

Jokkmokk: The Arctic future

Climate transitions and Urban design Challenges in Winter Cities



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ABSTRACT

Polar nights, extreme cold, and snow are part of the identity of Arctic cities; these elements together set a particular demand for urban designers to find solutions to make the city more livable and attractive during the long dark days in the winter and still thrive on being enjoyable during the long bright days in the short summers. However, Arctic cities are threatened continuously by shrinking populations, climate change, and industrial exploitation (ex. mining, forestry), directly affecting the native inhabitants. The northernmost city in Sweden, Jokkmokk, lies a strong tie with the Sami Heritage and possesses an astonishing natural landscape. This thesis aims to use the winter as a design driving force to transform Jokkmokk into a city more attractive to live in and addresses suggestions on how to increase the economy, focusing on local production and strategies to build up a place resilient for the upcoming challenges.

Keywords: winter city, climate sensitive design, climate change, small cities, local economy, winter resilience, native people, Sami, cultural identity.

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INTRO

When folks think about the Arctic, the first thought that comes to mind is a land with ice, few natives, polar bears, and wrongly penguins. As a result, some folks believe that the Arctic region is a lost land and infertile. Contrary, the Arctic has a rich biome diversity and has plenty of natural resources like minerals, natural gases, and oil. The climate is distinguished by its long dark winters (polar nights) with temperatures below freezing and short extreme bright summers (midnight sun) with mild temperatures. Indeed the severe weather rules up north, yet humankind has settled up in the Arctic thousands of years ago, and they learned how to survive.

Additionally, the Arctic is the land of many indigenous groups, possible ancestors of the north's first occupations. In the last centuries, the interests of expanding land and the search for natural resources moved the Arctic for second colonization (Sovereign lands like Russia, US; Sweden, Norway, Finland) started to occupy the Arctic and industrialize and urbanize the region, generating a series of challenges regarding social aspects (native people assimilation), environmental impacts and urban development. Despite slow urbanization, 4 million people live inside the circumpolar circle, and around 100 million people live in subarctic regions. Arctic and subarctic cities (especially rural cities) face

constant threats from sparse urbanization, population shrinking, extreme cold, and climate change problems. Climate change poses a threat to wildlife and as well cities in the Arctic.

This thesis has been divided into two parts: The first part (Chapter 1 and 2) will explore a more theoretical investigation concerning the Arctic region - global and regional. The research contains information about the history, natural landscape, urban design in winter cities, reports, and analyses about the Swedish Arctic (climate change and general information). Also, the introduction of the native people from the Swedish Arctic - The Sami. The second part (Chapter 3 and 4) will focus the research on more local aspects, presenting the city Jokkmokk, the main subject of this study. This part will explore the climate-sensitive design applied and focus on design strategies to bring up Jokkmokk to be more climate-resilient, sustainable, invigorating its ties with the Sami's local identity and suggestions to revitalizing its economy without mining the region.

Jokkmokk lies 10km above the Arctic Circle, and, like any other small town in Sweden, it is struggling with a shrinking population. The harsh climate conditions are both a challenge and a benefit for Jokkmokk. It puts particular demands on urban design and architecture and limits the possible activities in the city. However, the

climate also constitutes an essential part of the city's identity and opens up the door for tourism. Economically the city is challenged by aging and slowly decreasing population—the threat of local mining, pledging to reinvigorate the city. The choice of intensive exploration of its natural resources could negatively impact the Sami and, of course, an unalterable impact on the natural environment.

This thesis investigates and proposes a set of urban design strategies for Jokkmokk to recover the city dynamics through more sustainable actions focusing on local resources (natural, social, and cultural aspects) and embracing the winter to develop the urban design (climate-sensitive design).

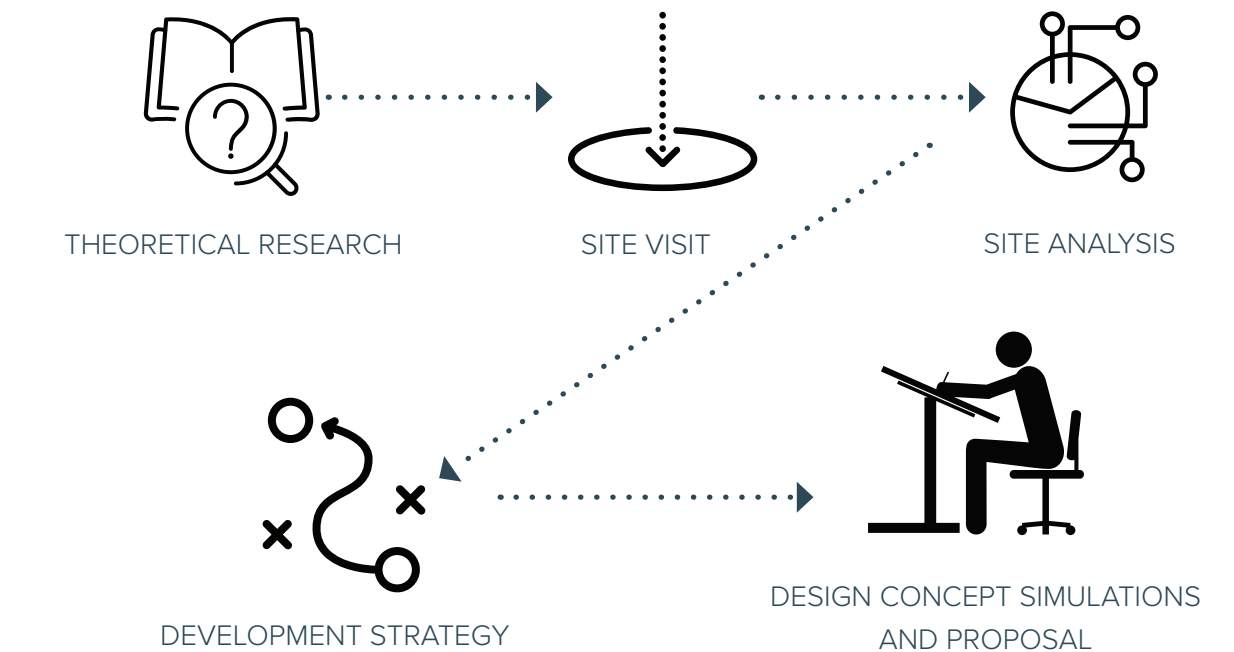
RESEARCH QUESTIONS

- How can we embrace the climate as a driving force to yield outdoor life quality and the opportunity to improve the local economy?
- How to make the city more active during the winter?
- How to build a strategy of urban development that will ensure the sustainable growth of Jokkmokk?
- How to protect the environment and the local culture (the Sami) constantly threatened by external interest (mining)?

OBJECTIVES

- Application of climate-sensitive design in Winter Cities.
- Reposition of small cities to be more competitive and attractive.
- Reintegration of the cultural aspects and make it part of identity and as well the use for local economic interest (Sami interests and cultural aspects should come first).
- Boost the local economy without spoiling the environment.

METHODOLOGY





1 THEORETICAL BACKGROUND

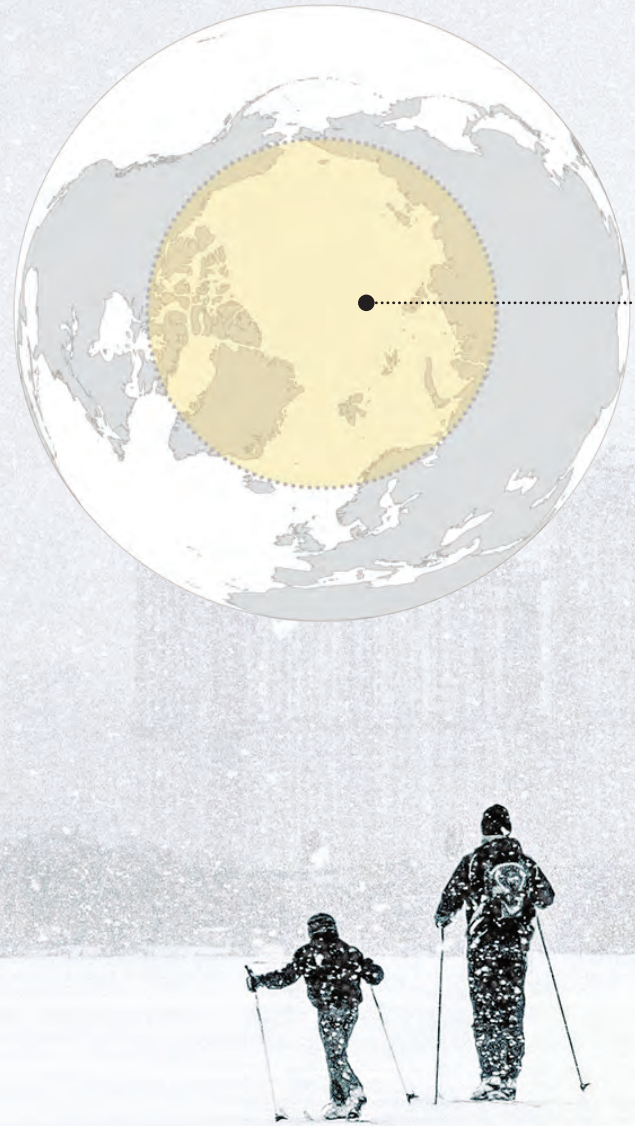
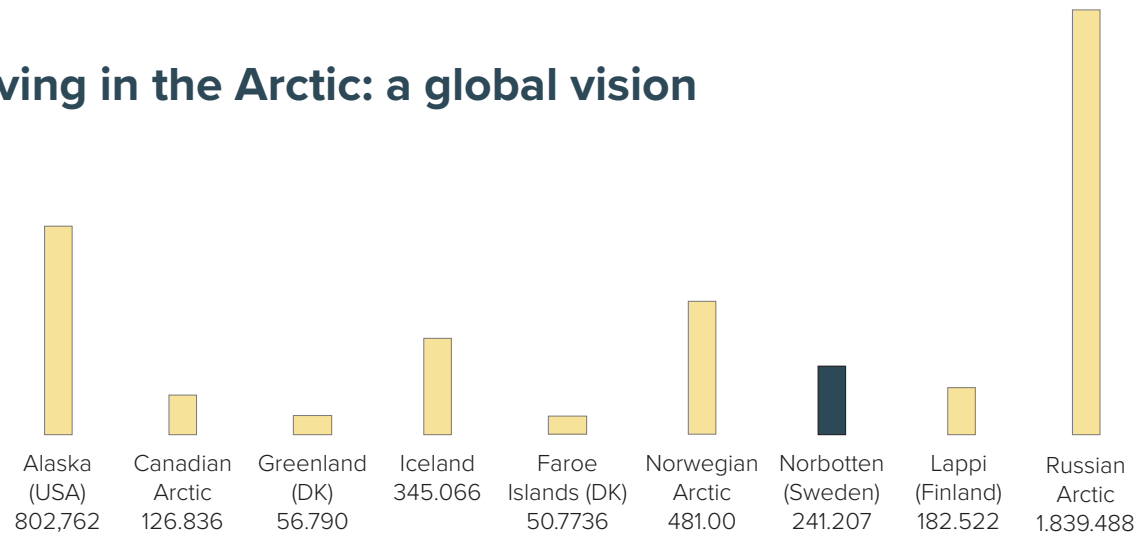


FIGURE 01 - Urban ski under the blizzard

1.1 Living in the Arctic: a global vision



There are around 4 million people living in the Arctic Region
100 million living in the Subarctic Region

"It is 7 am, and it is dark outside. I checked my car, and the engine didn't start because it was frozen. I had to change my clothes and put on some extra layers to endure the cold and walk. During the winter, days are long and darker, and I feel my energy drained out of my body. However, I enjoy being outside and contemplating the snowy landscape. To live in the Arctic, you have to be in connection with nature. Accept its cold and contrast of polar nights and midnight sun. Appreciate the snow for playtime. Learn how to deal with the snow in front of the door and wait for the summer."
Someone, from somewhere in the Arctic

Life in the Arctic is not easy; still, humankind has survived in the earth's northernmost location. The Arctic human occupation has happened in different periods, following climate

change and ice sheets' deglaciation. Some studies date the earliest human settlement in the North Scandinavian (Finnmarken) took place around 10.000yr. BC. As soon the ice melted, several groups dispersed up north. These occupations are attributed to the Komsa Culture, possible ancestors of the Sami.

The lifestyle of many native arctic people was mainly for hunting, fishing, and herding. To endure the harsh weather, they developed proper clothing and housing, and their survival also depended on their climate knowledge. The natives had nomadic habits. They kept moving around the regions according to the seasons. They settle in places where they could find



FIGURE 02 - Tromsø/Norway

climate protection and more natural resources essential to survival. Later on, explorers from Sweden, Norway, Finlandia, and Russia started to expand their territories into the Arctic region. The colonization in the Arctic Region (Euroasia or America) brought many negative impacts to the native people's lifestyle, such as loss of territory, diseases, and cultural assimilation. On the other hand, these expeditions started to lead to a settlement of non-arctic people, and it brought another series of transformations to the growing population, urban and industrial development.

The Arctic Region consists of nine countries: the United States (Alaska), Canada, Denmark (Greenland, Faroe Islands), Finland, Iceland,

Norway, Russia, and Sweden. According to the Arctic Human Development Report, around 4 million people live in Arctic cities, and one-tenth of the population is indigenous (except in Iceland). "Every Arctic Nation has a rich indigenous cultural heritage that continues to play an essential role in urban sustainability and development" (Carrie Schaffer).

The Arctic population is sparsely around the territory, and around two-thirds of the population lives in urbanized areas. Murmansk, located in Russia, is the largest city in the Arctic, with around 300000 inhabitants. No doubts, the Arctic Region has been an area of interest and conflicts, shaping into

the southern model (arctic post-colonization, a land rich in diversity and home for several indigenous people that has been placed outside and assimilated into the southern models of urbanization. The arctic vulnerabilities represent a big challenge for urban development: long distances, low population density, no possibility of farming, extreme cold, and right now, they are facing problems with climate change.

The first chapter aims to investigate deep further not only the climate characteristic of arctic cities, but the human behavior regarding the weather, the concept of winter cities and strategies for enduring the harsh climate, and impacts of climate change focusing on the north of Sweden.

1.2 Designing cities in cold climates

HUMAN BEHAVIOR AND WINTER

To understand the relationship between humans with cold climates, we must look into our physiological nature and origins; we are tropical animals, and our ancestors have their origins from East Africa. Considering the local zone temperature, it is similar to the human core temperature of 36,6° Celsius. The evolution origins point out that humans can cope better with warm environments than cold environments. As soon as humankind moved to areas, especially up North, where the cold climate is harsher than the tropics, the natural tolerance decreased as an unclothed man. To adapt to the climate conditions, humans developed housing and clothing, external additions to cope with the environment. Peter Broberg defines poetically the appearance of the Homo Chillicus “When Humans wandered towards the North, they met rain and damp winds, slush, cold, snow fog, and ice. So, this was the beginning of the Winter Man - Homo Chillicus we might call him - who must use a large portion of his resources to create small bubbles of East- Africa around himself”.

Humans are endothermic animals, and we need to keep a constant body temperature similar to the core temperature of 36,6° Celcius. To deal with the climate’s external environment, we need to prevent heat loss and keep the heat balance. The body will control the temperature

itself by sweating when it is too hot or shivering when it is too cold. Excess heat or extreme cold can be harmful to human health and can cause thermal distress that can lead to death. When the body is not shivering or not sweating, it means that the body reached thermal comfort status. Thermal comfort is a condition of mind that expresses satisfaction with the thermal environment. In other words, it is the point where the human feels satisfied with the temperature of the external environment. The human body temperature should balance the temperatures - heat balance - Exchange of body heat with the exterior. The graphic shows the parameter that affects thermal comfort:

- Air temperature
- Air movement (wind)
- Humidity
- Solar radiation
- Clothing and physical activity

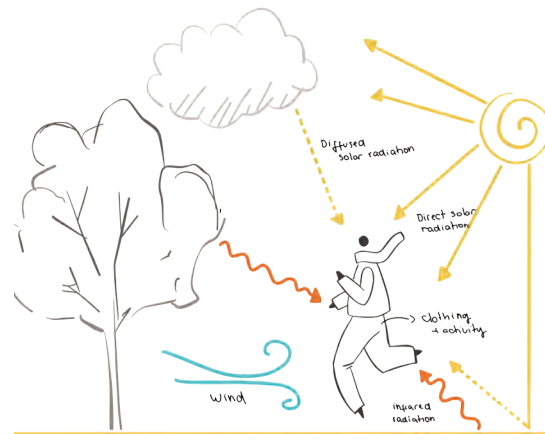


FIGURE 03- Le Mont Tremblant Street /Canada



90%

People spend around 70-90% of their time indoors



People tend to become less active and spend more time on TV



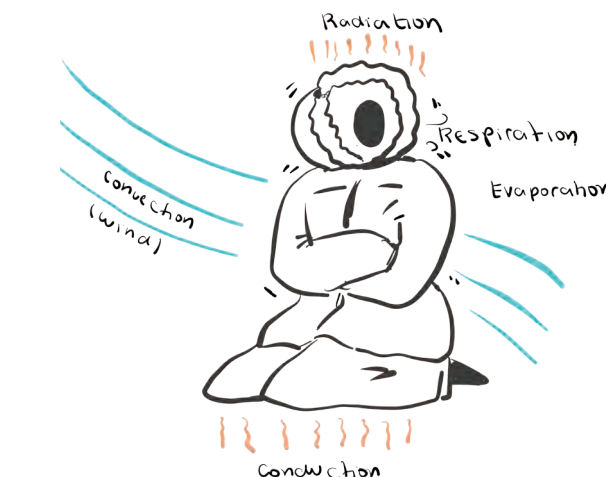
People tend to engage less social activity



People tend to develop more mental disease like depression (cabin fever)

Thermal comfort may vary from person to person. Other factors can influence this status, like age, sex, weight, and physical adaptation to the climate. Some studies have shown that the arctic native people have more physical resistance to cold environments than Caucasians living in the northern hemisphere. During the winter, the body heat loss is faster; the cold wind and the wetness take away the body heat. The excess of cold exposure can decrease mental performance, frostbite, hypothermia and lead to death in extreme cases.

Some studies suggest that people during the winter spend 70-90% of their time indoors to protect themselves from the severe weather; this can lead to isolation and social problems and directly impact their health. They become less active and increase the exposure to watch TV or computer games, low frequency of social



activities, suffer lack of vitamin D and tend to have more depression (winter blues). Children, older adults, and people suffering from other diseases are the most vulnerable group during the winter.

Here designers are challenged to change this pattern during the winter and improve the outdoor life quality to make people more active during the winter and get out of the hibernation state. “A healthy exposure within the optimal range of comfort stress scales will result in improved states both physiological and mental health” (Norma Pressman). However, the reality is different for other people. It is not only about the decision to stay inside. The winter can be lethal, especially for people in homeless situations where it is impossible to keep warm and for families and individuals with low income who cannot afford a proper heat system at home. The urban design should align with strong policies regarding the use of the city and promote a space open and fair for everyone, independent of the economic situation.

The next part will introduce the concepts of winter city and its characteristics and present a case study in Edmonton City, Canada.

Winter cities common characteristics



Winter cities are usually located over the 45° latitude



Average temperature below 0° at least for two months



Heavy precipitation in form of snow



Restriction hours of sunshine or daylight (polar nights)

CONCEPTS OF WINTER CITY

The terminology Winter City has its origin in the mid-'70s, where a group of northern architects has woken from the design warmer seasons oriented and started to think about how to deal with winter problems in the cities; here started the “Livable Winter Cities” movement in Minnesota, USA. The main goal was to reduce the winter’s negative aspects and use its positives characteristics to make the city more livable. Later on, the movement gained force and became an association, The Livable Winter Cities Association (nowadays Winter Cities Institute).

Although the concept of Winter Cities does not have an official definition, it is open to many interpretations. Norman Pressman, the co-founder of Livable Winter Cities, has defined that a winter city must check all the following items:

- Average temperature maximum daytime below 0° at least for two months
- Heavy precipitation in the form of snow
- Restriction hours of sunshine or daylight

Arctic cities are located in the high latitude above 60°, and its climates characterize long winters with short days (polar nights), heavy snowfall, and temperatures below 0°C with summers are usually temporary and mild temperatures with longer days (midnight sun). Arctic cities can

be classified as winter cities. However, not all cities located in the North can be considered winter cities. For example, Copenhagen and Glasgow lie at the same latitude as Edmonton and Moscow, but they are not cold. Climate conditions depend on not only its geographical location but also the topography and vegetation. Also, climate variability can be linked to how the city is built (microclimate). Different factors can interfere with climate conditions. According to Norman Pressman, the climate impacts as “a modifier of the urban spatial form.” In other words, the current environment of a place will influence building, transportation, and urban design and interfere directly with human behavior and their relation to public space use.

One of the biggest challenges of winter cities is creating spaces more attractive and facilitating outdoor activities to promote a better outdoor life quality to make people more active. Having in mind how thermal comfort works and how the body works, and the body heating loss process, we need to pay attention to three main aspects when designing winter cities:

- **Solar access**
- **Protection against wind, snow, and rain**
- **Light for darker days.**

WINTER CITIES DESIGN STRATEGIES: EDMONTON CASE

Edmonton is the Capital of Alberta, a province located in the western portion of Canada. The city is the sixth-largest metropolitan area in the country, with 1.321.465 inhabitants. The winter in Edmonton is less rigorous than in other Canadian cities. The cold season can last from November to March; however, the city has more sunny days (121 out 154 days are likely to be sunnier), low humidity, and less snow, but still temperatures can be freezing reach up to -40° Celcius. Edmonton city has worldwide recognition for its vibrant winter city design. In 2013, Edmonton’s City Council had approved the “Winter Design Guidelines: transforming Edmonton into a great Winter City”; the book collects information and strategies to develop the city thinking about the winter.

The aim is to help developers and other professionals focus on the winter lens to see the development and design from a winter perspective. It is to have in mind all four seasons during the development, and if the space is comfortable during the winter, it will be comfortable in all other seasons. The Winter Guidelines’ final goal is to seek how to make a winter city more livable and active in social and economic aspects. They developed the strategy following ten goals divided into four pillars:

WINTER LIFE

- Provide opportunities to be outside
- Improve pedestrian transit-oriented.

WINTER DESIGN

- Incorporate urban design elements to make the winter more attractive
- Winter design oriented for safety and comfort

WINTER ECONOMY

- Invest and promote the city’s winter festival in terms of capacity and sustainability.
- Promote the four-season patio culture
- Become the world leader in winter design innovation.

WINTER STORY

- Celebrate and embrace the winter
- Promote Edmonton as Winter City model local to global
- Focus on winter lens design thinking.

The diagram 01 (pag 20) shows the principles of winter design and how it works in public spaces and buildings. The five principles are:

1. **Protect from wind**
2. **Maximize solar access**
3. **Use color to reach a more vibrant winter space**
4. **Create visual interest with light**
5. **Winter infrastructure to support and provide comfort and access in cold weather.**



FIGURE 04- Illuminated ice skating Edmonton/Canada

PRINCIPLES OF WINTER DESIGN

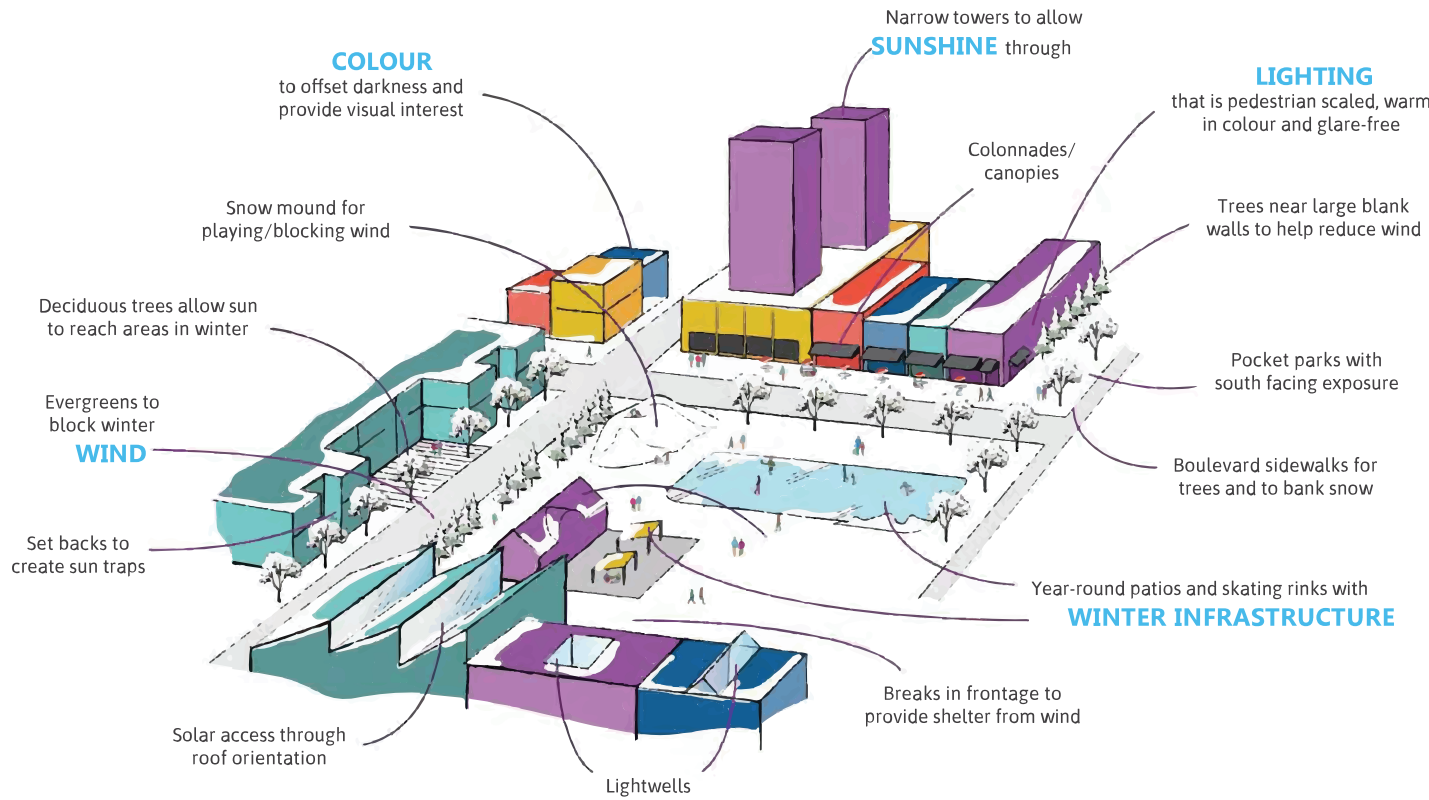


Diagram 01: Principle of Winter
Source: Winter Design Guidelines - pag 07



FIGURE 05



FIGURE 06



FIGURE 07



FIGURE 08



FIGURE 09



FIGURE 10



FIGURE 11



FIGURE 12



The Mihkajiegna Glacier in 1907
Sarek Park, Sweden
Photo: Axel Hamberg

FIGURE 13



The Mihkajiegna Glacier today
Sarek Park, Sweden
Source: Ájtte Museum

FIGURE 14

1.3 Impacts of Climate Change

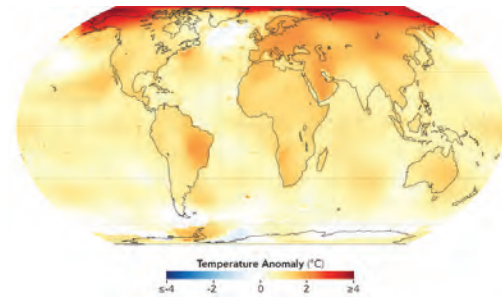


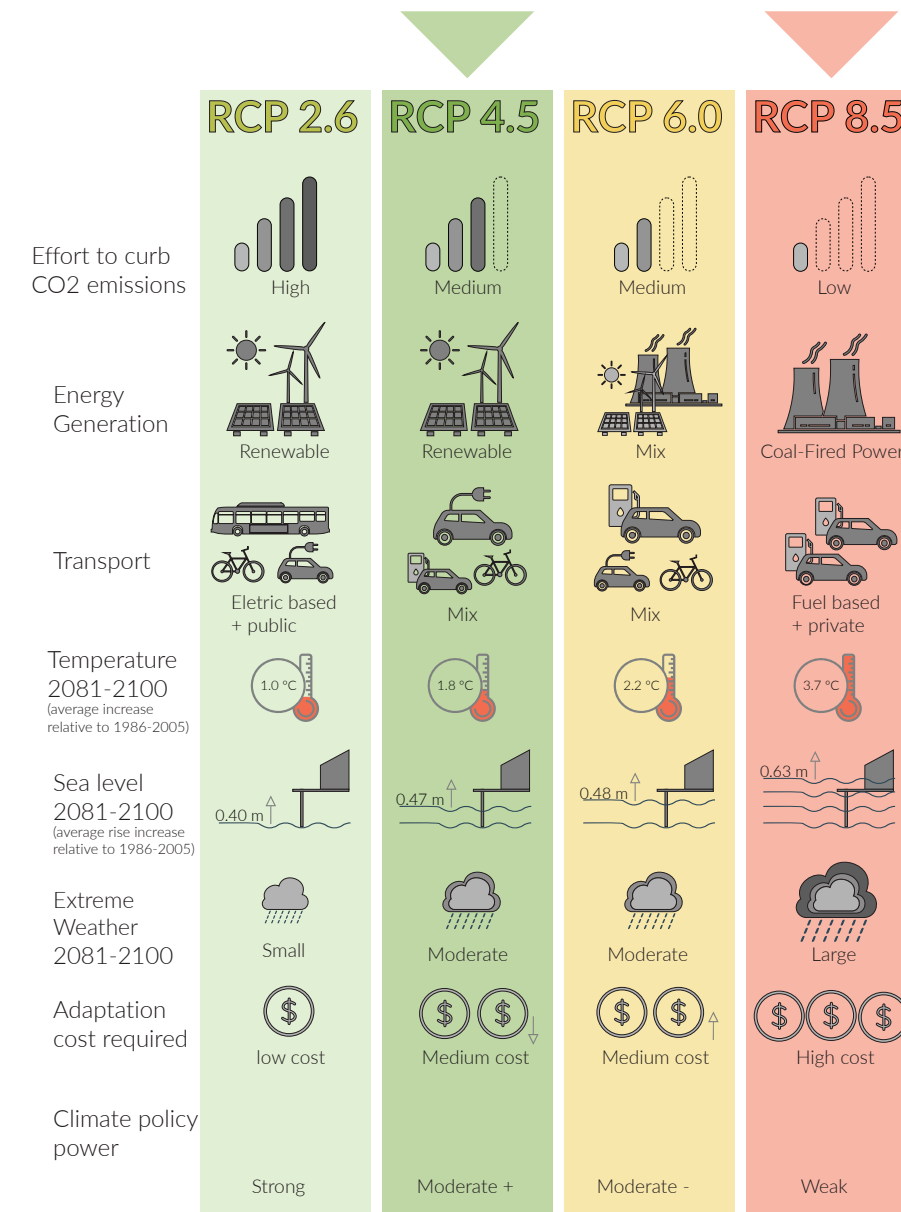
Diagram 02: Global Temperature Expectation
Source - Earth Observatory Nasa

Climate change is a natural phenomenon; however, human activities are accelerating the event for the first time. According to Karl Thomas et. , the primary source of global climate is human-induced gas emissions associated with energy use (local and global scales), rapid urbanization, and land-use changes. Emissions of greenhouse gases affect the ozone layer, allowing more solar radiation to hit the Earth's surface. Therefore temperatures are getting higher, precipitations are changing patterns, and the sea level is rising. These changes directly affect Earth's biomes, affecting all life types dynamics, including humans and the urban environments.

