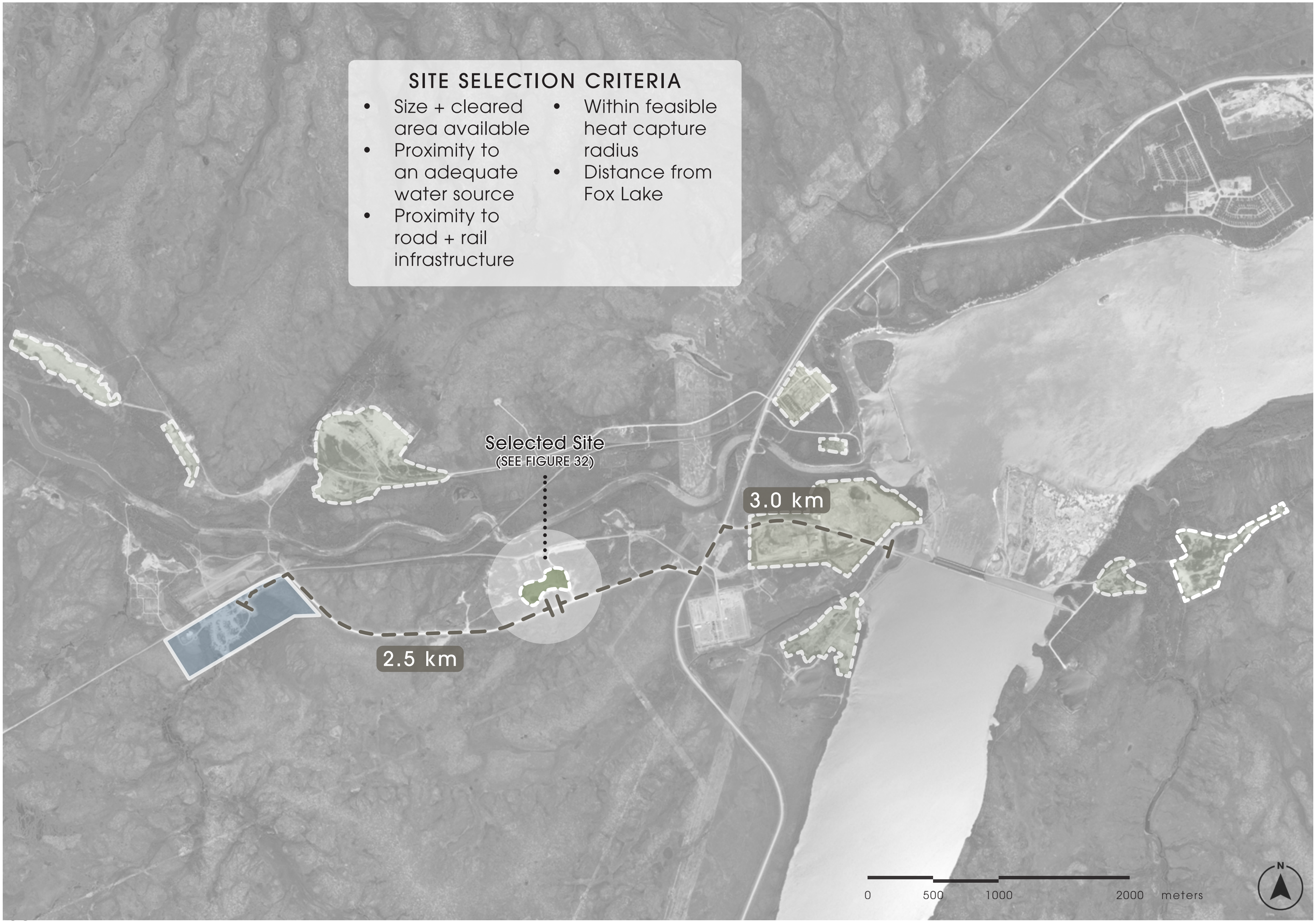


OPERATIONAL SITES



T R A N S P O R T A T I O N   I N F R A S T R U C T U R E

S C A R R E D   L A N D S C A P E S



SITE SELECTION

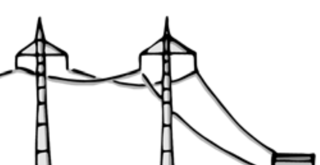
Site Analysis

After selecting the site for this practicum, its attributes needed to be identified in order to form fit a design to work optimally and to best utilize the space. The following are the general criteria identified as part of that analysis: major landforms, hydrology, vegetation, transportation infrastructure, sun angles/paths, and seasonal wind patterns.

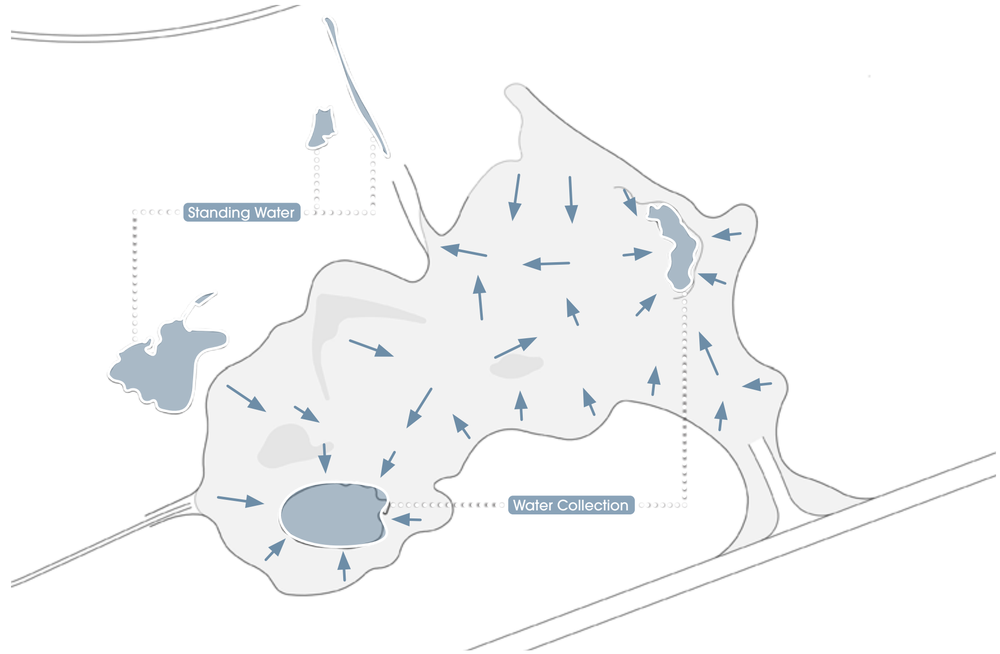
When assessing and identifying the existing conditions on site, through the analysis criteria, physical and environmental conditions were explored and assessed for the value they could add to the final design in terms of resource accessibility, wind and weather protection, grading and drainage opportunities, accessibility to the site and ideal growth conditions. Existing boulder piles and exposed ridge edges, creating the natural depression of the quarry, offer the potential for wind protection in harsh winter months and water collection for use in food generation/production. Existing topography in combination with the wind average data and existing major vegetation begins to inform the ideal greenhouse locations and positioning in order to best protect them from the influence of outside elements such as the wind. To further optimize growth conditions for greenhouse and outdoor growth operations, sun data for the area was studied and informs the location of greenhouse placement as well as future expansion areas and optimal revegetation efforts in order to allow for adequate light to reach the greenhouses on darkest days of the year. Additionally the topography lends itself to determining how best to allow drainage to exit the quarry pit site in order to control water intake for food growth and prevent flooding. Due to multiple depressions naturally collecting water, the site hydrology informs using the existing water collection reservoirs as amenities for both public space and productive operations in the final site design. Finally, infrastructure connecting to and adjacent to the site was identified to inform ideal entrances, as not to further damage the surrounding forest and ecosystem as well as future operational expansion to connect the project to the railway system and the opportunity to import or export goods and materials.

Overall, this site analysis of the existing conditions allows for a logical approach to applying site programming to meet Fox Lake Cree Nations needs and desires for such a project. Identifying the conditions that will be most optimal for each proposed entity and program on site is crucial in developing a conceptual layout plan for the system based functioning approach proposed for the site design.