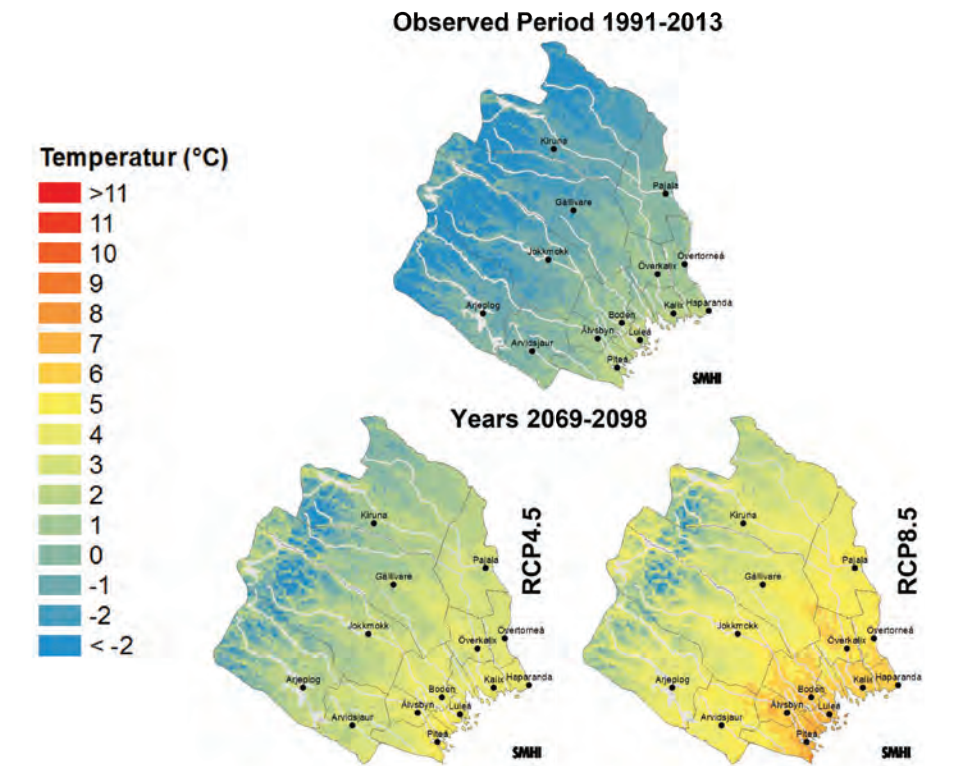
Climate change's impact has a more visual perception throughout the Arctic Regions: glaciers and icebergs are melting, more rainfall precipitation than snow, winter periods with mild temperatures, and changes in the flora-fauna biomes. The rising average temperature in the world is 2°C; meanwhile, in the arctic regions, this

number can reach 4°C. This section will directly address the climate change impacts on the Swedish Arctic, Norrbotten. The information and data collected are part of the report "Adaptation to Changed Climate in Norrbotten" and the SMHI climate institute. This report analyses the direct impacts of climate, identifying vulnerabilities in various sectors (economic, infrastructure, nature, health) and possible responses on how to cope with the climate. The following graphics will show the analysis in Norrbotten and which areas are more affected by climate change based on the RCP index (Representative Concentration Pathway).

The index is used to speculate how the climate will change in the future, based on choices regarding the CO2 emission. Graphic 01 shows the four ranges of RCP from very low to very high concentrations of CO2. In this analysis, the comparison will focus on the plots of RCP 4.5 and RCP 8.5. This study selected some analyses of average annual temperature, average precipitation, snow period, heat waves, and vegetation growth period. The observed period will be taking place from 1991 through 2013, and the prediction will be taking the last 30 years of the 21 century 2069-2098.



Graphic 01: Representative Concentration Pathway
Source - Adapted infographic from Coast Adapt | Department of the Environment and Energy - Australia Government

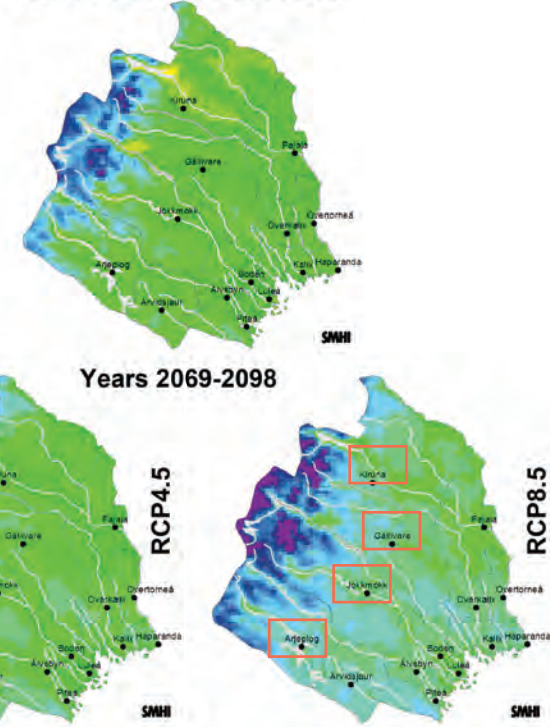
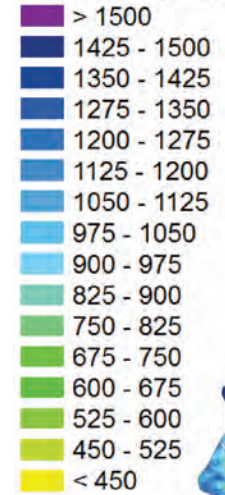


AVERAGE ANNUAL TEMPERATURE

The graphic above shows the rise of the annual average temperature compared with the period 1991-2013 and the two predictions RCP 4.5 and RCP 8.5 for 2069-2098. The average temperature in 1961-1900 was -1.5 C°, and the average temperature tends to rise higher in both scenarios. For RCP 4.5 by 3-4 C° and RCP 8.5, the average will be around 6°C.

Observed Period 1991-2013

Nederbörd (mm)



Years 2069-2098

RCP4.5

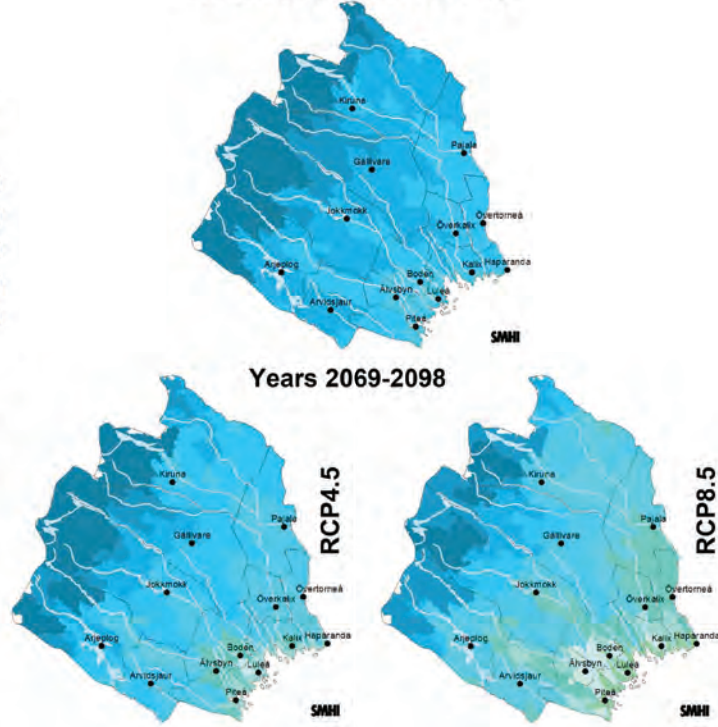
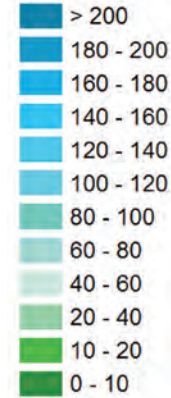
RCP8.5

AVERAGE PRECIPITATION

The average precipitation is expected to increase more in both scenarios. The expectation is 20% more rain for RCP 4.5 and 40% more rain for RCP 8.5. The municipalities located more north-west (Arjeplog, Jokkmokk, Gällivare, and Kiruna) will be more affected by the precipitation.

Observed Period 1991-2013

Antal dagar



Years 2069-2098

RCP4.5

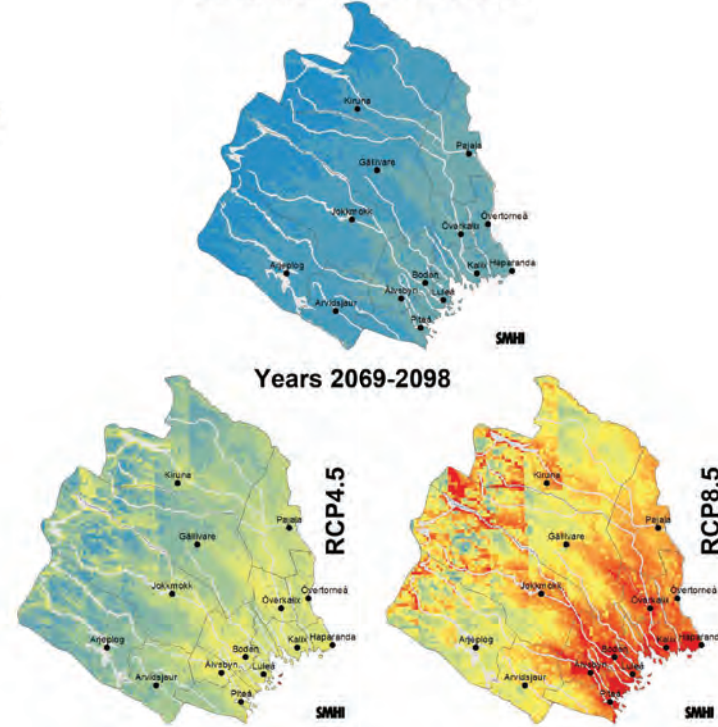
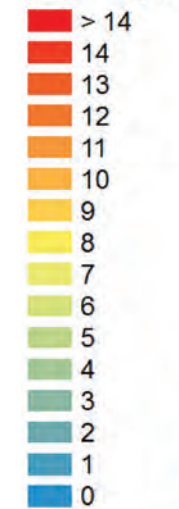
RCP8.5

SNOW PERIOD 20MM

The snow depth of 20mm shows a decrease already on the scenario RCP 4.5 on the coastal region than the observed period. Areas that used to be 100-120 days of snow will decrease to 60-80 days/year. The scenario RCP 8.5 shows a drastic reduction in the snow period for the whole county. This situation can affect reindeer husbandry, and as well winter tourism can be reduced.

Observed Period 1991-2013

Antal dagar



Years 2069-2098

RCP4.5

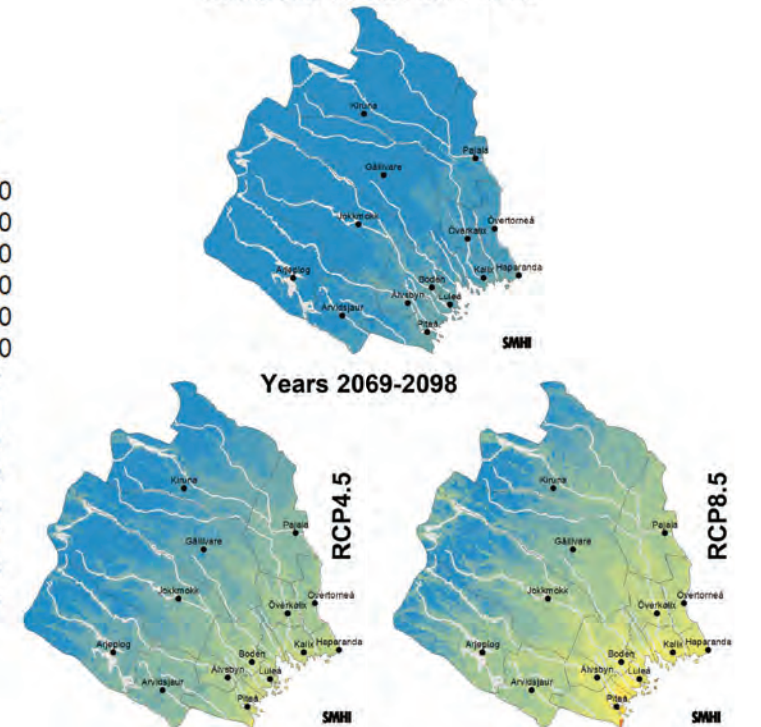
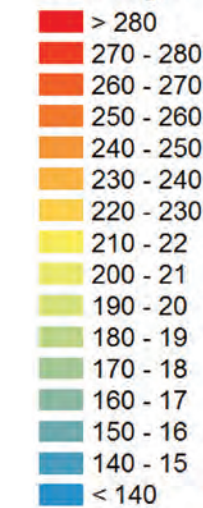
RCP8.5

HEAT WAVES

During the observed period, the heat waves occurred 1-2 days, and by the end of the century, the heat waves have an increase of 10 days; this can be a huge problem, especially for the elderly.

Observed Period 1991-2013

Antal dagar



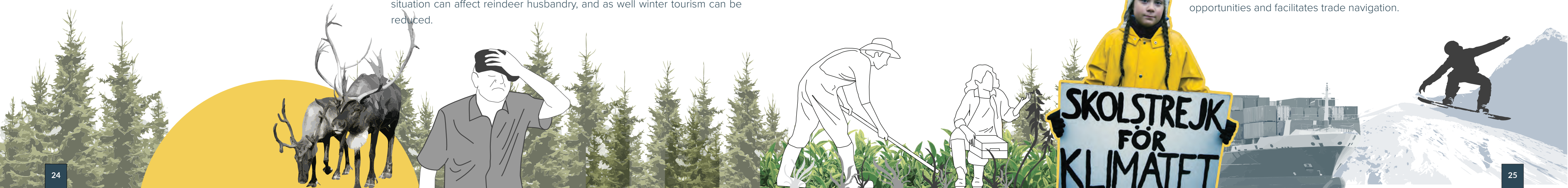
Years 2069-2098

RCP4.5

RCP8.5

VEGETATION GROWTH PERIOD

The vegetation period is expected to grow in both scenarios compared with the observed period. The Arctic getting warm can positively impact new types of economy, extended growth periods means growth in the agriculture sector, and less ice in the oceans opens more mobility opportunities and facilitates trade navigation.



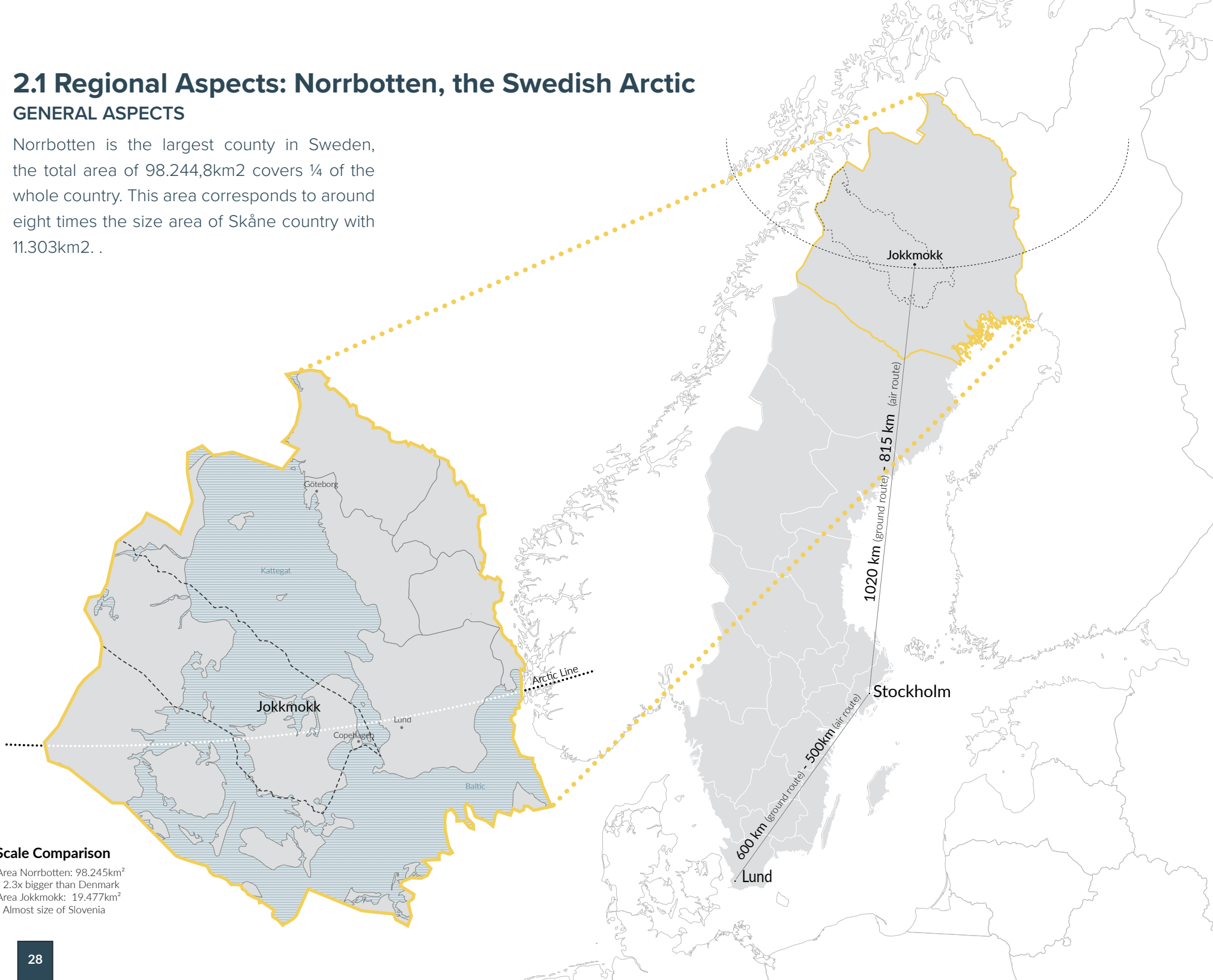


2 SITE DISCOVERY

2.1 Regional Aspects: Norrbotten, the Swedish Arctic

GENERAL ASPECTS

Norrbotten is the largest county in Sweden, the total area of 98.244,8km² covers 1/4 of the whole country. This area corresponds to around eight times the size area of Skåne country with 11.303km².



Scale Comparison

Area Norrbotten: 98.245km²
 - 2.3x bigger than Denmark
 Area Jokkmokk: 19.477km²
 - Almost size of Slovenia

DEMOGRAPHIC

According to the SCB Statistics, the total population in Norrbotten is 250.093, wherein most people live in the coastal area of Bothnia Golf. The biggest city is the capital Luleå, with 78.105 inhabitants, followed by Piteå with 42.500 inhabitants and Boden with 28.000 inhabitants. As far goes into the north, Norrbotten becomes more sparsely populated. The two biggest

cities in the North of Norrbotten are Kiruna and Gällivare, with 23.500 and 19.500 inhabitants. Both cities play a significant role in the mining sector. Jokkmokk municipality corresponds with only 4.923 inhabitants total. The map below shows the population density. Jokkmokk also is third less dense municipality in Norrbotten.

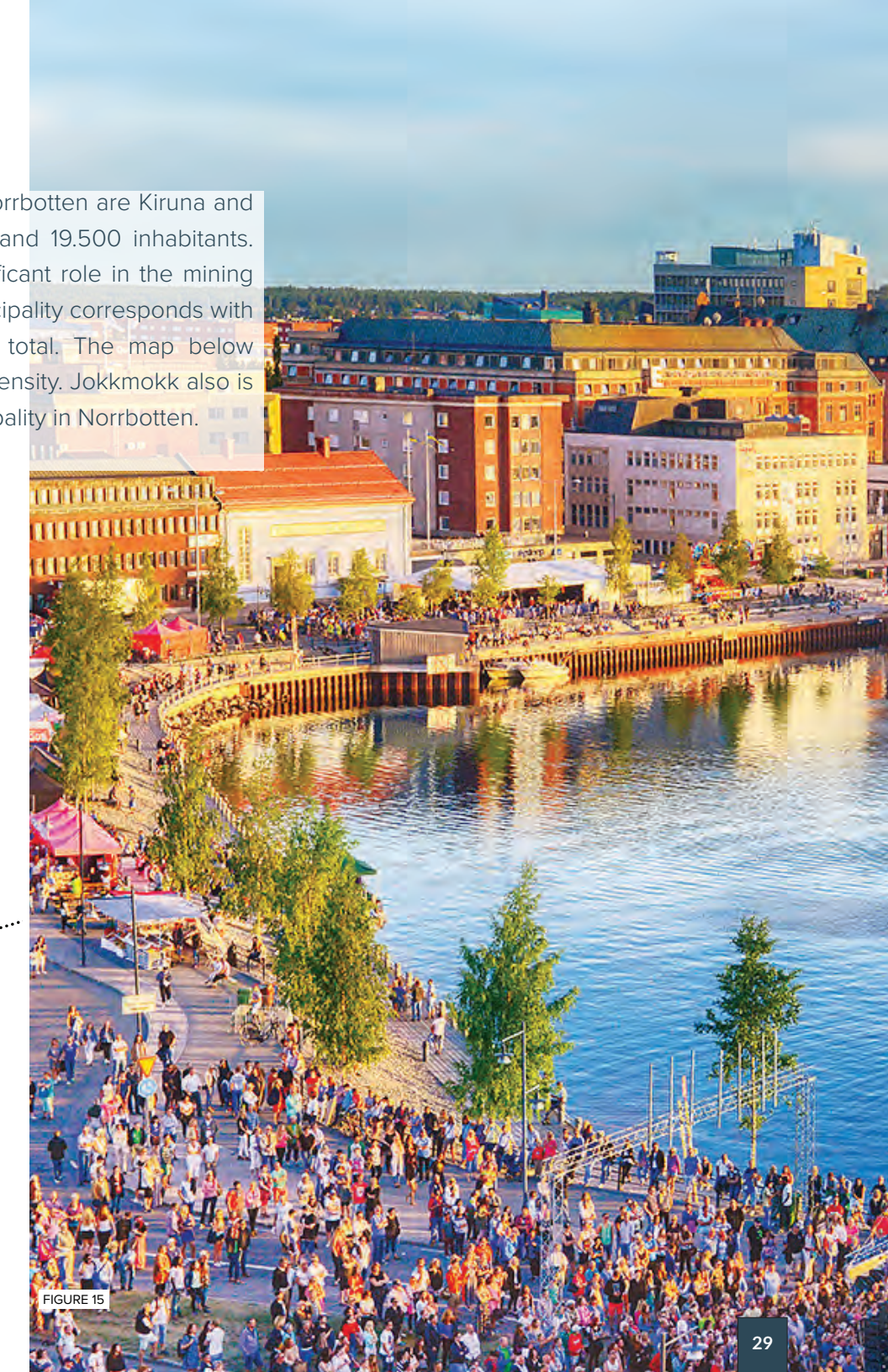
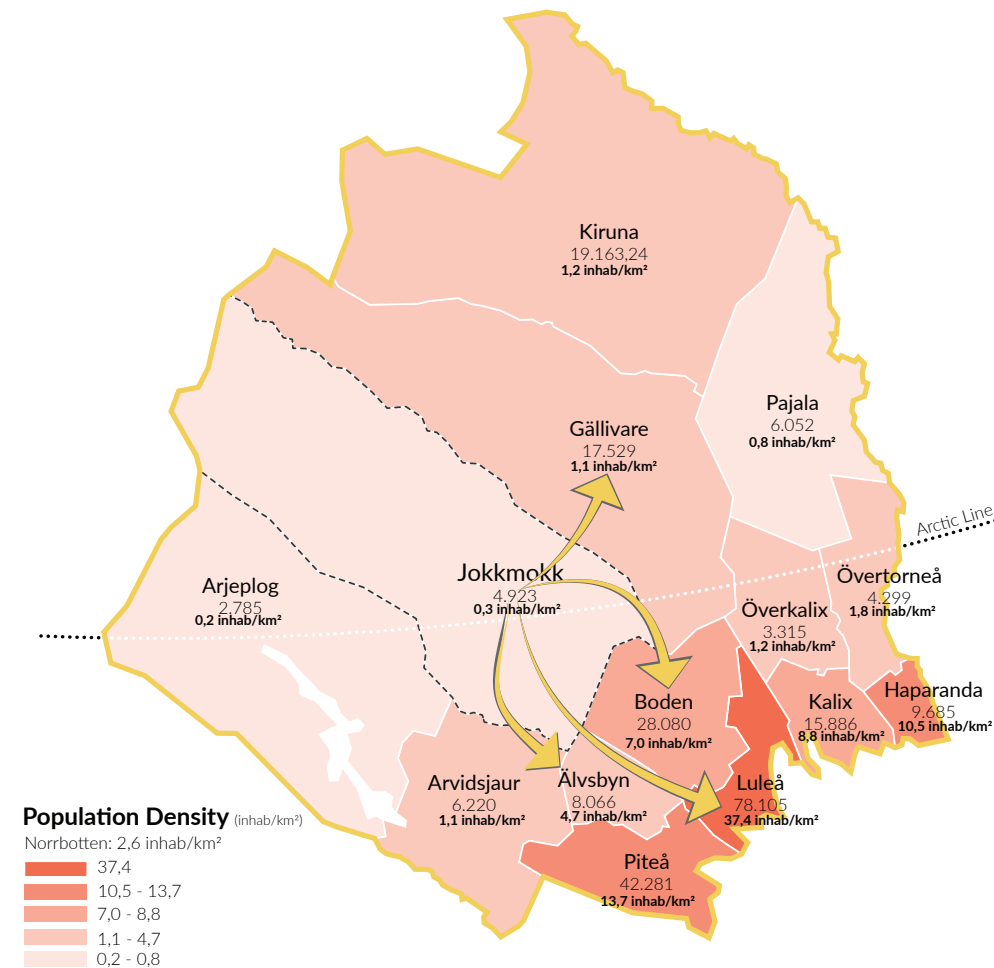


FIGURE 15

TRANSPORTATION

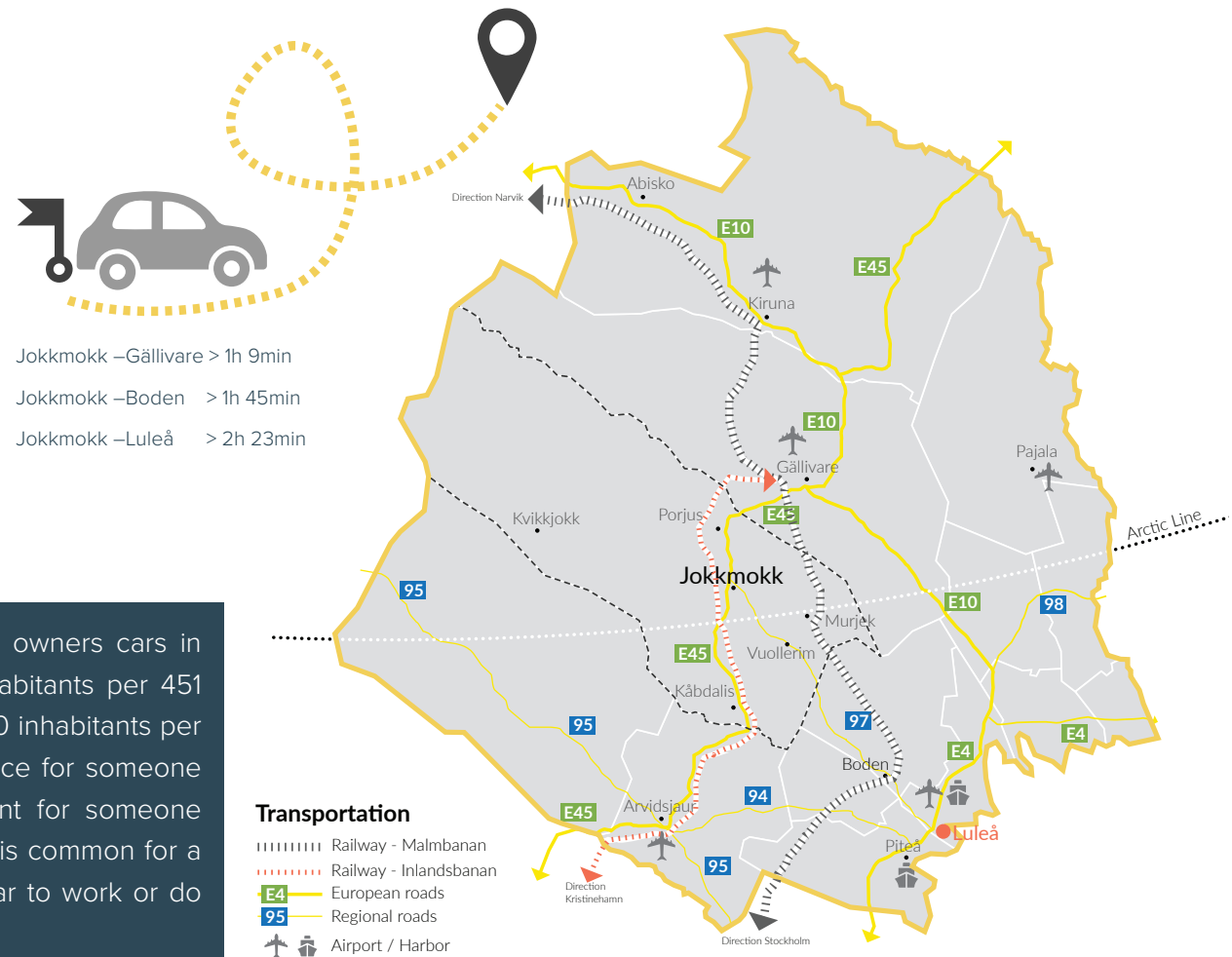
The transportation system includes three European routes (E4, E10, E45) and four regional roads (94, 95, 97, 98), five airports, two railways, and two harbors. The route E10 is one of the shortest international routes and connects Sweden from Luleå until Å in Norway; this route is known as the most picturesque route in the Nordic countries and very important for the freight transport-related with the mining in the region. Public transportation is very sparse, especially in rural areas and small towns. The majority of the population travels by private transport.

The railway network in Norrbotten has two lines: The first and oldest line, Inlandsbanan, connects Kristinehamn (Värmland County) to Gällivare. This railroad only operates during the summer for passenger tourist transport. The latest line, Malmbanan (the ore line), connects Boden (Sweden) and Narvik

(Norway). It is possible to take a night train direct from Stockholm with Destination Narvik. The two main airports in Norrbotten are Kiruna and Luleå (Luleå airport is one of Sweden's fifth most busy airports). Both airports operate with SAS and Norwegian airlines with international connections. The

airports in Gällivare, Pajala, and Arvidsjaur operate with regional flights and national flights connecting the Arlanda airport in Stockholm.

The harbors operating in Norrbotten are primarily for the transportation of goods. Luleå's harbor is one of the five largest ports in Sweden.



Norrbotten has the highest number of private owners cars in comparison to the national average. 1000 inhabitants per 451 privately owned cars in Norrbotten against 1000 inhabitants per 373 cars in Sweden. Also, the notion of distance for someone who lives in the North of Sweden is different for someone who lives in the South or a more dense city. It is common for a Northern person to travel daily one hour by car to work or do other activities.

ECONOMIC ASPECTS

Norrbotten County is a prosperous region with plentiful natural resources like minerals (ore, iron, copper), water, and timber. The local natural resources have facilitated local industrial development in the area. Currently, there are five mines under production in Norrbotten, according to Bergsstaten information. The Aitik mine located in Gällivare represents the

biggest copper mine in Europe. Also, the mines Kiirunavaara, Malmberget, Leväniemi and Kaunisvaara produce 90% of the European ore. Norrbotten is self-sufficient regarding electric energy generated by 20 hydropower. The two biggest hydropower plants are located in two rivers in Jokkmokk. Half of the energy produced in Norrbotten is retransmitted to

the rest of Sweden. The forest industry in the region concentrates on material extraction and includes wood processing goods (sawn wood, paper, and pulp). Although the economy is dominated by forestry, mining, and hydropower industry, other sectors are rising and contributing significantly to regional economic development.

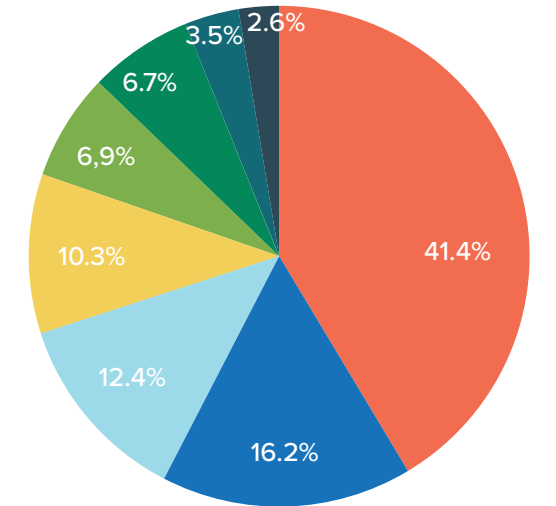
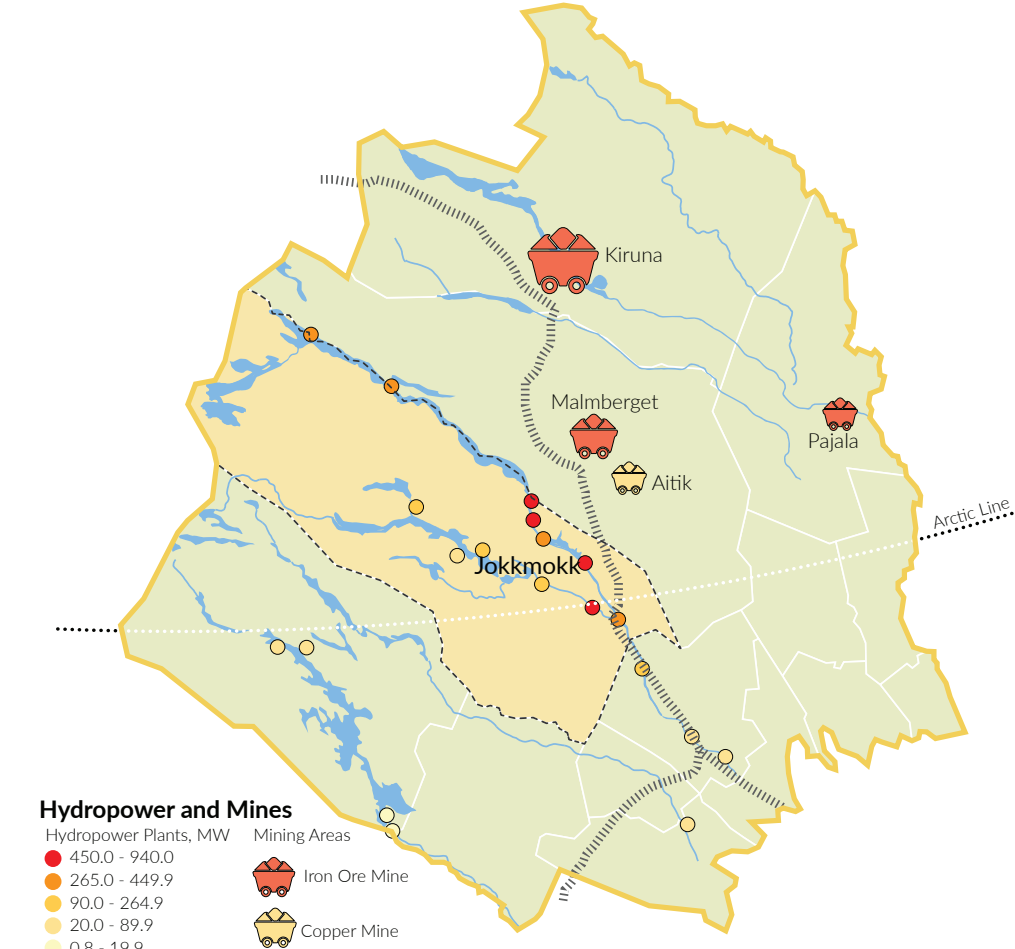




FIGURE 16

NATURAL ASPECTS AND CLIMATE

The natural assets of Norrbotten gather different types of landscape. 39% of the land is forest and 20% of mountains and bare rock land. Around 25% of the land is under protection; this area represents national parks and nature reserves. In 1996, four national parks, nature reserves, and Sami communities were grouped to form the World Heritage of Laponia by UNESCO.

The heritage area has 9,400km², covering the municipalities of Jokkmokk and Gällivare. The Laponia Heritage area is vital for the cultural heritage preservation of the Sami and nature. The topography of Norrbotten consists of high mountains in the northwest, followed by a plateau towards the east, and the declivity slows down until the coastal area. The area

is divided into two biomes. In the mountains, areas predominate the Alpine Zone (mountain tundra) characterized by low vegetation and trees' absence. This area's climate is classified as ET (Polar tundra), with frigid winter and cool summer. Annual temperatures cannot go higher than 10° Celcius. The Plateau Area is dominated by the Taiga, characterized by forest composed

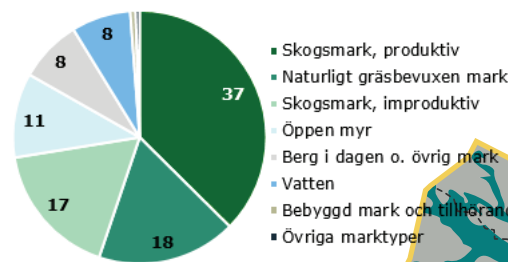
by coniferous trees and the two main species is Norway Spruce (Picea abies) and Scot Pines (Pinus Silvestris) it can occur some deciduous trees, where the most commons are the birch trees (Betula pendula and Betula pubescens). The soil is not fertile, which is one reason that the agricultural land represents less than 1% of the total area. In the inland part, the climate

is classified as continental subarctic (Dfc) freezing winters with mild summers. The primary precipitation is the snow, and the average temperature in the summer is between 12-18C, and winter temperatures can go below -30°C.



FIGURE 17

Markanvändningen i länet, 2015
Norrbottens län, procent



Källa: Statistiska centralbyrån

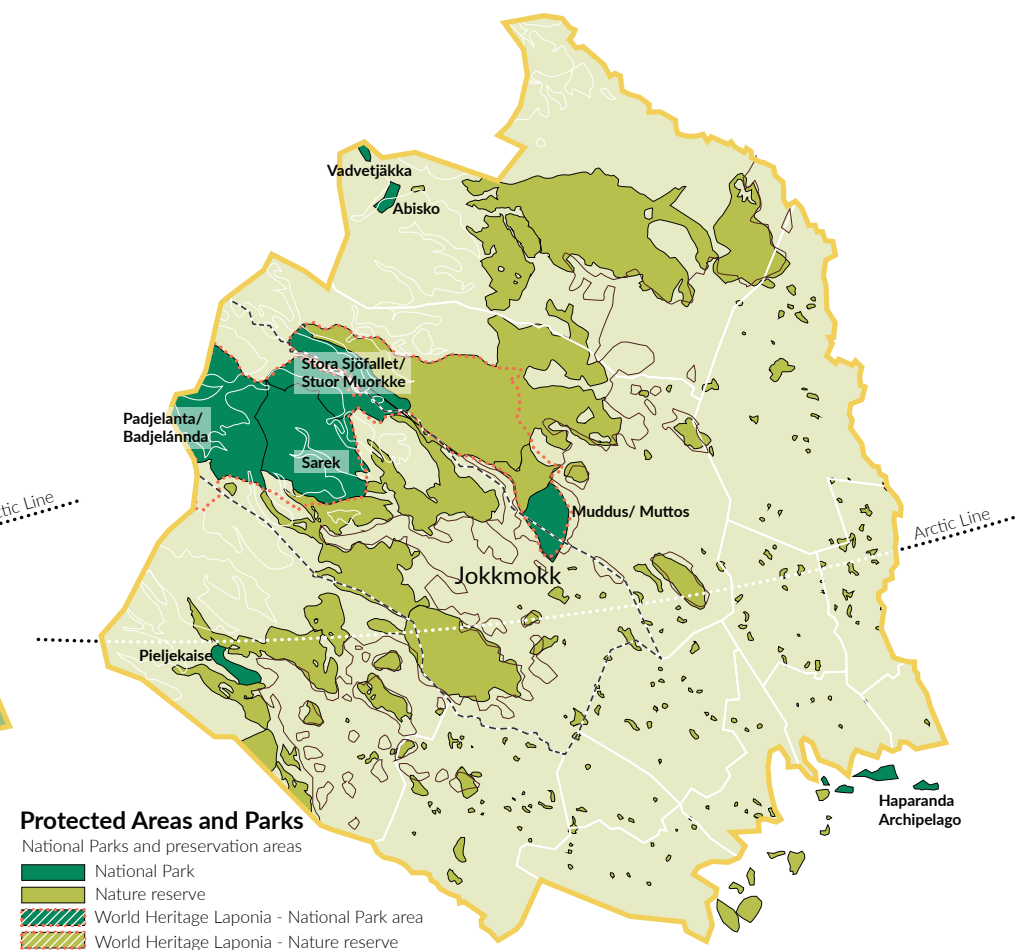
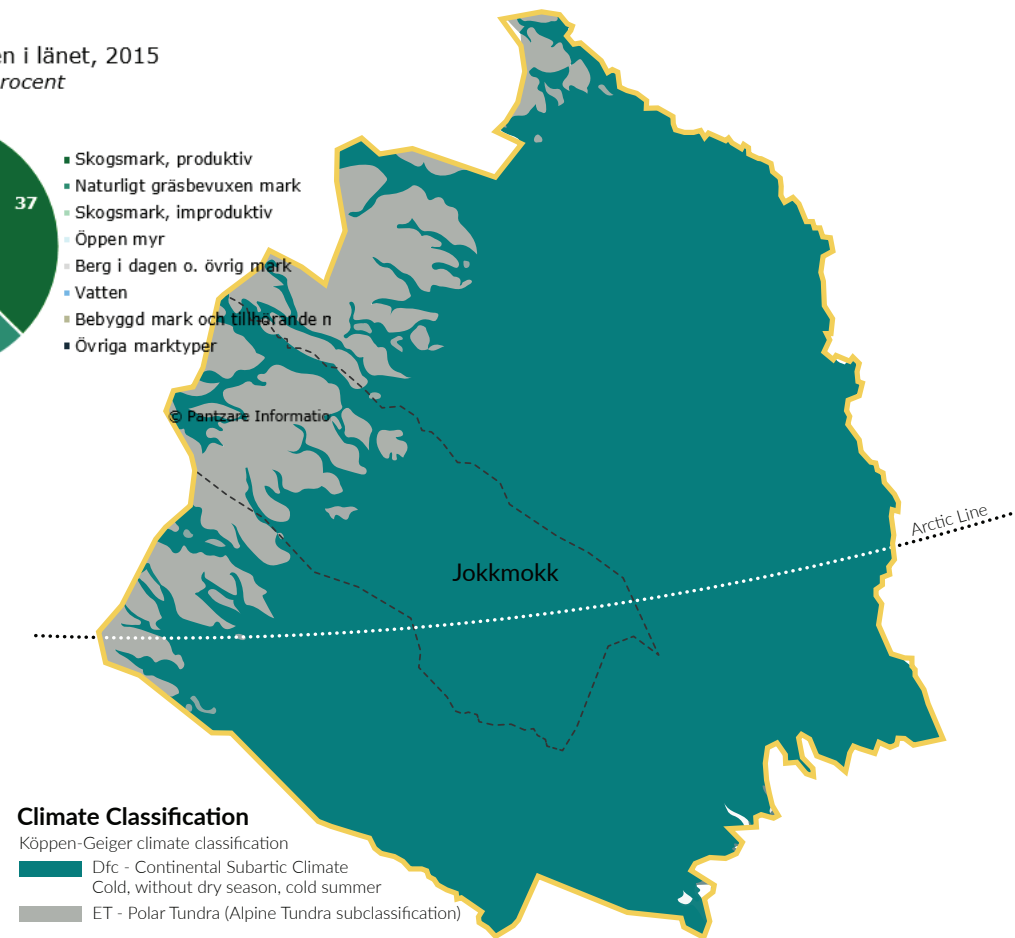


FIGURE 18



FIGURE 19

2.2 The Sami

Before Norrbotten, there is Sápmi Land. The Sapmi region reaches beyond the northern part of Sweden, expanding into the coastal and inland areas in the north of Norway, dives into the northernmost areas of Finland, and includes the Kola peninsula in Russia. The total area corresponds to 157.487 sq. km, wherein 35% is part of the Swedish territory. Here lies the home of the Sami people. It is estimated that around 80.000 people with Sami backgrounds spread over the four countries. In Sweden estimated 20.000, Norway 50.000, Finland 8.000, and Russia 2.000 people.

The Sami prehistoric lifestyle is characterized by Nomade behavior, moving around according to the climate, hunting, fishing, and producing handicrafts. Studies conducted by the Silver Museum in Arjeplog have found the oldest Sami settlement dated 9.800 years ago. It has found traces of firepits, bone fragments, some utensils, a slate knife, and a portable whetstone. The settlement is located near the lake Dumpokjaurtj, about 90km southwest of Jokkmokk. The reindeer herding is also one of the Sami's main activities, although the reindeer herding was introduced in 1800-900b.c, where the Sami started to tame the wild reindeer. Reindeer husbandry became the primary economic source for the modern Samis, along

with their handcrafts (duodji). The Sami history was stigmatized by a slow colonization and assimilation process by the emergent kingdoms (Finland, Norway, Sweden, and Russia). During the centuries 12th - 14th, Sami has traded with Finns, Scandinavian and Russian merchants in the Gulf of Finland and Bothnia. Later on, the emergent kingdoms started to raise interest in the Sápmi and proceed with colonization. During the middle ages, the Sami were taxed, forced to work in mines, Christianized, and pushed out of their land. The Sapmi region has become a region of a dispute of power between Finland, Norway, Sweden, and Russia. It was common for some Sami villages to pay taxes for two or three kingdoms at the same time.

In the Swedish part, king Gustav Vasa has encouraged swedes to settle up north and cultivate the soil to exchange tax exemption and war service. The king also decrees that settlers were not allowed to disturb the Sami and their lifestyle. The taxes collected from the Sami were considered of high value to the Swedish crown. However, the settlers could not survive up north only with land cultivation, and the Swede settlers started to compete with the Sami on hunting activities, burn-beating the forest for cultivation, and wood extraction. Several conflicts happened between Sami and swedes, and still, settlers

were building parishes and establishing their lives in the north. Churches and schools were built, and more people started to move into the north to live among the Sami. During this period, the Sami were assimilated into the Swedish culture at that time, they were baptized, and their kids were taught Swedish in boarding schools. For centuries, until 1950, the Sami have struggled their life with assimilation, discrimination, and repression, losing their lands with the advance of the forestry industry, hydropower, and mining.

Religion, language, and culture

The Sami religion is directly related to nature, where an element represents each god; as an example, the sun represents the goddess of life, is called Biejvve. They believed in the division of the three worlds, very similar to Nordic mythology. Their cults were held by a shaman that used a drum made of animal skin to help him/her to enter in trance and communicate with the other worlds. The church and missionaries demonized the drums had destroyed several drums. Another characteristic of the Sami religion is the "Sieides"; they are objects (like rocks, cliffs, or even mountains) used as a point for offerings. The Sami had another tradition to unbaptized their children recently baptized in

the Christian church. After the baptism, the Sami at their home held a secret ceremony to wash away the Christianity.

The same language is divided into three groups: Eastern Sami dialects from the kola peninsula, central Sami from Norway, Finland, and Sweden, and southern Sami dialects spoken in Sweden and Norway. The northern Sami dialect is the most widely spoken, estimated around 15.00-17.000 people can speak northern Sami fluently. The northern Sami dialect belongs to the same central group.





FIGURE 20



FIGURE 21



FIGURE 22

THE MODERN SAMI LIFESTYLE AND POLITICS

Since The way of life of a Sami is like any other Scandinavian. They live in cities, go to universities, work in the public sector or private companies; however, the Sami are committed to preserving their traditional values and culture. They are engaged to protect their cultural values through the language, arts, and music and protect their ancient traditions with the reindeer husbandry.

Although Sápmi is a region with an explicit perimeter, they never had their sovereign state. Despite this situation, the Sami have their flag, and they are politically engaged. The Sami have their parliament in Finland, Norway, and Sweden, which propose to enforce and protect the Sami rights. The reindeer herding is considered one of the main activities still practiced by the Sami. In Sweden, only ten percent of the Sami have reindeer herding as a primary income source; they supplement their income through tourism, fishing, the traditional handcraft doudji, and other trades. They are organized in a Sameby representing a region with economic and administrative characteristics—the Sameby grants the Sami the right to engage in reindeer herding in certain areas, fishing, hunting, and temporary building.

The Swedish law regulates them, Reindeer Husbandry Act. The Reindeer Pasture Law of 1928. The law protects only the reindeer owners, leaving aside the other 90% of Sami. The rule still represents many restrictions, and lately, the Sami are pushing the government to reformulate the law to allow other Sami to belong to the Sameby without having reindeer.

The practice of Doudji is widespread among the Sami. High-quality handcraft produced by their hands and translated into modern art crafts. Sami art has been represented by contemporary arts and also in architecture. The Parliament in Norway reflects the Sami architecture through the shape of tipis. In the music, the Sami also have their place with the traditional joik incorporated in contemporary music.



Sami Flag
National day: 06 February



FIGURE 23

2.3 Landing in Jokkmokk

Jokkmokk lies 10km above the Arctic Circle, a small city located in the Swedish Lapland. The distance traveled between Lund-Jokkmokk (1620 km) is almost the same as Lund-Venice (1602km) in Italy. It is similar distances, though different connections. It is easier to get a flight and go to Venice; however, it is not the same as traveling to Jokkmokk.

The town has been established in the middle of the boreal forest and represents a typical small arctic city: isolated from big urban life, problems with severe winter, shrinking population, economic struggles, and complicated access. On the other hand, an isolated small city can show different qualities from big urban centers. The astonishing landscape, direct connection with nature, and their cultural aspect with the native people, the Sami, represents the other side of Sweden that we are used to seeing.

This section aims to discover Jokkmokk regarding its history, local characteristics, population, climate, culture, and other aspects that will lead to a SWOT analysis.



FIGURE 24

JOKKMOKK HISTORY AND FACTS

"The site that was chosen lay at a confluence of the great River Lule, Julevuädno, which meanders its way down to the coast from the high mountains in the west of Lapland. One of the region's Saami communities, Jokkmokk's Forest Saami siida,² used this place as a winter settlement (Sw. 'vinterviste'), and during the summer, there were good connections to the surrounding lakes and to the mountain region in the west. The Saami word for 'vinterviste,' that is, the place where Saami families gathered together during the coldest part of the winter, is dálvvadis.³ This is a derivative of dálvve,⁴ 'winter', and became the early name of the place where Jokkmokk now stands."¹ (KORHONEN, Olavi)

The origin of Jokkmokk began around the 17th century when Karl IX initiated the journey to occupy the North of Sweden. The strategy used was to implement official marketplaces and churches to strengthen the north occupation. The name Jokkmokk appeared later as a modern derivative from Jáhkâmâhkke, which means in Sami "river's curve." The first Winter Market in Jokkmokk happened in 1605, and there was defined the Sami people's meeting point. The Swedish Crown gathered the Sami people in order to collect taxes and exchange other goods.

¹ The Place Name Jokkmokk, Jáhkâmâhkke. <http://mnytud.arts.unideb.hu/onomural/kotetek/ou4/09korhon.pdf> Läst 15 Aug 2020.

Later on, the Swedish Crown has incentivized Swedish people to build and live in the north. Jokkmokk started to grow its population and industrialize, first with the forestry industry (1732-1898), followed by the energy industry with hydropower implementation (1915-1940). Together with industrialization, its population growth reached a peak in 1968 with around 8000 people. All these occupation phases and industrialization of Jokkmokk have brought a more negative impact than positives to the Sami population. They were forced to become Christians, they lost lands and sacred places, and they were discriminated against and forced to assimilate the Swedish culture.

Today Jokkmokk's population has reduced to 4923, a rate of almost 50% in the last 50 years. Besides all problems related to the decreasing population, Jokkmokk has become a reference center for Sami culture. The Winter Market has continuously happened without any interruption, and in 1955 it was decided as the winter market as a symbol of Jokkmokk and Sami Culture. They inaugurated the Sami Museum in 1989, and in 1996, they became part of the Lapponia, Unesco World Heritage area with the goal of Sami preservation culture. Recently Jokkmokk has been the stage of a dispute of mining resources, and once again, this can threaten the Sami interests.



Sami people living 9000bc Dalvadis (actual Jokkmokk)



1732-1889 - Swedish start to occupy Jokkmokk - Live together with the Sami and the city start to develop because of the forest industry (Build church, school and the forestry industry started to grow)



1968 - Total population in Jokkmokk Municipality hits 8720 people



1989 - Sami Museum



2005 - Jokkmokk's Winter Market celebrated its 400th anniversary - Event had 80 000 guests!



2019 - Total population in Jokkmokk Municipality decline 4,923.



1605 - Charles IX State the First Winter Festival in order to collect taxes from sami people . The event usually took 2-3 weeks and was held every year



1915-1940 - Hydropower industry is starting to grow. Jokkmokk gets its first train station and they find ore in the region.



1955 - Jokkmokk's Winter Market celebrated its 350th anniversary - A committee decided to convert the market into a touristic attraction. The event was held in 3 days. They had 30 000 - 40 000 guests



1996 - Part of Lapponia Unesco World Heritage

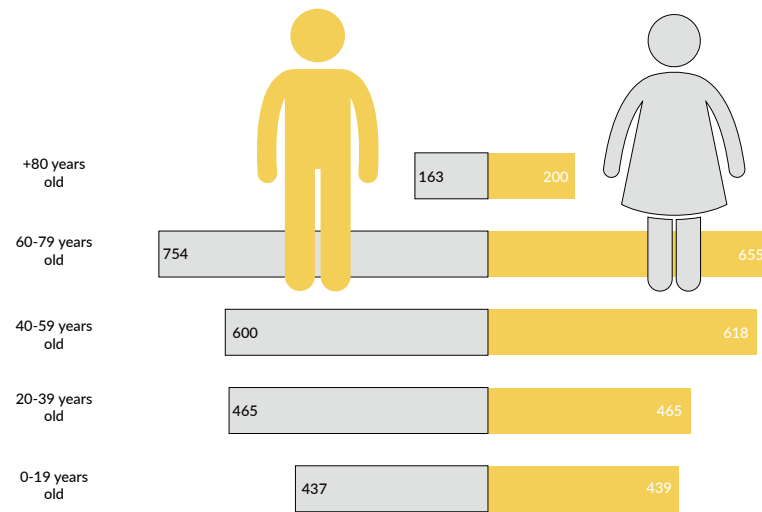
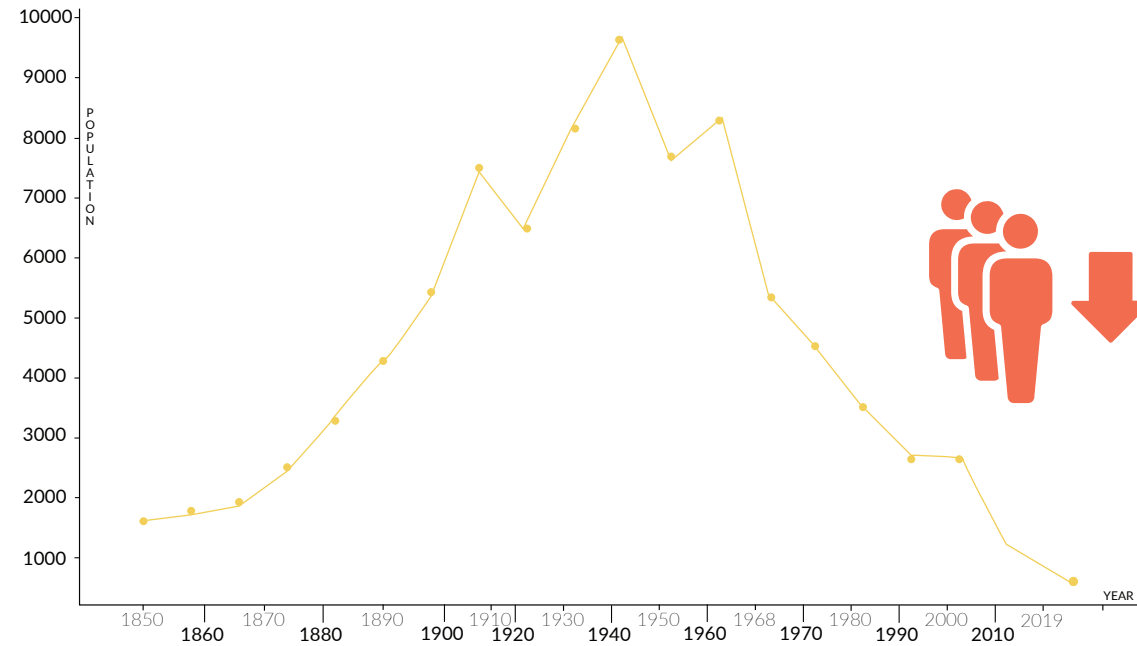


2012-now - Jokkmokk suffers from conflict interests between a british miner Bewolf and reindeer herding. Activities were suspended for a while.

POPULATION ASPECTS

The growth population dynamics in Jokkmokk between the years 1850-1950 is likely related to the industrial development in the region. First wave with the forest industry and later on with the arrival of hydropower plants (Vattenfall). The population has increased more than 100% between 1900-1950 and has reached its peak in 1960 with 11553 inhabitants. However, Jokkmokk has been suffering from a shrinking population; along with that, the population is getting old. The current Jokkmokk population corresponds to 4983 inhabitants. The population has reduced drastically in the last 50 years.

According to Ramboll's report, Jokkmokk's population reduction can relate to two factors, net migration (more people are leaving the city than moving in) and the net negative birth (Jokkmokk fertility rate is 1.6 meanwhile the national average is 2.1). The composition of the population of Jokkmokk shows that 35.5% of the citizens are already of retirement age. Less than 50% corresponds to the active working population. People at a young age correspond only to 18% of the total population. This composition can lead to future problems; the city hall can have fewer taxes and spend more money on elderly care.



1 "Statistiska centralbyrån - Folkmängden efter region, civilstånd, ålder och kön. År 1990 - 2019". Läst 20 nov 2020.
2 "CEDAR, Demografiska databasen, Umeå universitet". Jokkmokk Folkmängden 1850-1990 Läst 20 nov 2020.

ECONOMY AND EDUCATION

The current economy in Jokkmokk seems to be very diverse compared to its neighbor Gällivare, in that the economy depends mainly on the mining sector. The dominant sectors in Jokkmokk are construction and health care, followed by manufacturing, education, and energy. The unemployment rate in the Municipality is 2.2%. It is the same rate of unemployment in Kiruna, and this is below the national average of 3.7%. Despite the industry diversity and lower rate of unemployment, Jokkmokk is still reducing its population.

One possible reason seems the market still is not attractive enough for young people, especially women at age 19-24. The tourism and reindeer industries are the two sectors that

are exponentially increasing in the Municipality. Jokkmokk has excellent traditions with the Sami, and the Sami population wants to explore the possibility of increasing the income with tourism; however, due to lack of infrastructure and legislation, it is hard for them to deal with tourism without affecting the reindeer husbandry or avoid the exploitation of the Sami culture by non-Sami personal.

The education is also diversified; the Municipality provides different education levels as elementary school, high school, adult education, Swedish for foreigners (Kunskapens Hus), and polytechnic education (yrkeshögskola). Moreover, Jokkmokk is a reference in Sami Education with Sami elementary school and high school level where

students can have education in Sami language and learn traditional handcrafts (doudji) and reindeer herding.

The municipal upper secondary school Bokensolan is part of the upper secondary school association Lapplands gymnasium, where collaboration occurs with Gällivare, Kiruna, and Pajala municipality. The school has four educations with national admission: the Sami community program, the electricity program hydropower technology, the electricity program electricity distribution, and Sami industries.¹

1 Information extracted from Samhällsomvandling som följd av eventuell gruvetablering i Jokkmokk - Ramboll 2015

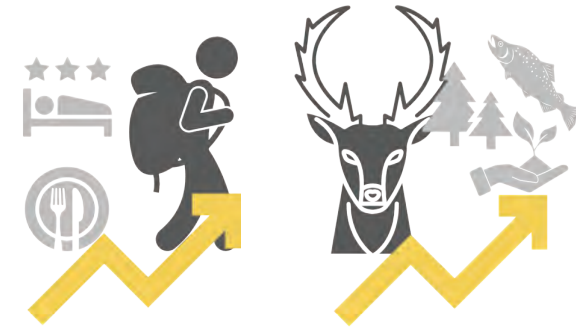


FIGURE 25 - Kunskapens Hus - Jokkmokk Architect: Lars Olausson



FIGURE 26



FIGURE 27

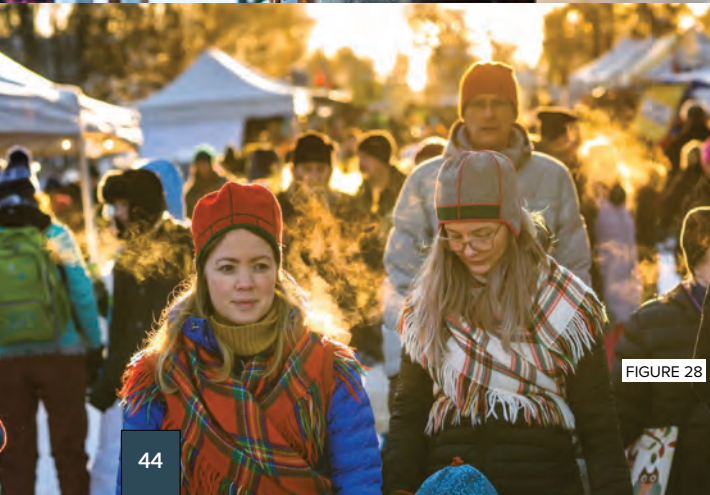


FIGURE 28

CULTURE: JOKKMOKKS MARKNAD

The winter market “Jokkmokks Marknad” represents the longest tradition of the city. Since 1605 the Winter Market has happened religiously every year. Originally the winter market was held in the last week of January and lasted the three following weeks. This pattern has changed many times. The market period has reduced to 3 weeks for ten days, and nowadays, the Festival has a duration of three days at the beginning of February.

The event has attracted many visitors, Sami and no-Sami people. In 1955, Jokkmokks Marknad became an official tourist attraction to celebrate and promote Sami Culture. The city receives between 30.000 up to 80 000 guests during the three days, and the Festival became more than a trading place but offered a broad experience with exhibitions, performances, culinary, reindeer races, and seminars. The event represents a significant income source for Jokkmokk. Sami tourism has been growing in the city, and it is a way of preserving the culture and educating the Swedish about the Sami existence. The Festival is also the stage for protests related to Sami Rights and the reindeers’ raid, the traditional handcrafts (doudji). In the year 2020, the Jokkmokk Marknad (the 415th edition) had some special guests, the King, the Prime Minister, and Greta Thunberg, which took all the attention from the

public. She joined other young Samis and talked about environmental problems like Climate Change and natural resource exploitation, such as mining activities that threaten the Sami reindeer herders. The pictures are about the Jokkmokks Marknad 2020, kindly conceded by the photographer Patrik Ohman.

Along with the Winter Festival, Jokkmokk has another important Sami institution, The Ájtte Sami Museum. The institute works to preserve the Sami culture and provide education to the Sami people providing language courses, courses on handcraft doudji, and husbandry reindeer. The Ájtte Museum was inaugurated in 1983 and possessed an extensive collection of Sami history, handicrafts, and heritage. Besides the exhibition rooms, the museum offers a library specialized in Sami history, a museum shop, and a restaurant specializing in Sami cuisine.

For the first time in 415 years, the Jokkmokks Marknad 2021 (416th) will be held online. Due to the COVID-19 Pandemic, the commission board has decided to broadcast the Festival online from Jokkmokk. Seminars, online shops, chat rooms, music, and traditional yoik songs will be available online.