SELECTED SITE



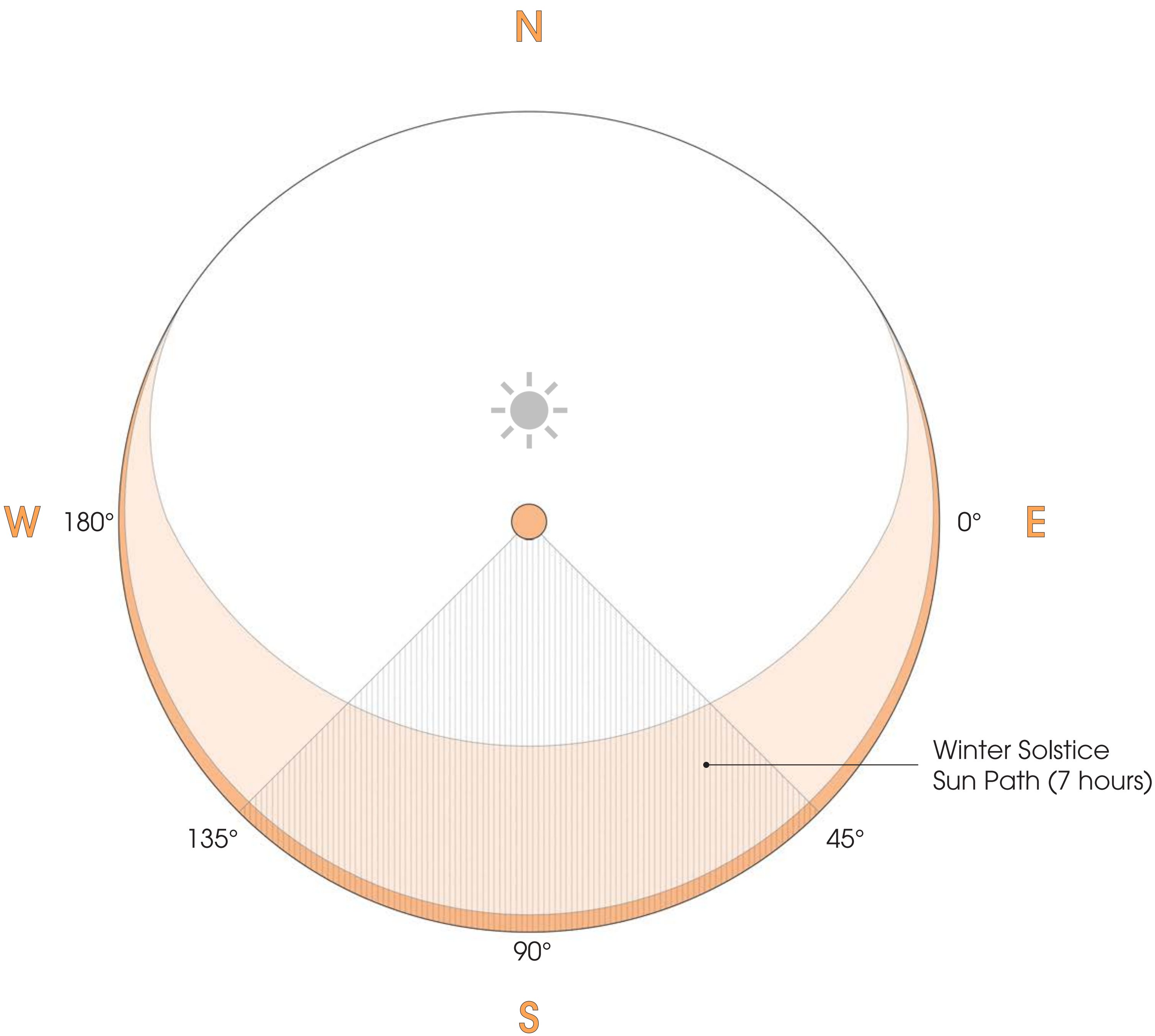
MAJOR EXISTING LANDFORMS

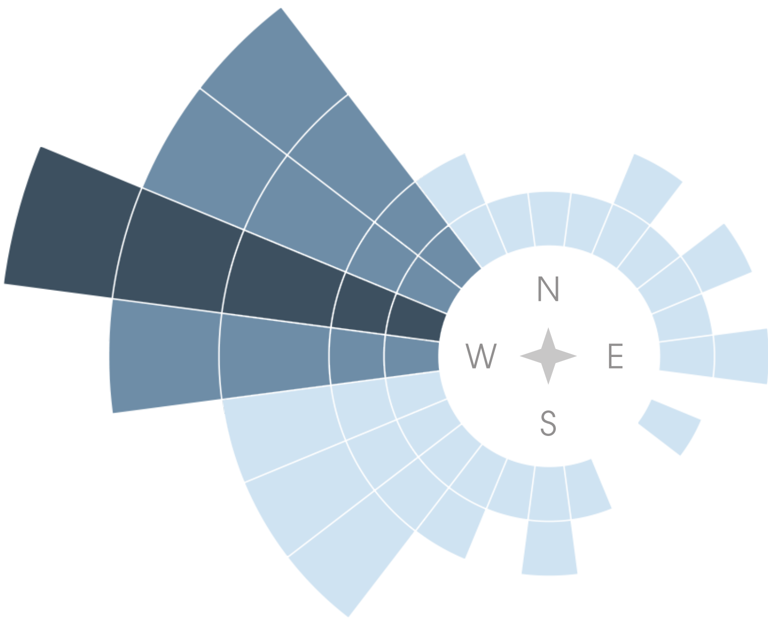


EXISTING HYDROLOGY

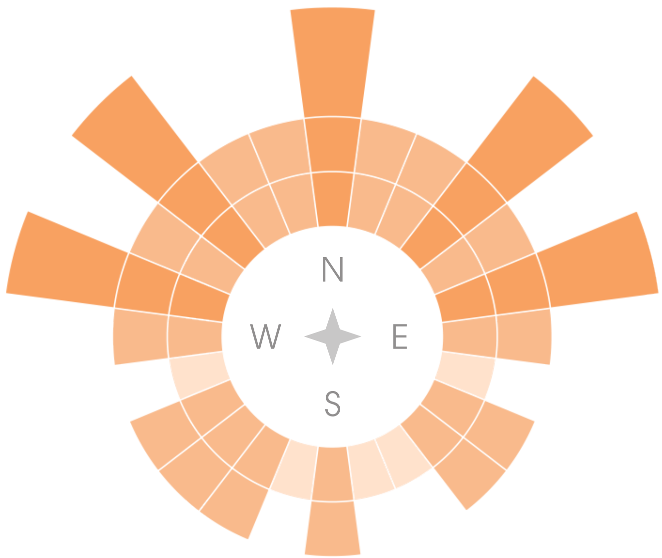
EXISTING VEGETATION

EXISTING TRANSPORTATION INFRASTRUCTURE


N
W
180°
0°
E
135°
45°
90°
S
Winter Solstice
Sun Path (7 hours)



WINTER WIND AVERAGES



SPRING, SUMMER + FALL WIND AVERAGES

Conceptual Design

As a result of analysis of the site, region and in keeping with the wishes of the community for the site design approach, this conceptual plan was developed through the use of programming criteria in addition to a cultural significance and conceptual design theme. The programming criteria were created by assessing what each design element would need in terms of resources, proximity to other elements of the site, and benefits from existing site conditions. The four main site elements I determined would be the most important to plan around based on the goals and approach to this site design are: greenhouses, water collection and drainage, public spaces and operational expansion areas.

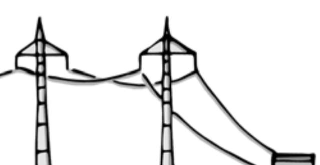
Greenhouses would best be served near a water supply, naturally wind sheltered areas, with unobstructed sunlight capture angles, along the waste heat supply pipe route, and centrally located within the site to allow for greenhouse expansion. These conditional criteria were selected to ensure the greenhouses would have the best growing conditions possible throughout the year.

Water collection and drainage design on site require using existing topography and naturally collecting depression points, connecting existing water collecting depressions, providing overflow access to the Limestone river, and ensuring proper site drainage. The water collection criteria were developed to focus water collection on site for greenhouse and outdoor plant growth as well as to ensure pooling and flooding on site would be minimal, ensuring water could drain from the quarry depression.

Public spaces were determined to need a flexible park/event space with a minimum capacity of 500 people, and to border or provide access to the main functions on site. These criteria were selected in order to provide an event area for Fox Lake Cree Nations resident population on the reserve and nearby in Gillam (Keeyask Hydropower Limited Partnership, 2022), as well as to encourage learning and intergenerational interaction through the different food production operations in the designed site.

Expansion areas were the final major site element to consider when designing a food producing landscape in this site design. In order to ensure greenhouse food production operations could expand, areas or zones would be required to be earmarked in advance to meet the same characteristics required for optimal greenhouse placement. These areas would also need to be planned so that in the case that they would never be used for expansion, they would fit and operate as part of the overall site design.

In addition to the importance of site program element placement and adjacencies, an equally important part of the concept design process was to accurately



determine the size, capacity and space required for each proposed programmed element.

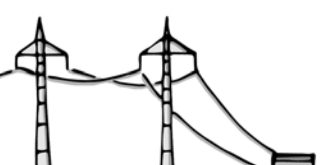
Size and capacity of programmed elements is additionally important to determine due to the limiting factor of growth medium and soil generation quantities per year in this location. Due to the rocky nature and thin layers of soil in the boreal landscape (Thomas Jordan, Personal Communication, 2022) collecting soil to cover and revegetate the quarry site is no simple matter. In order to properly convert the rocky limestone surface of the abandoned quarry, a multitude of resources are needed to slowly generate soil from the existing aggregate. These resources include similar elements needed for composting such as sewage, wood bi-products, recycled paper products, and green food waste, but instead on a larger scale and involves mixing them all on site (Jarvis, 2012). Alternatively household food waste combined with agricultural waste can be properly combined undergoing "bio-digestion techniques" (Jarvis 2012, p. 162) and shipped to the location to be mixed with the existing quarry surface and rock to recover them into healthy soils capable of supporting growth. In order to achieve this, the mixed soils need proper cover crops and regular maintenance/ monitoring to produce a well balanced growth medium (Jarvis, 2012). Based on the quantity of activation material transported from agricultural locations, rejuvenating the selected quarry site completely could take a few years, or with a slower approach, slowly convert it over decades to match growing food generating capacity and use of the site.

As for indoor greenhouse soils, maintaining healthy growth mediums comes down to access to waste composting materials from the surrounding communities and other operations. Assuming a compost method requiring a 50/50 split of green and brown waste materials, green materials become the limiting factor, as the abundance of waste paper products, dried yard waste and debris easily outscales the amount of household or other green materials mostly composed of food waste. Based on this method of composting, using a standard practice of one to three inches of compost added to planting beds per year (Spengler, 2022), and assuming green household waste is collected from Fox Lake/Gillam to be added to the green materials created by the greenhouse itself, there will be more than enough compost to ensure the greenhouses can be self sustaining without importing further soils (Thomas Jordan, Personal Communication, 2022).

As a result of determining the viability of sustainable soil practices, the number of greenhouses and their size is the next logical step in this process. By aiming to produce half of Fox Lakes required vegetable servings, as per Canada's Food Guide (Government of Canada, 2022) and serving amounts for the average adult (Food for Health, 2022), 3.5 servings of vegetables per member of Fox Lake' primary reserve per day should be the goal. Ensuring room for expansion in the short term by accounting for population fluctuation, this would equate to 700 servings of vegetables required per day or 255,500 servings per year. In order to supply this portion of Fox Lakes required vegetable servings, using a three month staggered growth cycle and narrow planted crops (such as carrots), 3,200 square meters minimum of planting bed space will be required (Tui Garden, n.d.). In order to grow a wider variety of vegetables such as leafy greens, the use of hydroponics should be used to increase the amount of vegetable servings that can be grown per square meters due the ability to vertically stack the growing beds. All things considered, if one quarter of the required vegetable servings are grown in traditional planting beds, the greenhouses will require 800 square meters of soil growing areas in addition to hydroponic growing bed stacks.

Water requirements for growth on site are simple to calculate. Existing water collection on site measured by the existing collection ponds is in excess of what is required for not only for use in the greenhouses, but for growth outside of the greenhouses as well. Rainfall averages combined with the quarry site naturally collecting water within its boundary, as well as from the surrounding landscape provides adequate water for the purposes of a food production landscape. The selected site is approximately 65,000 square meters in total area, collecting an average yearly precipitation of 266 liters of precipitation per square meter (Custom Weather, 2022). This adds up to over 17 million liters of precipitation each year which can be captured and retained on or drained off site based on the water needs of the greenhouses and the designed site, as it is slowly regenerated. Water use in the greenhouses in the site design will be minimal, due to the nature of greenhouses as heavily controlled environments. Greenhouse environments in themselves are unique to their location, structure and layout, and so experimenting with the ideal watering practices needs to be conducted (Van Iersel, 2010). However, plants in greenhouse environments can be grown approximately with a tablespoon of water per day, or about 1.4 liters of precisely applied water across the entire lifecycle of the plant (Van Iersel, 2010). Although it can vary per plant and by species, water collected and retained on site will easily be in adequate supply.

The conceptual design theme was created based on the history of Fox Lake Cree Nation, North American Indigenous relationships with food security and the current circumstances/hydro-electric impacts the community faces today. On the Fox Lake website, it is stated that their peoples and ancestors have always lived on the banks of what is now called the Nelson River (Fox Lake Cree Nation, 2015). For this reason, coupled with the need to capture, use and drain water on site, one of the main focuses of this project is to be connection to water, both through connection to the Limestone and Nelson River as well as to metaphorically create the sense of once again, living on the banks of a river. Indigenous groups and their relationship with food acquisition covered earlier, emphasizes the importance of intergenerational interaction and learning as part of the process, and how information and cultural practices are handed down. This will be a main focus of the site, in order to foster and reinforce cultural practices surrounding natural foods in the landscape as well as implementing modern food generation as possibly part of the culture. Finally through connecting with Manitoba Hydro through the proposed waste heat capture system, repairing relationships through demonstrating the new partnership on site will be a main focus through making the waste heat system visible on site as well as using the excess waste heat in alternative ways throughout the public portions of the site. Overall the conceptual design theme will help focus the aim of the project and accomplish the goals set out to facilitate growth and benefit for the community of Fox Lake Cree Nation.



CONCEPTUAL SITE DESIGN PLAN

Final Site Design

A culmination of the conceptual site design and incorporating the site analysis determinations resulted in the final site design for this practicum. The final design encapsulates the desires and needs expressed by the community as well as merges in harmony with the existing site boundaries and elements. This site plan represents a future version of the site, where a pseudo phase one is completed, however it is expected based on soil generation methods and complexity of the proposed site design that this stage would be reached after decades of development. Overall the final design aims to be effective in growing food for Fox Lake as well as facilitating new experiences and the strengthening of relationships, both within and outside the community.

In the site design plan, there are many elements and functions that serve their own purpose while interacting directly or indirectly with the rest of the site, based on adjacencies, viewpoints and functions. These are represented in the rendered plans and design plan diagrams that follow.

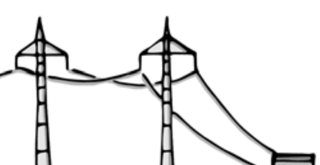
RENDERED SITE DESIGN PLAN

ANNOTATED SITE DESIGN PLAN

Final Site Design - Continued

To begin, the concept of using waste heat from the Limestone Generating Station and its delivery method to and throughout the site needed to be concretely decided. Through using an existing clear cut corridor through the adjacent forest, that leads directly to the Limestone Generating Station, an elevated insulated pipe delivers thermally heated water to the site and is used as a central axis on which the greenhouses and major spaces are arranged around. Centralizing the thermal heat transfer pipe on site both efficiently serves its function in heating the greenhouses as well as cementing the proposed partnership between Fox Lake and Manitoba Hydro as an ever present site element.

Next, the greenhouses were placed into the existing boulder pile and ridge along the north-western corner of the site in order to gain protection from the winter winds. This



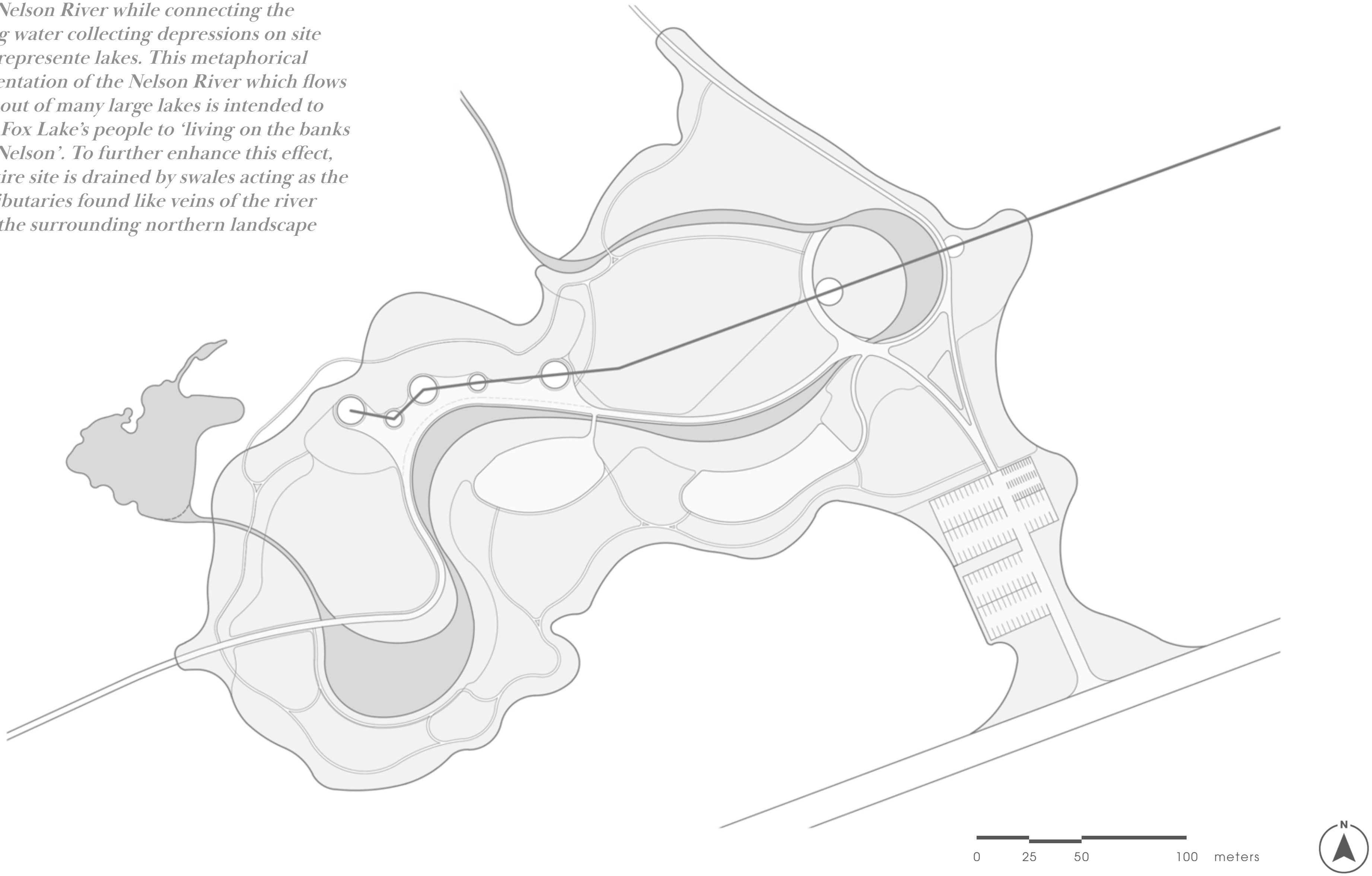
ridge was altered and enhanced in order to provide increased protection and allow for optimal sun ray capture during the darkest months of the year. The greenhouses vary in size and provide more than enough space to supply Fox Lake with the target amount of vegetable servings required. The additional space is intended to grow saplings for reforestation efforts on site at first, and in the future for other quarry pits and locations in the region. Surrounding the greenhouses is the operations yard, with storage sheds for maintenance vehicles and equipment as well as storage of soil and aggregate to be used regularly on site. In the north-east corner of the site, where the heat transfer pipe arrives, is the main public space for community use, which also sports a greenhouse, with the intention of it being an interior botanical garden mimicking the surrounding boreal forest in order to have an accessible greenspace both in the summer and winter months. This greenhouse would serve as a place of learning and in the winter, somewhere to warm-up when using the site. Future development areas are highlighted in long curving white zones south of the site's artificial river where revegetated berms stand ready to protect them from winter winds if expansion begins.

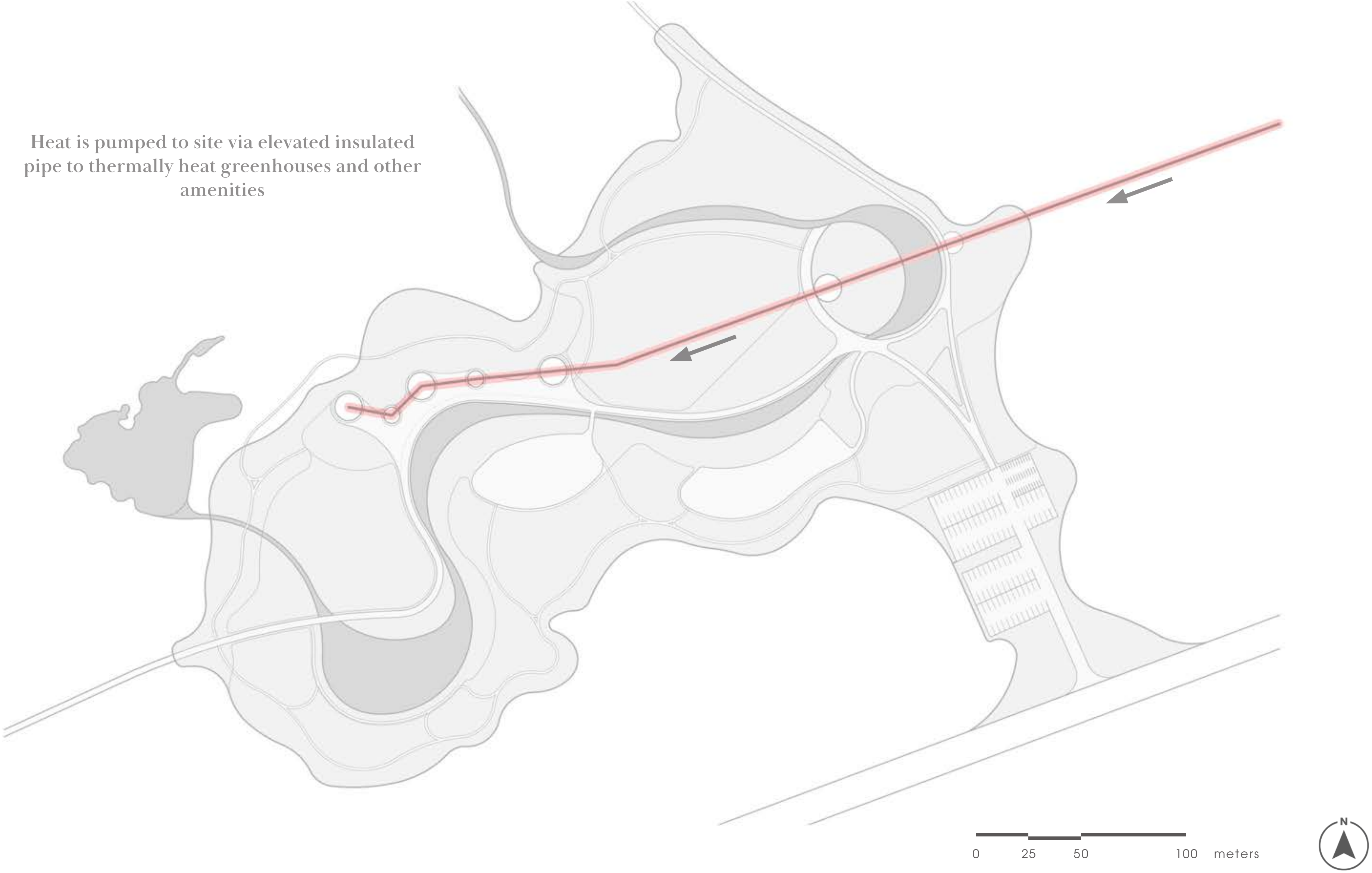
Running through the center of the site is an artificially created 'river' which serves multiple purposes. Overflow from the wetland plateau above has the opportunity to spill into the sites water system during heavy rainfalls or snow melts, and the river flows out of the quarry pit site through an existing natural drainage route to the Limestone River to which the site river connects to. The river on site is designed to replicate the narrow and large courses of the Nelson River while connecting the existing water collecting depressions on site which mimic lakes. This metaphorical representation of the Nelson River, which flows in and out of many large lakes, is intended to return Fox Lake's people to 'living on the banks of the Nelson'. To further enhance this effect, the entire site is drained by swales acting as the thin tributaries found like veins of the river across the surrounding northern landscape. Finally the river helps connect the largest water collecting depression on site to be stored and used for irrigation both in and outside of the greenhouses.

In order to facilitate movement on site for both greenhouse/site workers as well as visitors, the transportation infrastructure was split into three tiers. The goal of these tiers was to facilitate the main food production operations on site while allowing visitors to experience the entire site in order to foster important intergenerational learning and interaction. This was done by separating the operational side of the site from the main public spaces while using pedestrian pathways to allow sitewide access safely. The tiers of transportation were split into public vehicular access, restricted to the access road and parking lot, main site pathways for maintenance vehicles, vehicles for events, and pedestrian thoroughfares and wilderness trails, and for pedestrian and small maintenance access throughout the site and tree farm.