FIGURE 29



FIGURE 30



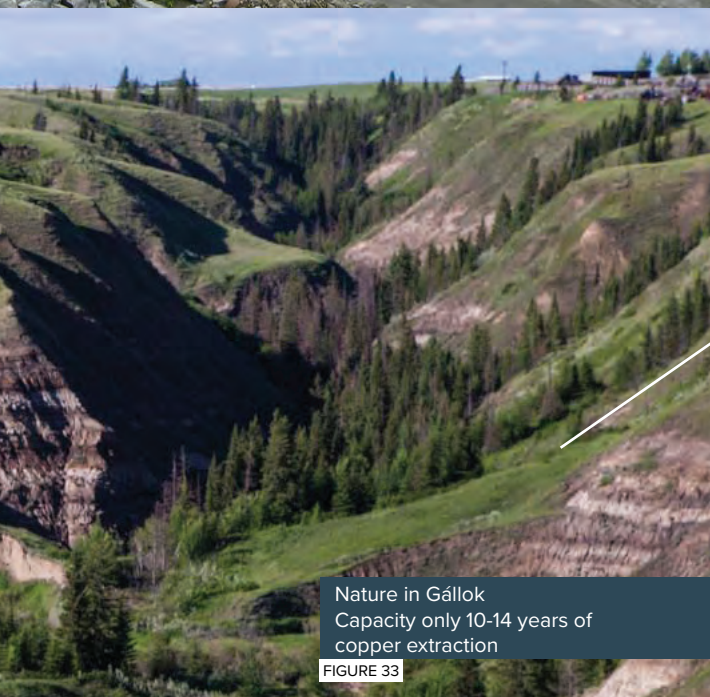
FIGURE 31

PICTURES 26 TO 31 GENTLY CONCEDED BY PATRIK ÖHAMEN
ALL RIGHTS RESERVED PATRIK ÖHAMEN - WEBSITE: <https://palott.se>



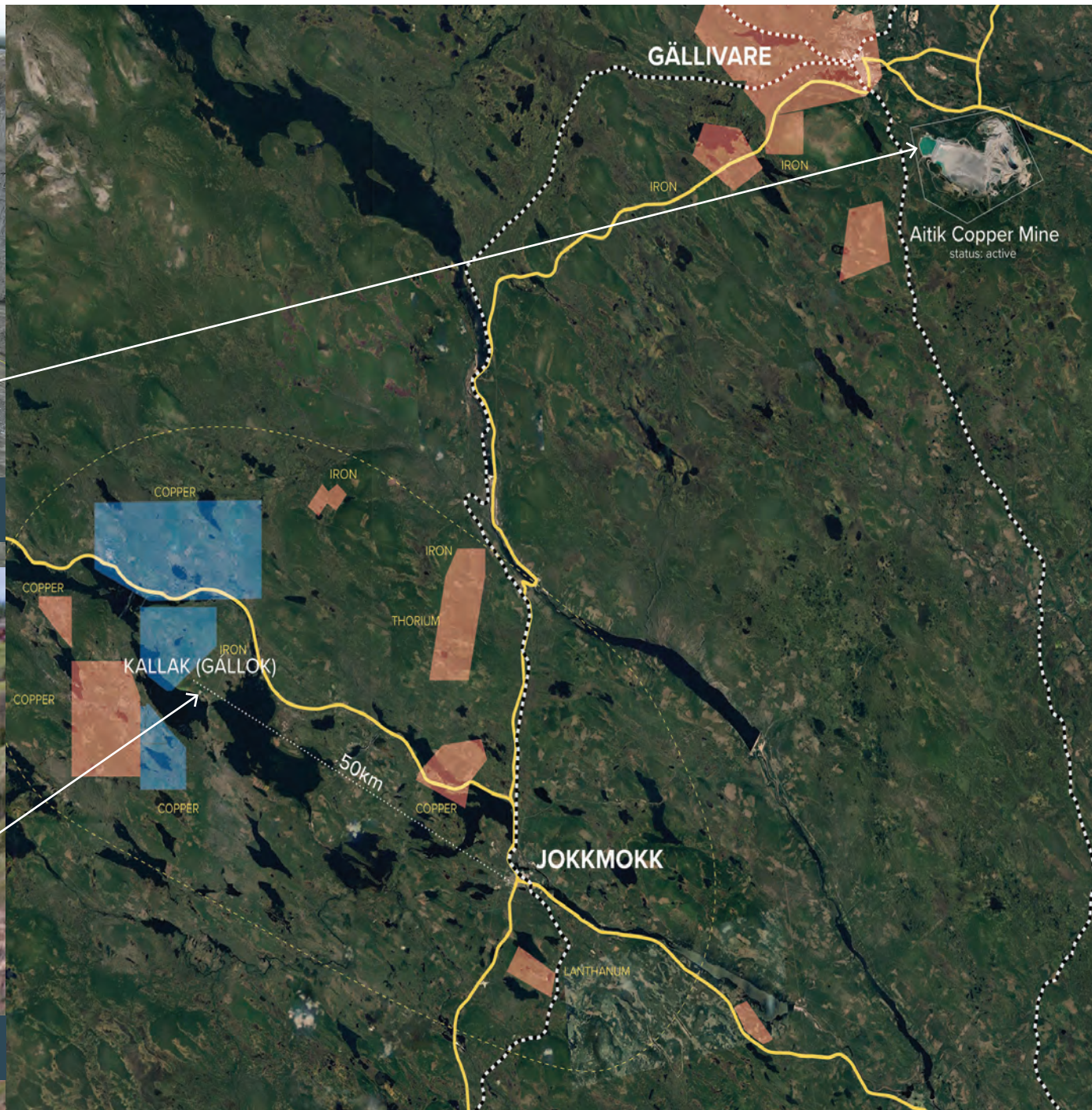
Aitik Mines in Gällivare active since 1968 (copper, gold, silver)

FIGURE 32



Nature in Gällok Capacity only 10-14 years of copper extraction

FIGURE 33



CONFLICT: MINING VERSUS REINDEER

Jokkmokk, like any other rural city in Sweden, is suffering from a shrinking population, which can directly hit the Municipality's economy. One of the authorities' options to reinstate the Municipality's economic power is to focus on developing the region's mining economy and following their neighbors' example: Kiruna, Gällivare, and Pajala. These northern cities have their economy dependent on the mining sector. The mining industry offers more attractive investments to the cities with a promise of high investments and economic miracle; however, all activities related to natural resource exploitation have high costs.

The Swedish Government, Jokkmokk municipality, and the British company Beowulf Mines have initiated some studies to mine in Gällok (Kallak), approximately 50km from the Jokkmokk city. With the Swedish Government's authorization, Beowulf started to sample the area in 2006 (they found some reserves of ore and copper). This situation brought much tension to the local community, especially to the Sami reindeer herders, who have reindeer herding as a primary income source. The Municipality believes the investment in Kallak could increase job opportunities and the possibility of Jokkmokk regaining its population. Contrary to political beliefs that the mining in Jokkmokk can lead

to an economic miracle, the mining can bring more impacts than gains. The life expectancy of mining is estimated to be 14 years. It will be 14 years of exploitation of a limited resource, and it will leave an incurable scar on the environment. Besides the massive impact on the environment, mining activities are incompatible with reindeer husbandry. Mining will disturb reindeer's natural behavior, which grazes freely in nature and has specific routes to follow and find food. Facing that situation, the remaining Sami that depend on reindeer husbandry will be affected once more and will have a loss and impact on its primary source of income.

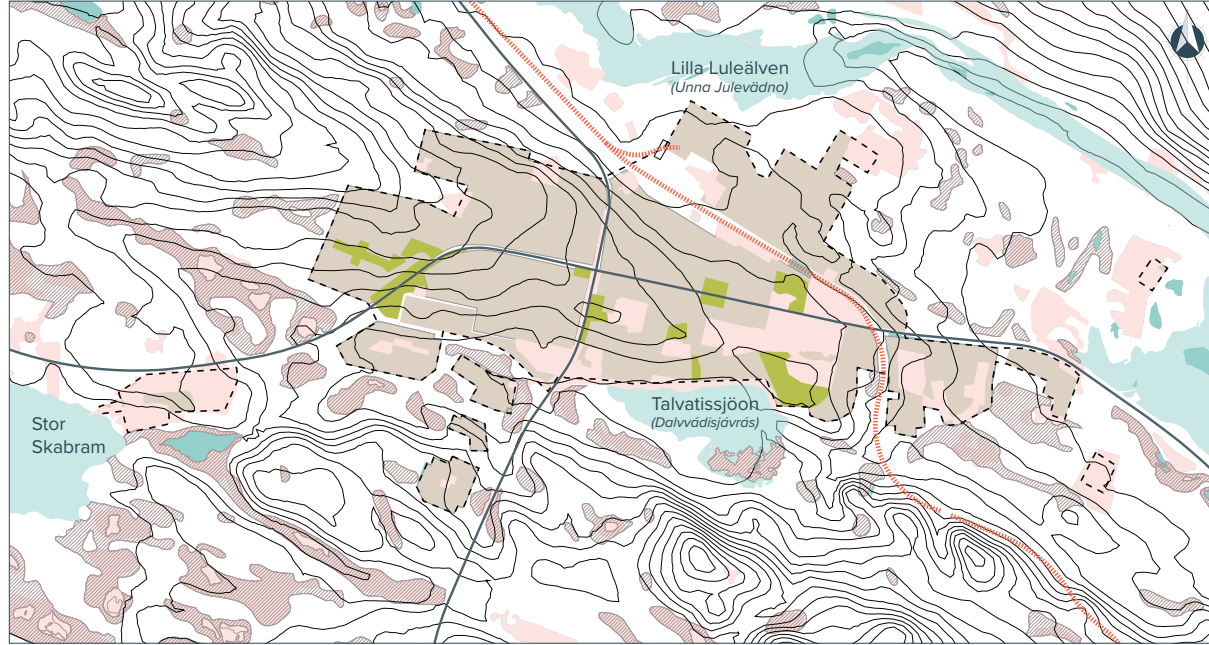
Several mining protests happened in Gallok against mining activity, and the activities were suspended for a while, but there is no official formalization about if the Government will allow or not the Beowulf start to mining in the region. Tor L. Tuorda is a Sami Activist and has been protesting actively against the mining situation in Jokkmokk. Last year he wrote on a Facebook group page a series of impacts that mining activities can bring to Jokkmokk (free translation Swedish to English):

- The old village Björkholmen locates in the safety zone for explosives. If mining happens, this old village will disappear; Indigenous Sami's right to their land is

- threatened once again by national interest;
 - The natural route of reindeer will be affected, and this will harm the Sami's herding work;
 - Laponia World Heritage status is endangered;
 - The local supply of meat, fish, herbs, berries, and mushrooms will be spoiled, contaminated, or cease to exist;
 - Jokkmokk as the symbol of the natural and cultural Municipality will corrode;
 - The contamination of the Lule River;
 - The Jokkmokk's air quality will deteriorate;
 - High traffic will increase in the road Kvikkjokk (around 180 trucks loaded with 90 tons of minerals per day). It will increase the rate of fatal accidents for residents, reindeer, tourists, and other wildlife;
 - The only remaining old forest will be destroyed;
- (Tor L. Tuorda)

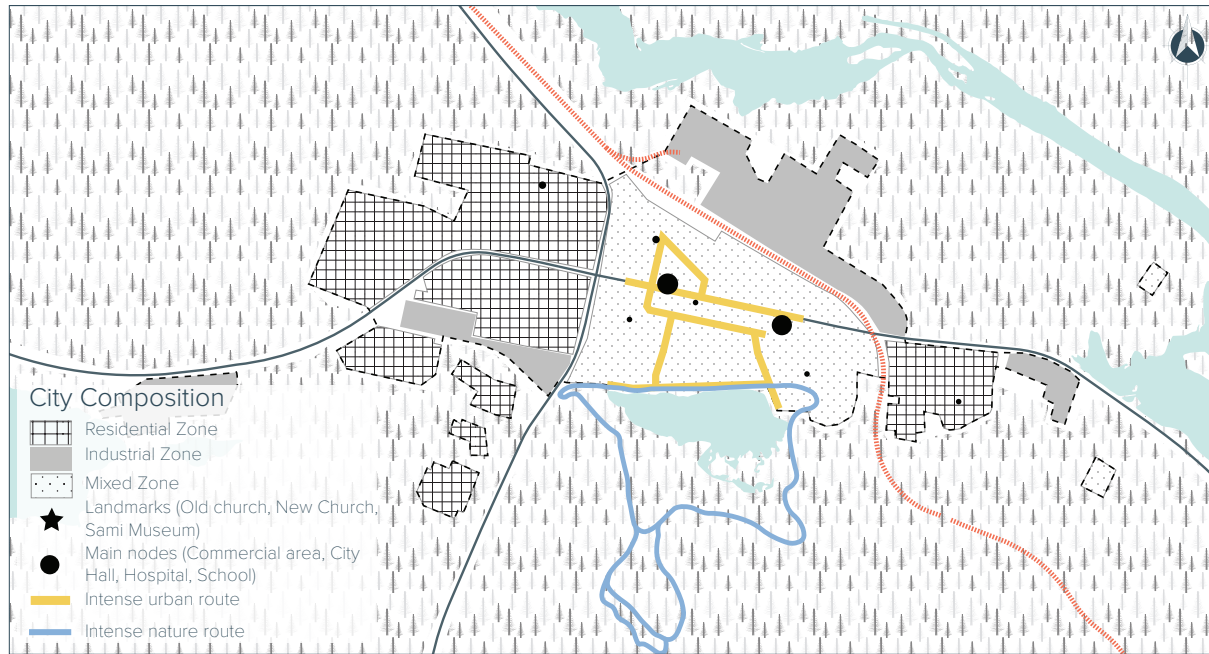
It has passed 14 years, and yet no final decision has been made. The delay represents a financial loss from Beowulf Mines, which has already invested around SEK 80 million in the project. On the other side, a small victory for the Sami, especially the reindeer's herders. Also, it could represent an opportunity to rethink the city development without aligning with its nature intensive exploitation.

2.4 Site Analysis



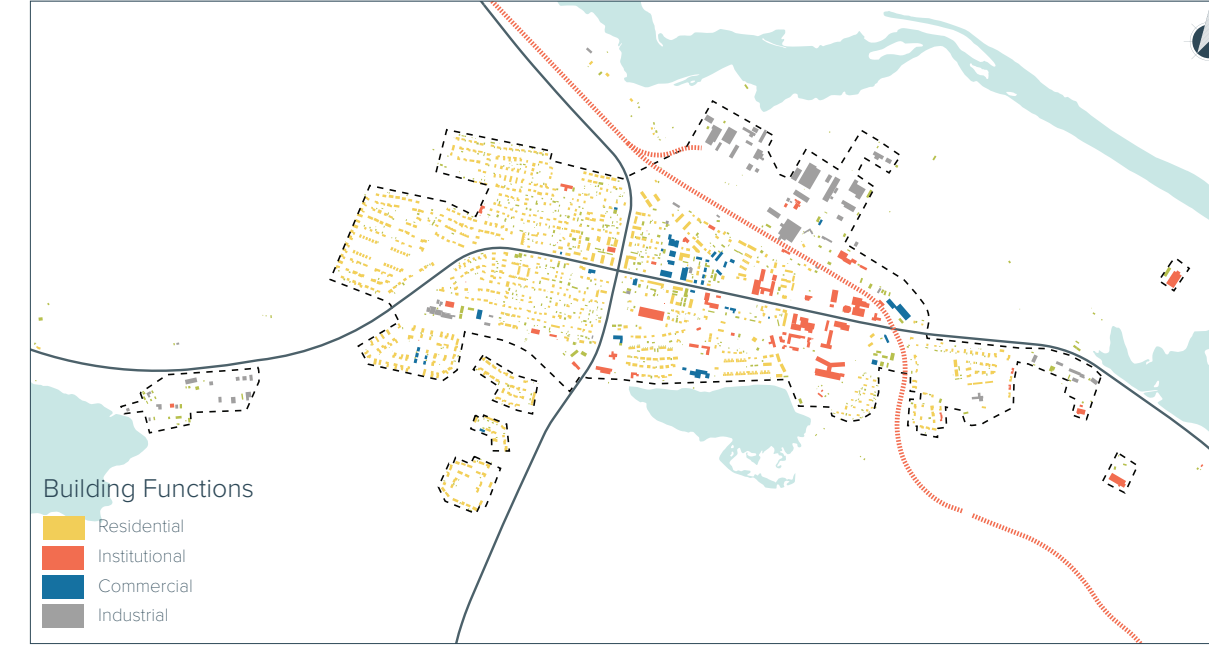
TOPOGRAPHY AND WATER BODIES

Jokkmokk lies in a region abundant in water resources. The city is located in a valley surrounded by three water bodies, the Lilla Luleälven river, Talvatissjön, and Stor Skabram lake. The subtle contrasts in elevation define the topography adjacent to the city; the latitude range is 209m (lowest point) to 590 (highest point). The biome predominant is Taiga Forest (mainly composed of coniferous trees) with spruces and pine trees. However, it is possible to find other trees like birch and willow and bushes with berries, like cloudberries, blueberries in the wetlands.



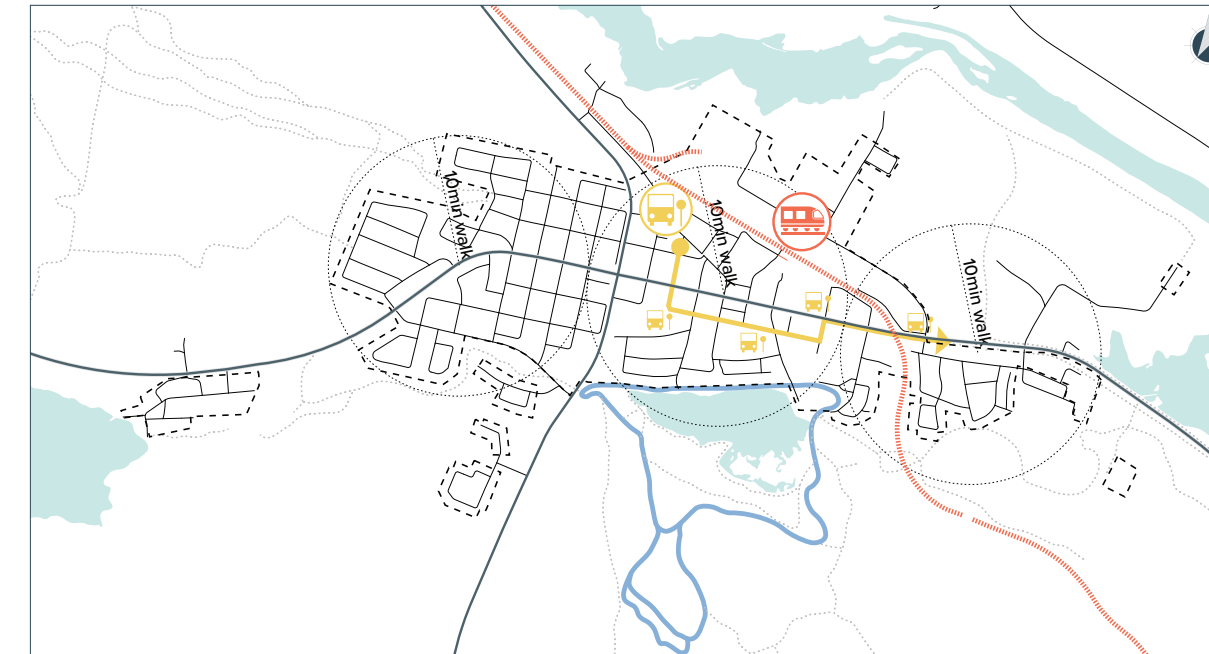
ZONING COMPOSITION

The map represents how the user experiences in Jokkmokk. The sensorial map shows the walking transition between districts with different functions and paths that connect and, at the same time, can be seen as a soft edge (main roads dividing the city into four areas and the train line). Jokkmokk shows a contrast between the urban issue and the natural environment. During the winter, the snow can behave as an edge blocking some points in the city, but at the same time can provide other types of mobility.



BUILDING FUNCTIONS

The building area is dominated by residential buildings (01 up to 04 stories), and the type of construction is mixed (timber, concrete, and bricks). The east portion of the city has more mixed uses characteristics. In this portion of the city, it is possible to find the main institutional buildings, museums, educational centers, and shops.



TRANSPORT AND CONNECTIONS

The city lacks in terms of public transport. The majority of the population travels with their private transportation. Ten bus lines connect to the other cities and villages around; most of the services have one up to four trips per day. All the bus stops are concentrated in the east part of the city. The main destinations are Piteå-Gällivare-Älvsbyn-Boden- Kvikkjokk-Kåbdalis-Murjek-Vuollerim- Purkijaur and Luleå Airport. Besides, the city has a train station, operated by Inlands Banan, but the company only provides train trips for tourist activities.

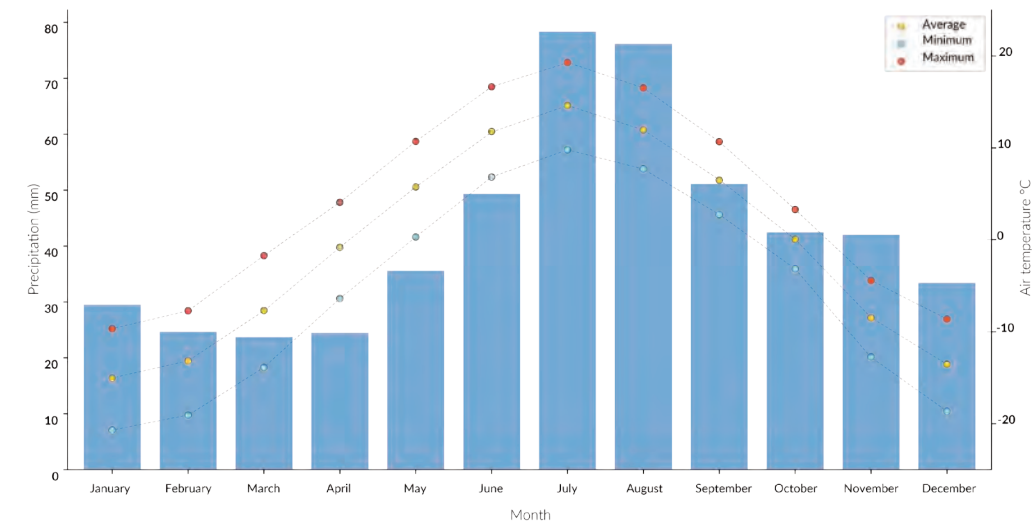


CLIMATE ASPECTS

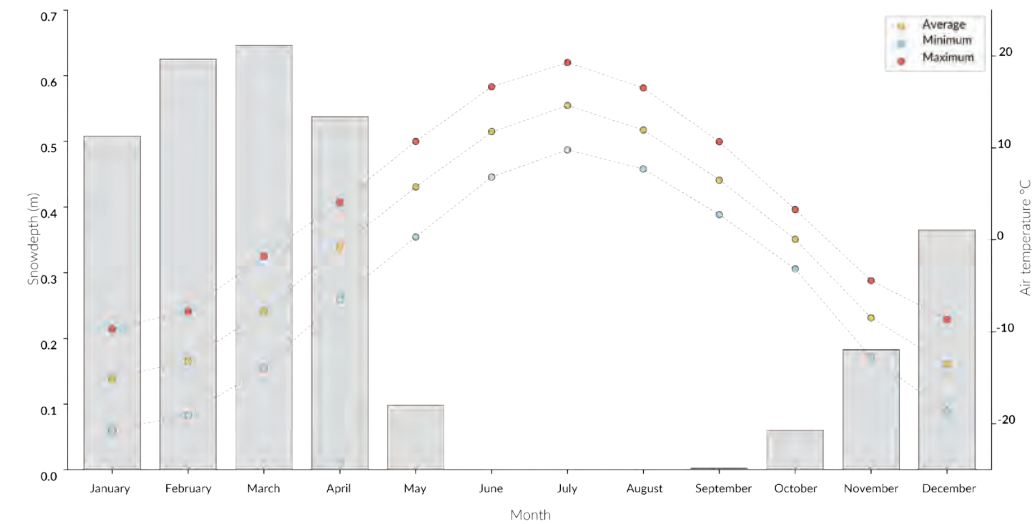
Jokkmokk is located in the coordinates 66°37N 19°50E. The altitude is 257m above the sea. The general description of its weather is rated as frigid winters and usually cool summers. According to Köppen classification, Jokkmokk classifies as Dfc (Subarctic zone without dry seasons and cold summers).

The average temperature during the winter is -15° Celcius (January), and summer temperature can reach up to 14° Celcius (July). Precipitations can occur all over the year, and in July and August, the highest amount of precipitation falls almost to 80mm. The snow period starts in October and lasts for the next eight months. The highest average of snowfall is registered in March, the beginning of spring. The longest days happen in July with an average of 23h9min, and the shortest days are in December with only 2h6min of duration.

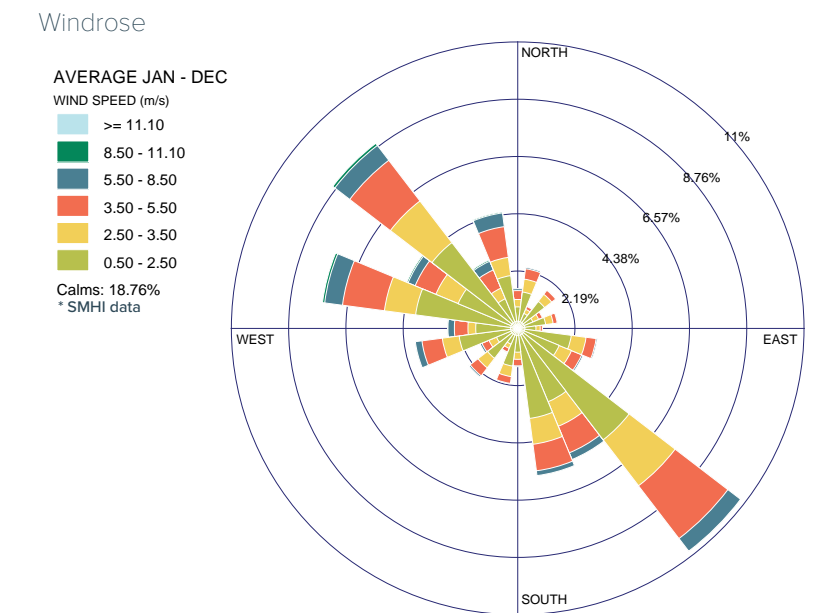
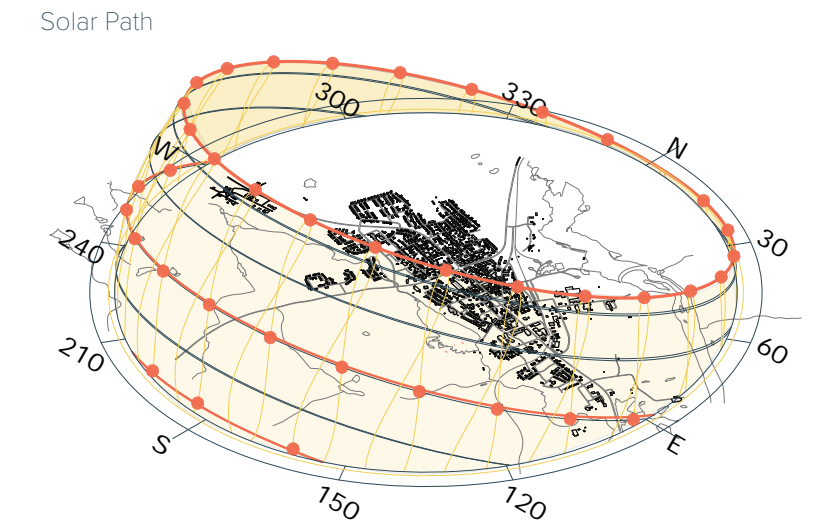
Regarding the wind, Jokkmokk prevailing winds come through two directions: South-East and North-West. The prevailing wind coming from the southeast side represents a challenge because this is the area that receives more sun, and following the recommendations of urban design in cold areas, the south areas should be exposed to receive as much solar access.



Monthly average precipitation (mm) and temperature (C°)

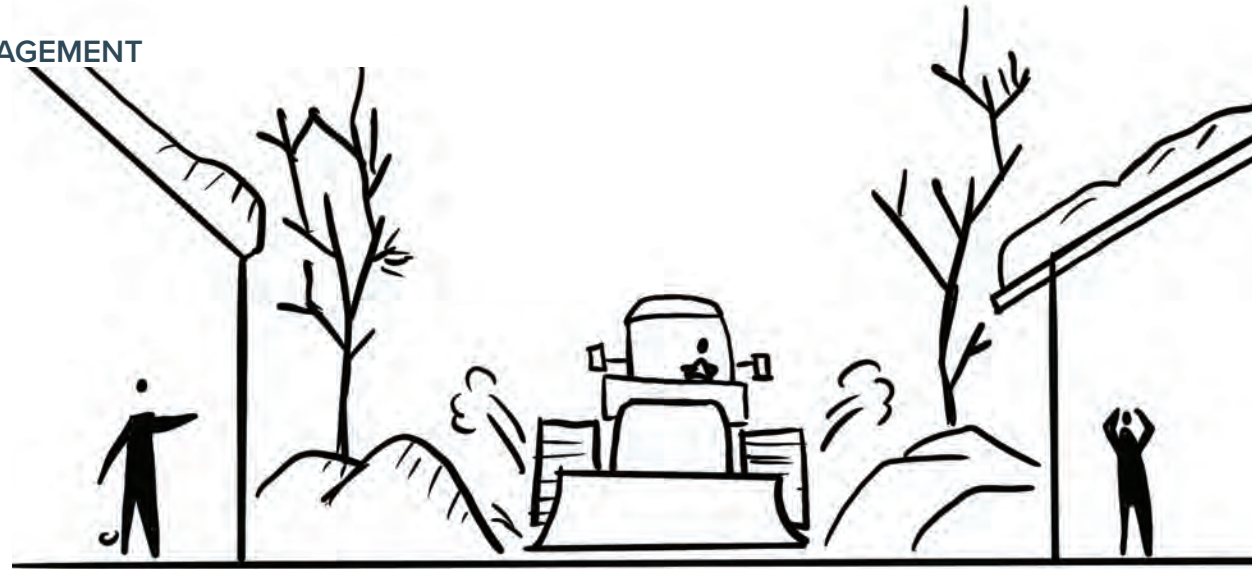


Monthly average snow depth (m) and temperature (C°)



CITY WINTER DYNAMICS AND SNOW MANAGEMENT

Jokkmokk is covered by snow for at least eight months in the whole year. The landscape transition of green areas to full white color. The snow will shape the forest, the green of pine trees will persist until they get covered with snow. Moreover, the snow will shape the city as well. It will change the shape of buildings, colors, and perceptions. The snow favors other ways to move around: it is easy to spot people using sleds for snowmobiles. However, the majority of the population rely on the use of their private cars. The city hall is responsible for the snow clearing of the public spaces in the city. There is a hierarchy of clearing streets and paths, first the main street, sidewalks, and later the local streets. The snow is accumulated into mounds in some spots in the city, and later on, they will remove the rounds using trucks in dumpsites outside the city.



The snow comes in different shapes and textures. In the Sami language (Lule Sami), there are diverse ways to name a type of snow. For the Sami, the snow is connected directly with their lifestyle, and they have the best ways to describe the landscape. According to Yngre Ryd, the word snow appears in different contexts, and the words will be different when they talk about reindeer grazing or skiing.

- **Slathe:** new snow is watery
- **Vathsa:** new snow on the top of old snow
- **Slabttese:** rain mixed with snow
- **Bulttie:** large lumps of snow that stick to a house
- **åppas:** virgin snow without a trace.

CLIMATE CHANGE IN JOKKMOKK

Climate change is moving faster in the Arctic regions. In Jokkmokk, the temperature average will rise, precipitation will increase between 20-40%, fewer days of snow periods, and more frequent heatwaves. The impact will hit directly on reindeer, urbanized areas, and the elderly population.

The reindeer herding depends on the natural landscape for their survival, and climate change will be changing their migration patterns, hindering their access to food. Many lakes and rivers will not be frozen enough to allow the reindeer to traverse. Also, the access to grazing land will be disrupted; the primary source of food of reindeers are liches, cold temperatures mixed with snow and rain can transform an ice sheet and block the access to their food.

In the urbanized areas, problems with water management will be more frequent. More rain precipitation without a system to discharge the water can lead to problems with flooding. The soft mobility will be affected as well; the rain mixed with snow will form ice sheets on the sidewalks leaving the area more slippery. Warmer summers will be a problem; heatwaves will be more constant, affecting mainly the elderly population. However, warmer temperatures and long summers can be seen as positive changes regarding tourism and local agriculture.



FIELD TRIP: DISCOVERING JOKKMOKK

The contrast of landscape in Jokkmokk is evident during the season transitions (winter to summer). I made two trips to Jokkmokk, one trip in March (end of winter) and the second trip in August (end of summer). The field trip has the main objective of observing the landscape transitions during the winter and summer period, learning about the cultural aspects of Jokkmokk, and watching the people's daily lives during two different seasons. For the landscape study, it was taken pictures with the same angle during the winter and summer. The following images will show how the snow shapes the landscape during the winter and how the green dominates the landscape during the summer.

In the winter period, the snow covers all the surfaces, giving another shape to the city. Thick layers of 80cm or more of snow stacks on roofs and cars, playgrounds are submersed in the white snow. The city hall and dwellers have one concern to keep clean essential paths and the main street for circulation. When people are not in their leisure time, they are

moving inside their cars. During February there is still much snow and as well much sunshine. Days are slightest longer enough to walk in nature, play in the snow, or ski in the tracks around the lake Dalvaddis. The sunlight reflects in the snow and gives a few thumbs up. I mainly did not feel under the weather there, but I was only a tourist. I walked around 4 hours under -15° , and I felt good, but I still missed some warm places to recover from the lengthy exposition to the cold weather.

The second time I visited Jokkmokk in August, I felt like I was in another place different. The greenery was exuberant, and I could follow other paths clearer (once covered by the snow). The main street, with its birch trees full of leaves, gives another feeling. One of the most pleasurable things to enjoy in Jokkmokk is to walk in nature close to its border and plock berries (very easy to find blueberries).