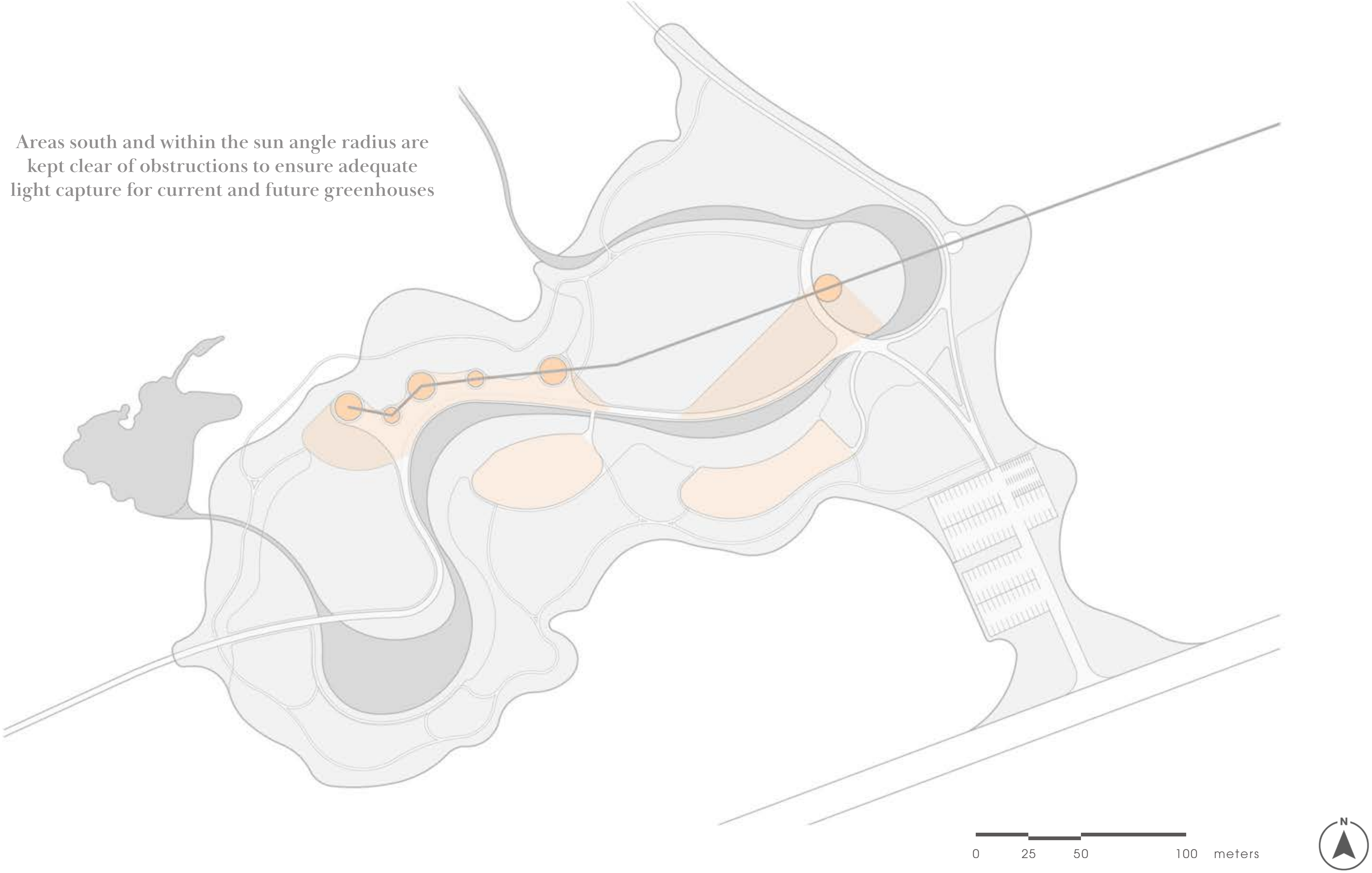
Site vegetation is made up primarily of enhanced planting along the north and western edges of the site in order to shelter the entire space and the tree farm. The tree farm is to be planted throughout the site without blocking sun ray capture angles and in a cardinal grid pattern for optimal growth. White spruce was selected as the focus species for the tree farm as it is the dominant tree of the region and will work well in reforestation efforts as well as it is a hearty plant and does well in a variety of soil and moisture conditions (Thomas Jordan, Personal Communication, 2022). In addition to the tree farm, wild strawberry/raspberry patches are included in and around the public spaces to again encourage and reinforce intergenerational learning and interaction and promote passive foraging and eating of healthy foods.

The river on site is designed to replicate the narrow and large openings of the Nelson River while connecting the existing water collecting depressions on site which represente lakes. This metaphorical representation of the Nelson River which flows in and out of many large lakes is intended to return Fox Lake's people to 'living on the banks of the Nelson'. To further enhance this effect, the entire site is drained by swales acting as the thin tributaries found like veins of the river across the surrounding northern landscape



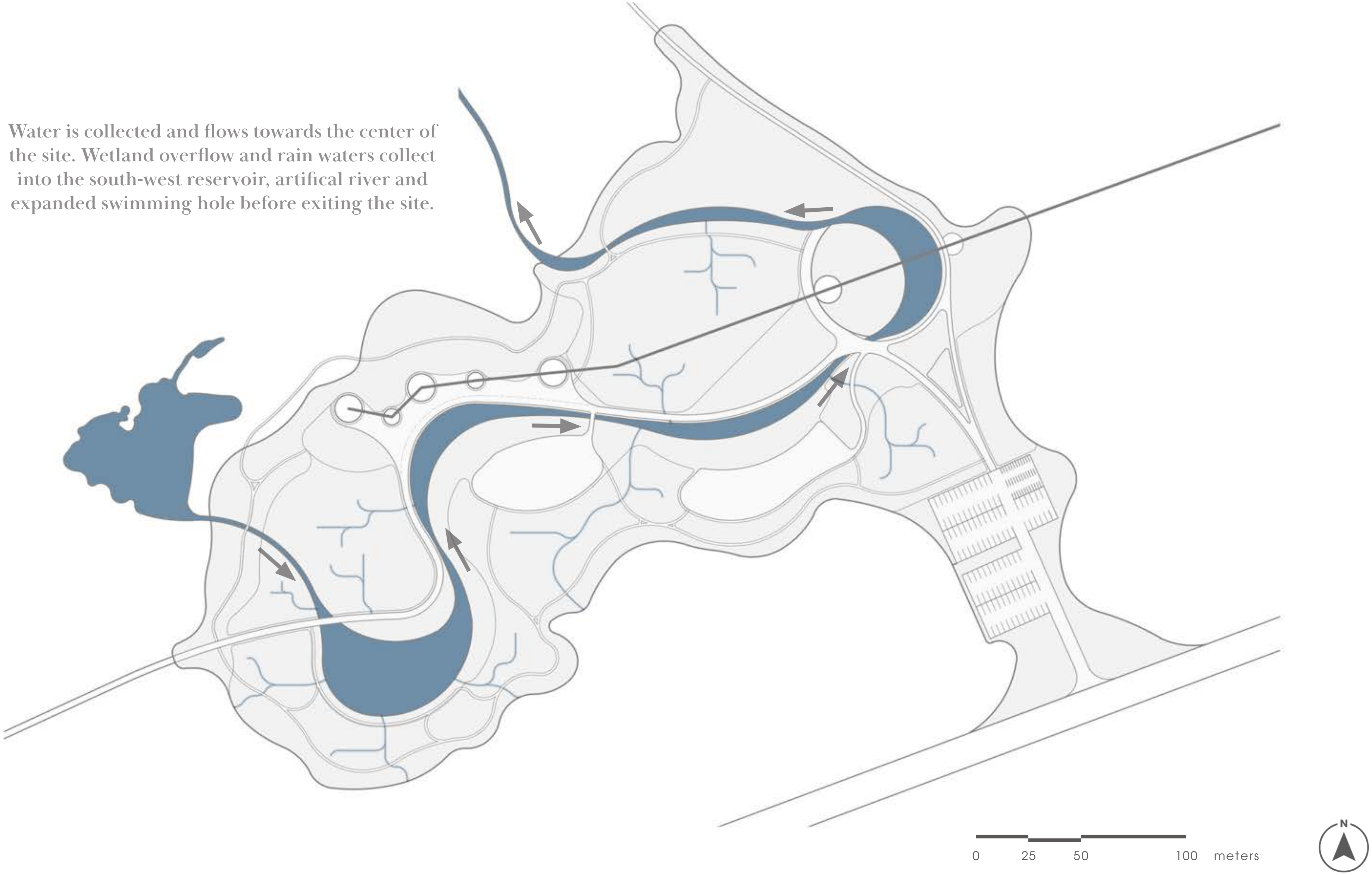


HEAT CAPTURE SUPPLY PIPE



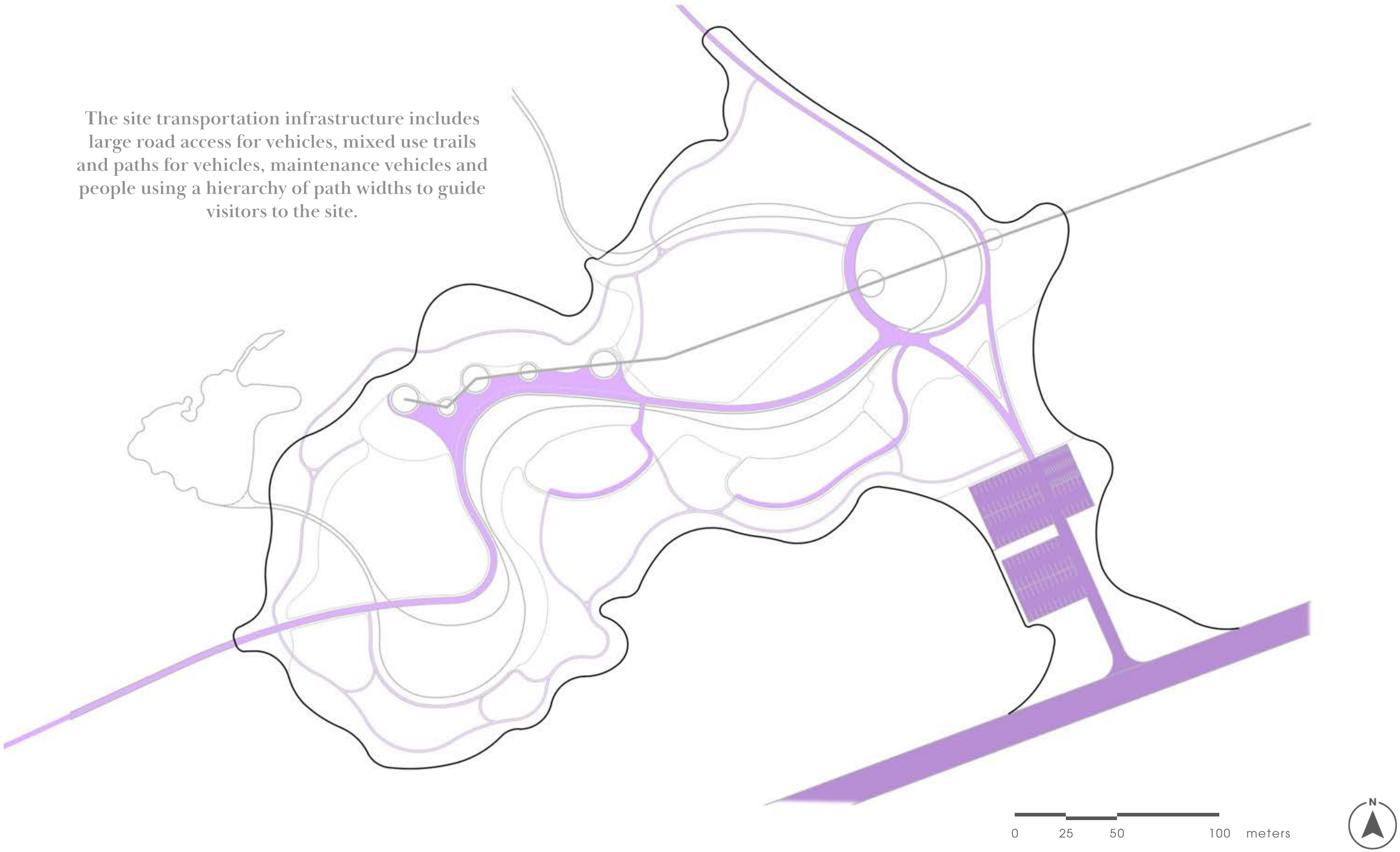
SUN ANGLE ALLOWANCES

Water is collected and flows towards the center of the site. Wetland overflow and rain waters collect into the south-west reservoir, artifical river and expanded swimming hole before exiting the site.

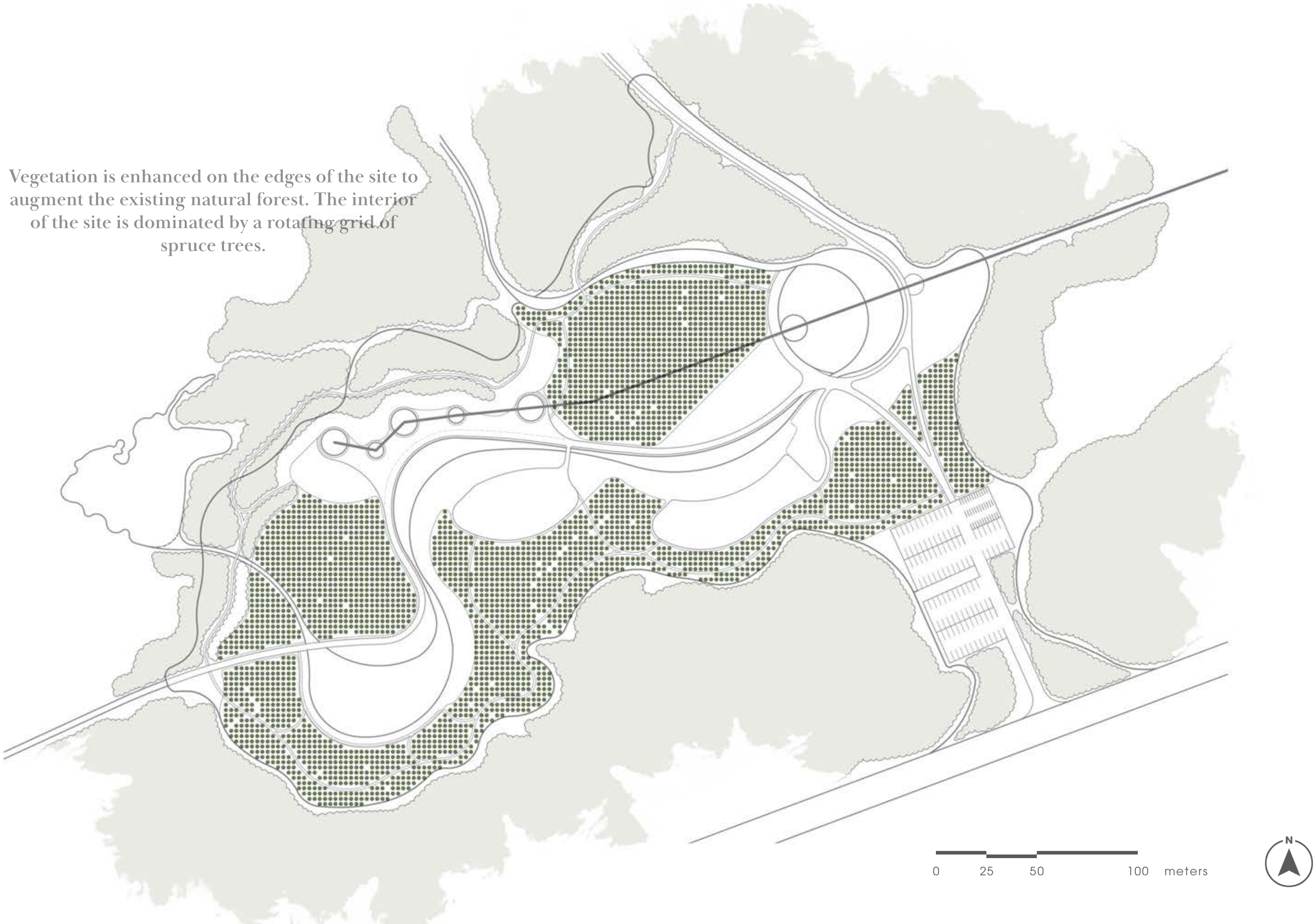


SITE HYDROLOGY

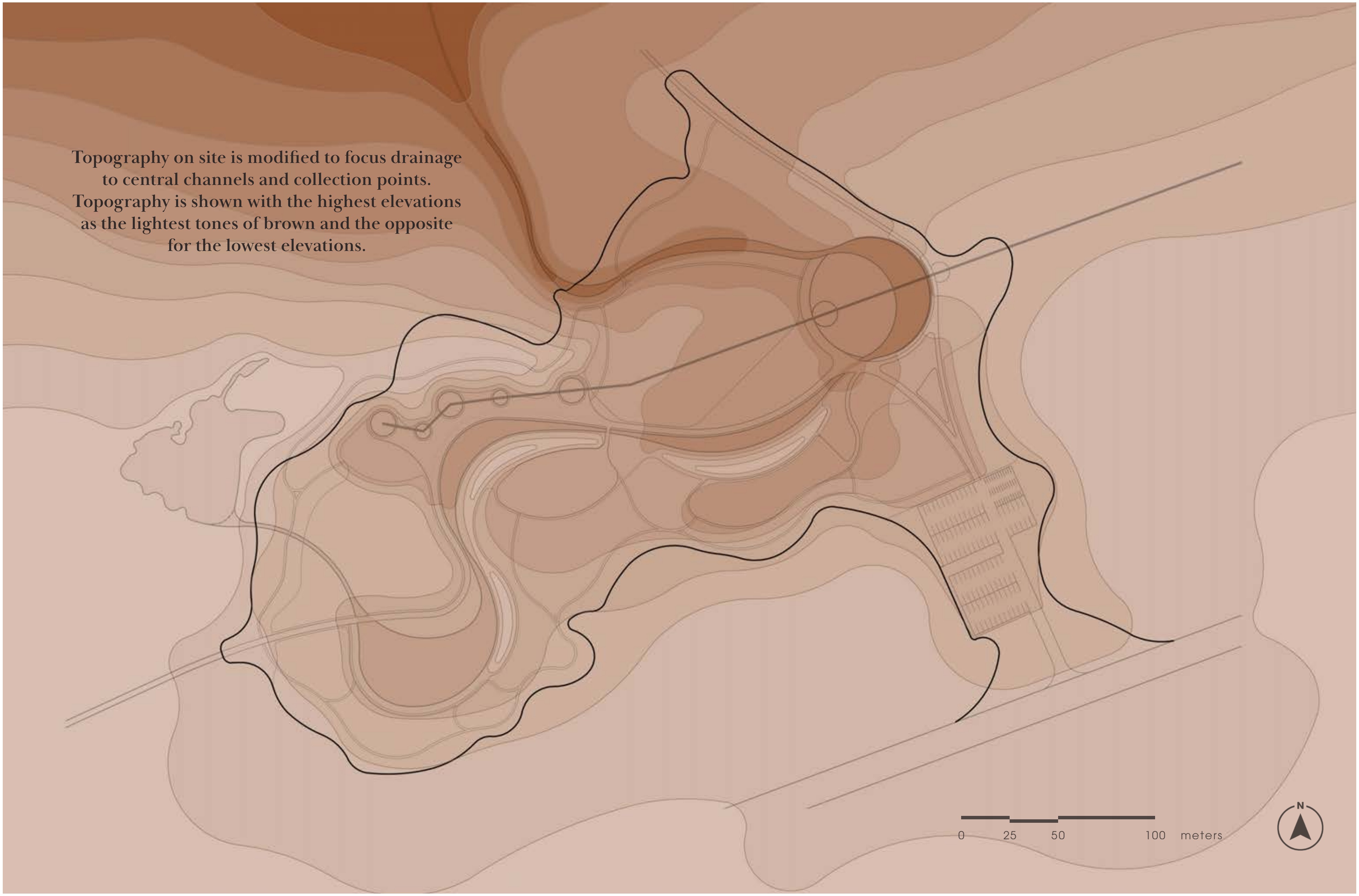
The site transportation infrastructure includes large road access for vehicles, mixed use trails and paths for vehicles, maintenance vehicles and people using a hierarchy of path widths to guide visitors to the site.



Vegetation is enhanced on the edges of the site to augment the existing natural forest. The interior of the site is dominated by a rotating grid of spruce trees.