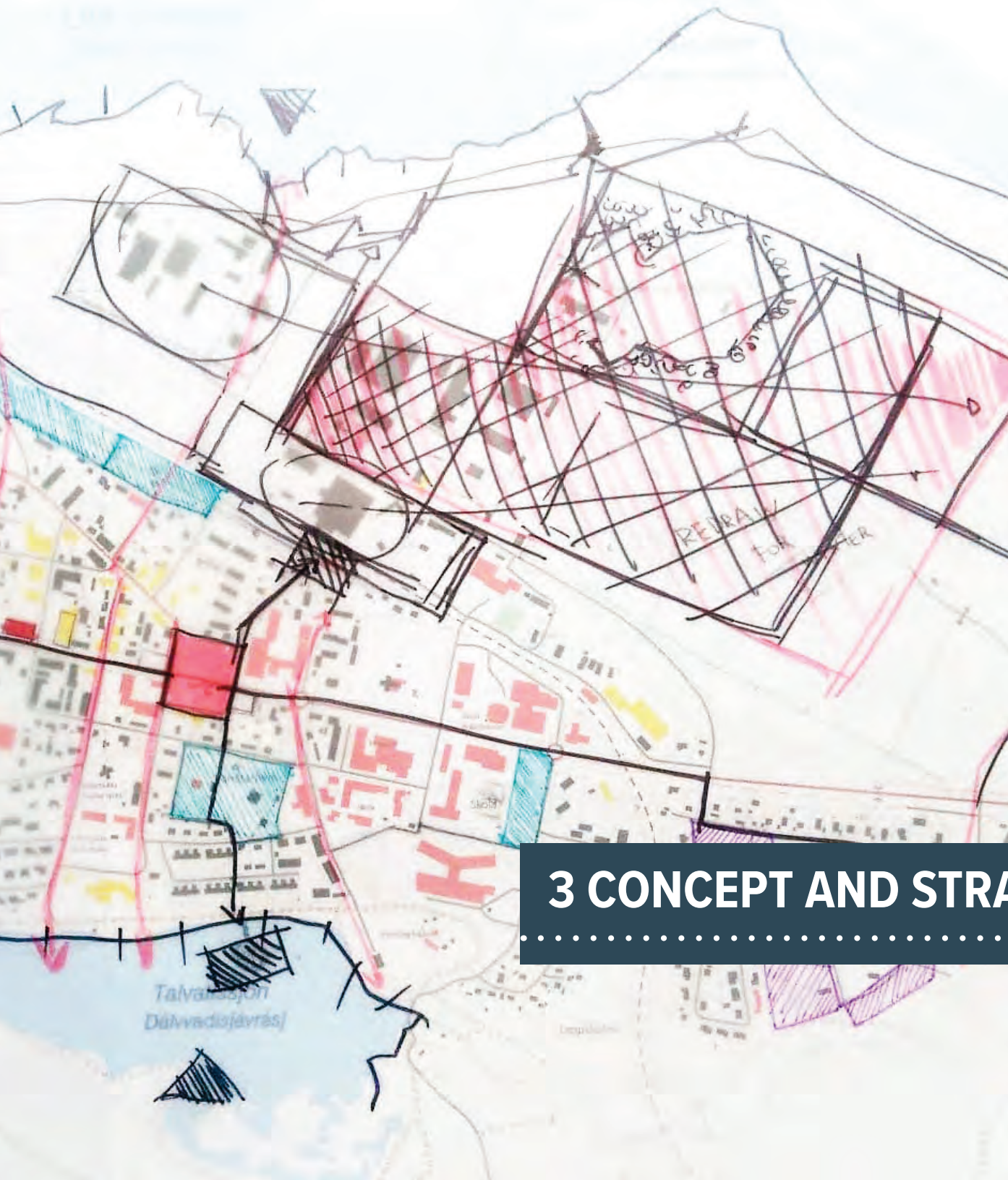


SWOT ANALISYS

The SWOT analysis of Jokkmokk aims to build awareness about what is happening in the territory, analyzing all aspects of the community (not only in the urban center but in the whole municipality). The preliminary step is to identify aspects where the city is needing more attention. Building a SWOT matrix to visualize everything negative and the positive aspects and evaluate each case should be considered in the strategies

plans. The analysis took into consideration the investigation about Jokkmokk combined with the study trip and some personal interpretations. The ideal analysis should also consider the community's participation to be aware of some problems hidden in the view. However, due to a lack of resources and contacts, the study was single viewed.

STRENGTHS	WEAKNESS
<ul style="list-style-type: none"> • Unique natural landscape • Strong cultural identity (Sami) • Laponia UNESCO World Heritage • Diversity on employment sector • Sami Cultural Center (Museum and Educational Center) • Reinder industry as sustainable industry • Cultural Diversity 	<ul style="list-style-type: none"> • Harsh weather (Rigorous winter) • Transportation (Train Station only works summer time) • Lack of accessible housing for elderly and young people. (elderly needs houses with easy maintenance and young people needs cheaper house) • Uncontrolled urban sprawl
OPPORTUNITIES	THREATHS
<ul style="list-style-type: none"> • Winter Festival • Sami Industry (Reindeer Husbandry) • Tourism growth • Traditional knowledge readapted for modern days (ex. Duoduji) • House market price is acessible • Snow can provide new types of landscape and activities 	<ul style="list-style-type: none"> • Mining companies (Threat for the environment and local life style) • Continuous shrinking population • Climate change (affecting the landscape and the reinder husbandry) • Minority population • Uncontrolled exploitation of Sami culture Discrimination. • Racism.



3 CONCEPT AND STRATEGIES

3.1 Vision and Design Guidelines for Jokkmokk

CONCEPT AND GUIDELINES

“Jokkmokk: the Arctic Future” envisions a city engaged with its landscape and inhabitants, take into consideration its climate (the winter) as a design driver force. When it is snowing, dark, and cold, Jokkmokk arouses as a lively and attractive city—inspiring its inhabitants and guests not to fear the snow and the cold, and walk through the city and discover the outside full of activities.

Warmth, light, and sheltered spaces are accessible to all residents and guests. An example of an Arctic City that values its

native culture (Sami) shows that a productive city relies not only on mining and natural resources exploitation; they can concentrate on sustainable development focusing on local growth respecting the environment and all living beings.

The project has three main concept design goals:

- **Climate resilience:** Prepare the city to endure during the winter (access to sunlight, protection against wind, shelter places) and

prepare for future climate change.

- **Cope with the Winter:** Reshape urban spaces with snow. Activate public spaces using lightning and designing areas that provide better thermal body comfort.
- **Cultural and environmental respect:** Focus on the local economy, emphasizing Sami culture, and preserving the natural landscape from mining degradation.



CLIMATE RESILIENCE



COPE WITH THE WINTER



CULTURAL AND ENVIRONMENTAL RESPECT

INTERVENTION AREAS

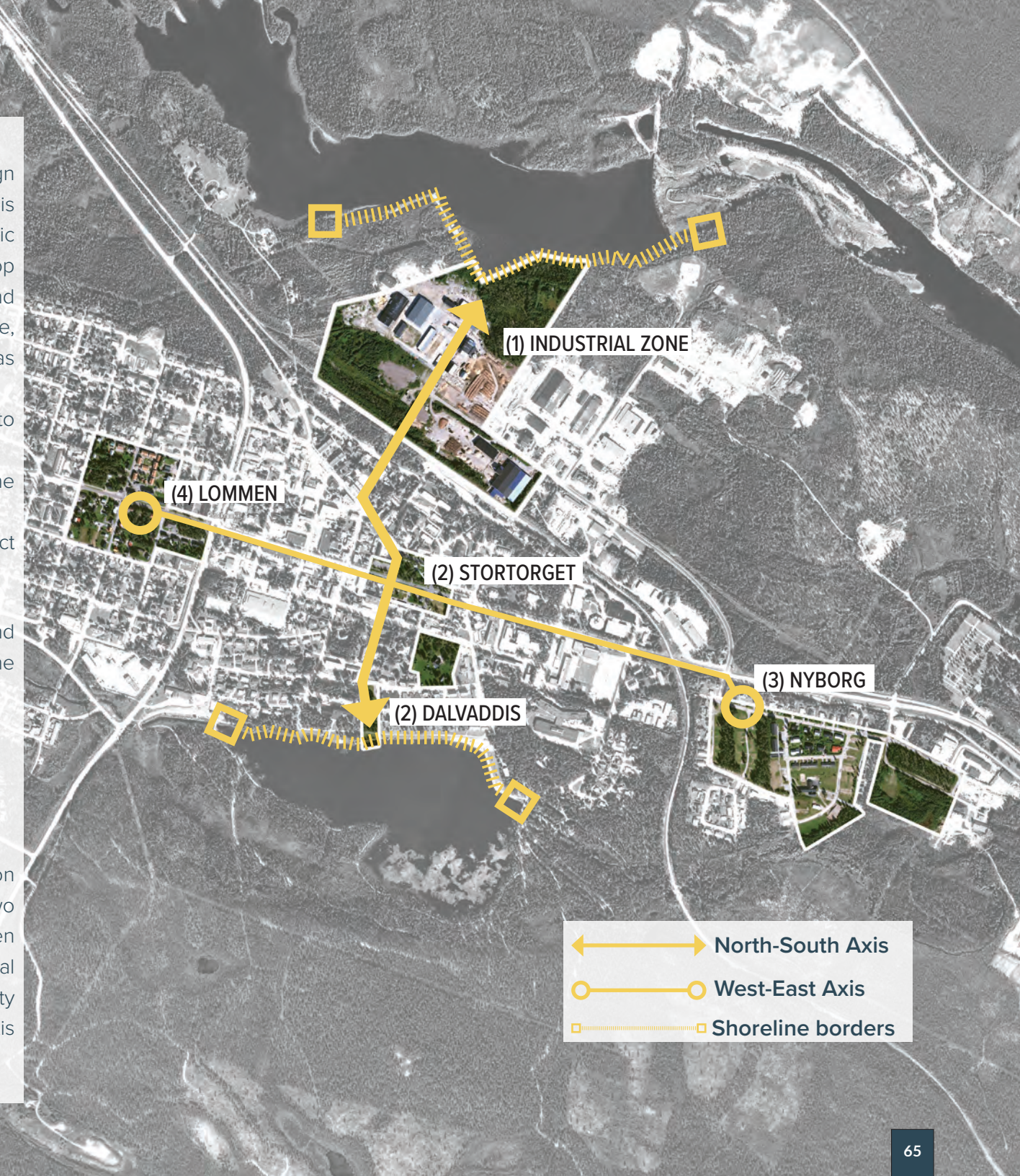
The areas selected for the urban design intervention result from the site analysis combined with its social and economic background investigation. The goal is to develop the project inside the existing urban tissue and connect the city with the external landscape, avoiding urban sprawl. The intervention areas were selected to fulfill the following requisites:

- Areas located inside the urban perimeter to avoid urban sprawl,
- Areas that possibility transition between the city the natural landscape
- Areas in strategic positions that can connect Jokkmokk to be more walkable

The areas had subdivided into four areas, and small interventions proposed along with the urban fabric:

- (1) Industrial Zone
- (2) Stortorget + Dálvadis
- (3) Nyborg
- (4) Lommen

The plan is to intensify the city development on two axes. The axis north-south connects the two water bodies (Dalvaddis Lake and Lulleälven River) to enhance the connection with the natural landscape. The axis West-East connects the city inside to spread more diversity along this axis towards the west.



North-South Axis
 West-East Axis
 Shoreline borders

3.2 Landscape Strategy

The proposed landscape strategy aims to reconnect the urban tissue with its natural landscape, keeping in mind the winter as a design drive and highlight the cultural identity of the Jokkmokk with the Sami Culture.

The landscape strategy should focus on the winter lens principle promoting an attractive winter city, offering activity, and assuring thermal comfort during all seasons. The approach should also include architecture diversity, avoid urban sprawl, and promote other economic resources that lead to a more sustainable city. It was considered five general aspects to develop

the landscape strategy:

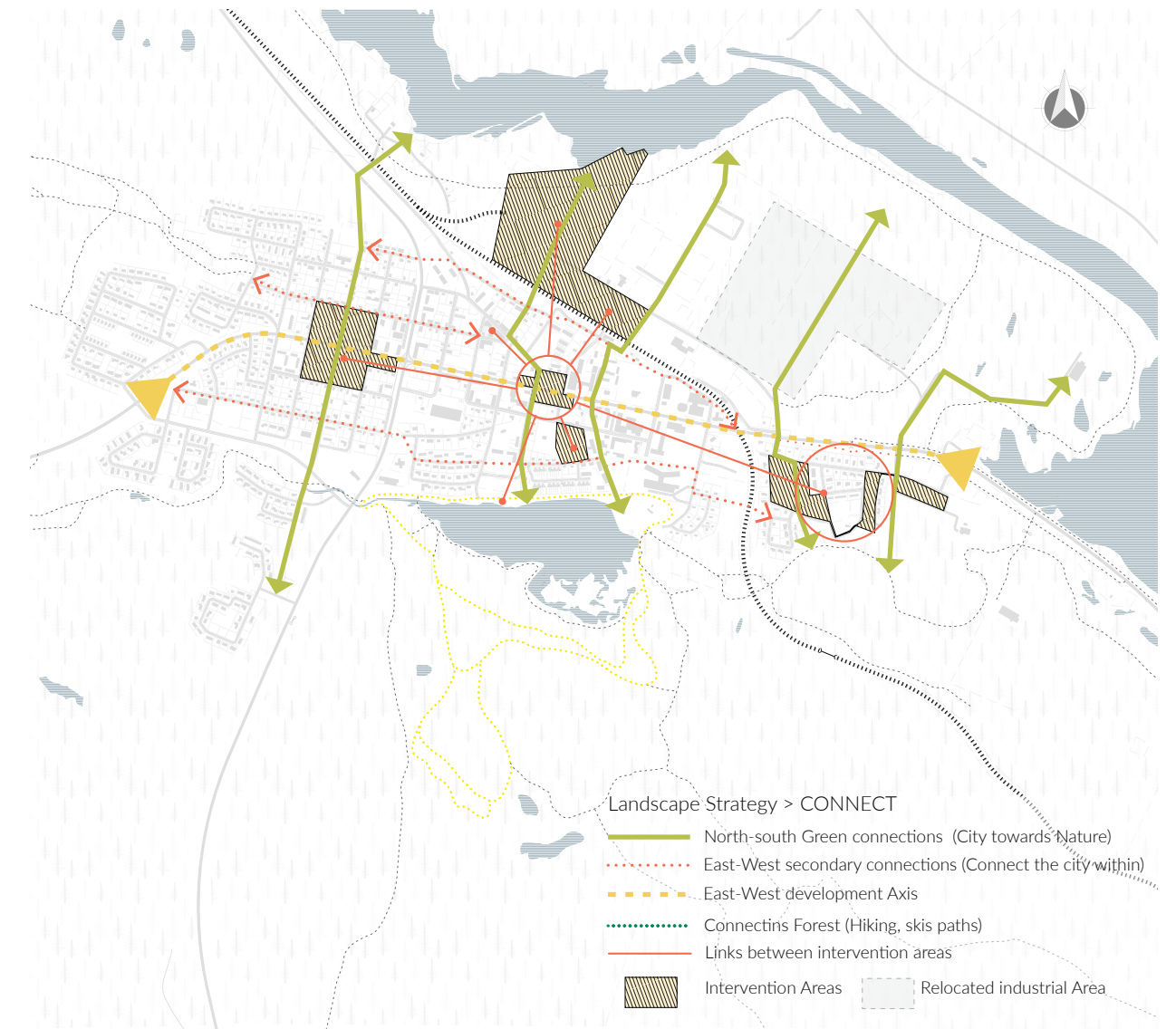
- Harsh Weather
- Climate Change
- Population shrinking/aging
- Economical struggles
- Cultural conflicts and interests.

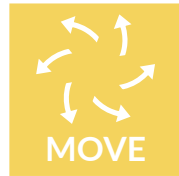
The landscape strategy includes five fundamental elements (Connect, Move, Adapt, Endure, Attract) that integrate the climate-sensitive design as the central aspect. In addition to the strategies, it should align some SDGs goals to achieve a sustainable community.



Jokkmokk could be described as a small urban agglomeration cut out from the boreal forest. The dense forest surrounding its perimeter gives a sense of belongingness with nature. The first step of the landscape strategy is to establish links between the urban space and the natural landscape and soften the transitions between urban spaces and the forest. The approach is to work with two primary connections and subsequently work with secondary connections to facilitate the encounters inside and outside the city.

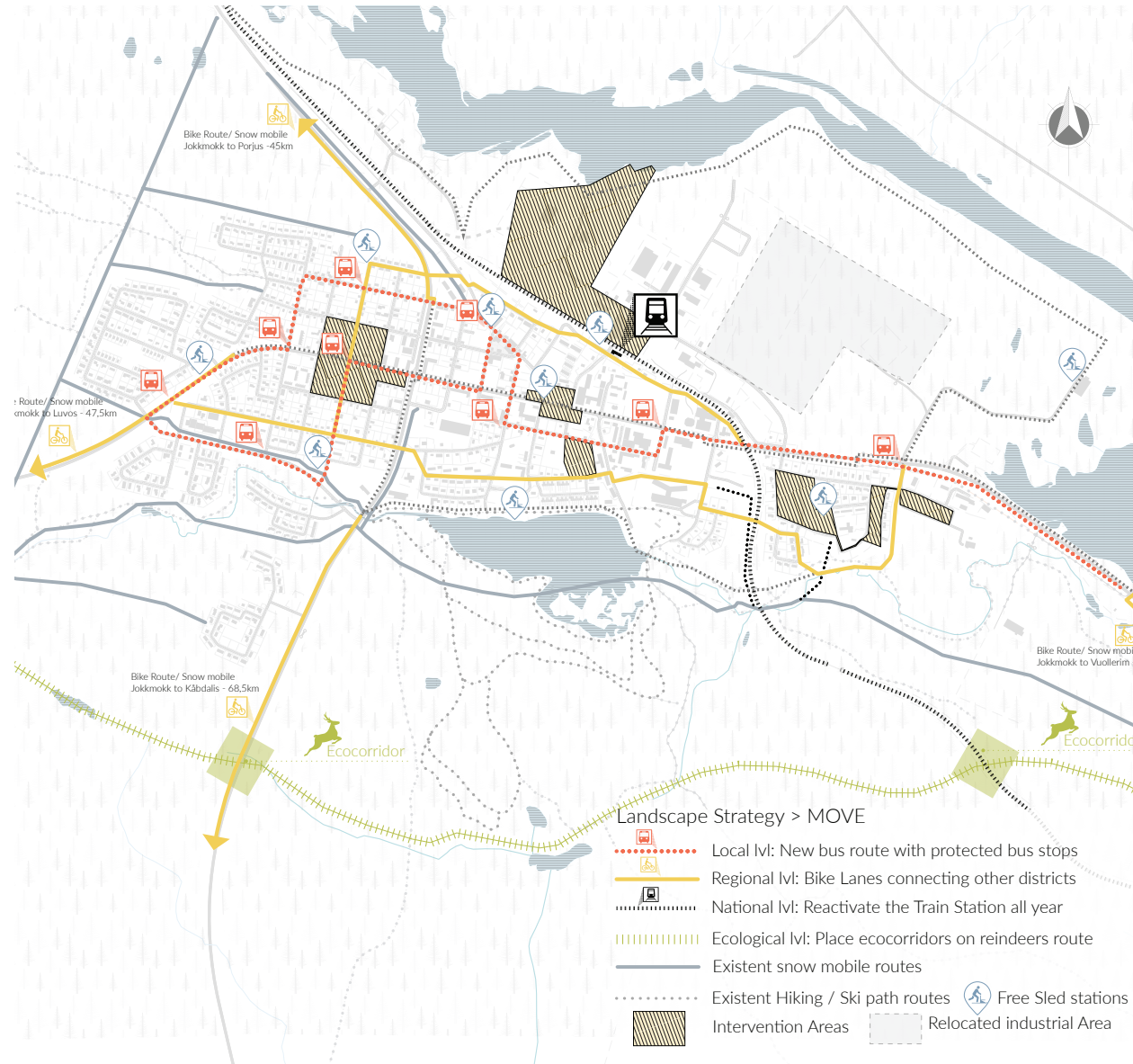
- North-south green connections. Reinforce existing connections city towards the forest. These connections should provide easy access to the natural landscape.
- East-west connections refer to connections within the city. Prioritize development and prepare for better mobility. Spread the use diversity.





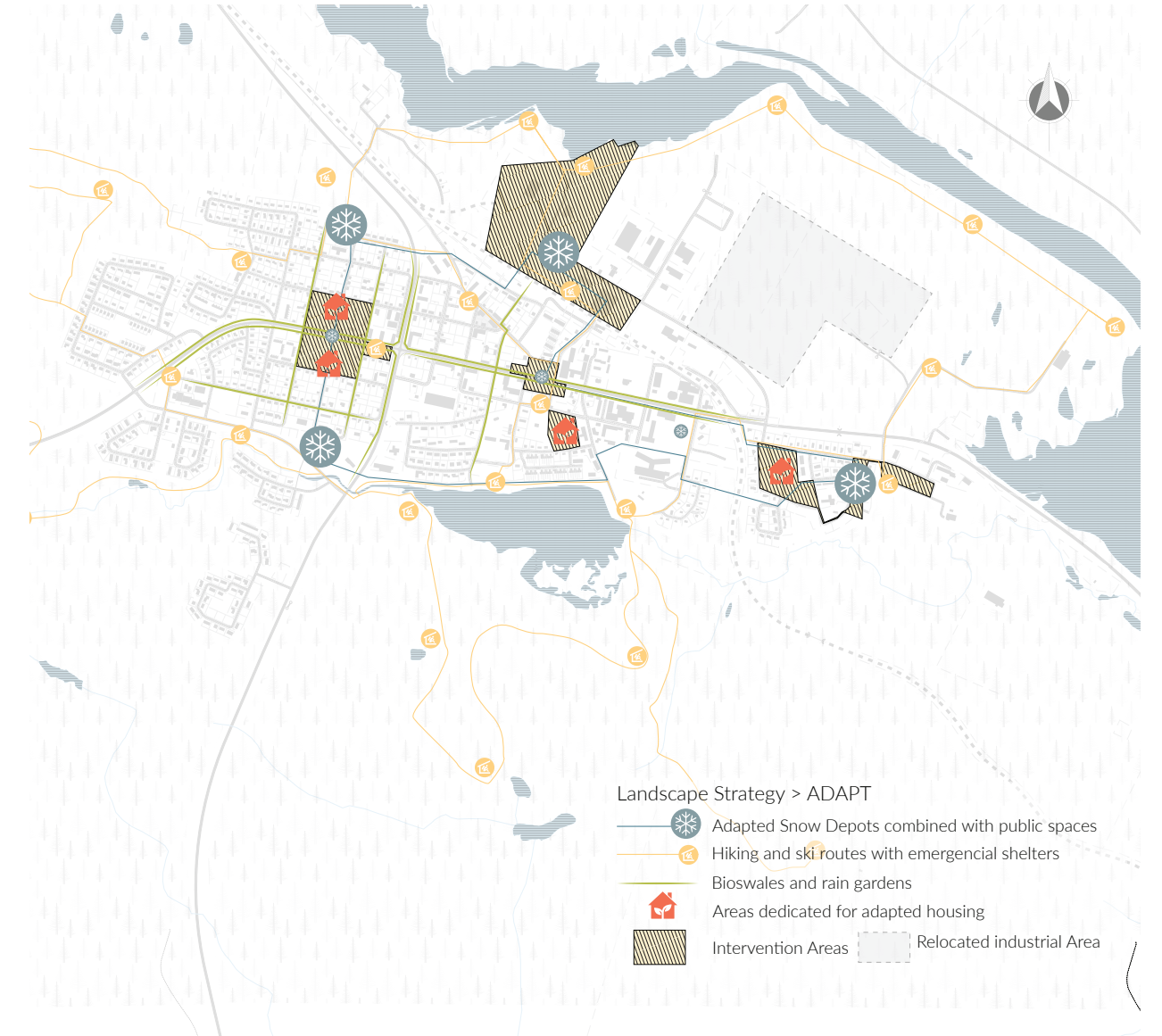
Mobility is one of the biggest challenges in Arctic Cities. Nowadays, Jokkmokk inhabitants are entirely dependent on their cars. Improving the existing public transport can create the chance of choice and improve the snow mobility within the city to promote outdoor spaces. A better system of transportation can also benefit tourists that arrive in the city by train or buses. The mobility action focus on four strategy levels:

- National level: Reactivate the train station for full-year use (this action could benefit other Swedish cities along the Inlandsbanan railways.)
- Regional level: Create new bus stops towards the west side. Nowadays the buses stop only at the bus station, and people need to get their car to access public transport.
- Local-level: Improve the soft mobility creating new routes for snowmobiles, shelters, and the city for the walkers and provide kicksled stations in strategic points.
- Environmental level: Provide an ecological corridor for the reindeers when the roads and railway cross with their grazing route. The ecological corridor could also benefit other local animals.



Jokkmokk needs to embrace its condition as WinterCity. When the urban design copes with the winter, it guarantees that the design will work all seasons. Although Jokkmokk is already a structured city, it is possible to plan for the future to have in mind the winter and climate change's future impacts. The following strategies will help Jokkmokk to be adequate more into its climate reality:

- Contain urban sprawl through development West-East, creating a horizontal urban spine for possible development.
- Allow medium densification through the west-east spine: transform existent plots (medium densification in the future)
- Promote housing diversity (ex.: houses adapted for elderly inhabitants) and energy-efficient.
- Define snow depots to contain melted water from snow and support rainwater.
- Implement bioswales in the streets to facilitate the water flow.

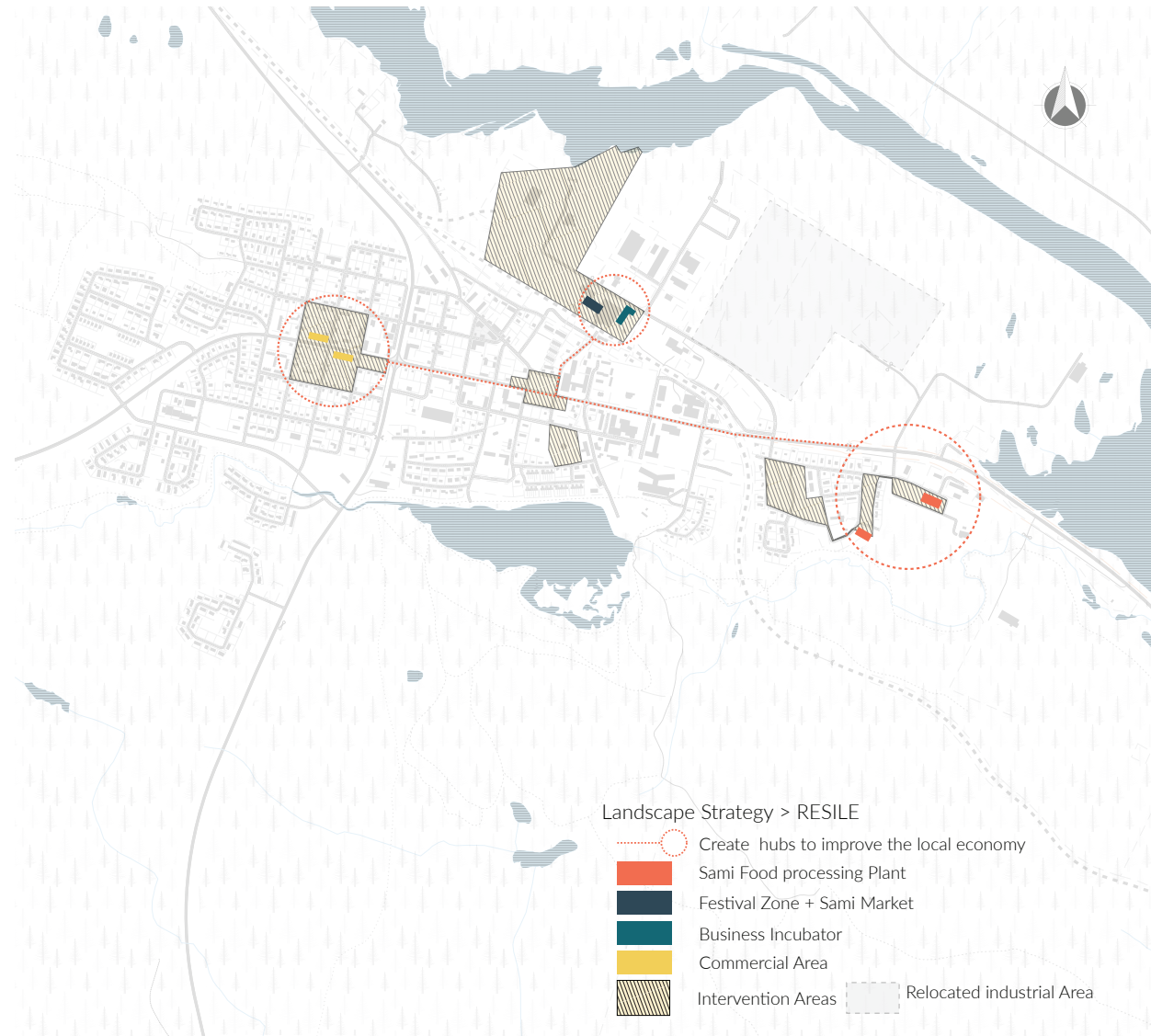




ENDURE

The local resilience action is connected directly with the local economy focusing on tourism and local production, preserving the landscape, and respecting the local culture. Jokkmokk has a rich landscape and needs to show the chance to improve their economic situation without destroying the landscape. The focus is to establish a northern city independent from mining.

- The strategies proposed for this action are:
- Protect the reindeer husbandry and its tradition.
- Propose a food processing plant focused on the Sami Cuisine to prepare commodities for national-level exportation.
- The Forest industry focused on berries production rather than extraction.
- Expand tourism in the city. The tourism involving Sami culture must be conducted only by the Sami in the community.
- Create hub support for the Winter Festival. Jokkmokk receives more than 30000 visitors every Winter Festival; this means an excellent opportunity for the local economy and a significant impact on the city itself.
- Create an incubator for new ideas of business.
- Implementation of data centers.



ATTRACT

It is essential to build a city more attractive to tourists and for its inhabitants' well-being. Especially winter cities that have a long winter where the cold and dark are predominant characteristics. The snow can play a role significant in the attractiveness action. Using the snow as the primary material of the landscape modifier can create microclimates in the city and allow people to endure longer outside. The strategies are:

- Reshaping the public space using the snow.
- Place new landmarks in the city—the possibility of creating ICE buildings like the Ice-Hotel in Kiruna.
- Create indoor spaces to promote sports and connect with nature.
- Create sheltered places along the city to provide thermal comfort. (winter gardens, greenhouses, pavilions)
- Promote diversity in Architecture (Ideally more buildings inspired by Sami architecture made by Sami Architects)
- Use of lights and sculptures during the dark winter to activate public spaces.
- Provide winter equipment available for residents and visitors.



3.3 Design Methodology

WINTERCITIES TOOL BOX DESIGN

The Winter toolbox is a tool created to visualize several possibilities of interventions to promote a better life quality during the winter. The toolbox consists of 16 starters' actions referent to the five principles (see pg. 17) of the winter design guidelines combined with winter cities' theoretical studies. All interventions are designed to apply in both dimensions of the building and the public space.