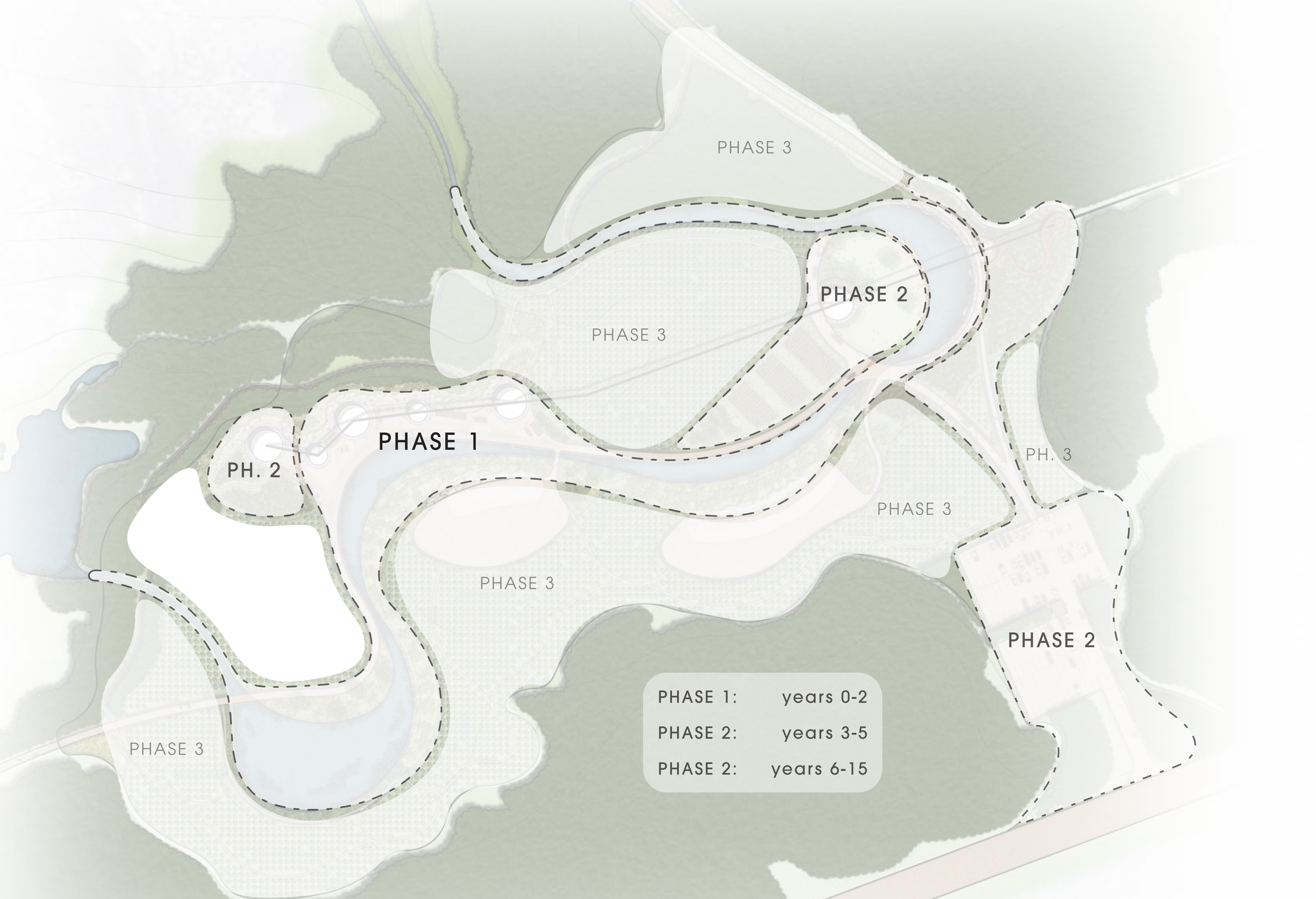
SITE VEGETATION



SITE TOPOGRAPHY

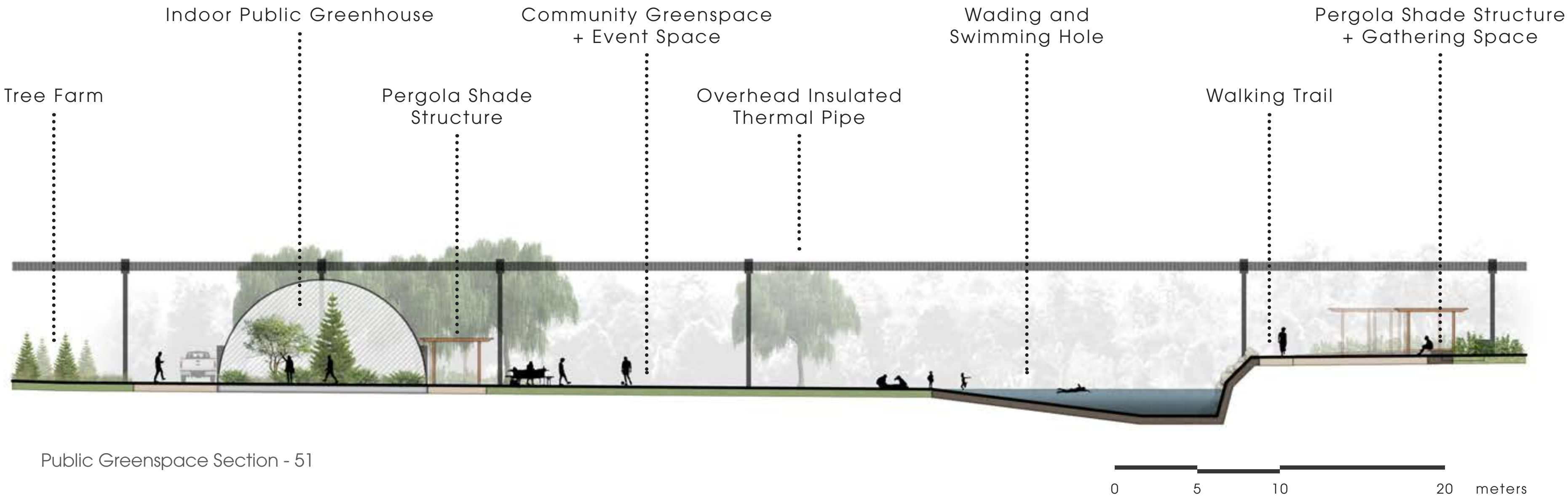
Site Evolution and Phasing

Finally, an important part of the final site design, particularly due to the size and multiple complex elements proposed, is producing a phasing plan to help guide the site's evolution from abandoned quarry pit to the aspirational final version of the project in the rendered plan. The phasing for site development is divided into three phases with the opportunity to expand upon operations in the future. Phase one is focused on starting to transform the site and beginning food production through the construction of the greenhouses. This phase will include earthworks and grading to ensure proper drainage moving forward as well as to create the artificial river and restructuring the boulder piles to properly fit and nestle the food producing and composting greenhouses. Phase one is planned to be complete within the first two years. Phase two focuses on developing the site further to begin hosting the community of Fox Lake and their surrounding neighbours as well as begin sapling production in the west most greenhouse. This phase encompasses the creation of road infrastructure and access to the site as well as the main greenspace for events, seasonal activities and intergenerational interactive catalysts. Phase two is planned to be complete within three years once started. Finally, phase three will focus on beginning reforestation efforts along the edges of the site as well as begin developing the tree farm as soil is slowly generated as well. This phase is planned to take over a decade, as soil generation may be slow and sapling production in the greenhouse may limit the speed at which the tree farm and reforestation efforts are completed.



SITE EVOLUTION AND PHASING

SECTION CUT REFERENCE PLAN

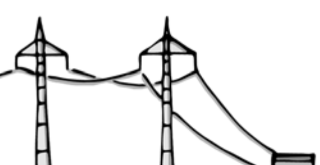


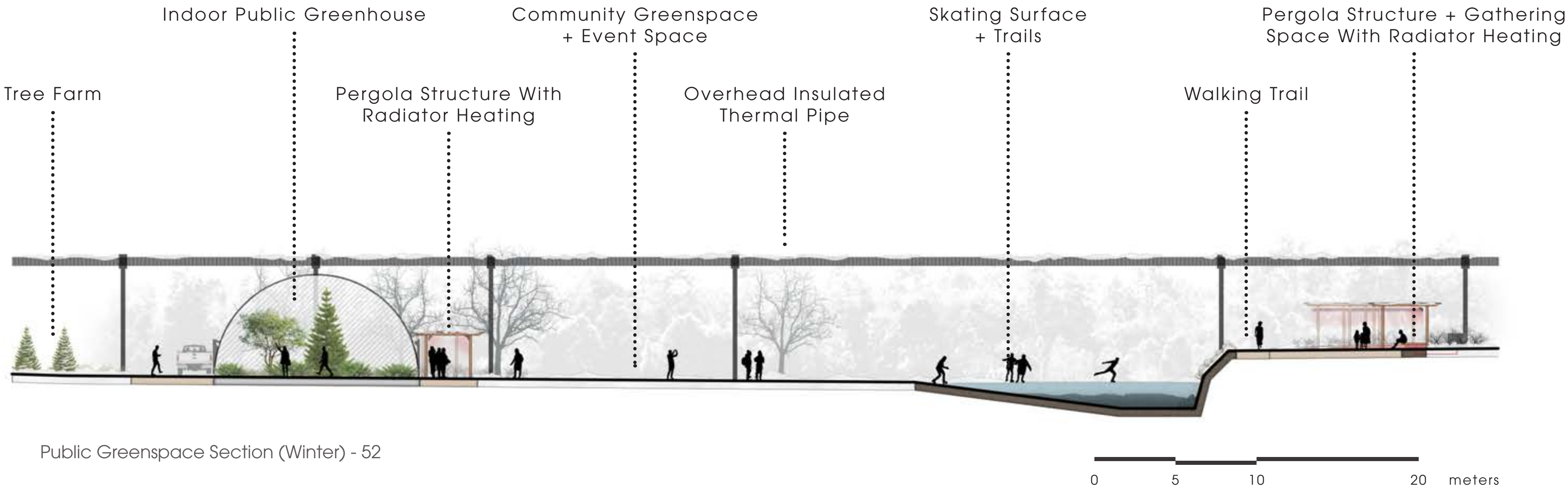
Public Greenspace Section - 51

Section Cut - 1

The public space was a main focus of the site design, because it would have the greatest experiential impact to visitors on site. For this reason it was important to ensure it was a flexible space, with a large enough area to house seasonal events and function as a day to day park. As an event space, it is designed to hold well over 500 people for festivals or events in need of a stage, in which the gathering space above the rock wall would function as an elevated stage with the greenspace serving as an informal amphitheater. As a day to day park space, it functions as a relaxing picnic space, wading/ swimming hole, interactive learning centre greenhouse, gathering space, lookout trail, and is adjacent to communal interactive garden plots.

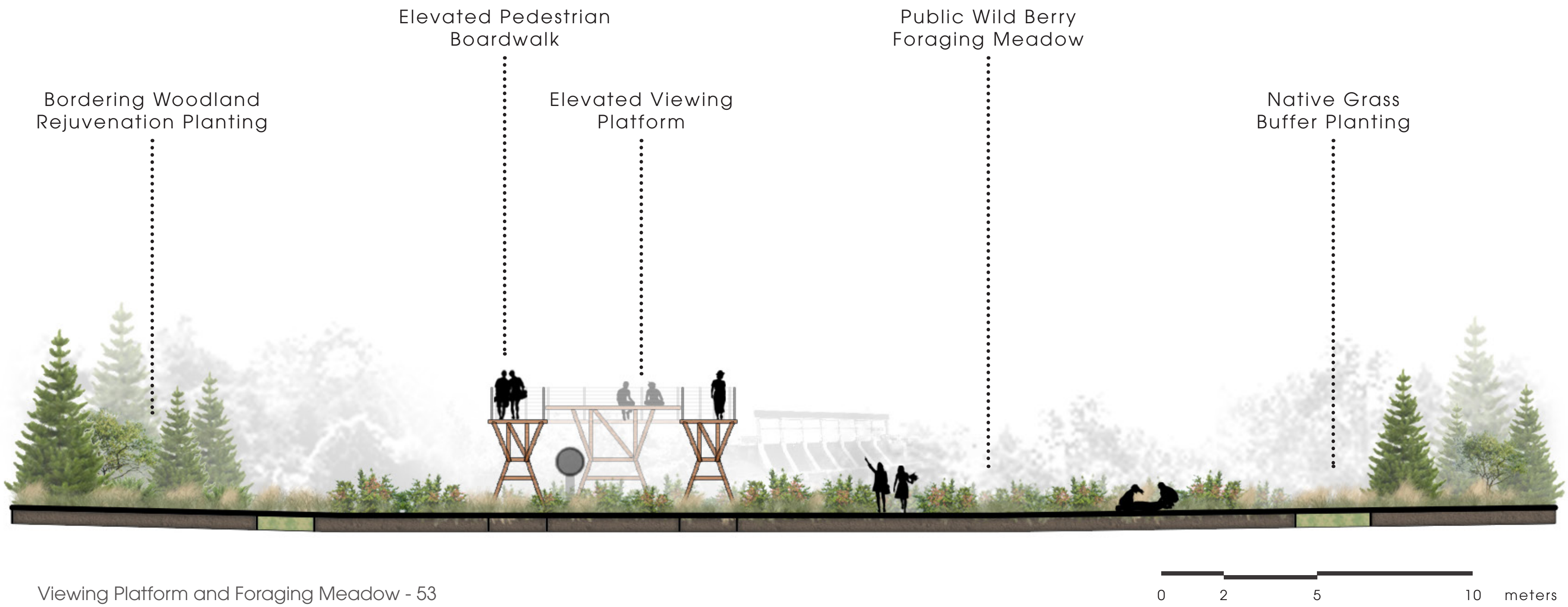
In addition to its multifaceted functions and program, the space reinforces significant cultural practices and desired functions for the site. In providing a swimming hole and indoor public greenhouse, outdoor swimming areas and specific niche boreal plants lost to Manitoba Hydro development can be facilitated through this site instead. This is conducted through the indoor public greenspace year round as well as through the willow trees along the edge of the water, which used to line the banks of the Nelson River and provide shelter to Fox Lakes ancestors (Thomas Jordan, Personal Communication, 2022). Although this space will never fill the void felt by Fox Lake, the possibility that it begins to repair connections to the land and activities their ancestors engaged in is well worth investing in. Additionally, by creating a public space for the community to invite their neighbours to join in, services one of the main goals the community have in the near future, of strengthening bonds and relationships with the people of Gillam, instead of feeling separate and isolated.