- 01 - The building should faces south (optimize solar access).
- 02 - Place pocket parks with solar access.
- 03 - Build Canopies (Protect rain, snow, wind)
- 04 - Special snow depots to filter dirty snow
- 05 - Colorful facades
- 06 - Decorative lighting
- 07 - Place public winter gardens/ green houses
- 08 - Shelters to protect from the weather
- 09 - Provide warmer places (firepits + benches)
- 10 - Use of right vegetation on the landscape
- 11 - Board walking in green areas.
- 12 - Use vegetation (or snow mound) to block the wind
- 13 - Facilitate soft mobility - use of sleds during the winter and bike during summer.
- 14 - Winter toolbox - provides easy access to winter equipments.
- 15 - Promote winter sports
- 16 - Promote more festivals during the winter

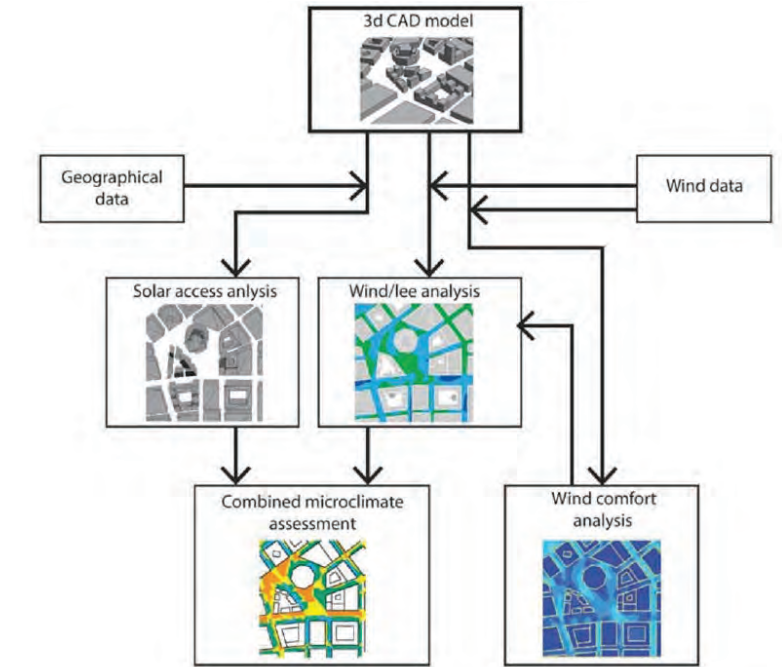


CLIMATE SIMULATIONS PROCESS

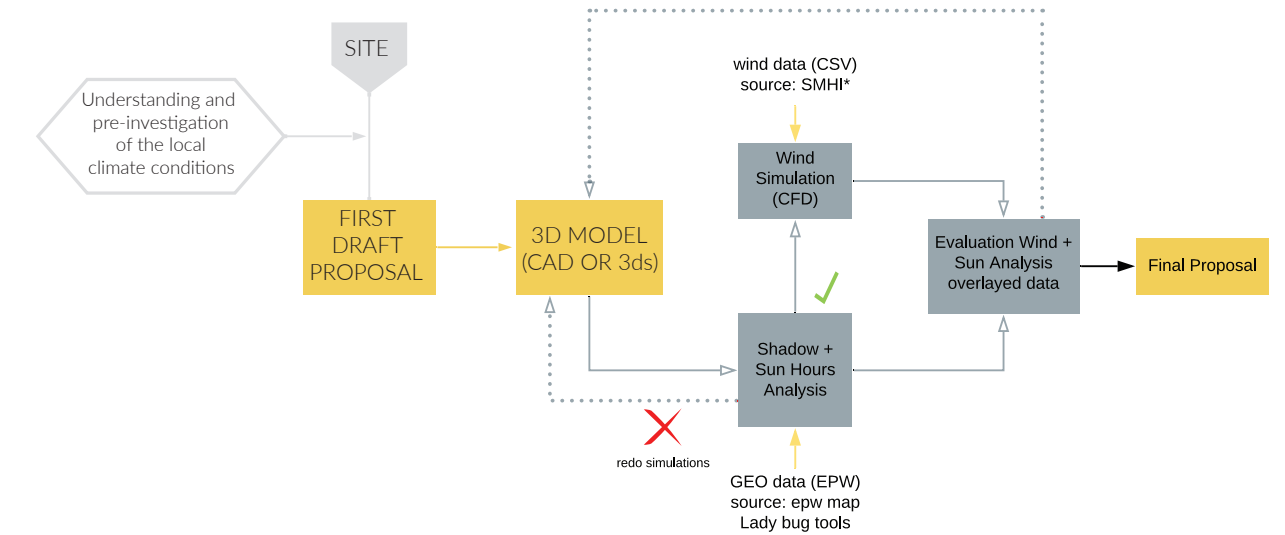
One of this thesis's objectives is to practice and evaluate climate simulations using specific software to analyze shadow studies (Rhino), total sunlight hours (Ladybug -Grasshopper plugin), and wind (Autodesk CFD).

The methodology presented was inspired by Saeed Ebrahimad's studies regarding microclimate analysis in Kiruna. The author shows the importance of the microclimate study during the early development stage of the design process. In his paper analyzes the project of the new city in Kiruna. The study involves using simulations (solar access and wind speed) to determine areas and cross the data and produce maps to help analyze local climate conditions to improve thermal comfort.

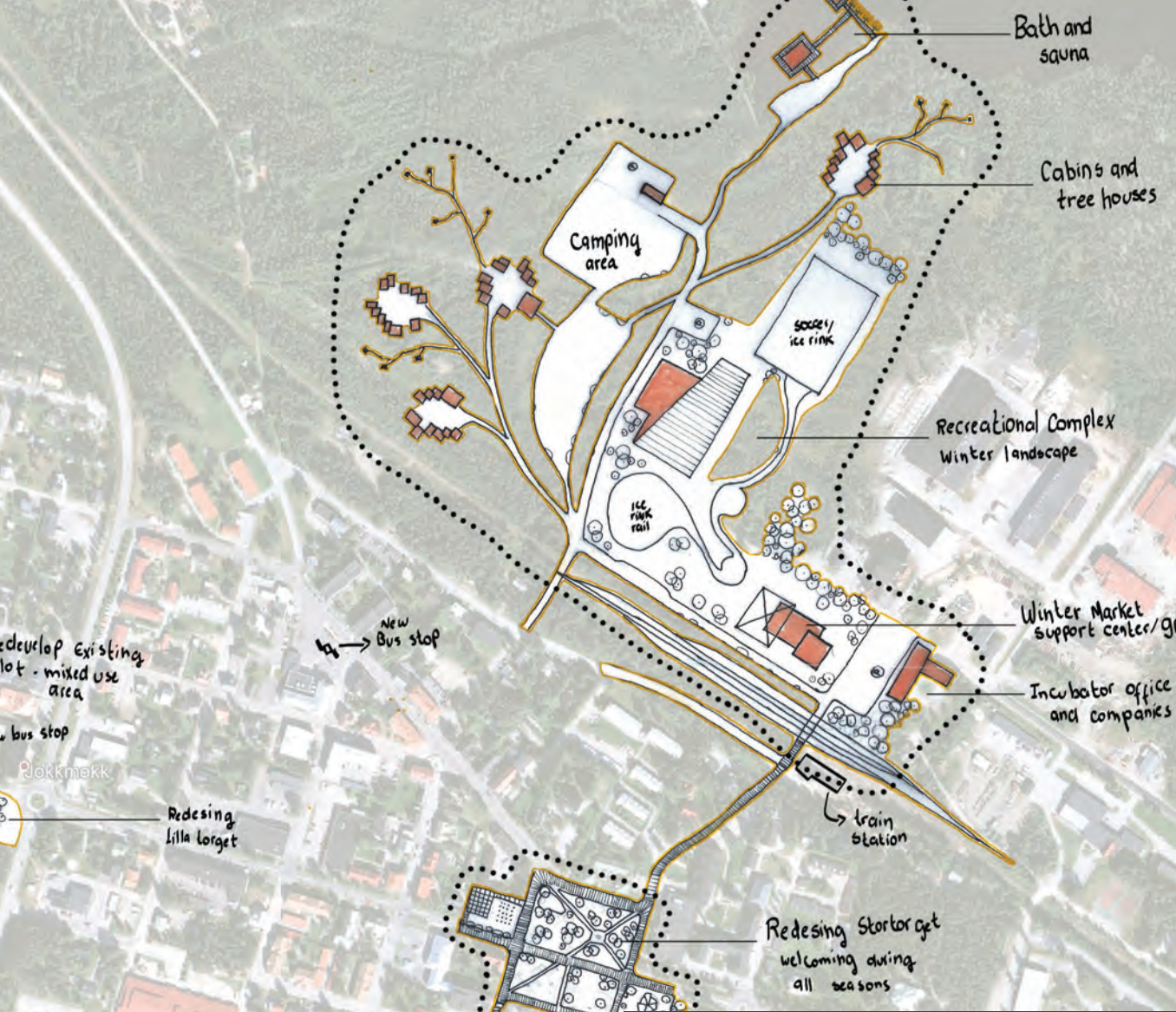
The application of his flow in this proposal has resulted in a different flow. In his study, the simulation was done after the design proposal with the 3D was already done. For this proposal, the climate simulations will help to define the shape during the design process. The flow consists of a primary focus on the buildings' solar simulation and, later on, sunlight hours and wind analysis.



Work flow proposed by Saeed Ebrahimabadi et al.



Work flow adapted for the current project



4 DESIGN PROPOSAL



Jokkmokk: The Arctic Future

Jokkmokk has a beautiful natural legacy and a rich cultural background. The nature close to its urban area gives the city a unique landscape and is also accessible. The design proposal aims to unite the natural landscape and the city, making new connections. The main goal is to restore Jokkmokk attractiveness as a place not only to visit but also to live.

The proposal counts with several interventions placed strategically in the city to decentralize activities in one concentrated area. Revive the city's attractiveness both in economic and activity aspects and reaffirm Jokkmokk's identity as the Sami home, arousing the local economy connected with the Sami culture through tourism and local production.

Nonetheless, the interventions were designed according to the "winter lens" principle, which the winter should not be only to endure but also to enjoy. The program contains a series of urban interventions divided into three areas: The North-south Axis, Nyborg, and Lommen. All interventions aim to redefine Jokkmokk as a winter city, reclaim its identity, protect the environment, and choose other ways to recover its economy. This chapter will display the interventions' purposes and visualize the landscape transition from winter to summer. The design decisions were based on the previous research, considering all aspects of Jokkmokk (cultural, social, and economics) and decisions based on climate simulations (shadow studies, solar access, and wind).



4.1 The North-South Axis

The North-South Axis contains a series of interventions connected with public spaces, social housing, and synergetic economic actors. The Axis connects the two water bodies that the urbanized mass of Jokkmokk lies between; Dalvvadis Lake and Lule River. The interventions aim to spread more diversity into the city regarding activities, uses, and boost the tourism infrastructure in the city, focusing on the Winter Festival where it attracts more than 30 000 - 50 000 people during a week. The Axis North-south contains five interventions that combine several types of uses and activities:

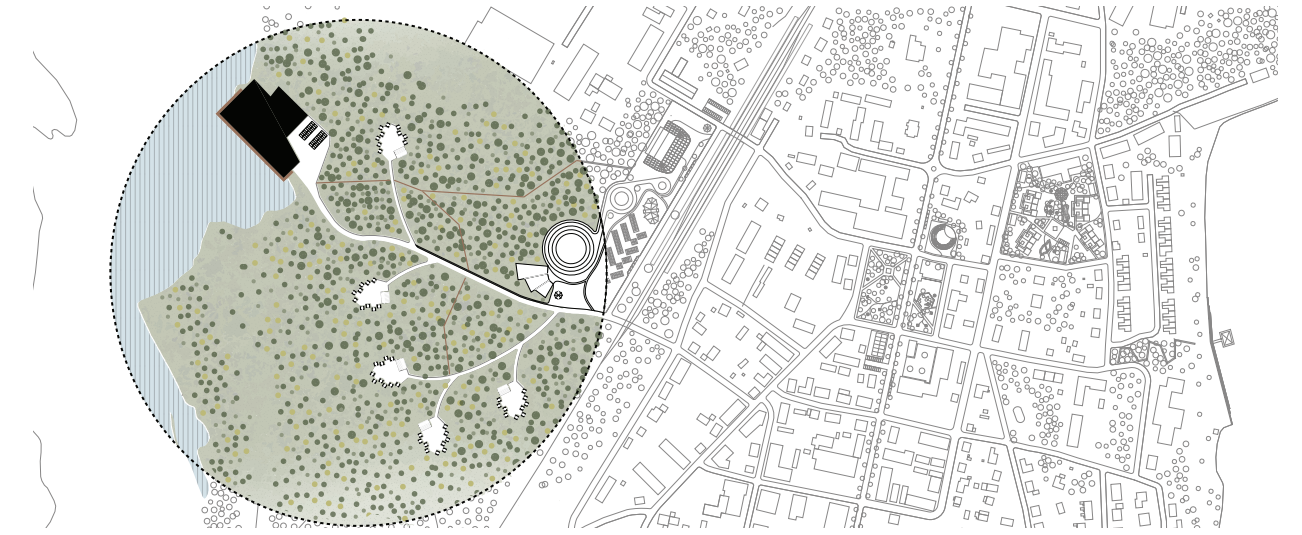
1. Recreational Area
2. Winter Festival Area
3. Stortorget
4. Dalvvadis housing Area
5. Dalvvadis Lake Shelter

This section will present the interventions and the main concepts behind it, considering the winter lens's use: walking-friendly, vibrant and attractive spaces that provide thermal comfort and protection from the harsh weather.



MASTER PLAN NORTH-SOUTH AXIS 1:2500

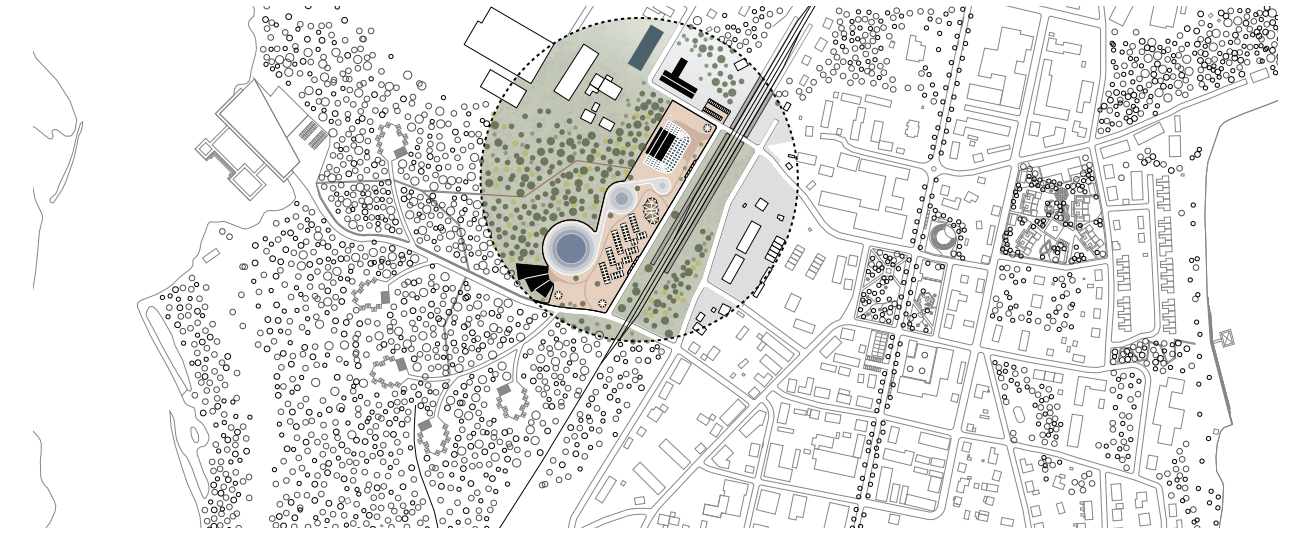




Recreational Area

The Recreational area is part of the formal industrial zone of Jokkmokk. The proposal idea is to recover the natural landscape (retransform the industrial zone) and facilitate access to the Lule River connecting with the urban area of Jokkmokk. The retransformation includes a series of interventions that allow easy access to natural landscape - like board forest paths, designated areas for picnics, and small shelters

from weather protection. The intervention proposes installing wood cabins to help the local tourism and a Swimming Hall center placed in the Lule River shoreline. The swimming hall is equipped with indoor sports courts (ex. squash), a cafe, and a protected external bath area with a sauna. The external bath will facilitate the use of winter baths and also provide safety.



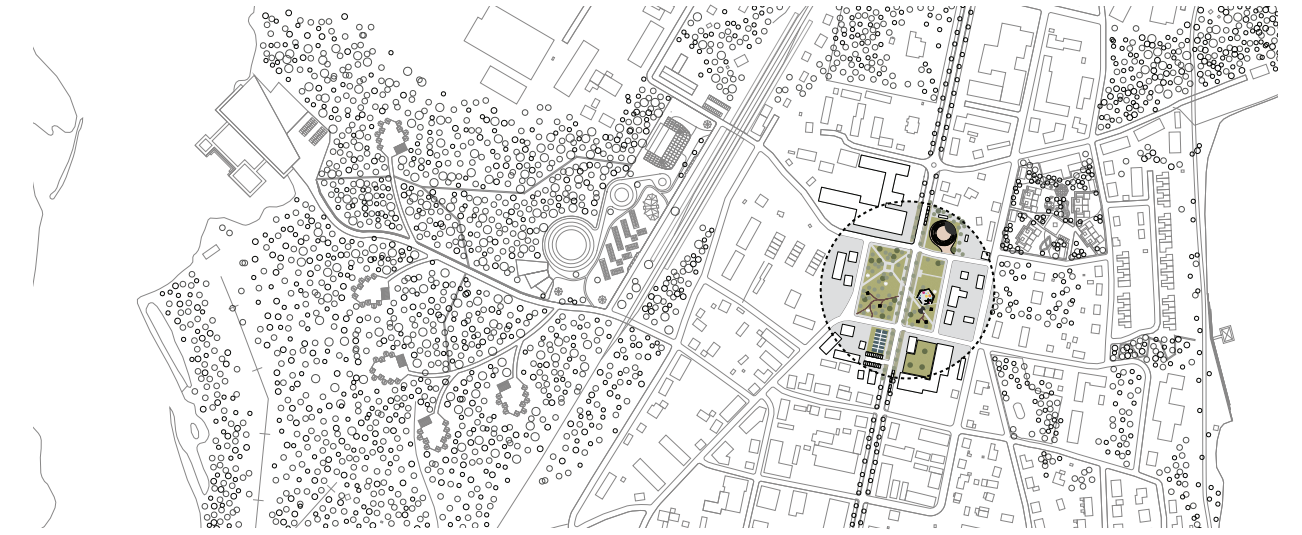
Winter Festival Area

Jokkmokks Marknad is the heart of the city. It is the celebration of the Sami Culture and also an economic synergist for the city. The intervention proposes a dedicated area for Jokkmokks Marknad and other attractions. The aim is to extend the event for more than three days, providing extra support for the merchants and guests, and reserve a place for other city events.

- Winter Festival Building: Provide a space with extra facilities for guests and exhibitors and a warmer place for people more sensitive to winter to enjoy the festival.
- Ice-Rink: The ice-rink can be an alternative

to ice-skating while the lakes and rivers are not frozen or an opportunity for those who fear ice-skating in nature. Also, the area can be used later as a snow depot.

- Market Stall Area: Fixed market stalls placed in order to create protected areas from the wind. Snow mounds also should be used as a wind blocker.
- Ice-Building: Inspiration from the Ice-Hotel in Kiruna. The Ice-Building in Jokkmokk expresses the opportunity to celebrate the winter and create new traditions in the city.



Stortorget

The new redesign of Jokkmokk's town square provides comfortable places and attractive space during the winter. The main concept highlights the local identity, giving space to Sami Artists to rebuild the plaza to reflect the local culture. The new Stortorget should be resilient and planned to think the space through the weather, dealing with snow or rain, and becoming an adaptable area to use all seasons. During the winter, elements like light, ice sculptures, shelters,

warm spots, unique furniture, and adequate vegetation will provide thermal comfort and incentive to be more outside. The snow is crucial for planning the space and creates an opportunity for community engagement. The area contains a winter garden, Sami Pavillion, a new playground, and an amphitheater used as a snow depot during the spring to melt the snow.



Dalvadis Senior Housing

This area was chosen to develop new houses prioritizing senior people due to the proximity of the central area, commercial facilities, and hospital. Young people are welcomed to live in the complex; this could work as a symbiosis house where the young people could help the elderly tenants with garden maintenance (taking care of snow, grass, and others) to rent discount.

The area also has a winter garden to allow meetings outside the house during the winter and make it easier for older people who are more sensitive to the weather.



Dalvadis Lake Shelter

The proposal for the lake counts with a strip park connecting with the water, and a shelter/ cafe should be placed as iconic to frame the landscape. The architecture should reflect on Sami/culture, and also, this can be a spot to warm

up. The place to be free of charge to be inside and a spot for people to borrow equipment from the local winter library

4.2 Nyborg: Living in a productive land

AXIS EAST-WEST | The intervention proposes a mixed-used activity involving housing, community center, and local production. The housing area design aims to alter the way of traditional building isolated homes. A shared garden and open paths can facilitate snow maintenance and also an opportunity to bring the community together, especially during harsh weather. The new and existing dwellers can benefit from a local community center; the area can incentivize community engagement, for example, workshops, sharing equipment (gardening tools or snow maintenance), or co-working spaces. The local production is connected with the

possibility to explore Sami Cuisine. The two food processing plants proposed can bear activities related to local production (exportation level national and regional), focusing on the Sami traditions. The proximity of the reindeer's natural route to the food processing plant can provide new activities. For example, one of the plants can be associated with a more touristic display with a reindeer zone for visitors.

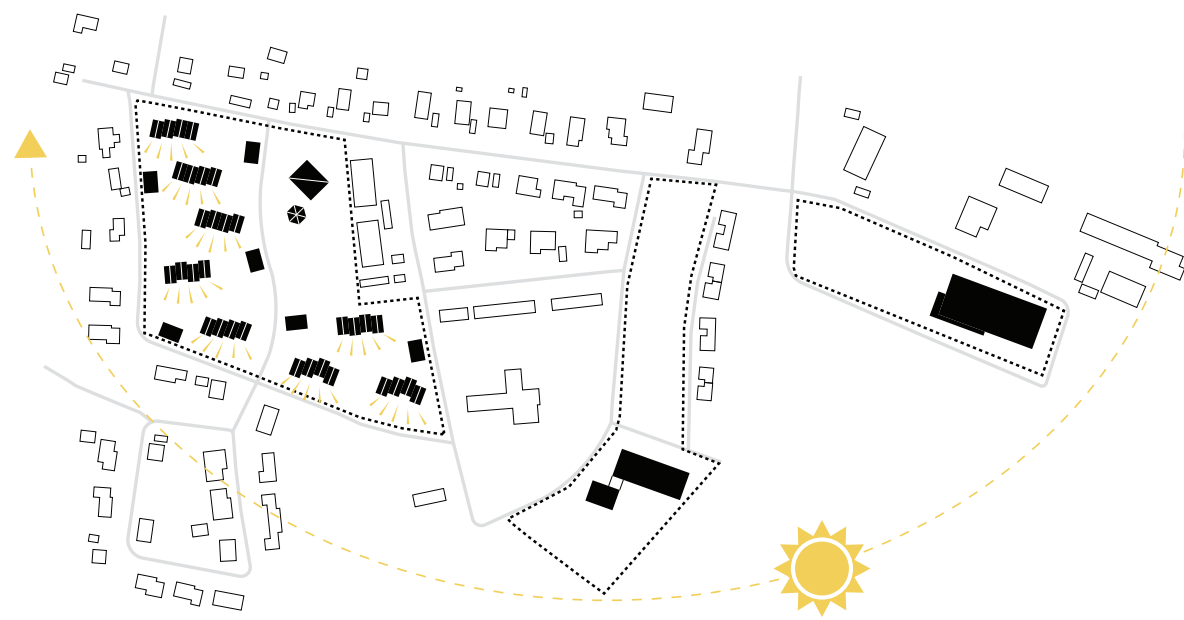
For this part, the concept design process will use climate analysis tools (shade analysis, sunlight hours, and wind simulation) combined with the winter toolbox design.



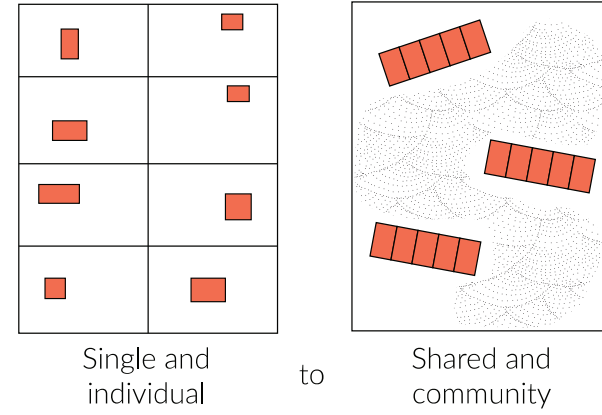
CONCEPT DIAGRAMS AND CLIMATE ANALYSIS



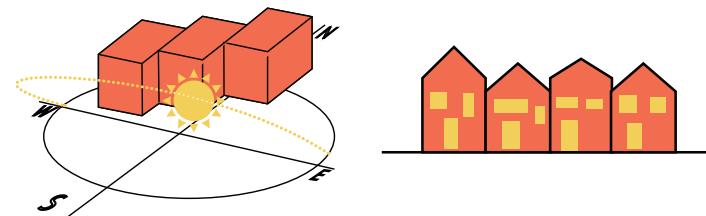
1. Nyborg Site / Transform existent plots



2. Place buildings facing south maximizing solar access



Detached houses in the north can be seen as symbols of more independence and individualism. However, this situation can lead to some problems of isolation and less community life. The proposal aims to build places connected with shared gardens that can help the community's life and be more climate-resilient.



South building orientation to maximize the sun access and build together to preserve energy.

SUN ACCESS ANALYSIS

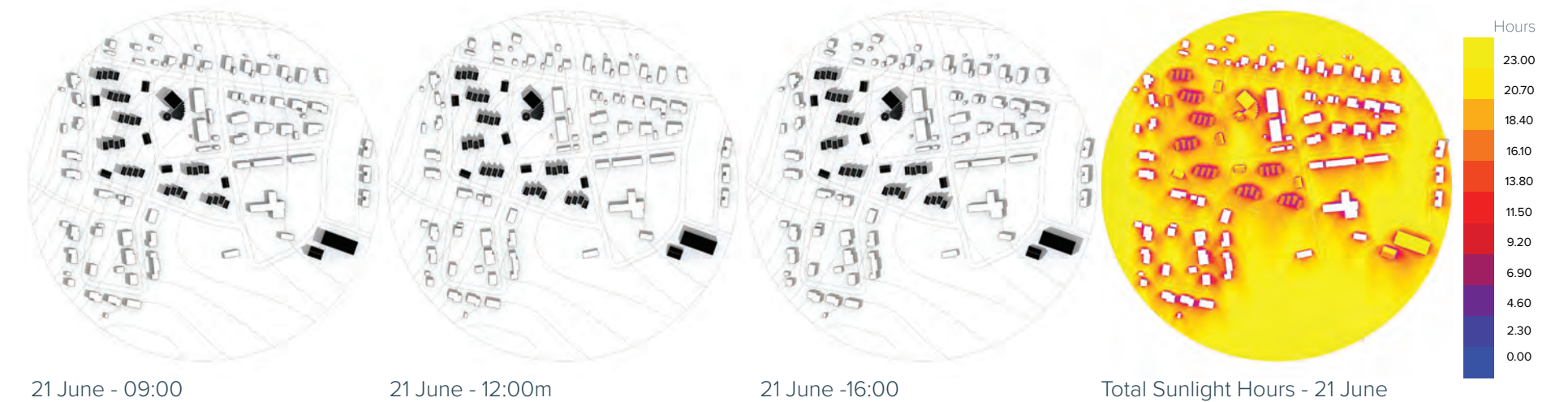
The sun access results during the Equinox were satisfactory regarding the length of the shadows that do not cover the other building's facade. The south front is exposed to direct sunlight for at least 11 hours. However, the north face does not get any sunlight. In that case, it should consider the room orientation. The south orientation is recommended to place

rooms with more long permanency, like the living room, bedrooms, and north face of the home office, kitchen, staircases, or garages. The areas between buildings have a satisfactory sunlight exposition in both periods of Equinox or Solstice.

SHADE ANALISYS EQUINOX - Nyborg



SHADE ANALISYS SOLSTICE- Nyborg





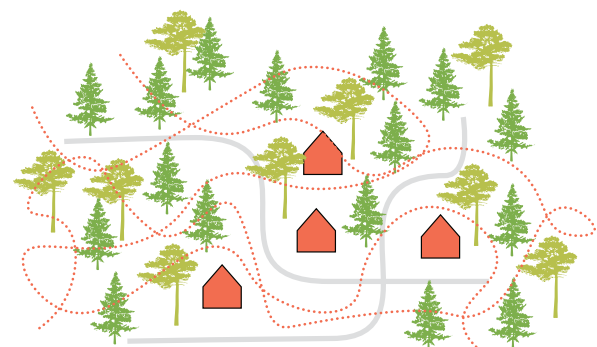
3. Open blocks and expand connections

- connections between Buildings
- connections towards Nature
- new street



4. Green areas and shelters

- Shared green spaces
- Private garden
- Coniferous Forest
- Low vegetation to protect from wind
- ★ Shelter protection - windsnow
- Evergreen trees (ex. Pine tree)
- Deciduous tree (ex. Birch tree)

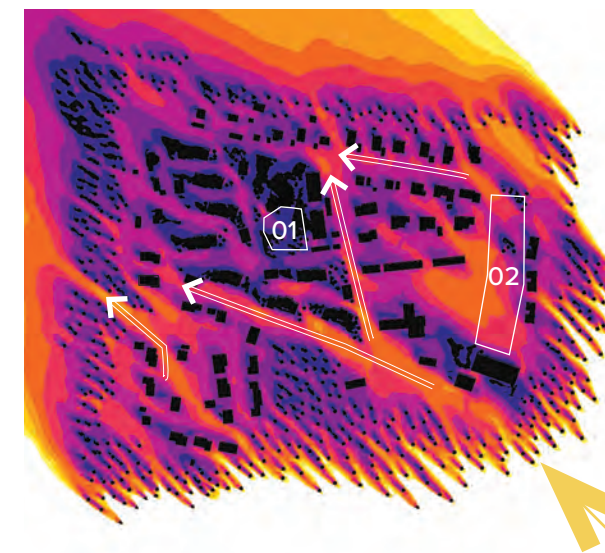
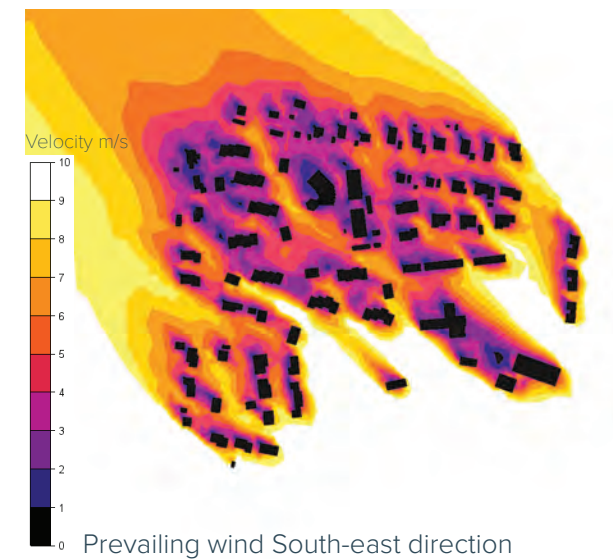
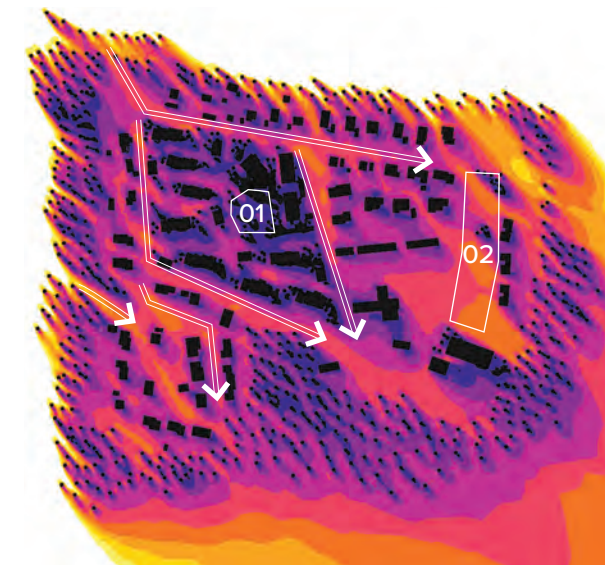
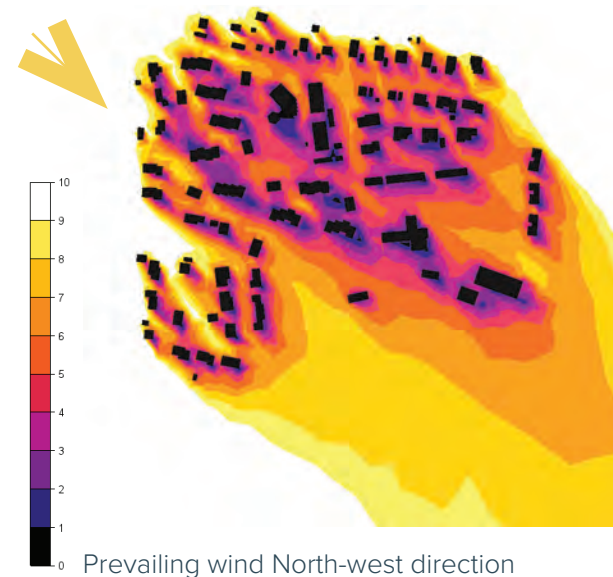


Making distance short is essential, especially in places where the weather is harsh in winter. It is possible to open paths between buildings by shared gardens. Also, shared gardens will allow more integration in the community and raise neighbor vigilante awareness.



Wind can be hazardous during the winter. It is essential to provide wind protection. The wind's adverse effects can be reduced using adequate vegetation and shelter protection in public areas. So people can endure outside for more extended periods.

WIND ANALYSIS



By early definition, maximizing sun access became a priority for the final design achievement. However, it is still interesting to run wind simulations to analyze the prevailing wind behavior. It was realized two simulations refer to the local two prevailing winds (North-west and South-east), one with trees and another without trees.

In both wind simulations without trees, the formation of high-speed wind tunnels was identified with a velocity between 9-6m/s. The velocity of the wind was reduced in the simulations using the tree as barriers. The arrows show some wind tunnel formation. According to Erskine, wind tunnels can act as a natural agent to clear the snow out of the street.

The tagged areas numbers 01 and 02 indicate the main public spaces for the area. Area number 01 has more vegetation than area number 02; consequently, the wind velocity results are better. However, the lack of vegetation in area 02 was intentional because it will be destined to be a snow depot and solar access is its priority. The overall suggestion to produce more pleasant public spaces is to work with local solutions at the landscape level, like implementing shelters and vegetation to assuage the wind velocity.



5. Define functions: Live/ Produce / Enjoy

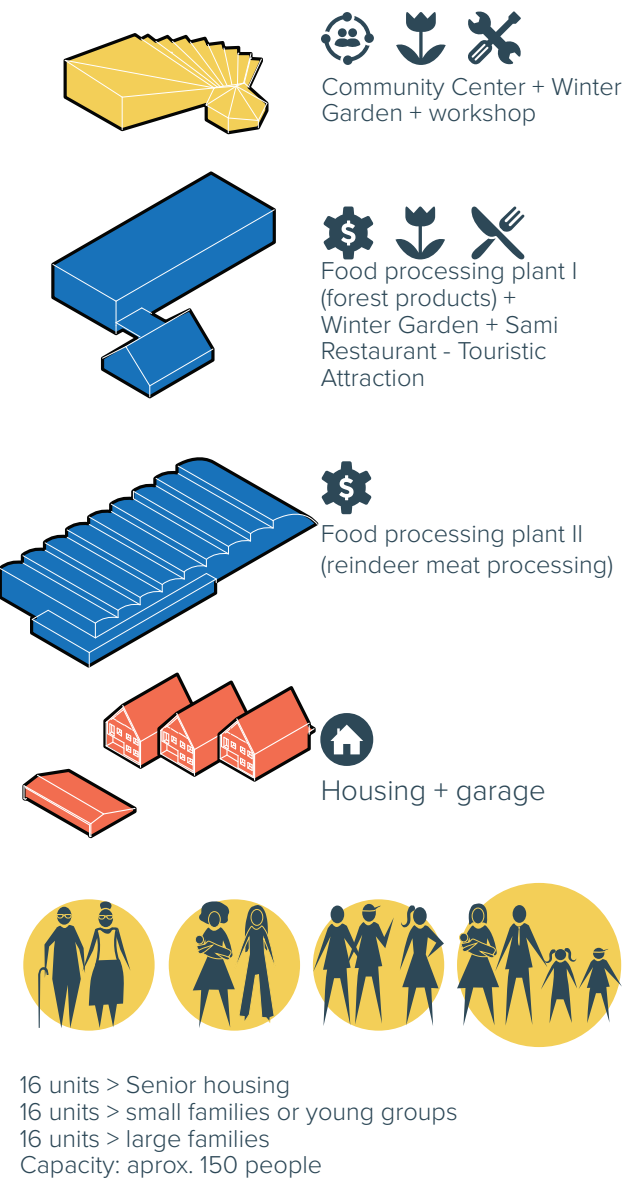
- Housing + private garage
- Collective Workshop - Public Winter Garden
- Food Processing Plant

The intervention proposed a mixed-use area with housing, public shared buildings (Community building and Winter Garden), and light industry (food processing plant) focused on Sami Cuisine.

The housing complex gathers 48 apartment units with sizes 70 sqm and 140 sqm. The typologies can be adapted for all sorts of users to bring more diversity to the area. The industrial area brings two food processing plants, focusing on Sami cuisine combining with food tourism.

The idea is to stimulate local production, using the local resource that does not damage the natural landscape and bring more independence of reindeers herders concerning the food industry. Another aspect is raising the interest in reindeers meat consumption; the reindeer meat can be considered climate-friendly.

Typologies: Uses and Users



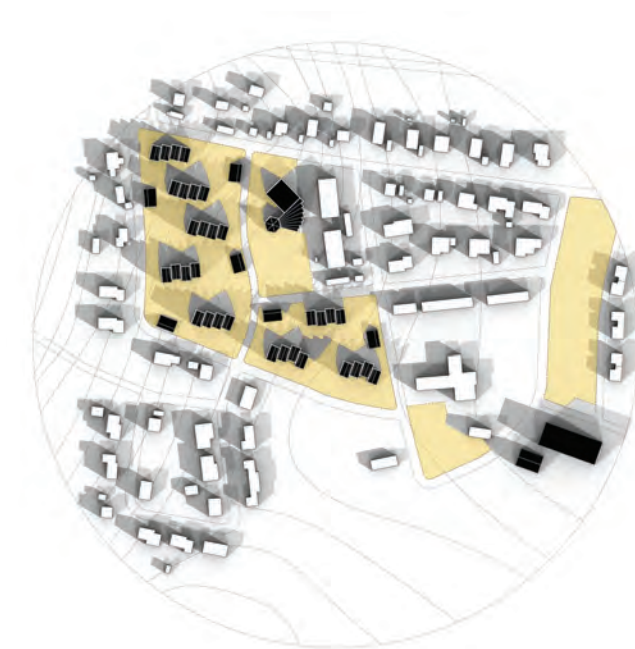
6. Snow and Storm Management

- Area with major sun exposition
- Rain Gardens
- Snow depots with melting system
- Bioswales
- Snow / water run off

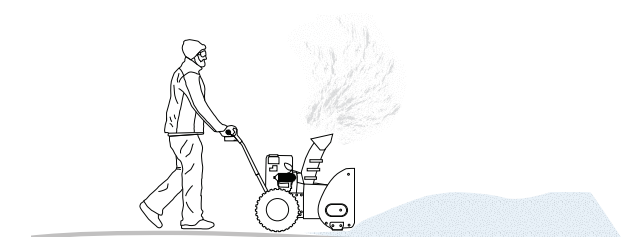
The proposal aims to integrate the snow into the landscape and prepare the snow melting process area during the spring. The main objective is to prepare a system that can cope with snow water residues and contain the water runoff during the rainfall periods. The system employed uses rain gardens combined with bioswales in strategic places to facilitate water filtration and discharge into nature.

The use of rain gardens provides more water absorption capacity than flat lawns, and it has

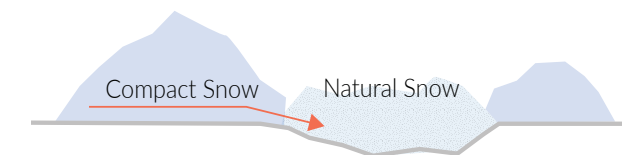
simple maintenance during the winter periods. Rain gardens and bioswales should be placed in strategic areas between buildings with more solar access, facilitating the natural snow melting process. Snow mounds with compacted snow should be placed in designated areas, sun access, and in the rain gardens. There are three snow depots in the neighborhood dedicated to accumulating dirty snow coming from the streets. These areas are equipped with a snow melting system and also water filters.



The diagram shows the areas with significant sun exposition with a small fraction of shaded areas (shadow touches the area only once per day).



Use of small snowblowers to clean the snow could be organized by the dwellers.



The compact snow should be deposit close to the raingardens and it can melt naturally during the spring



Food Processing plant +
Restaurant

Public Green House

Shelters/ protect areas

Reindeer Zone

Bioswales

MASTER PLAN NYBORG - 1:2500

NYBORG HOUSING



DETAIL PLAN NYBORG - 1:500



SECTIONS AND DETAILS

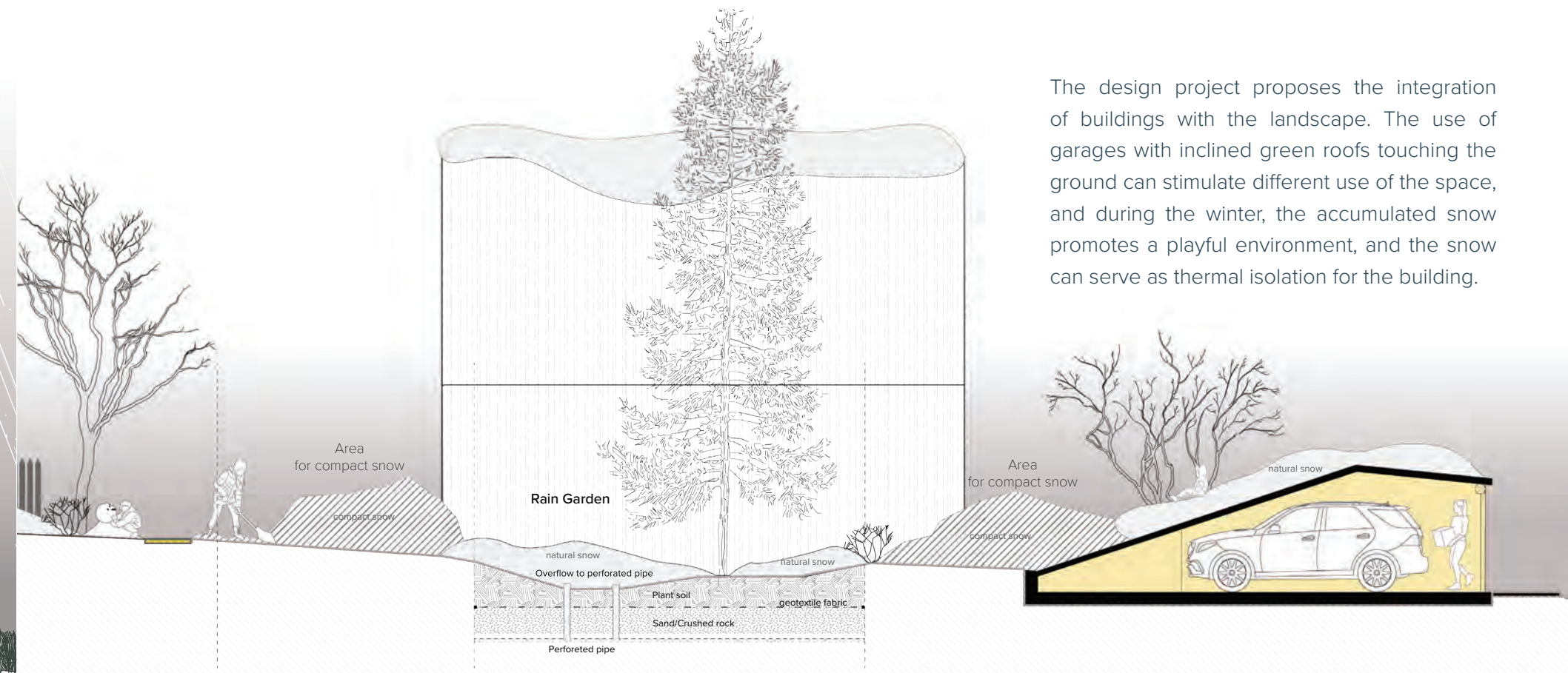
Long section AA: Between buildings - Nyborg Housing Area



The section above shows how the landscape interacts with the snow between buildings. The house footprint is reduced and gives space for a shared space, including rain gardens to help with the water/snow management. The detail section (page 105) shows the rain garden maintenance during the winter. It is recommended to pile the snow near the rain garden, and during the spring, the snow will melt and be redirected to the rain garden. There is no problem leaving natural snow to accumulate inside the rain garden; the recommendation is to use local vegetation to withstand the snow, drought, and cold weather. Also is suggested to use some natural reaction agents, like sand, sugar beet juice, to accelerate the snow melting process.



Schematic section: Shelter weather protection



Detail section: Rain Garden and snow mounds (compacted and natural)

The design project proposes the integration of buildings with the landscape. The use of garages with inclined green roofs touching the ground can stimulate different use of the space, and during the winter, the accumulated snow promotes a playful environment, and the snow can serve as thermal isolation for the building.

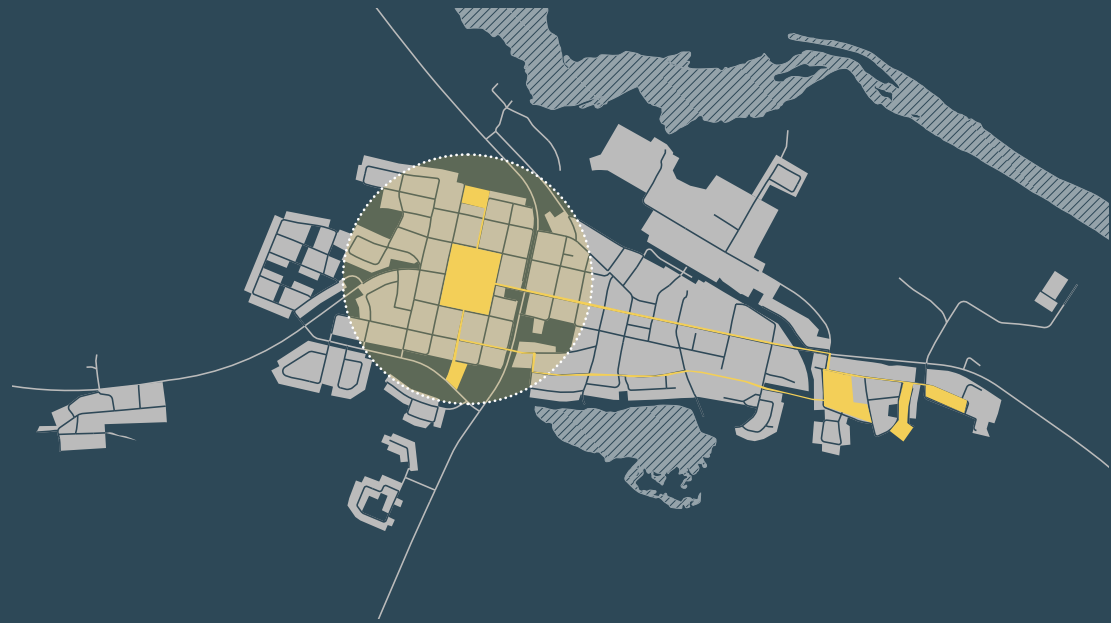


4.3 NyLommen: Diversity in the Future

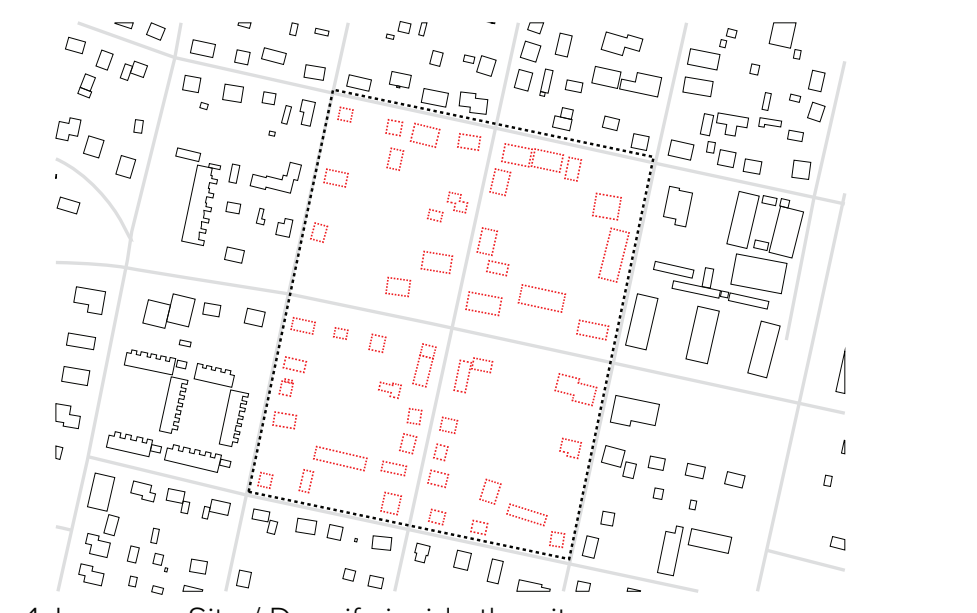
The most significant challenge in the Arctic cities is the uncontrolled urban sprawl; this can negatively affect distance to facilities and impact the environment. The proposal proposes the renovation of existing plots and densifies the area following the necessities of the city.

The intervention in Lommen proposes expanding diversity to the west side (mainly composed of detached houses), bringing more diversity and making distances shorter. The design proposes

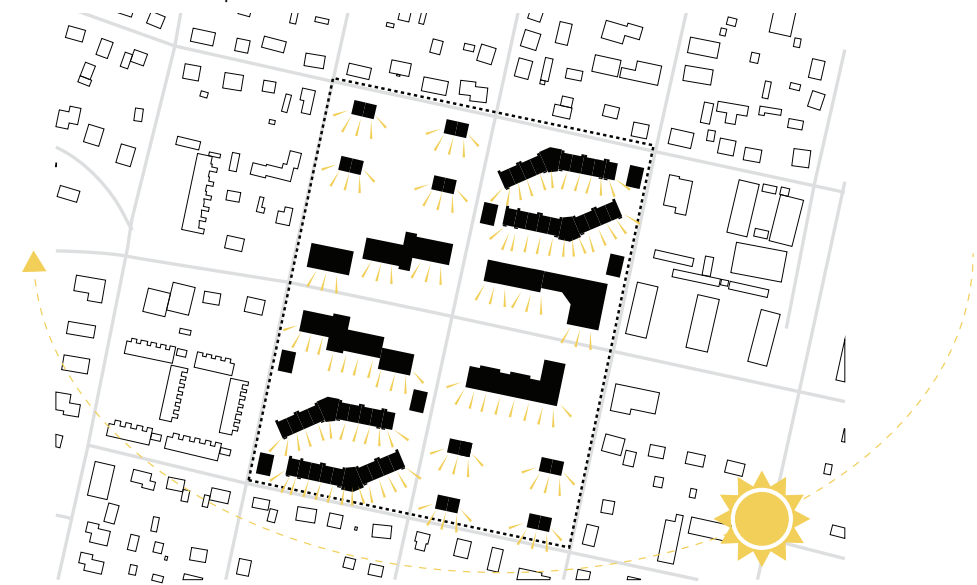
multi-diverse housing, diversifying users and activities for people who live there or are just passing by. The intention is to Integrate the Architecture with the landscape and use the Architecture to celebrate the local culture with the Sami (Sami Building inspired). New homes, more densification, more service, shared spaces, shared greenhouse library.



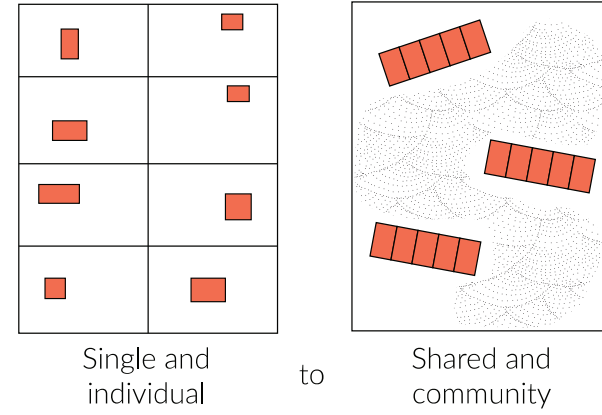
CONCEPT DIAGRAMS AND CLIMATE ANALYSIS



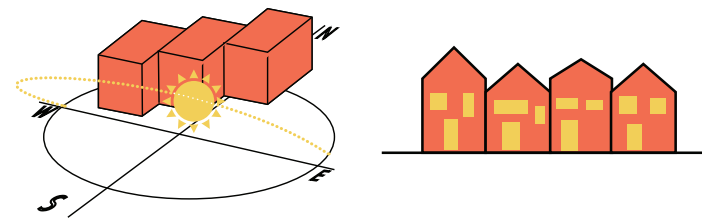
1. Lommen Site / Densify inside the city avoid urban sprawl



2. Place buildings facing south maximizing solar access



The concept design for the Lommen area follows the same strategy as in Nyborg. The medium densification will allow this area to become a more diverse center on the west side of Jokkmokk. Shared gardens will provide more space for meetings and social interaction and also will facilitate snow management.



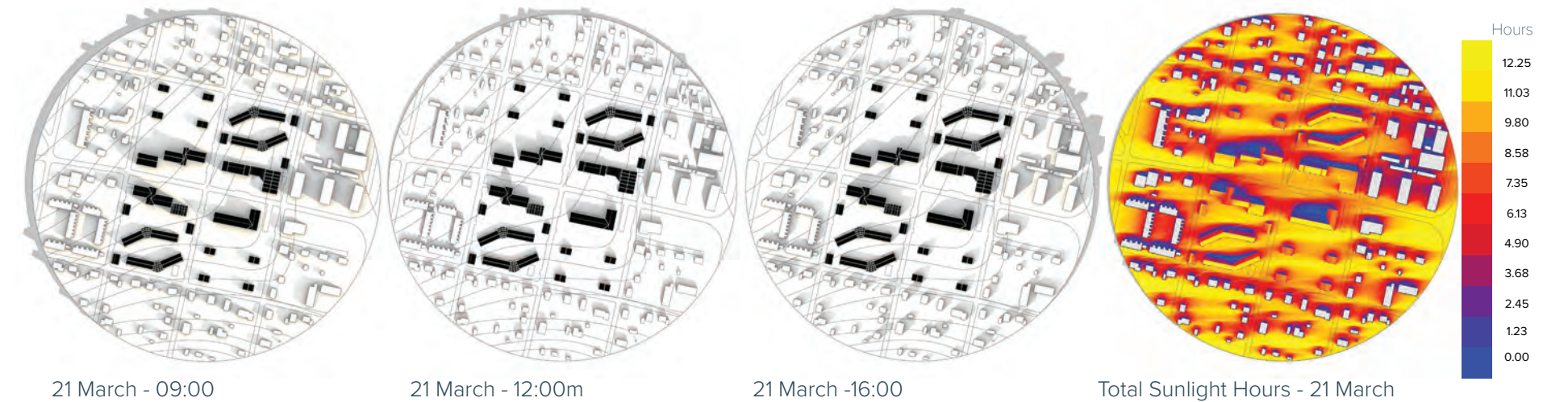
South building orientation to maximize the sun access and build together to preserve energy.

SUN ACCESS ANALYSIS

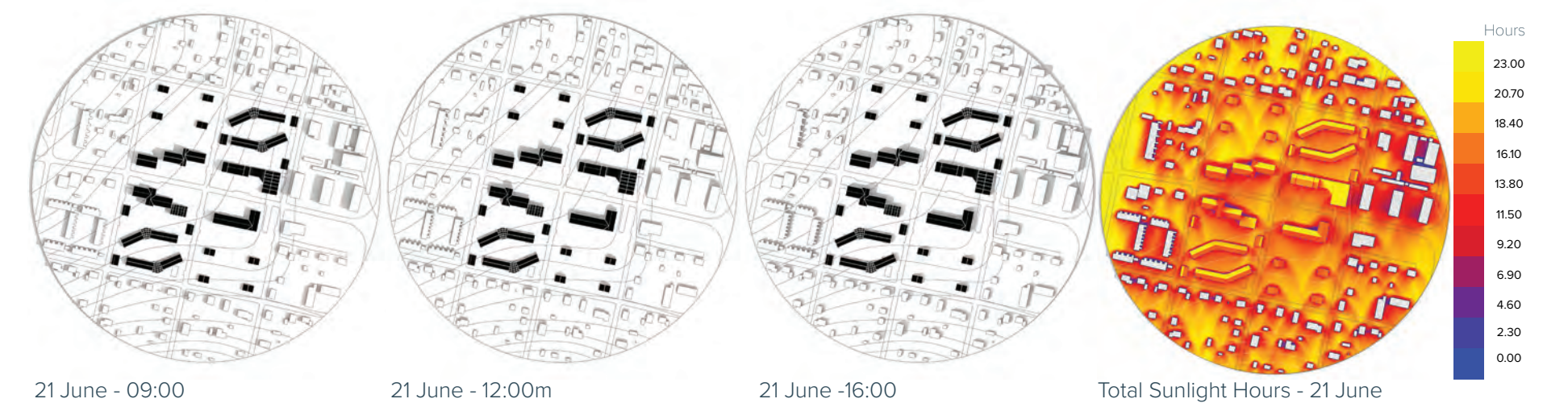
The results of the shadow analysis were satisfactory regarding the length of the shadows during the Equinox. The houses with the facade exposed to the sun and the shadow do not overcome the next building. It was still possible to maintain areas with total sun exposure between the buildings. These areas can place the social parts like pocket parks. Here we face the

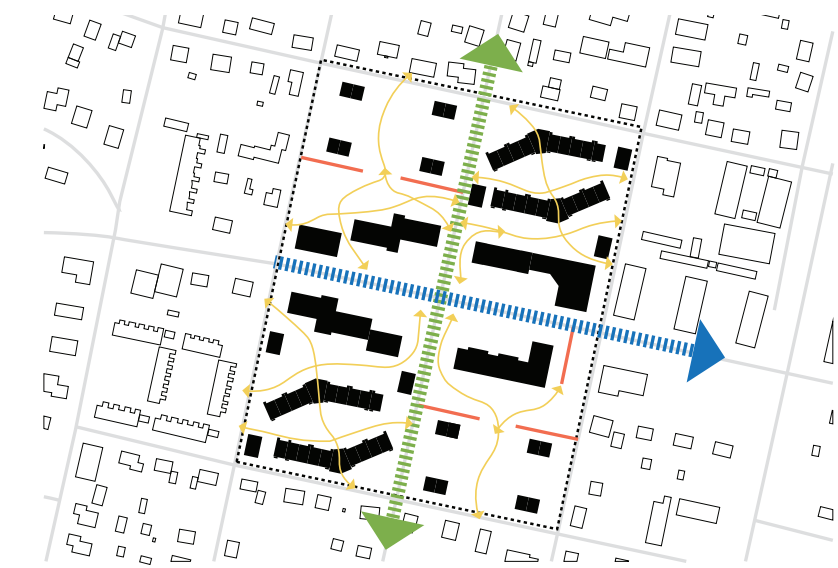
same problem as the north face. In that case, it should consider the room orientation. Taller buildings will create long shadows during the Equinox, and they will tend to be colder areas. For public areas with an extended period, shadow will require special attention regarding thermal comfort

SHADE ANALISYS EQUINOX - Ny Lommen



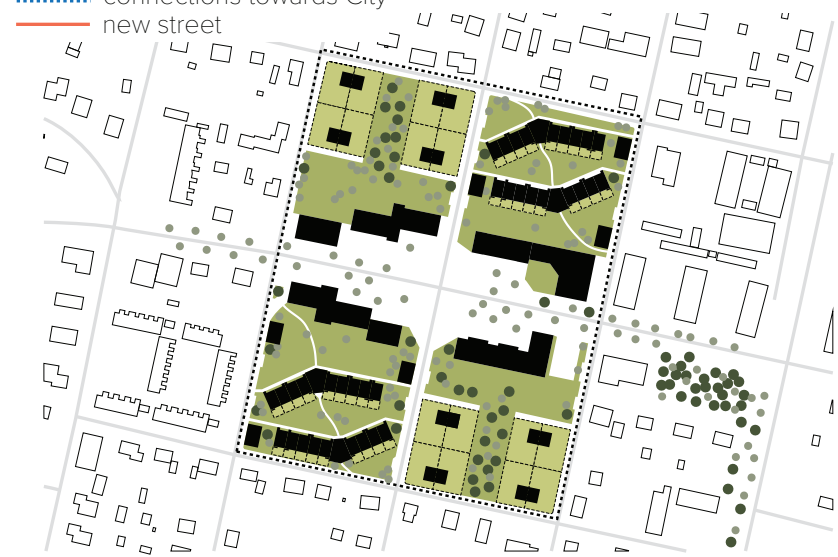
SHADE ANALISYS SOLSTICE- Ny Lommen





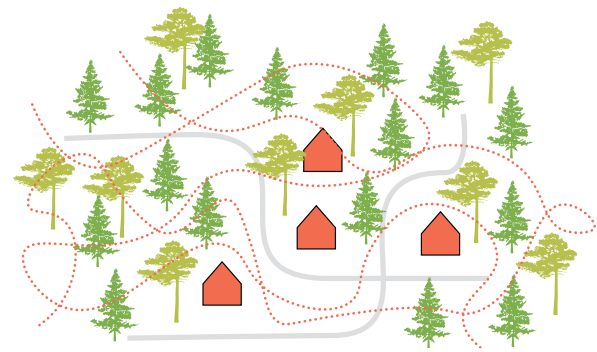
3. Open blocks and expand connections

- connections between Buildings
- connections towards Nature
- connections towards City
- new street



4. Define functions: Live/ Produce / Enjoy

- Shared green spaces
- Private garden
- Coniferous Forest
- Low vegetation to protect from wind
- Shelter protection - windsnow
- Evergreen trees (ex. Pine tree)
- Deciduous tree (ex. Birch tree)

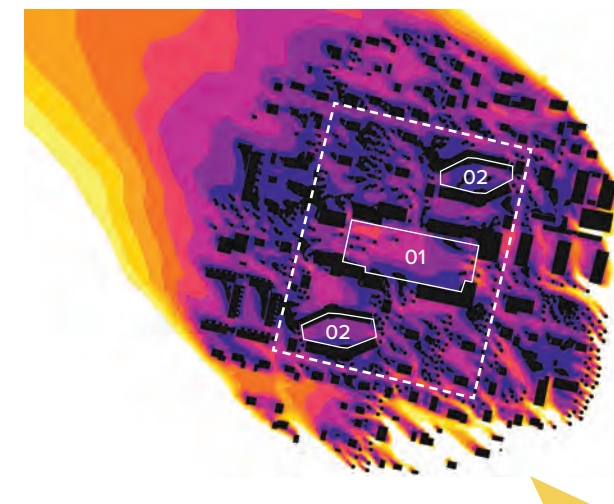
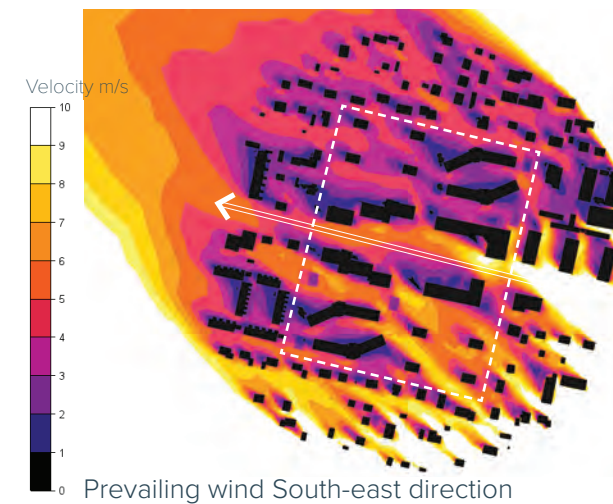
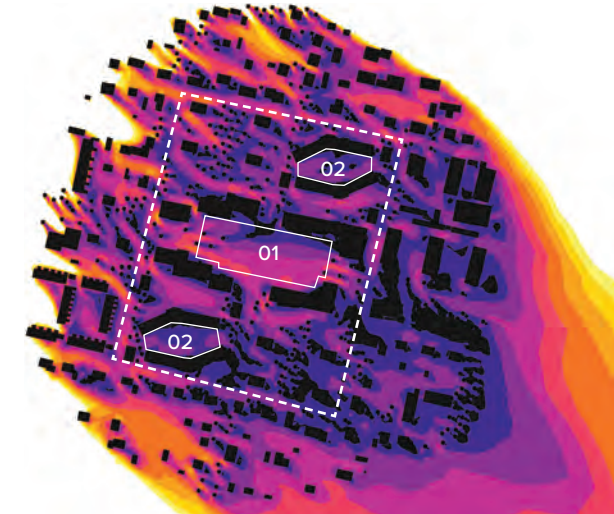
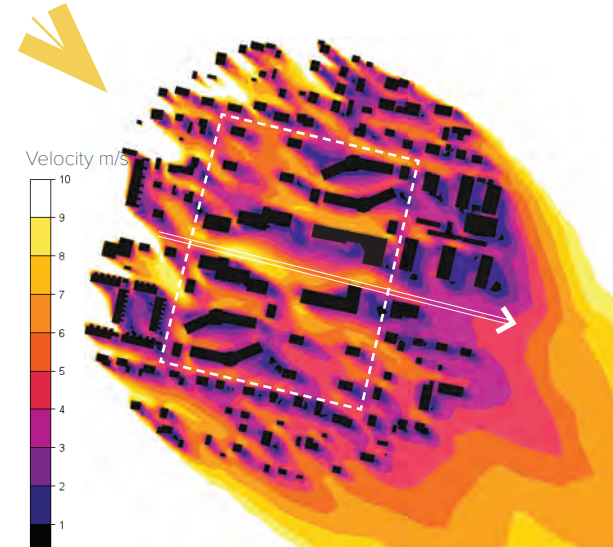


Making distance short is essential, especially in places where the weather is harsh in winter. It is possible to open paths between buildings by shared gardens. Also, shared gardens will allow more integration in the community and raise neighbor vigilante awareness.