Public Greenspace Section (Winter) - 52

This space is also an asset to the community in the winter. The space transforms to accommodate ice skating and other winter activities with the indoor public greenhouse being the central public hub. The greenhouse can be used to warm up or equip skates, snowshoes, cross country skis etc. Outside of the greenhouse and above in the gathering space, the pergolas are equipped with radiator style heating powered by the thermal pipe in order to create further places to warm up and make outdoor activities more long-lived and bearable.

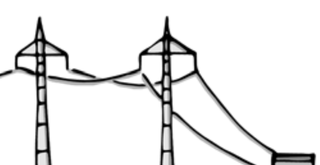


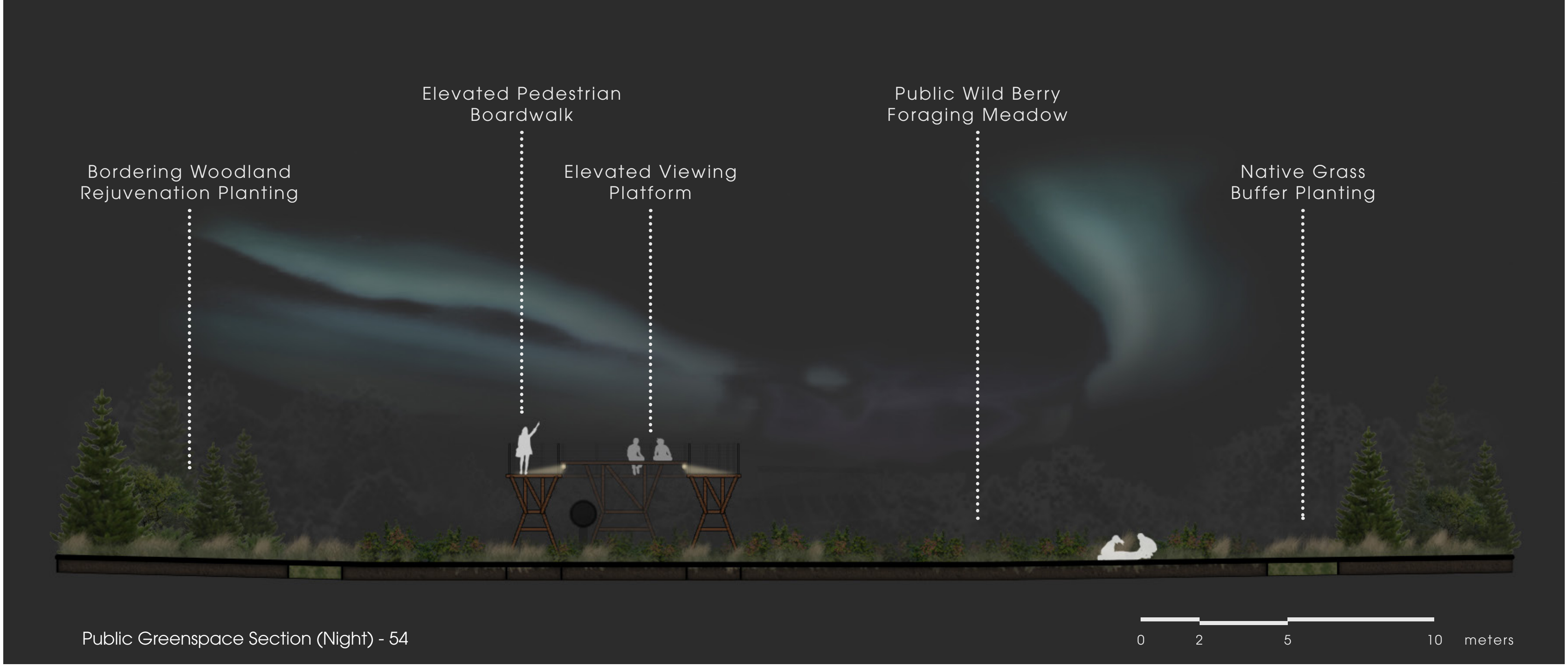
Viewing Platform and Foraging Meadow - 53

Section Cut - 2

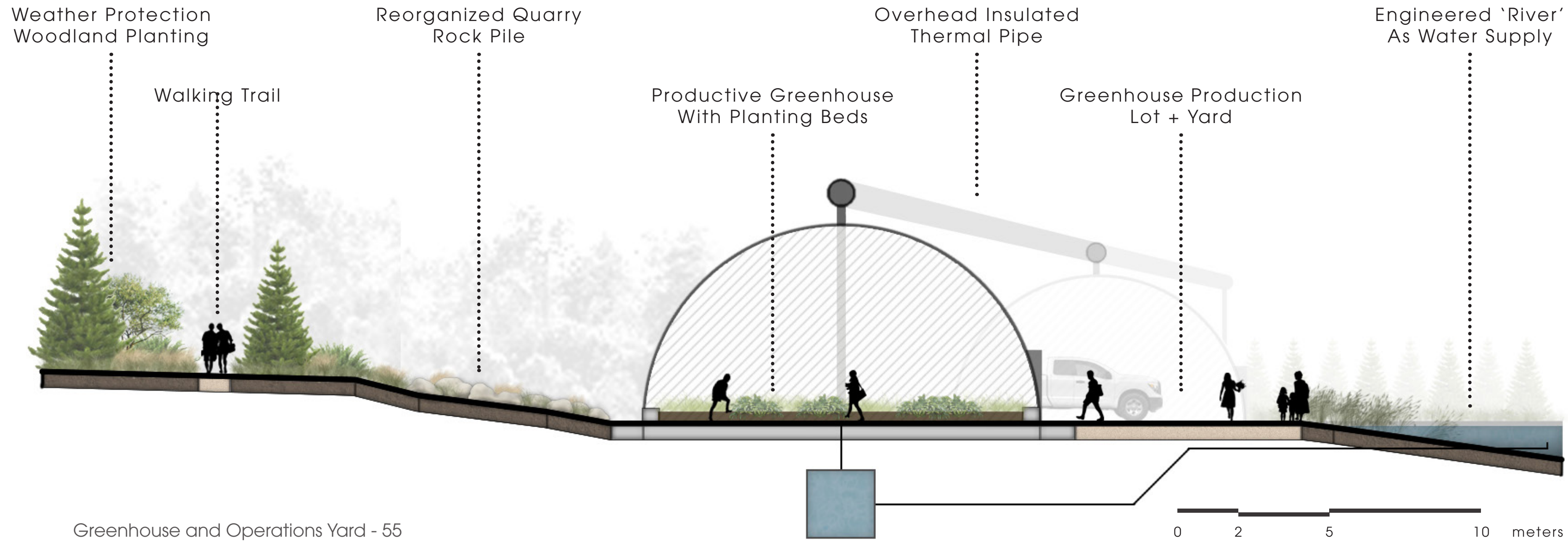
In addition to the main public greenspace area, is the viewing platform and foraging meadow. Located where the thermal pipe enters the site, a swooping pathway slowly elevated above the ground plane to bring visitors high enough to view the entire designed site as well as the Limestone Generating Station and Nelson River. Here the sense of connection to the Nelson River is once again implemented in the site design as a small step towards creating that relationship for future generations of Fox Lake Cree Nation. This space is accentuated by the low growth foraging meadow beneath it, where visitors can enjoy picking berries, have picnics and enjoy the views of the site. This place is intended to be a haven, a sanctuary of sorts, representing new beginnings and new relationships-relationships between generations, neighbours and the community as well as a partnership with Manitoba Hydro that represents a brighter future.

This space in the site design has the ability to transcend a viewing platform through its use at night. By using minimal down-lighting, visitors can venture to the end of the viewing platform to enjoy the dazzling view and lights cast from the generating station as well as possibly the Northern Lights. Additionally the meadow and platform can act as a stargazing location.



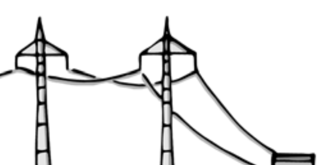


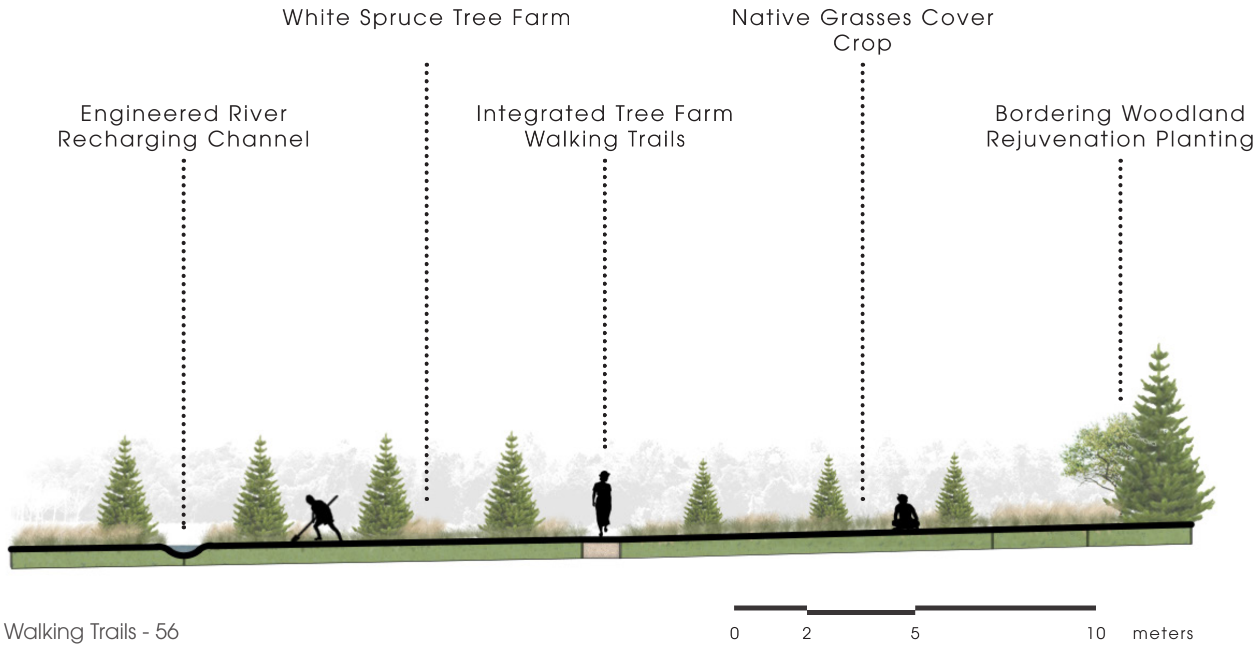
Public Greenspace Section (Night) - 54



Section Cut - 3

The greenhouse operations area shown above, demonstrates the basic layout of this main site function. The insulated pipe delivers thermal heating to the greenhouse where planting beds or hydroponics are used to grow plants. Below the greenhouses are water storage tanks for easy control of water supply from the nearby artificial site river. Outside of the greenhouse, is the production lot, where greenhouse and site workers have access to materials, space to unload and load delivery trucks and store equipment. The greenhouses are nestled close to the modified boulder piles which, in addition to windbreak tree planting, grants them protection from the cold winter winds. It is important for the rockpile to be shallow and deep enough to ensure ambient light still reaches the backside of the greenhouses which do not receive direct sunlight.

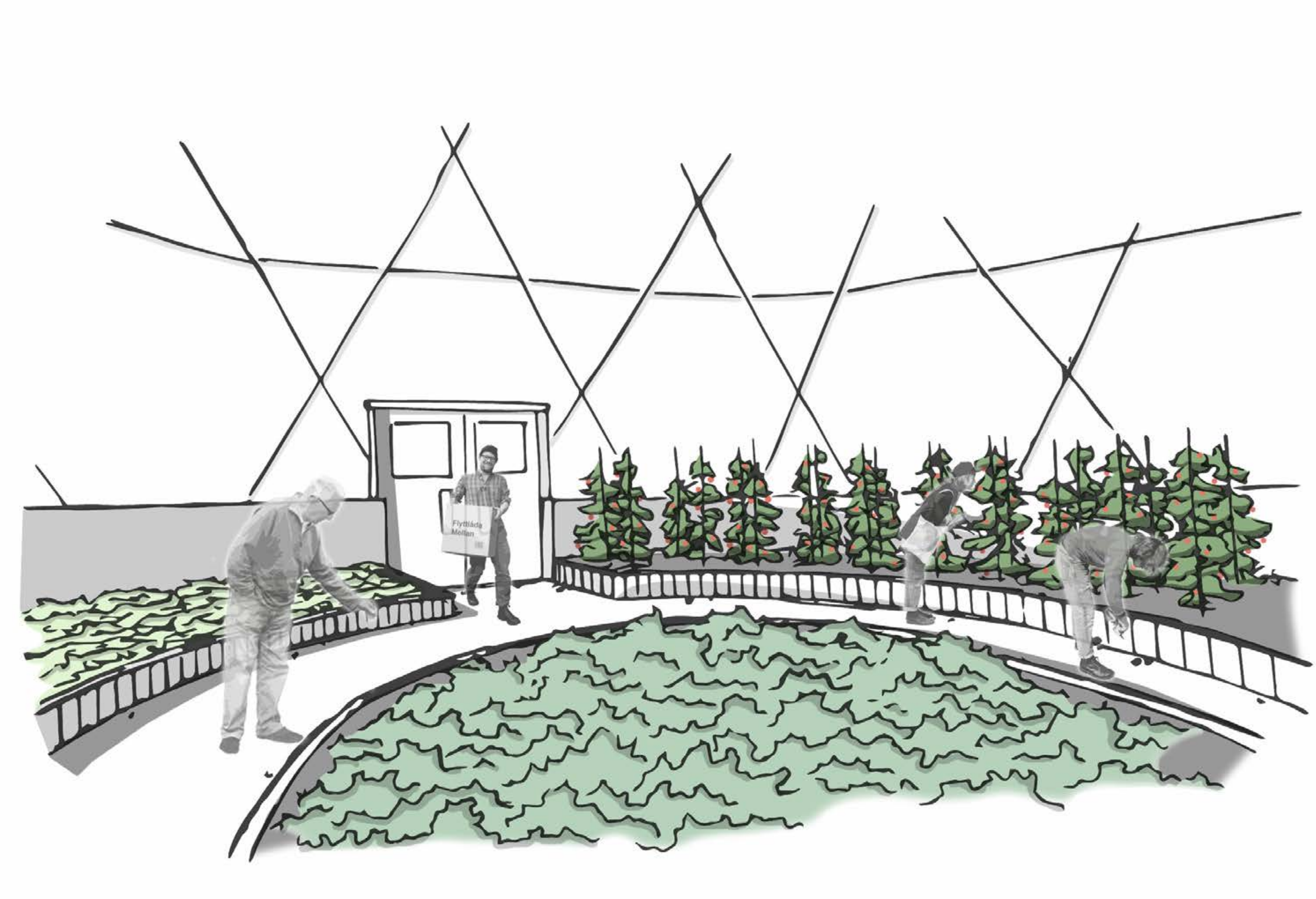




Tree Farm Walking Trails - 56

Section Cut - 4

The tree farm areas on site are simple in nature, yet important to this project as they dominate the majority of the site. The rigid rows of white spruce may feel alien to walk amongst compared to the wildness of the surrounding ecosystem, however the generational growth of the trees lends a unique opportunity to pass down information on each stage of the tree farming and reforestation process for visitors of the site. Additionally, the area hosts a cover crop of native grasses to keep soil in place, which makes every area a place of solitude and relaxation as an escape from the main public spaces, if visitors need or seek out a secluded break from social interaction.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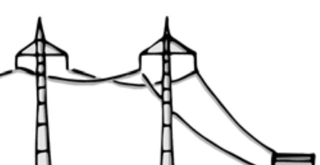

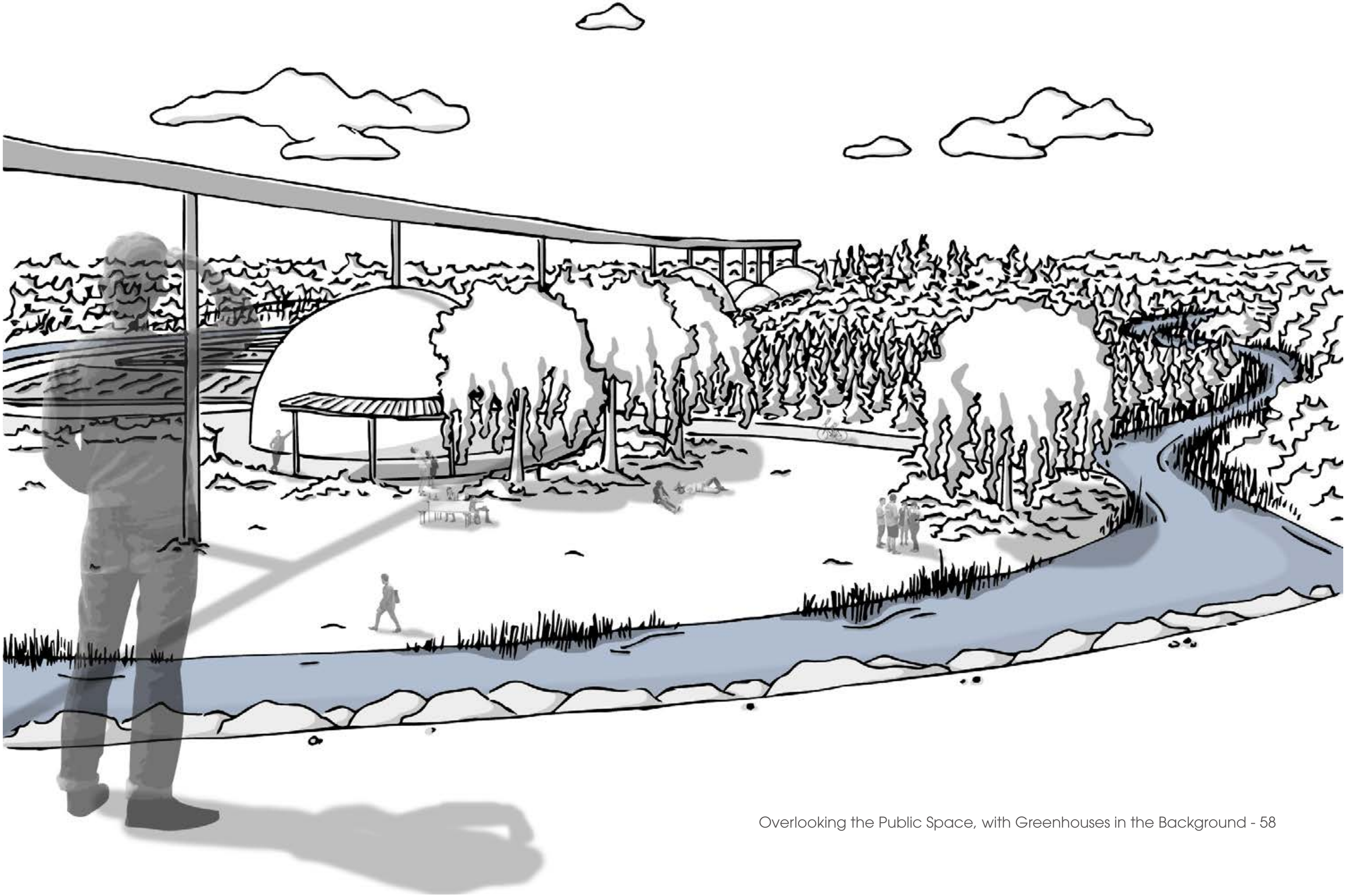

Overlooking the Public Space, with Greenhouses in the Background - 58

5 - Connections

Conclusion

This practicum sought out a solution to food insecurity in northern Manitoba Indigenous communities. Existing conditions in these communities are unjust and seem to not be improving quickly. However, it was surprising to find that the situation, through discussions with a representative from the community, did not seem so "black and white". Conway Arthurson from Fox Lake Cree Nation believes in the future of his community and the wider community of the region. He embodies hope; it comes through in the way he speaks about current initiatives and his dreams of the future. Not only did Arthurson want to improve food security and sovereignty in his community, but he immediately wanted to accomplish it in such a way, that Fox Lake could share their new found security in food access and forge strong bonds with their nearby neighbours in Gillam.

Hope for a better future, and connections with the land and with one another are the goals this practicum aims to facilitate. Through the creation of an integrated landscape with food security and forging of social relationships at its core, well being in Fox Lake Cree Nation is foster in multiple ways. The final outcome of this practicum is a way of envisioning a new future which embraces the same hope that Arthurson conveys. This practicum is a case study for remote northern communities, in that it shows the possibility to partner with Manitoba Hydro, and to create resiliency without compromising a communities character and values. It is my hope that food security is strengthened in northern Manitoba, and that it can be done in such a way that creates partnership, strong relationships and bonds communities together who face the same struggles.

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Image References

Figure - i
Photo taken by Matthew Peters

Figure - ii
Photo taken by Matthew Peters

Figure - 04
Photo taken by Matthew Peters

Figure - 09
Unknown, n.d. Electricity helped to improve the efficiency of operations on farms in Manitoba, as well as to improve the lifestyle of farm families. [photograph] (A History of Electric Power in Manitoba).

Figure - 10
Unknown, n.d. The Assiniboine steam plant's capacity was originally measured in horsepower, a unit of power in the Imperial system equal to 550 footpounds per second, which is approximately 746 watts (W). A watt is a unit of power in the metric system. The Assiniboine steam plant's capacity in 1895 was rated at 750 horsepower. The term horsepower was initially used to describe the power of pumps, beginning in about 1806. As time passed, horsepower was used to describe the power of a variety of mechanical devices, such as steam engines. [photograph] (A History of Electric Power in Manitoba).

Figure - 11
Unknown, n.d. Pinawa Generating Station was Located Close to the Pinawa Townsite Seen at Upper Right. [photograph] (A History of Electric Power in Manitoba).

Figure - 14
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Figure - 15
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Figure - 16
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Figure - 17
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Figure - 22
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Figure - 24
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