Wind can be hazardous during the winter. It is essential to provide wind protection. The wind's adverse effects can be reduced using adequate vegetation and shelter protection in public areas. So people can endure outside for more extended periods.

WIND ANALYSIS



The urban composition of the Lommen Area is different compared with Nyborg. Lommen is denser than Nyborg, and the typology proposed has more diversity (in use and size). The wind simulation was realized using the same methodology as the Nyborg area. The wind simulation results were similar considering the wind velocity with the versions with tree and without trees (the trees placed in all simulations have considered the existent trees and trees proposed for the project area).

The area indicated by the number 01 locates the main public area combined with snow depots to melt the snow and collect the water. Also is where the local commercial is placed. The wind varies between 5-2m/s, and sometimes strong winds can generate uncomfortable areas. However, some parts of the area need to be cleared out of the vegetation to facilitate the snow depot. It is suggested to place shelters and some flexible barriers to create a better microclimate to use the space.

The courtyards indicated by number 02 had a better performance with trees than the simulation without trees. The reached velocity is below four m/s and can be a delightful area; low wind velocity combined with sun access can be very favorable to generate better micro-climate in winter cities

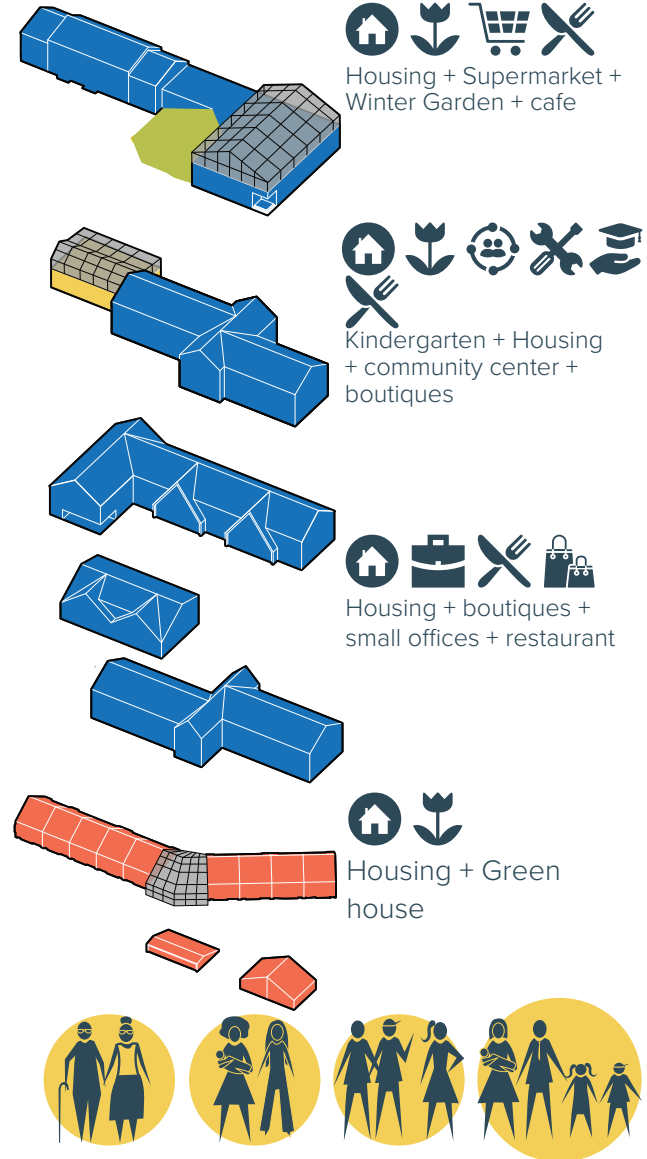


5. Define functions: Live / Work / Enjoy

- Housing + private garage
- Public Winter Garden
- Mixed-use buildings

The new proposal provides high density inside the urban perimeter. Rebuild and rethink big plots inside the Winter cities could be a solution to be adopted in order to avoid urban sprawl in harsh environments. The NY Lommen center proposal presents a neighborhood more densified and promotes diversity of use and housing. The intention is to bring more diversity into the East side of Jokkmokk, building an attractive new city core.

Typologies: Uses and Users

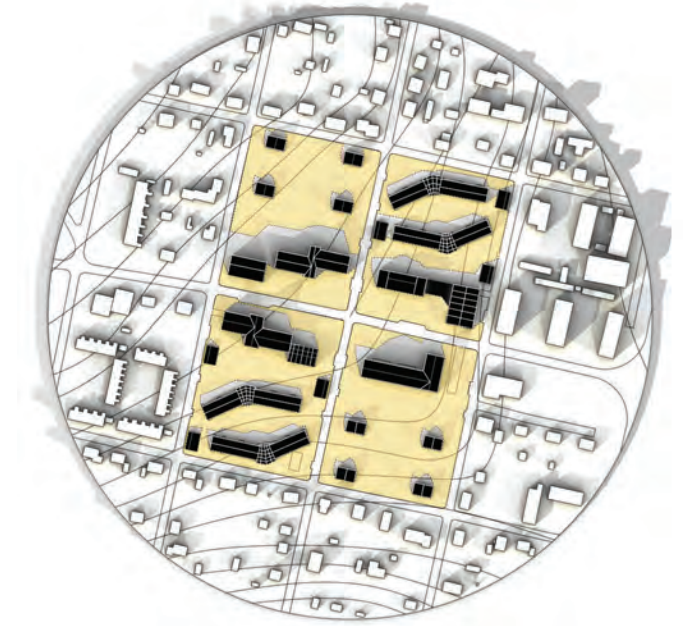


Total 140 units
 42 units (35%) > Senior housing
 49 units (35%) > small families or young groups
 49 units (35%) > large families

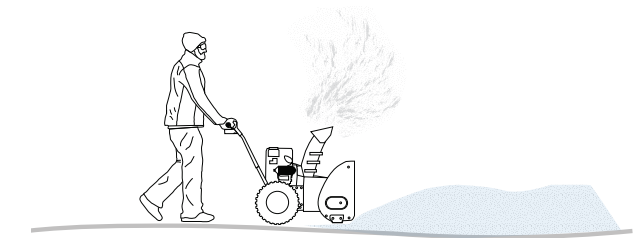


6. Snow and Storm Management

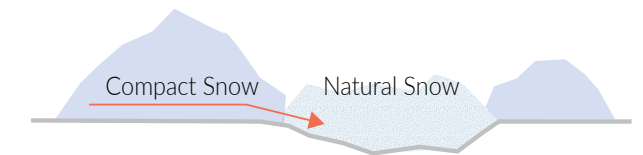
- Area with major sun exposition
- Rain Gardens
- Snow depots with melting system
- Bioswales
- ~ Snow / water run off



The diagram shows the areas with significant sun exposition with a small fraction of shaded areas (shadow touches the area only once per day).



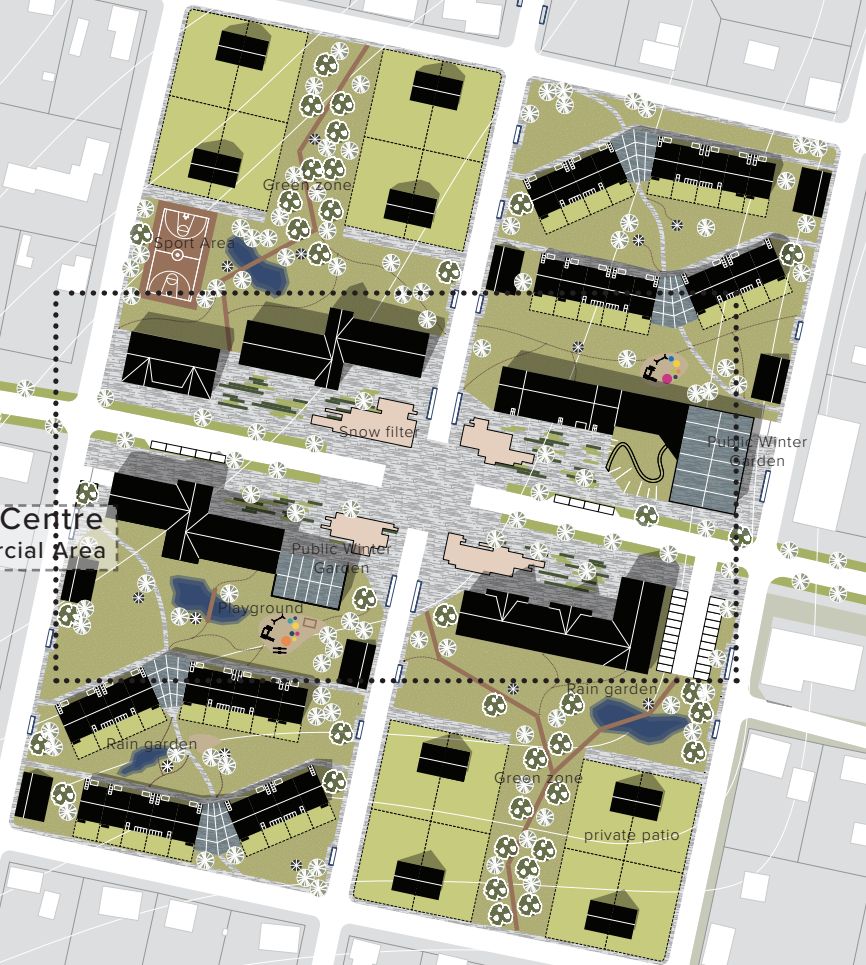
Use of small snowblowers to clean the snow could be organized by the dwellers.



The compact snow should be deposit close to the raingardens and it can melt naturally during the spring

MASTER PLAN LOMMEN_1:2500

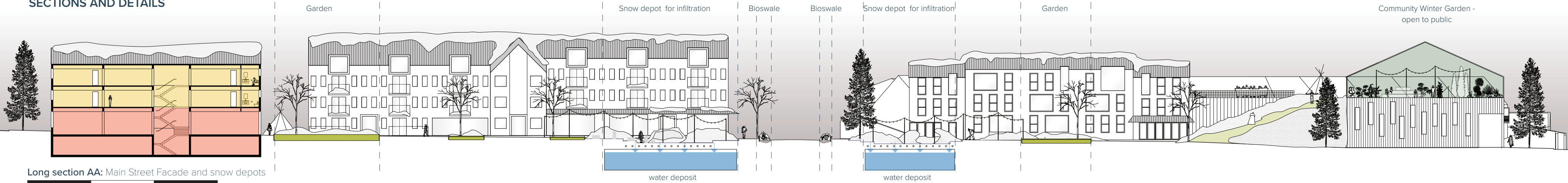
Ny Lommen Centre
Housing/Commercial Area



DETAIL PLAN LOMMEN_1:750

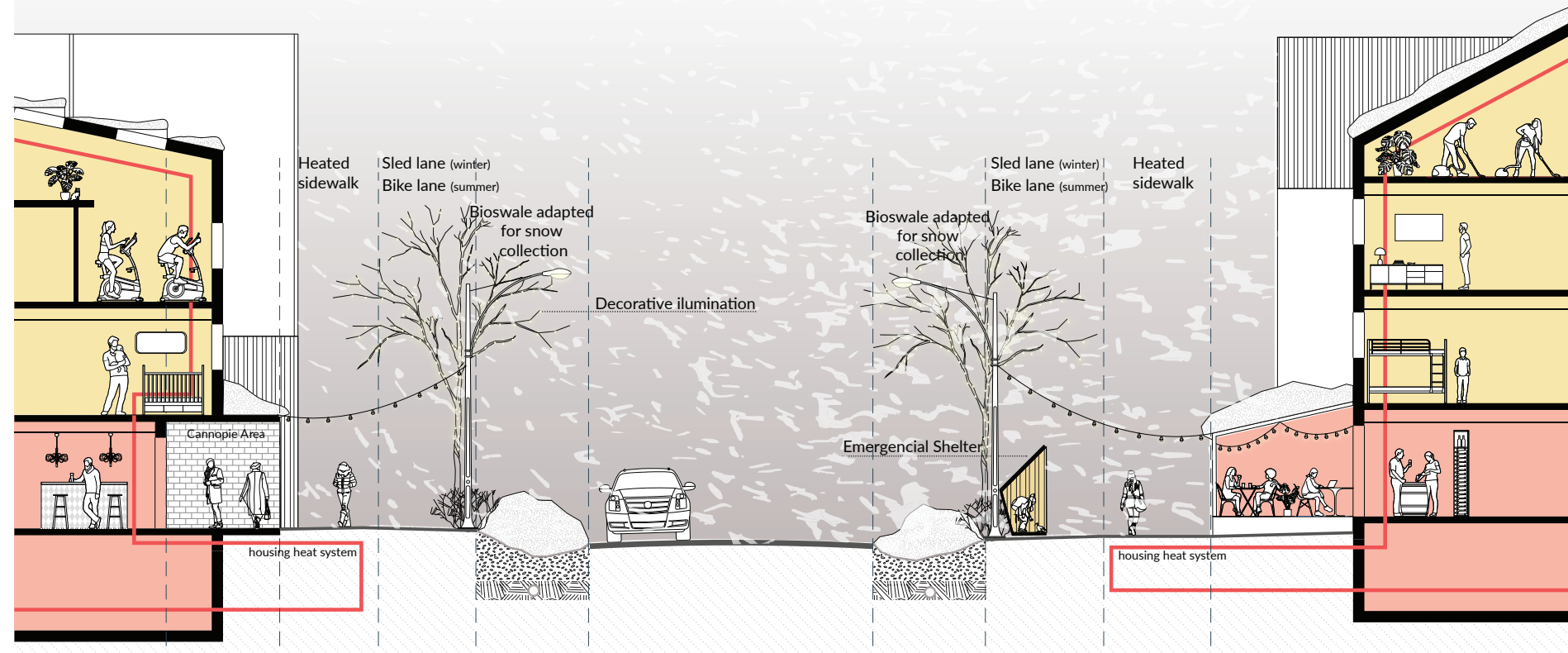


SECTIONS AND DETAILS

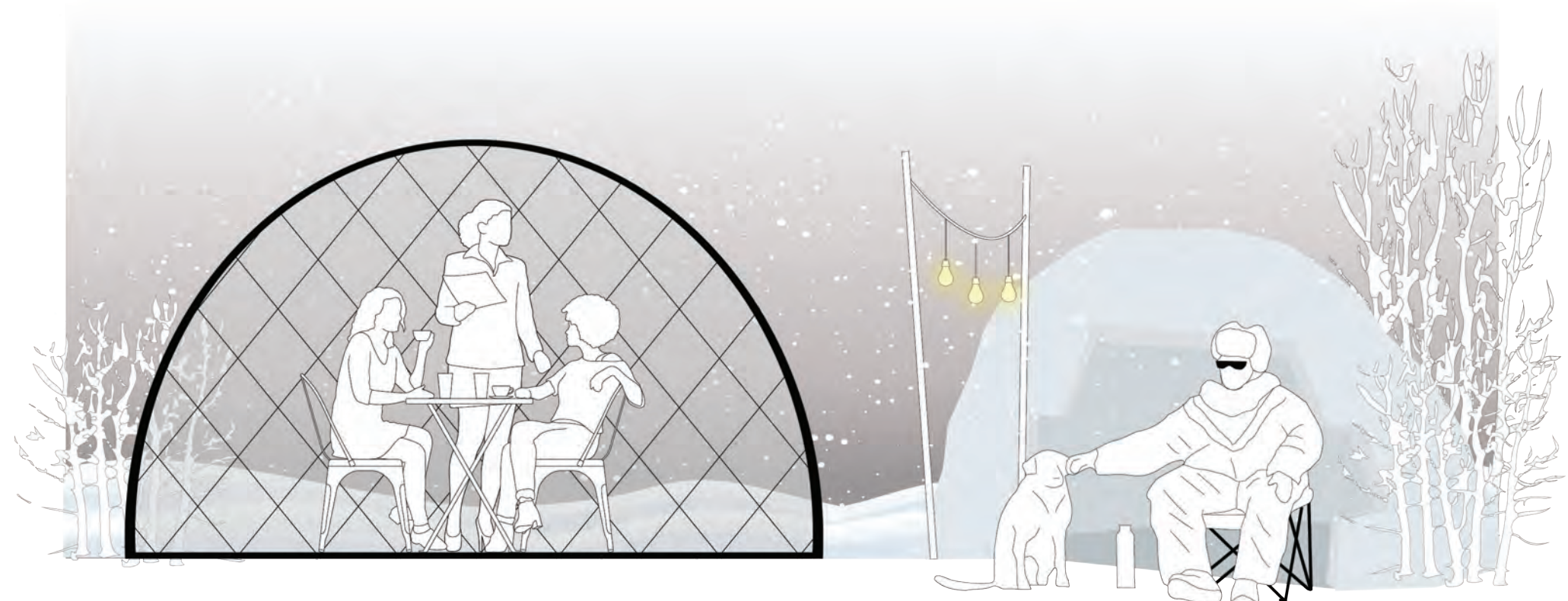


Long section AA: Main Street Facade and snow depots

0 5 15



Detail section: Street section



Schematic section: Example of shelter protection and uses



4.3 Construction Phase

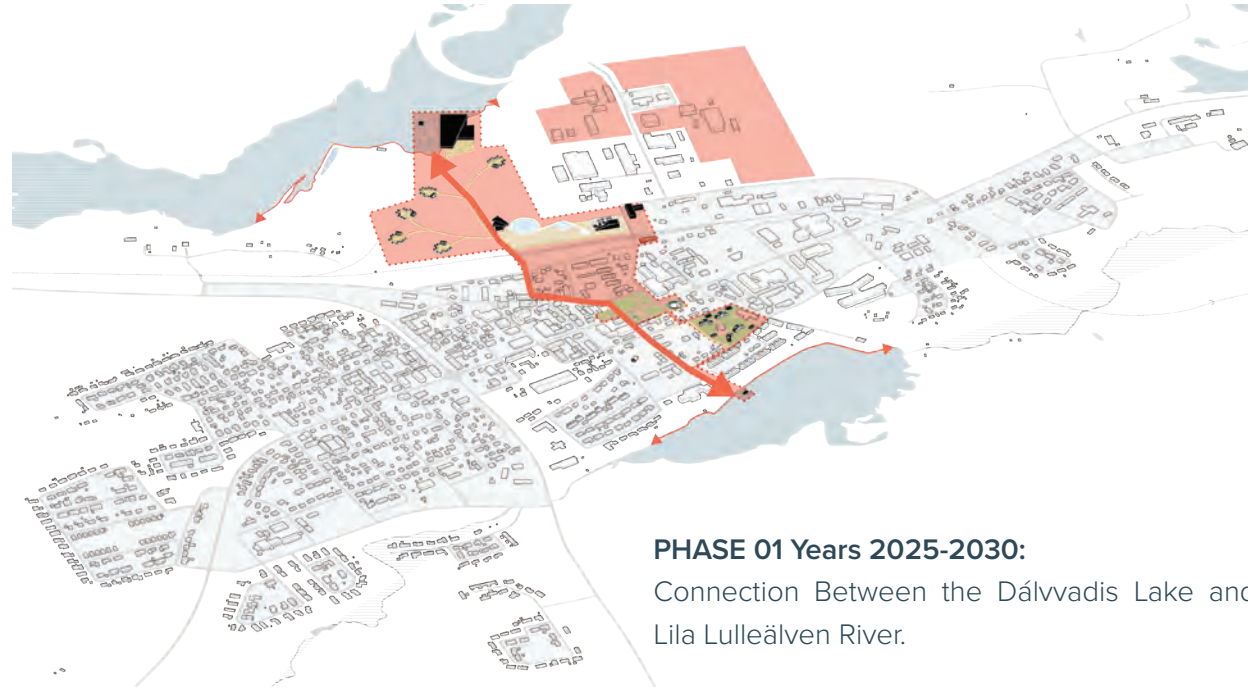
The Construction Phase's complete development is carefully thought to be implemented in 30-50 years. This lengthy process can give time for the city analysis its growth and plan for what the city needs first. The first need of Jokkmokk is to revigorate the public spaces and make them active during the winter. The development process is divided into three phases:

PHASE 01 Years 2025-2030:

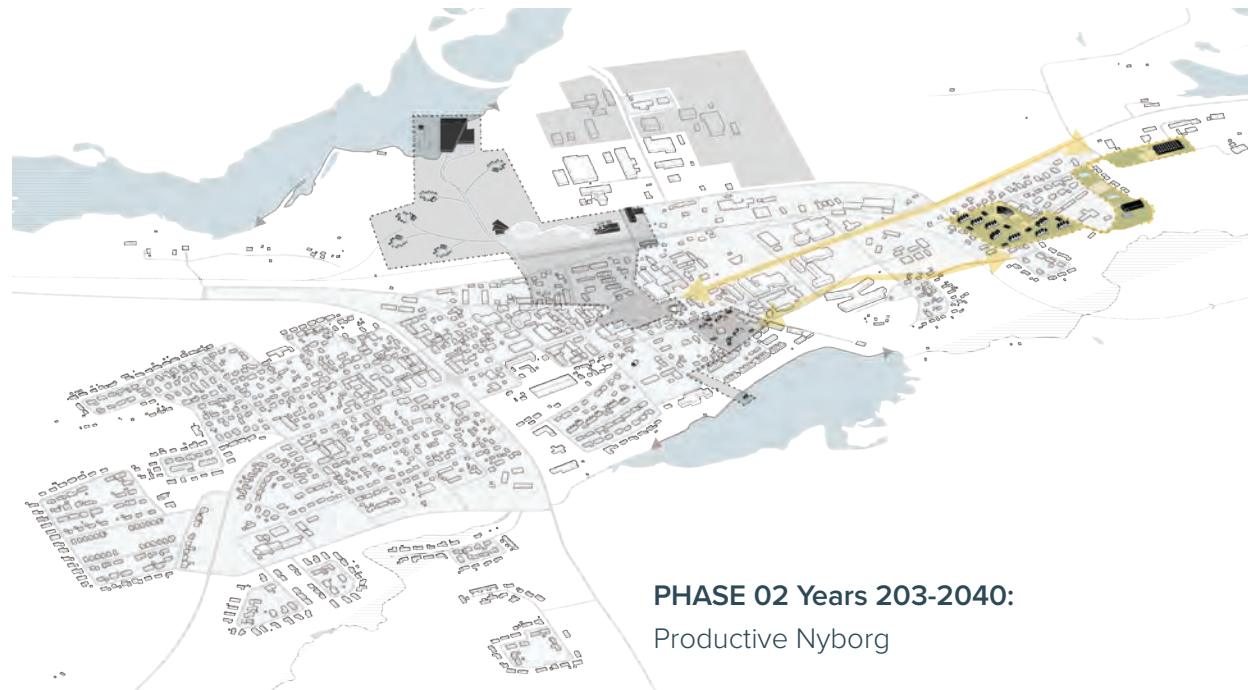
Connection Between the Dálvadis Lake and Lila Lulleälven River.

This phase will focus on the public spaces, connecting the city to the natural landscape, opening easy access to the Lila LulleÄalven river. This phase is essential for stimulating the local tourism in the city, and it will provide direct support for the Winter Festival, giving full support for the Sami traditions. To be built next:

- >Sami Market + Winter Plaza
- >Adapted housing for seniors
- >Connection Dalvadis
- >Aquatic Center + Cottage accomodation
- >Activate train station
- >New townsquare
- > Protected Shelters + Snow treatment area



PHASE 01 Years 2025-2030:
Connection Between the Dálvadis Lake and Lila Lulleälven River.



PHASE 02 Years 203-2040:
Productive Nyborg

PHASE 02 Years 203-2040:

Productive Nyborg

This phase will focus on the production level combined with tourism and housing. The intention is to improve the local economy using local resources, protect the reindeer husbandry and elevate the Sami Cuisine to a national level. To be built next:

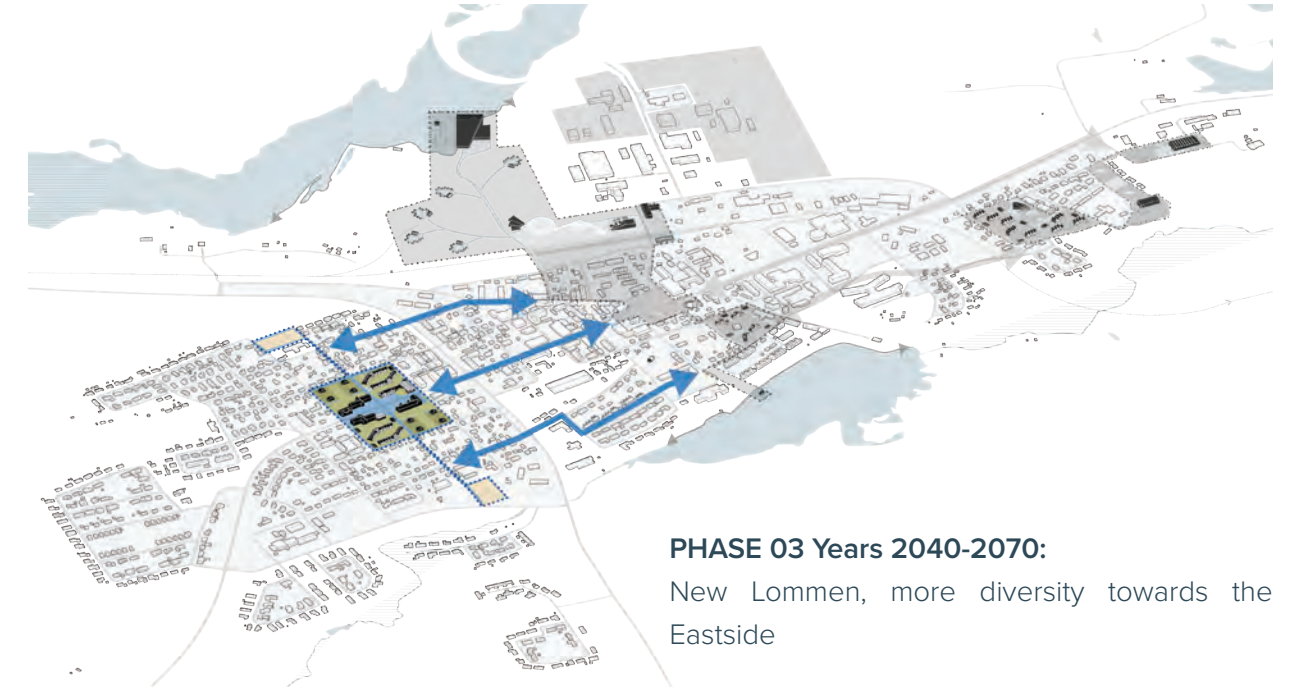
- > Two Food Processing Plant specialized in Sami Cuisine.
- > Restaurant + Public Winter Garden
- > Reindeer Zone
- > Housing Area +Community center + Workshop
- > Protected Shelters + Snow treatment area

PHASE 03 Years 2040-2070:

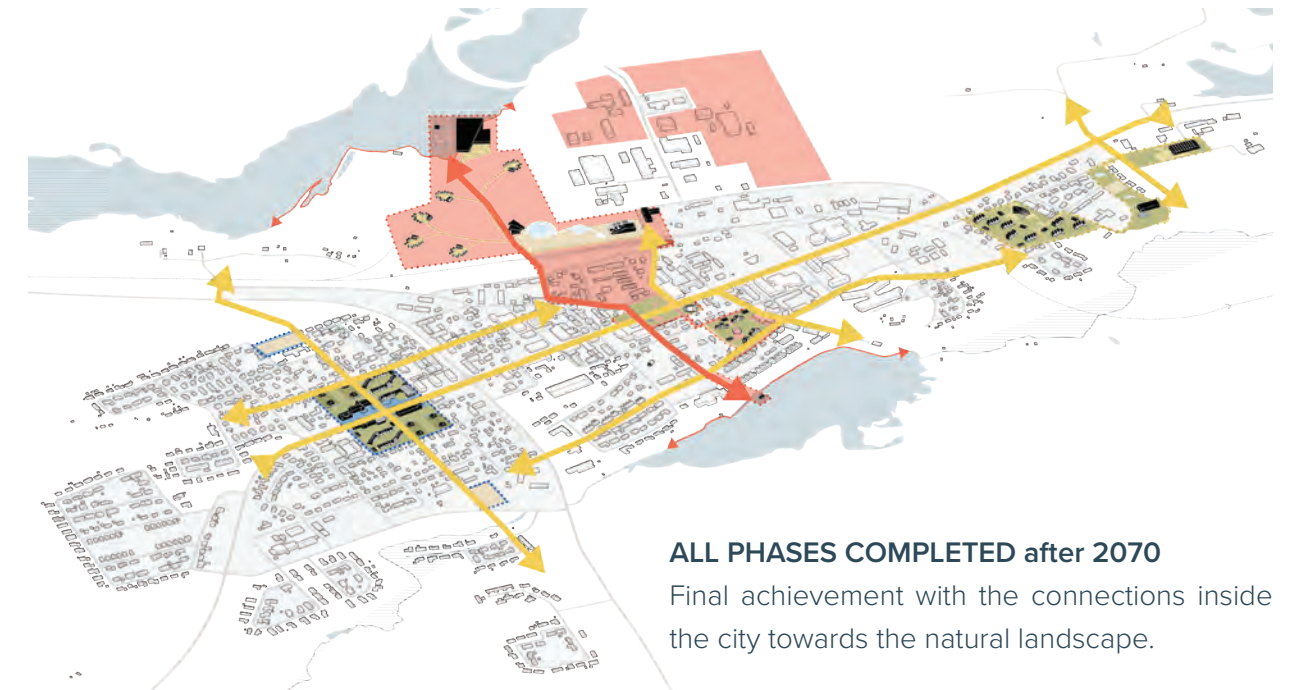
New Lommen, more diversity towards the Eastside

The last phase regards the city's remodeling existent plots instead of expanding the city avoiding urban sprawls. This phase will need cooperation between the private and public sectors. After the ownership of land is solved, in this area will be located the new city core with more diversity in uses and typologies.

- > Housing *diversity in typologies
- > Pre-school
- > Commercial area
- > Public Winter garden
- > Protected Shelters + Snow treatment area



PHASE 03 Years 2040-2070:
New Lommen, more diversity towards the Eastside



ALL PHASES COMPLETED after 2070
Final achievement with the connections inside the city towards the natural landscape.



5 CONCLUSIONS



5.0 Conclusions and reflections

The thesis presented topic “Winter City” has started from my personal desires to seek out new varieties of the landscape and interest about the Arctic region. In my research, I explored several topics related to urban design in the Arctic. The approach begins with a theoretical background, site analysis, and lastly, the design proposal in Jokkmokk, located in the Swedish Arctic.

The main objective was to explore urban design strategies to make Jokkmokk more attractive and resilient during the winter. However, the extreme cold and darkness is not the only problem of Jokkmokk. Along with the harsh climate, the city faces challenges like shrinking and aging population, climate change, economic struggles, and internal conflicts relating to mining (Beowulf) in the region and with the local population (Sami reindeer herders). All this situation has raised other concerns that I should integrate into the project, especially regarding the Sami, which I did not have so much knowledge about, and the circumstances made me investigate further about their history, culture, and current situation. At some point, Winter and Sami became the drivers of my project. Considering the new challenges, I reformulated my objectives to adapt to the

local situation of Jokkmokk. Besides the harsh climate, I wanted to relate my project to the economic, cultural, and environmental aspects.

The proposal matured response of a Winter city model that respects its local culture above national interest and an example of sustainable development. In this thesis, I criticize that mining and other predatory activities cannot be the only answer to revitalize small cities' economies.

The specific design achievements incorporate urban actions to mitigate the climate change combined with snow management, public spaces adaptable for the winter (better thermal comfort in public areas), visual attractions in public areas, adapted houses typology for the climate and users, use diversification and a future growth envision for the city avoiding the urban sprawl. In the end, the proposal design resulted in a complex combination of strategies and concepts aligned with climate-sensitive design, taking the winter as a design driving force in order to revitalize, enhance the identity and make Jokkmokk more attractive to live and as well to visit.

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